



City of Tigard

13125 SW Hall Blvd
Tigard, Oregon 97223
Phone: (503) 639-4171
Fax: (503) 684-7297

CONTRACT DOCUMENTS for the construction of

ASR 3 & 2 Wellhouse Improvements

Project No.: CIP 2020 – 96053
Solicitation No.: 2022-21

Single Point of Contact: Toni Riccardi
Contracts & Purchasing
Email: contractspurchasing@tigard-or.gov

Bid Due & Bids Open: July 28, 2022 - 2:00 pm

**ADVERTISEMENT FOR BIDS
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

The City of Tigard will receive sealed Bids from qualified firms submitted electronically to Contracts & Purchasing Department until 2:00 pm local time, Thursday, July 28, 2022, for the ASR 3 & 2 Wellhouse Improvements project. Bids will be opened and publicly read aloud immediately after the Bid Closing time and date via conference call at (971) 203-2862. Conference ID 102 702 654#.

The project generally consists of the following:

- Construction of ASR 3 Well House
 - ASR 3 well house construction
 - New seismic valve vault on Reservoir 16 inlet/outlet piping installation
 - Site stormwater and grading improvements
 - Site piping improvements
- Improvements to Reservoir 4
 - New reservoir vent installation
 - Sealing of existing reservoir vents
 - PRV valve vault installation
 - Site piping improvements
- Improvements to ASR 2
 - VFD replacement
 - Electrical and telemetry improvements
 - Water quality instrumentation replacement

Basis of Bid Award shall incorporate all items identified on the Bid Schedule.

Pursuant to Tigard Public Contracting Rule 30.055, all Bidders must submit a Bid security to the City along with their Bid in an amount equal to ten percent (10%) of their Bid. Because the City's estimate of contract value exceeds \$100,000, Bidders must submit a First Tier Subcontractor Disclosure Form, provided in this Bid Booklet, to the City no later than 4:00 pm local time, Thursday, July 28, 2022.

The provisions of ORS Chapters 279A and 279C and all other Oregon and Federal provisions pertaining to minimum salaries and wages shall be incorporated by reference as if fully set forth in any Contract resulting from this Advertisement for Bid. Contractor shall provide proof to the City prior to the beginning of any of the work that the Contractor has filed a public works bond with a corporate surety in the amount of \$30,000 with the Construction Contractors Board as required under Oregon Prevailing Wage Rate (PWR) law.

No Bid will be considered unless fully completed in a manner provided in the Bid Packet. Facsimile Bids will not be accepted nor will Bids be accepted after the stated Bid Closing. Bids received after the Bid Closing will be returned to the submitting firm unopened after a Contract has been awarded for the required services.

Bid Documents may be downloaded from the City of Tigard website at www.tigard-or.gov/bids. The City may reject any Bid not in compliance with all prescribed public bidding procedures and requirements and may reject for good cause any or all Bids upon a finding of the City if it is in the public interest to do so.

All questions about the meaning or intent of the Bid Documents shall be submitted to the Contracts and Purchasing Department at contractspurchasing@tigard-or.gov. Clarifications to the Bid Documents will be made by addenda only. Oral statements may not be relied upon by Bidders and will not be binding or legally effective.

Published: Daily Journal of Commerce

Date: June 29, 2022

**ATTACHMENT A – BIDDER’S CHECKLIST
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

FORMS TO EXECUTE FOR SUBMISSION OF BID

The Bidder's attention is especially called to the following forms which must be executed in full before Bid is submitted:

ATTACHMENT B - BID

ATTACHMENT C – ACKNOWLEDGMENT OF ADDENDA

ATTACHMENT D – BID CERTIFICATION

ATTACHMENT E – FIRST TIER SUBCONTRACTOR DISCLOSURE FORM (within 2 hours of Bid Closing)

ATTACHMENT F – BID BOND

FORMS TO EXECUTE AFTER AWARD OF BID

ATTACHMENT G – PUBLIC IMPROVEMENT CONTRACT – PWR COVERED CONTRACT

ATTACHMENT H – PUBLIC IMPROVEMENT CONTRACT – PERFORMANCE BOND

ATTACHMENT I – PUBLIC IMPROVEMENT CONTRACT – PAYMENT BOND

EXHIBIT A – COVID-19 VACCINATION ATTESTATION

Certificate of Insurance including Additional Insured Provision in accordance with the Public Improvement Contract.



**ATTACHMENT B – BID
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

This Bid must be signed in ink by an authorized representative of the Bidder; any alterations or erasures to the Bid must be initialed in ink by the undersigned authorized representative.

Project: ASR 3 & 2 Wellhouse Improvements _____

Bid Due Date: Thursday, July 28, 2022 _____

Name of Submitting Firm: _____

The Undersigned (*check one of the following and provide additional information*):

- An individual doing business under an assumed name registered under the laws of the State of _____; or
- A partnership registered under the laws of the State of _____; or
- A corporation organized under the laws of the State of _____; or
- A limited liability corporation organized under the laws of the State of _____;

hereby proposes to furnish all material and labor and perform all work hereinafter indicated for the above project in strict accordance with the Contract Documents for the Basic Bid as follows:

_____ and ____/100 Dollars (\$_____)

and the Undersigned agrees to be bound by all documents comprising the Contract Documents as defined in the Contract. The Undersigned declares that it has carefully examined the site(s) of the work, the Contract Documents, and forms. Submission of this Bid shall be conclusive evidence that the Undersigned has investigated and is satisfied as to the condition to be encountered, as to the character, quality and scope of work to be performed, the quantities of materials to be furnished, and as to the requirement of the Contract Documents.

Accompanying herewith is a Bid Security which is equal to ten percent (10%) of the total amount of the Bid.

BID SCHEDULE
ASR 3 & 2 WELLHOUSE IMPROVEMENTS

Contract will be awarded based on total for Parts A, B, C, and D as specified in the table below.

Item No.	Item Description	Quantity	Unit	Unit Price	Total Price
PART A – ASR 3					
A-1	Mobilization, bonds, permitting, and insurance	1	LS		
A-2	Temporary traffic control	1	LS		
A-3	Erosion control and permitting	1	LS		
A-4	Construction survey and staking	1	LS		
A-5	ASR 3 facility, complete	1	LS		
A-6	Clearing and grubbing, including tree removal	1	LS		
A-7	Site preparation, excavation, backfill, and grading	1	LS		
A-8	Furnish and install chain link gate, fence, and anchors, complete	1	LS		
A-9	Furnish and install seismic valve vault, complete	1	LS		
A-10	Site access driveway, complete	150	SF		
A-11	Furnish and install street lighting improvements	1	LS		
A-12	5-foot concrete building perimeter sidewalk	1,110	SF		
A-13	Standard concrete curb	50	LF		
A-14	Asphalt concrete (AC) paving				
	a. AC paving, 4-inch depth	110	TON		
	b. Crushed rock roadway base, 8-inch depth	100	CY		
	c. Sawcut	30	LF		
A-15	Furnish and install 12-inch diameter class 52, restrained ductile iron (DI) pipe	62	LF		
A-16	Remove and re-install buried valves	1	EA		
A-17	Furnish and install ductile iron fittings	532	LBS		
A-18	Connections to existing pipes				
	a. 713 PZ water line	1	EA		
	b. Pump to waste line	1	EA		
	c. 24-inch DI through seismic vault	2	EA		
	d. 2-inch copper through seismic vault	2	EA		
A-19	Connections to existing structures				
	a. SS MH	1	EA		
	b. SD MH-5	1	EA		
	c. SD MH-8	1	EA		
A-20	Furnish and install 10-inch diameter PVC storm piping	23	LF		
A-21	Furnish and install catch basin	1	EA		
A-22	Furnish and install drainage ditch with ditch inlet at base of reservoir slope	1	LS		
A-23	Furnish and install 4-inch diameter PVC roof drain	110	LF		

A-24	Furnish and install 4-inch diameter PVC sanitary sewer lateral	40	LF		
A-25	Overexcavation and select backfill material for unsuitable foundation conditions	50	CUYD		
A-26	Additional cost for rock and boulder excavation	10	CUYD		
A-27	Final site grading, surface restoration, and site cleanup	1	LS		
A-28	Landscaping allowance	1	LS		
TOTAL FOR PART A =					
PART B – RESERVOIR 4					
B-1	Mobilization, bonds, permitting, and insurance	1	LS		
B-2	Temporary traffic control	1	LS		
B-3	Erosion control and permitting	1	LS		
B-4	Construction survey and staking	1	LS		
B-5	Removal and patching of existing reservoir vents	1	LS		
B-6	Furnish and install new roof vent with curb and new roof penetration	1	LS		
B-7	Furnish and install flow control vault, complete	1	LS		
B-8	Furnish and install 8-inch diameter class 52, restrained DI pipe	105	LF		
B-9	Furnish and install DI fittings	500	LBS		
B-10	Hot tap connection, including tapping sleeve	1	EA		
B-11	Furnish and install buried valves	1	EA		
B-12	Connection to existing piping, 560G zone	1	EA		
B-13	Electrical, instrumentation, and telemetry	1	LS		
B-14	Pavement restoration, AC trench repair, 4-inch thickness	22	TON		
B-15	Sawcut existing AC pavement and concrete resurfacing	270	LF		
B-16	Final site grading, surface restoration, and site cleanup	1	LS		
TOTAL FOR PART B =					
PART C – ASR 2					
C-1	Mobilization, bonds, permitting, and insurance	1	LS		
C-2	Conduits, conductors, and electrical, complete	1	LS		
C-3	Furnish and install VFD, power distribution	1	LS		
C-4	Furnish and install water quality instrumentation	1	LS		
TOTAL FOR PART C =					
PART D – EXTRA WORK AS AUTHORIZED					
D-1	Extra Work as Authorized	1	LS	\$200,000	\$200,000
TOTAL FOR PART D =					\$200,000

Bid Schedule Summary

1) **TOTAL FOR PART A** \$ _____

2) **TOTAL FOR PART B** \$ _____

3) **TOTAL FOR PART C** \$ _____

4) **TOTAL FOR PART D** \$ **150,000** _____

GRAND TOTAL BID AMOUNT \$ _____

Total Bid: \$ _____

(Use Words)

The Undersigned agrees, if awarded the Contract, to execute and deliver to the City of Tigard, within ten (10) days after receiving the Contract forms, a satisfactory Performance Bond and a satisfactory Payment Bond each in an amount equal to one hundred percent (100%) of the Contract sum, using the forms provided by the City. The surety(ies) requested to issue the Performance Bond and Payment Bond will be _____ . The Undersigned hereby authorizes said surety(ies) company(ies) to disclose any information to the City concerning the Undersigned's ability to supply a Performance Bond and Payment Bond each in the amount of the Contract.

The Undersigned further agrees that the Bid Security accompanying the Bid is left in escrow with the City; that the amount thereof is the measure of liquidated damages which the City will sustain by the failure of the Undersigned to execute and deliver the above-named Agreement Form, Performance Bond, and Payment Bond, and that if the Undersigned defaults in either executing the Agreement Form or providing the Performance Bond and Payment Bond within ten (10) days after receiving the Contract forms, then the Bid Security may become the property of the City at the City's option; but if the Bid is not accepted within sixty (60) days of the time set for the opening of the Bids, or if the Undersigned executes and timely delivers said Agreement Form, Performance Bond, and Payment Bond, the Bid Security shall be returned.

The Undersigned certifies that: (1) This Bid has been arrived at independently and is being submitted without collusion with and without any agreement, understanding, or planned common course of action with any other vendor of materials, supplies, equipment, or services described in the solicitation documents designed to limit independent Bidding or competition; and (2) The contents of the Bid have not been communicated by the Undersigned or its employees or agents to any person not an employee or agent of the Undersigned or its surety on any bond furnished with the Bid and will not be communicated to such person prior to the official opening of the Bid.

The Undersigned HAS HAS NOT (*check applicable status*) paid unemployment or income taxes in Oregon within the past 12 months and HAS HAS NOT (*check applicable status*) a business address in Oregon.

The Undersigned HAS HAS NOT (*check applicable status*) complied with any Affirmative Action Requirements included within the procurement documents.

The Undersigned agrees, if awarded a Contract, to comply with the provisions of ORS 279C.800 through 279C.870 pertaining to the payment of the prevailing rates of wage.

The Undersigned's CCB registration number is _____ with an expiration date of _____. As a condition to submitting a Bid, a Contractor must be registered with the Oregon Construction Contractors Board in accordance with ORS 701.035 to 701.055, and disclose the registration number. Failure to register and disclose the number will make the Bid unresponsive and it will be rejected unless contrary to federal law. The Undersigned further certifies that Undersigned shall provide proof to the City prior to the beginning of any of the work that the Undersigned has filed a public works bond with a corporate surety in the amount of \$30,000 with the Construction Contractors Board as required under Oregon PWR law.

The successful Bidder hereby certifies that all subcontractors who will perform construction work as described in ORS 701.005(2) were registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time the subcontractor(s) made a Bid to work under the Contract.

The successful Bidder hereby certifies that, in accordance with the Worker's Compensation Law of the State of Oregon, its Worker's Compensation Insurance provider is _____, Policy No. _____, and that Undersigned shall submit Certificates of Insurance as required.

Name of Company: _____

Company Address: _____

Federal Tax ID: _____

Telephone: _____

Email: _____

I attest that I have the authority to commit the firm named above to this Bid amount and acknowledge that the firm meets the qualifications necessary to perform this Work as outlined in the Invitation to Bid. I understand that I will be required to provide necessary information to verify that the firm meets these qualifications if selected for the subsequent Contract.

Authorized Signature: _____

Printed Name & Title: _____

Date: _____

Payment information will be reported to the IRS under the name and federal taxpayer ID number provided above. Information not matching IRS records or not provided to the City could subject the successful Contractor to a twenty eight percent (28%) backup withholding.

SCOPE FOR BID SCHEDULE

Measurement and payment for all Work shown or specified herein will be made on a unit or lump sum price basis in accordance with the prices set forth in the Bid Schedule for individual items of Work. Contractor shall make a careful assessment when preparing the Bid.

The items listed in Section 01 22 00, Measurement and Payment, of Attachment M – Technical Specifications refer to and are the same pay items listed in the Bid Schedule. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory services or all other items not specifically named in specific Bid item description and needed for prosecution of the Work, and all other requirement of the Contract Documents. Compensation for all such services, things and materials shall be included in the prices stipulated for the lump sum and unit price pay items listed herein.

The prices stated in the Bid Schedule, include overhead and profit and all costs and expenses for bonds, insurance, taxes, labor, equipment, materials, commissions, transportation charges and expenses, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the Work, complete and in place, as shown on the Plans and specified herein. The basis of payment for an item at the lump sum or unit price shown in the Bid Schedule shall be in accordance with the description of that item in Section 01 22 00, Measurement and Payment, of Attachment M – Technical Specifications.

BID ITEM DESCRIPTIONS: ASR 3 & 2 Wellhouse Improvements

See Section 01 22 00, Measurement and Payment, of Attachment M – Technical Specifications for the measurement and payment descriptions for the various Bid items included in the ASR 3 & 2 Wellhouse Improvements project.

**ATTACHMENT C – ACKNOWLEDGMENT OF ADDENDA
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

I/WE HAVE RECEIVED THE FOLLOWING ADDENDA:

If none received, write "None Received"

1. _____

3. _____

2. _____

4. _____

Date

Signature of Proposer

Title

Corporate Name

**ATTACHMENT D – BID CERTIFICATION
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

Non-discrimination Clause

The Bidder agrees not to discriminate against any client, employee or applicant for employment or for services, because of race, color, religion, sex, national origin, handicap or age with regard to, but not limited to, the following: employment upgrading, demotion or transfer; recruitment or recruitment advertising; layoffs or termination; rates of pay or other forms of compensation; selection for training; rendition of services. It is further understood that any contractor who is in violation of this clause shall be barred from receiving awards of any purchase order or Bidder from the City, unless a satisfactory showing is made that discriminatory practices have terminated and that a recurrence of such acts is unlikely.

Agreed by: _____

Firm Name: _____

Address: _____

Officer's signature: _____

Type or print officer's name: _____

ATTACHMENT E – FIRST TIER SUBCONTRACTOR DISCLOSURE FORM
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS

PROJECT #: CIP 2020-96053 **CLOSING: Date:** July 28, 2022 **Time:** 2:00 pm

This form must be submitted at the location specified in the Advertisement for Bids on the advertised Bid closing date and within two working hours after the advertised Bid closing time.

List below the name of each subcontractor that will be furnishing labor or will be furnishing labor and materials and that is required to be disclosed, the category of work that the subcontractor will be performing and the dollar value of the subcontract. Enter "NONE" if there are no subcontractors that need to be disclosed. (ATTACH ADDITIONAL SHEETS IF NEEDED).

	NAME	DOLLAR VALUE	CATEGORY OF WORK
1)	_____	\$ _____	_____
2)	_____	\$ _____	_____
3)	_____	\$ _____	_____
4)	_____	\$ _____	_____

Failure to submit this form by the disclosure deadline will result in a nonresponsive Bid. A nonresponsive Bid will not be considered for award.

Form submitted by (Bidder name): _____

Contact name: _____ **Phone #:** _____

**ATTACHMENT F – BID BOND
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

We, _____, as “Principal,”
(Name of Principal)

and _____, an _____ Corporation,
(Name of Surety)

authorized to transact Surety business in the State of Oregon, as “Surety,” hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors, and assigns to pay unto the City of Tigard (“Obligee”) the sum of _____ and ____/100 Dollars (\$_____).

WHEREAS, the condition of the obligation of this bond is the Principal has submitted a Bid to the Obligee in response to Obligee’s solicitation for the project identified as ASR 3 & 2 Wellhouse Improvements which Bid is made a part of this bond by reference, and Principal is required to furnish Bid security in an amount equal to ten percent (10%) of the total amount of the Bid pursuant to the solicitation document.

NOW, THEREFORE, if the Bid submitted by Principal is accepted, and if a Contract pursuant to the Bid is awarded to Principal, and if Principal enters into and executes such Contract within the time specified in the said documents and delivers to Obligee its good and sufficient Performance Bond and Payment Bond required by Obligee within the time fixed by Obligee, then this obligation shall be void; otherwise, it shall remain in full force and effect.

IN WITNESS WHEREOF, we have caused this instrument to be executed and sealed by our duly authorized legal representatives this _____ day of _____, _____.

PRINCIPAL: _____

SURETY: _____

By: _____
Signature

BY ATTORNEY-IN-FACT

Printed Name & Title

Printed Name

Attest: _____

Signature

Address

City State Zip

ATTACHMENT G – PUBLIC IMPROVEMENT CONTRACT SAMPLE
PWR COVERED PROJECT
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS

THIS CONTRACT, made and entered into this (Day), (Month), (Year), by and between the City of Tigard, a municipal corporation of the State of Oregon, hereinafter called "City" and hereinafter called "Contractor", duly authorized to perform such services in Oregon.

RECITALS

WHEREAS, the City requires services which Contractor is capable of providing, under terms and conditions hereinafter described; and

WHEREAS, time is of the essence in this contract and all work under this contract shall be completed within the time period stated in the Contract Documents;

THEREFORE, in consideration of the promises and covenants contained herein, the parties hereby agree as follows:

TERMS OF AGREEMENT

1. Services to be Provided

Contractor's services under this Agreement shall consist of the following:

- Construction of ASR 3 Well House
 - ASR 3 well house construction
 - New seismic valve vault on Reservoir 16 inlet/outlet piping installation
 - Site stormwater and grading improvements
 - Site piping improvements
- Improvements to Reservoir 4
 - New reservoir vent installation
 - Sealing of existing reservoir vents
 - PRV valve vault installation
 - Site piping improvements
- Improvements to ASR 2
 - VFD replacement
 - Electrical and telemetry improvements
 - Water quality instrumentation replacement

2. Contract Documents

The Contractor is hereby bound to comply with all requirements of the Contract Documents prepared by the City and performance pertaining to this Agreement, in the City of Tigard, Oregon, and by this reference made a part hereof to the same legal force and effect as if set forth herein in full.

3. EFFECTIVE DATE AND DURATION

This Agreement is effective upon notice to proceed issued by the City and shall be substantially completed by June 30, 2024

4. Compensation

A. City agrees to pay Contractor (\$) for performance of those services provided herein.

B. City certifies that sufficient funds are available and authorized for expenditure to finance costs of this Contract during the current fiscal year. Funding in future fiscal years shall be contingent upon budgetary approval by the Tigard City Council.

5. Early Termination

A. This Agreement may be terminated without cause prior to the expiration of the agreed upon term by mutual written consent of the parties and for the following reasons:

- 1) If work under the Contract is suspended by an order of a public agency for any reason considered to be in the public interest other than by a labor dispute or by reason of any third-party judicial proceeding relating to the work other than a suit or action filed in regard to a labor dispute; or
- 2) If the circumstances or conditions are such that it is impracticable within a reasonable time to proceed with a substantial portion of the Contract.

B. Payment of Contractor shall be as provided by ORS 279C.660 and shall be prorated to and include the day of termination and shall be in full satisfaction of all claims by Contractor against City under this Agreement.

C. Termination under any provision of this paragraph shall not affect any right, obligation, or liability of Contractor or City which accrued prior to such termination.

6. Cancellation with Cause

A. City may terminate this Agreement effective upon delivery of written notice to Contractor, or at such later date as may be established by City, under any of the following conditions:

- 1) If City funding from federal, state, local, or other sources is not obtained and continued at levels sufficient to allow for the purchase of the indicated quantity of services. This Agreement may be modified to accommodate a reduction in funds,
- 2) If Federal or State regulations or guidelines are modified, changed, or interpreted in such a way that the services are no longer allowable or appropriate for purchase under this Agreement,
- 3) If any license or certificate required by law or regulation to be held by Contractor, its Subcontractors, agents, and employees to provide the services required by this Agreement is for any reason denied, revoked, or not renewed, or
- 4) If Contractor becomes insolvent, if voluntary or involuntary petition in bankruptcy is filed by or against Contractor, if a receiver or trustee is appointed for Contractor, or if there is an assignment for the benefit of creditors of Contractor.

Any such termination of this Agreement under paragraph (A) shall be without prejudice to any obligations or liabilities of either party already accrued prior to such termination.

B. City, by written notice of default (including breach of Contract) to Contractor, may terminate the whole or any part of this Agreement:

- 1) If Contractor fails to provide services called for by this Agreement within the time specified herein or any extension thereof, or
- 2) If Contractor fails to perform any of the other provisions of this Agreement, or so fails to pursue the work as to endanger performance of this Agreement in accordance with its terms, and after receipt of written notice from City, fails to correct such failures within ten (10) days or such other period as City may authorize.

The rights and remedies of City provided in the above clause related to defaults (including breach of Contract) by Contractor shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Agreement.

If City terminates this Agreement under paragraph (B), Contractor shall be entitled to receive as full payment for all services satisfactorily rendered and expenses incurred, an amount which bears the same ratio to the total fees specified in this Agreement as the services satisfactorily rendered by Contractor bear to the total services otherwise required to be performed for such total fee; provided, that there shall be deducted from such amount the amount of damages, if any, sustained by City due to breach of Contract by Contractor. Damages for breach of Contract shall be those allowed by Oregon law, reasonable and necessary attorney fees, and other costs of litigation at trial and upon appeal.

7. Force Majeure

Neither City nor Contractor shall be considered in default because of any delays in completion of responsibilities hereunder due to causes beyond the control and without fault or negligence on the part of the party so disabled, including, but not restricted to, an act of God or of a public enemy, volcano, earthquake, fire, flood, epidemic, quarantine, restriction, area-wide strike, freight embargo, unusually severe weather or delay of Subcontractor or suppliers due to such cause; provided that the party so disabled shall within ten (10) days from the beginning of such delay, notify the other party in writing of the causes of delay and its probable extent. Such notification shall not be the basis for a claim for additional compensation. Each party shall, however, make all reasonable efforts to remove or eliminate such a cause of delay or default and shall, upon cessation of the cause, diligently pursue performance of its obligation under Contract.

8. Nonwaiver

The failure of the City to insist upon or enforce strict performance by Contractor of any of the terms of this Contract or to exercise any rights hereunder shall not be construed as a waiver or relinquishment to any extent of its right to assert or rely upon such terms or rights on any future occasion.

9. Attorney's Fees

In case suit or action is instituted to enforce the provisions of this contract, the parties agree that the losing party shall pay such sum as the Court may adjudge reasonable attorney's fees and court costs including attorney's fees and court costs on appeal.

10. Governing Law

The provisions of this Agreement shall be construed in accordance with the provisions of the laws of the State of Oregon. Any action or suits involving any questions arising under this Agreement must be brought in the appropriate court of the State of Oregon.

11. Indemnification

Contractor agrees to indemnify and defend the City, its officers, agents and employees and hold them harmless from any and all liability, causes of action, claims, losses, damages, judgments or other costs or expenses including attorney's fees and witness costs and (at both trial and appeal level, whether or not a trial or appeal ever takes place) that may be asserted by any person or entity which in any way arise from, during or in connection with the performance of the work described in this Contract, except liability arising out of the sole negligence of the City and its employees. If any aspect of this indemnity shall be found to be illegal or invalid for any reason whatsoever, such illegality or invalidity shall not affect the validity of the remainder of this indemnification.

12. Insurance

Contractor shall maintain insurance acceptable to City in full force and effect throughout the term of this Contract. Such insurance shall cover all risks arising directly or indirectly out of Contractor's activities or work hereunder, including the operations of its Subcontractors of any tier. Such insurance shall include provisions that such insurance is primary insurance with respect to the interests of City and that any other insurance maintained by City is excess and not contributory insurance with the insurance required hereunder.

The policy or policies of insurance maintained by the Contractor shall provide at least the following limits and coverages:

A. Commercial General Liability Insurance: Contractor shall obtain, at contractor’s expense, and keep in effect during the term of this Contract, Comprehensive General Liability Insurance covering Bodily Injury and Property Damage on an “occurrence” form (CG 2010 1185 or equivalent). This coverage shall include Contractual Liability insurance for the indemnity provided under this Contract. The following insurance will be carried:

<u>Coverage</u>	<u>Limit</u>
General Aggregate	\$3,000,000
Products-Completed Operations Aggregate	\$2,000,000
Personal & Advertising Injury	\$1,000,000
Each Occurrence	\$2,000,000
Fire Damage (Any one fire)	\$50,000

B. Commercial Automobile Insurance: Contractor shall also obtain, at Contractor’s expense, and keep in effect during the term of the Contract, “Symbol 1” Commercial Automobile Liability coverage including coverage for all owned, hired, and non-owned vehicles. The Combined Single Limit per occurrence shall not be less than \$2,000,000.

C. Workers’ Compensation Insurance: The Contractor, its Subcontractors, if any, and all employers providing work, labor or materials under this Contract are subject employers under the Oregon Workers’ Compensation Law and shall comply with ORS 656.017, which requires them to provide workers’ compensation coverage that satisfies Oregon law for all their subject workers. Out-of-state employers must provide Oregon workers’ compensation coverage for their workers who work at a single location within Oregon for more than 30 days in a calendar year. Contractors who perform work without the assistance or labor of any employee need not to obtain such coverage. This shall include Employer’s Liability Insurance with coverage limits of not less than \$1,000,000 each accident.

D. Additional Insured Provision: The City of Tigard, Oregon, its officers, directors, and employees shall be added as additional insureds with respect to this contract. All Liability Insurance policies will be endorsed to show this additional coverage.

E. Insurance Carrier Rating: Coverage provided by the Contractor must be underwritten by an insurance company deemed acceptable by the City. The insurance carrier shall have a minimum of an AM Best Rating “A” with a financial strength of VII or better. The City reserves the right to reject all or any insurance carrier(s) with an unacceptable financial rating.

F. Certificates of Insurance: A copy of each insurance policy, certified as a true copy by an authorized representative of the issuing insurance company, or at the discretion of City, in lieu thereof, a certificate in form satisfactory to City certifying to the issuance of all such insurance provisions of this Contract shall be forwarded to:

City of Tigard
 Attn: Office of Contracts and Purchasing
 13125 SW Hall Blvd
 Tigard, Oregon 97223

Such policies or certificates must be delivered prior to commencement of the work and no Contract shall be affected until the required certificates have been received and approved by the City. Ten days cancellation notice shall be provided to the City by certified mail to the name at the address listed above in event of cancellation or non-renewal of the insurance. A renewal certificate will be sent to the above address 10 days prior to coverage expiration. The procuring of such required insurance shall not be construed to limit

Contractor's liability hereunder. Notwithstanding said insurance, Contractor shall be obligated for the total amount of any damage, injury, or loss connected with this Contract.

G. Primary Coverage Clarification: All parties to this contract hereby agree that the contractor's coverage will be primary in the event of a loss.

H. Cross-Liability Clause: A cross-liability clause or separation of insureds clause will be included in all general liability, and pollution policies required by this Contract.

13. Method and Place of Giving Notice, Submitting Bills and Making Payments

All notices, bills and payments shall be made in writing and may be given by personal delivery or by email. Notices, bills and payments sent by email should be addressed as follows:

CITY OF TIGARD		(CONTRACTOR)	
Attn:	Shasta Billings-Beck	Attn:	(insert contract manager's name)
Address:	13125 SW Hall Boulevard Tigard, Oregon 97223	Address:	(insert contract manager's address)
Phone:	(503) 718-2698	Phone:	(insert #)
Email:	shastab@tigard-or.gov	Email:	(insert address)

and when so addressed, shall be deemed given upon deposit in the United States mail, postage prepaid. In all other instances, notices, bills and payments shall be deemed given at the time of actual delivery. Changes may be made in the names and addresses of the person to whom notices, bills and payments are to be given by giving written notice pursuant to this paragraph. Invoices shall list each project separately with work completed and amount due for each.

14. Severability

In the event any provision or portion of this Agreement is held to be unenforceable or invalid by any court of competent jurisdiction, the remainder of this Agreement shall remain in full force and effect and shall in no way be affected or invalidated thereby.

15. Complete Agreement

This Agreement constitutes the entire Agreement between the parties. No waiver, consent, modification, or change of terms of this Agreement shall bind either party unless in writing and signed by both parties. Such waiver, consent, modification, or change if made, shall be effective only in specific instances and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, not specified herein regarding this Agreement. Contractor, by the signature of its authorized representative, hereby acknowledges that he has read this Agreement, understands it and agrees to be bound by its terms and conditions.

IN WITNESS WHEREOF, City has caused this Agreement to be executed by its duly authorized undersigned officer and Contractor has executed this Agreement on the date hereinabove first written. Approved by Tigard's Local Contract Review Board at their _____ business meeting.

CITY OF TIGARD

(CONTRACTOR)

Signature

Signature

Date

Date

**ATTACHMENT H – PERFORMANCE BOND
PUBLIC IMPROVEMENT CONTRACT
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

Bond Number: _____

Project Name: _____

_____ (Surety #1)
_____ (Surety #2)*

Bond Amount No. 1: \$ _____
Bond Amount No. 2:* \$ _____
Total Penal Sum of Bond: \$ _____

** If using multiple sureties*

We, _____ as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors, and assigns firmly by these presents to pay unto the City of Tigard, a municipality of the State of Oregon, the sum of (total Penal Sum of Bond) _____ (Provided, that we the Sureties bind ourselves in such sum “jointly and severally” as well as “severally” only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposed each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into a Contract with the City of Tigard, the plans, specifications, terms, and conditions of which are contained in the above-referenced project solicitation;

WHEREAS, the terms and conditions of the Contract, together with applicable plans, standard specifications, special provisions, technical specifications, schedule of performance, and schedule of Contract Prices, are made a part of this Performance Bond by reference, whether or not attached to the Contract (all hereafter called “Contract”); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans, and specifications, and all authorized modifications of the Contract which increase the amount of the work, the amount of the Contract, or constitute an authorized extension of the time for performance, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal herein shall faithfully and truly observe and comply with the terms of the Contract and performs the Contract within the time prescribed by the Contract, then this obligation is null and void; otherwise it shall remain in full force and effect. If the Contractor is declared by City to be in default under the Contract, the surety shall promptly remedy the default, perform all of Contractor’s obligations under the Contract in accordance with its terms and conditions and pay to City all damages that are due under the Contract. This obligation jointly and severally binds the Contractor and surety and their respected heirs, executors, administrators, and successors. Nonpayment of the bond premium shall not invalidate this bond nor shall the City of Tigard be obligated for the payment of any premiums.

Said surety for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or the Work to be performed thereunder, or the specifications accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract or to the Work or to the specifications.

This Performance Bond shall also guarantee the subject project against defects in materials or workmanship for a period of one (1) year from the date of written Substantial Completion acceptance of the subject project by the City of Tigard.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES.

Dated this _____ day of _____, _____.

PRINCIPAL: _____

By: _____

Signature

Printed Name & Title

Attest: _____

SURETY: _____

(Add signatures for each surety if using multiple bonds)

BY ATTORNEY-IN-FACT:

(Power-of-Attorney must accompany each surety bond)

Name

Signature

Address

City State Zip

Phone Fax

**ATTACHMENT I – PAYMENT BOND
PUBLIC IMPROVEMENT CONTRACT
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

Bond Number: _____

Project Name: _____

_____ (Surety #1)
_____ (Surety #2)*

Bond Amount No. 1: \$ _____

Bond Amount No. 2:* \$ _____

Total Penal Sum of Bond: \$ _____

** If using multiple sureties*

We, _____ as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors, and assigns firmly by these presents to pay unto the City of Tigard, a municipality of the State of Oregon, the sum of (total Penal Sum of Bond) _____ (Provided, that we the Sureties bind ourselves in such sum “jointly and severally” as well as “severally” only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposed each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into a Contract with the City of Tigard, the plans, specifications, terms, and conditions of which are contained in above-referenced project solicitation;

WHEREAS, the terms and conditions of the Contract, together with applicable plans, standard specifications, special provisions, technical specifications, schedule of performance, and schedule of Contract Prices, are made a part of this Payment bond by reference, whether or not attached to the Contract (all hereafter called “Contract”); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans, and specifications, and schedule of Contract Prices which are set forth in the Contract and any attachments, and all authorized modifications of the Contract which increase the amount of the work, or the cost of the Contract, or constitute authorized extensions of time for performance of the Contract, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal shall faithfully and truly observe and comply with the terms, conditions, and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things to be performed under said Contract and any duly authorized modifications that are made, upon the terms set forth therein, and within the time prescribed therein, or as extended therein as provided in the Contract, with or without notice to the Sureties, and shall indemnify and save harmless the City of Tigard its officers, agents, and employees against any claim for direct or indirect damages of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Contractor or its subcontractors, and shall promptly pay all persons supplying labor, materials, or both to the Principal or its subcontractors for prosecution of the work provided in the Contract; and shall promptly pay all contributions due the State Industrial Accident Fund and the State Unemployment Compensation Fund from the Principal or its subcontractors in connection with the performance of the Contract; and shall pay over to the Oregon Department of Revenue all sums required to be deducted and retained from the wages of employees of the Principal and its subcontractors pursuant to ORS 316.167, and shall permit no lien nor claim to be filed or prosecuted against the City on account of any labor or materials furnished; and shall do all things required of the Principal by the laws of the State of Oregon, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond nor shall the City of Tigard be obligated for the payment of any premiums.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES.

Dated this _____ day of _____, _____.

PRINCIPAL: _____

By: _____
Signature

Printed Name & Title

Attest: _____

SURETY: _____

(Add signatures for each surety if using multiple bonds)

BY ATTORNEY-IN-FACT:

(Power-of-Attorney must accompany each surety bond)

Name

Signature

Address

City State Zip

Phone Fax

**ATTACHMENT J – OREGON PREVAILING WAGE RATES
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

May be downloaded from: http://www.oregon.gov/boli/WHD/PWR/Pages/pwr_state.aspx

**ATTACHMENT K – GENERAL CONDITIONS
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

[INTENTIONALLY BLANK]

**NEXT PAGE TOC-1 TO TOC-5
GENERAL CONDITIONS PAGES 1 TO 126**

General Conditions for Construction for the City of Tigard

TABLE OF CONTENTS

Part 00100 - GENERAL CONDITIONS

Section 00110 - Organization, Conventions, Abbreviations, and Definitions 5

00110.00 Organization of Specifications 5

00110.05 Conventions Used Throughout the Specifications Include..... 5

00110.10 Abbreviations 7

00110.20 Definitions 9

Section 00120 - Bidding Requirements and Procedures 16

00120.01 Receipt of Bids; Opening 19

00120.02 Prequalification of Bidders 19

00120.03 Request for Solicitation Documents 19

00120.04 Pre-Bid Meeting..... 19

00120.10 Bid Booklet..... 19

00120.15 Examination of Work Site and Solicitation Documents;
Consideration of Conditions to be Encountered 19

00120.16 Material, Equipment, and Method Substitutions 20

00120.17 Use of Agency-Owned Land for Staging or Storage Areas 20

00120.18 Contractor-Obtained Land for Staging or Storage Areas..... 21

00120.20 Interpretation of Quantities in Bid Schedule 21

00120.25 Subsurface Investigations 21

00120.30 Changes to Plans, Specifications, or Quantities before Opening of Bids 22

00120.40 Preparation of Bids 22

00120.45 Submittal of Bids 24

00120.60 Modification or Withdrawal of Bids 24

00120.65 Opening and Comparing Bids 25

00120.67 Bid Mistakes 25

00120.68 Low Tide Bids..... 26

00120.70 Rejection of Nonresponsive Bids 26

00120.80 Reciprocal Preference for Oregon Resident Bidders 27

00120.90 Disqualification of Bidders..... 27

00120.91 Rejection of Bid on Grounds of Nonresponsibility of Bidder 27

Section 00130 - Award and Execution of Contract 28

00130.00 Consideration of Bids..... 28

00130.10 Award of Contract 28

00130.15 Right to Protest Award 29

00130.20 Cancellation of Award..... 29

00130.30 Contract Booklet 29

00130.40 Contract Submittals 30

00130.50 Execution of Contract and Bonds..... 31

00130.60 Failure to Execute Contract and Bonds 31

00130.70 Release of Bid Guaranties 31

00130.80 Project Site Restrictions..... 31

00130.85	Tigard Business License.....	31
00130.90	Notice to Proceed	32

Section 00140 - Scope of Work 33

00140.00	Purpose of Contract	33
00140.10	Typical Sections	33
00140.20	Thickness.....	33
00140.30	Agency-Required Changes in the Work	33
00140.40	Differing Site Conditions	34
00140.50	Environmental Pollution Changes	34
00140.60	Extra Work	34
00140.65	Disputed Work	34
00140.70	Cost Reduction Proposals.....	34
00140.80	Use of Publicly Owned Equipment	36
00140.90	Final Trimming and Cleanup.....	36
00140.95	“AS-BUILT” Drawings	36

Section 00150 - Control of Work..... 38

00150.00	Authority of the Engineer	38
00150.01	Project Manager.....	38
00150.02	Inspector's Authority and Duties	38
00150.10	Coordination of Contract Documents	39
00150.15	Construction Stakes, Lines, and Grades	39
00150.20	Inspection.....	40
00150.25	Acceptability of Materials and Work	40
00150.30	Delivery of Notices.....	41
00150.35	Submittals.....	41
00150.37	Equipment Lists and Other Submittals.....	46
00150.40	Cooperation and Superintendence by the Contractor	46
00150.50	Cooperation with Utilities	47
00150.53	Utilities and Existing Improvements	48
00150.55	Cooperation with Other Contractors	49
00150.60	Construction Equipment Restrictions.....	50
00150.70	Detrimental Operations.....	50
00150.75	Protection and Maintenance of Work During Construction	51
00150.80	Removal of Unacceptable and Unauthorized Work	51
00150.90	Final Inspection.....	51
00150.91	Post-Construction Review.....	52
00150.95	Final Acceptance	52
00150.96	Maintenance Warranties and Guarantees	52
00150.97	Responsibility for Materials and Workmanship	52

Section 00160 - Source of Materials 53

00160.00	Definitions	53
00160.01	Notification of Source of Supply and Materials	53
00160.05	Qualified Products List (QPL)	53
00160.10	Ordering, Producing, and Furnishing Materials	53
00160.20	Preferences for Materials	54
00160.30	Agency-Furnished Materials	55

00160.50	Agency-Controlled Land; Limitations and Requirements.....	55
00160.60	Contractor-Furnished Materials and Sources	55
00160.70	Requirements for Plant Operations	56
00160.80	Requirements for Sources of Borrow and Aggregate	56

Section 00165 - Quality of Materials..... 58

00165.00	General	58
00165.01	Rejected Materials	58
00165.03	Testing by Agency.....	58
00165.04	Costs of Testing.....	58
00165.10	Materials Acceptance Guides	58
00165.20	Materials Specifications and Test Method References.....	59
00165.30	Field-Tested Materials.....	59
00165.35	Nonfield-Tested Materials.....	59
00165.50	Acceptance Sampling and Testing.....	60
00165.70	Use of Materials without Engineer’s Acceptance	60
00165.75	Storage and Handling of Materials	60
00165.80	Measurement	61
00165.90	Incidental Basis	61

Section 00170 - Legal Relations and Responsibilities..... 62

00170.00	General	62
00170.01	Other Agencies Affecting Agency Contracts.....	62
00170.02	Permits, Licenses, and Taxes	64
00170.03	Furnishing Rights-of-Way, Easements and Permits.....	64
00170.04	Patents, Copyrights, and Trademarks	65
00170.05	Assignment of Antitrust Rights	65
00170.07	Record Requirements	65
00170.10	Required Payments by Contractors.....	68
00170.20	Public Works Bond.....	69
00170.32	Protection of Navigable Waters.....	69
00170.60	Safety, Health, and Sanitation Provisions	69
00170.61	Industrial Accident Protection	69
00170.62	Labor Nondiscrimination	69
00170.63	Payment for Medical Care	70
00170.65	Minimum Wage and Overtime Rates for Public Works Projects	70
00170.70	Insurance	72
00170.71	Independent Contractor Status	72
00170.74	Employee Drug Testing Program	72
00170.75	Oregon Tax Laws	72
00170.76	Subcontractors Nondiscrimination	73
00170.78	Conflict of Interest.....	73
00170.79	Third Party Beneficiary	73
00170.80	Responsibility for Damage to Work	73
00170.82	Responsibility for Damage to Property and Facilities.....	73
00170.85	Responsibility for Defective Work.....	74
00170.89	Protection of Utility, Fire-control, and Railroad Property and Services; Repair; Roadway Restoration.....	76
00170.92	Fencing, Protecting Stock, and Safeguarding Excavations	76
00170.93	Trespass	77

00170.94	Use of Explosives.....	77
Section 00180 - Prosecution and Progress		78
00180.00	Scope.....	78
00180.05	Assignment/Delegation of Contract	78
00180.06	Assignment of Funds Due under the Contract	78
00180.10	Responsibility for Contract	78
00180.15	Agency's Right to Do Work at Contractor's Expense	78
00180.20	Subcontracting Limitations	78
00180.21	Subcontracting.....	79
00180.22	Payments to Subcontractors and Agents of the Contractor.....	81
00180.30	Materials, Equipment, and Work Force	81
00180.31	Required Materials, Equipment, and Methods	81
00180.40	Limitation of Operations.....	82
00180.41	Project Work Schedules.....	83
00180.42	Preconstruction Conference	91
00180.43	Commencement and Performance of Work	91
00180.44	Project Meetings	91
00180.50	Contract Time to Complete Work	93
00180.60	Notice of Delay.....	95
00180.65	Rights-of-Way and Access Delays	95
00180.70	Suspension of Work	95
00180.80	Adjustment of Contract Time	96
00180.85	Failure to Complete on Time; Liquidated Damages	98
00180.90	Termination of Contract and Substituted Performance	98
Section 00190 - Measurement of Pay Quantities		101
00190.00	Scope.....	101
00190.10	Measurement Guidelines	101
00190.20	Contractor to Provide Vehicle Weigh Scales	102
00190.30	Plant Scales	1050
Section 00195 - Payment		106
00195.00	Scope and Limit.....	106
00195.10	Payment For Changes in Materials Costs	106
00195.13	Asphalt Cement Material Price Escalation/De-Escalation Clause	106
00195.20	Changes to Plans or Character of Work	107
00195.30	Differing Site Conditions	107
00195.40	Unreasonable Delay by the Agency	108
00195.50	Progress Payments and Retained Amounts.....	108
00195.60	Advance Allowance for Materials on Hand	112
00195.70	Payment under Terminated Contract	113
00195.80	Allowance for Materials Left on Hand.....	114
00195.90	Final Payment.....	114
00195.95	Error in Final Quantities and Amounts	115
Section 00196 - Payment for Extra Work.....		117
00196.00	General	117
00196.10	Negotiated Price	117

00196.20 Force Account	117
Section 00197 - Payment for Force Account Work.....	118
00197.00 Scope.....	118
00197.01 Extra Work on Force Account Basis.....	118
00197.10 Materials	118
00197.20 Equipment	119
00197.30 Labor.....	120
00197.80 Percentage Allowances.....	121
00197.90 Billings.....	121
Section 00199 - Disagreements, Protest and Claims.....	122
00199.00 General	122
00199.10 Procedure for Resolving Disagreements.....	122
00199.15 Inappropriate Protest or Claim	122
00199.20 Protest Procedure.....	122
00199.30 Claims Procedure	124
00199.40 Claim Decision; Review; Exhaustion of Administrative Remedies	129
00199.60 Review of Determination Regarding Records	129

PART 00100 - GENERAL CONDITIONS

Section 00110 - Organization, Conventions, Abbreviations, and Definitions

00110.00 Organization of Specifications

The Specifications are comprised of the following:

- The “General Conditions for Construction for the City of Tigard”, published by the Agency, which contain Part 00100 “General Conditions”, which deal with the solicitation process and contractual relationships;
- The “2021~~8~~-Oregon Standard Specifications for Construction”, published by the Oregon Department of Transportation, which contain Parts 00200 through 03000 which contain the detailed “Technical Specifications” involved in prosecution of the Work, organized by subject matter; and
- The Special Provisions.

In addition, throughout the Specifications:

- Each Part is divided into Sections and Subsections.
- Reference to a Section includes all applicable requirements of the Section.
- When referring to a Subsection, only the number of the Subsection is used; the word “Subsection” is implied.
- Where Section and Subsection numbers are not consecutive, the interval has been reserved for use in the Special Provisions or future expansion of the Standard Specifications.

00110.05 Conventions Used Throughout the Specifications Include

A. Grammar - The “General Conditions for Construction for the City of Tigard”, Part 00100 “General Conditions”, is written in the indicative mood, in which the subject is expressed. The “2021~~8~~ Oregon Standard Specifications for Construction”, published by the Oregon Department of Transportation, which contain Parts 00200 through 03000, the detailed “Technical Specifications”, are generally written in the imperative mood, in which the subject is implied. Therefore, throughout Parts 00200 through 03000, and on the Plans:

- The subject, “the Contractor”, is implied.
- “Shall” refers to action required of the Contractor, and is implied.
- “Will” refers to decisions or actions of the Agency and/or the Engineer.
- The following words, or words of equivalent meaning, refer to the actions of the Agency and/or the Engineer, unless otherwise stated: “allowed”, “directed”, “established”, “permitted”, “ordered”, “designated”, “prescribed”, “required”, “determined”.
- The words “approved”, “acceptable”, “authorized”, “satisfactory”, “suitable”, “considered”, and “rejected”, “denied”, “disapproved”, or words of equivalent meaning, mean by or to the Agency and/or the Engineer, subject in each case to Section 00150 of the General Conditions.
- The words “as shown”, “shown”, “as indicated”, or “indicated” mean “as indicated on the Plans”.
- Certain Subsections labeled “Payment” contain statements to the effect that “payment will be made at the Contract amounts for the following items” (followed by a list of items). In such cases the Agency shall pay for only those Pay Items listed in the Schedule of Items.

- B. Capitalization of Terms** - Capitalized terms, other than titles, abbreviations, and grammatical usage, indicate that they have been given a defined meaning in the Standard Specifications. Refer to Section 00110.20 “Definitions”. Defined terms will always be capitalized in Part 00100; in Parts 00200 through 03000, defined terms will generally not be capitalized, with the notable exception of “the Contractor”, “the Agency”, and “the Engineer”.
- C. Punctuation** - In this publication the “outside method” of punctuation is employed for placement of the comma and the period with respect to quotation marks. Only punctuation that is part of the quoted matter is placed within quotation marks.
- D. References to Laws, Acts, Regulations, Rules, Ordinances, Statutes, Orders, and Permits** - References are made in the text of the Specifications to “laws”, “acts”, “rules”, “statutes”, “regulations”, “ordinances”, etc. (collectively referred to for purposes of this Subsection as “Law”), and to “orders” and “permits” (issued by a governmental authority, whether local, state, or federal, and collectively referred to for purposes of this Subsection as “Permits”). Reference is also made to “applicable laws and regulations”. The following conventions apply in interpreting these terms, as used in the Specifications.
- Statutes and Rules - Oregon Revised Statutes (ORS) and Oregon Administrative Rules (OAR) referenced in the Specifications are accessible on line, including through the Oregon Legislative Counsel Committee website and through the Oregon Secretary of State Archives Division website.
 - Law - In each case, unless otherwise expressly stated therein, the Law is to be understood to be the current version in effect. This also applies where a specific Law is referenced or cited, regardless of whether the text of the Law has been included in the Specifications or not, and regardless of whether the text of the Law has been summarized or paraphrased. In each case, the current version of the Law is applicable under any Contract. The reader is therefore cautioned to check the actual text of the Law to confirm that the text included in the Specifications has not been modified or superseded.
 - Permits - Orders and permits issued by a government agency may be modified during the course of performing the work under a contract. Therefore, wherever the term “order” or “permit” is used in the Specifications, it is intended to refer to the then-current version. That version may be embodied in a modified, superseding order or permit, or it may consist of all terms and conditions of prior orders or permits that have not been superseded, as well as the additional terms added by amendment or supplement. In certain cases, the orders and/or permits are identified by name in the Specifications; in other cases the terms are used in the generic sense. The reader is cautioned to check the text(s) of each order and permit identified either by name or by generic reference.
 - Applicable Laws and Regulations - Where the phrase “applicable laws and regulations” appears, it is to be understood as including all applicable laws, acts, regulations, administrative rules, ordinances, statutes, and orders and permits issued by a governmental or regulatory authority.

00110.10 Abbreviations

Following are meanings of abbreviations used in the Standard Specifications, in the Special Provisions, on the Plans, and in other Contract Documents. Other abbreviations and meanings of abbreviations may be in the individual Sections of the Standard Specifications to which they apply, in the Special Provisions, and in OAR 731-005 and OAR 731-007.

AAR	- Association of American Railroads
AASHTO	- American Association of State Highway and Transportation Officials
ABC	- Associated Builders and Contractors, Inc.
AC	- Asphalt Concrete
ACI	- American Concrete Institute
ACP	- Asphalt Concrete Pavement
ACWS	- Asphalt Concrete Wearing Surface
AGC	- Associated General Contractors of America
AIA	- American Institute of Architects
AISC	- American Institute of Steel Construction
AISI	- American Iron and Steel Institute
AITC	- American Institute of Timber Construction
ANSI	- American National Standards Institute
APA	- Engineered Wood Association
APWA	- American Public Works Association
AREMA	- American Railway Engineering and Maintenance of Right-of-Way Association
ASCE	- American Society of Civil Engineers
ASME	- American Society of Mechanical Engineers
ASTM	- American Society for Testing and Materials
ATPB	- Asphalt Treated Permeable Base
AWG	- American Wire Gauge
AWPA	- American Wood Protection Association
AWS	- American Welding Society
AWWA	- American Water Works Association
CAGT	- Certified Aggregate Technician
CAT-I	- Certified Asphalt Technician I
CAT-II	- Certified Asphalt Technician II
CBM	- Certified Ballast Manufacturers
CCO	- Contract Change Order
CCT	- Concrete Control Technician
CDT	- Certified Density Technician
CEBT	- Certified Embankment and Base Technician
CMDT	- Certified Mixture Design Technician
CPF	- Composite Pay Factor
CRSI	- Concrete Reinforcing Steel Institute
CFR	- Code of Federal Regulations
CS	- Commercial Standard, Commodity Standards Division, U.S. Department of Commerce
D1.1	- Structural Welding Code - Steel, American Welding Society, current edition
D1.5	- Bridge Welding Code, American Welding Society, current edition
DBE	- Disadvantaged Business Enterprise

DEQ	- Department of Environmental Quality, State of Oregon
DOGAMI	- Department of Geology and Mineral Industries, State of Oregon
DSL	- Department of State Lands, State of Oregon
EAC	- Emulsified Asphalt Concrete
EPA	- U.S. Environmental Protection Agency
ESCP	- Erosion and Sediment Control Plan
FHWA	- Federal Highway Administration, U.S. Department of Transportation
FSS	- Federal Specifications and Standards, General Services Administration
GSA	- General Services Administration
ICEA	- Insulated Cable Engineers Association (formerly IPCEA)
IES	- Illuminating Engineering Society
IMSA	- International Municipal Signal Association
ISO	- International Standards Organization
ITE	- Institute of Transportation Engineers
JMF	- Job Mix Formula
MFTP	- Manual of Field Test Procedures (ODOT)
MIL	- Military Specifications
MSC	- Minor Structure Concrete
MUTCD	- Manual on Uniform Traffic Control Devices for Streets and Highways, FHWA, U.S. Department of Transportation
NEC	- National Electrical Code
NEMA	- National Electrical Manufacturer's Association
NESC	- National Electrical Safety Code
NIST	- National Institute of Standards and Technology
NPDES	- National Pollutant Discharge Elimination System
NPS	- Nominal Pipe Size (dimensionless)
OAR	- Oregon Administrative Rules
ODA	- Oregon Department of Agriculture
ODOT	- Oregon Department of Transportation
ORS	- Oregon Revised Statutes
OR-OSHA	- Oregon Occupational Safety and Health Division of the Department of Consumer and Business Services
OSHA	- Occupational Safety and Health Administration, U.S. Department of Labor
PCA	- Portland Cement Association
PCC	- Portland Cement Concrete
PCI	- Precast/Prestressed Concrete Institute
PCP	- Pollution Control Plan
PF	- Pay Factor of a constituent
PLS	- Professional Land Surveyor
PMBB	- Plant Mixed Bituminous Base
PTI	- Post-Tensioning Institute
PUC	- Public Utility Commission, State of Oregon
QA	- Quality Assurance
QC	- Quality Control
QCT	- Quality Control Technician
QL	- Quality Level
QPL	- Qualified Products List

RAP	- Reclaimed Asphalt Pavement
REA	- Rural Electrification Administration, U.S. Department of Agriculture
RMA	- Radio Manufacturers Association or Rubber Manufacturers Association
SAE	- Society of Automotive Engineers
SI	- International System of Units (Système Internationale)
SRCM	- Soil and Rock Classification Manual (ODOT)
SSPC	- Society for Protective Coatings
T	- Tolerances, AASHTO Test Method
TM	- Test Method (ODOT)
TV	- Target Value
UBC	- Uniform Building Code (as adopted by the State of Oregon)
UL	- Underwriters Laboratory, Inc.
UPC	- Uniform Plumbing Code (as adopted by the State of Oregon)
USC	- United States Code
WAQTC	- Western Alliance for Quality Transportation Construction
WCLIB	- West Coast Lumber Inspection Bureau
WWPA	- Western Wood Products Association

00110.20 Definitions

Following are definitions of words and phrases used in the Standard Specifications, in the Special Provisions, on the Plans, and in other Contract Documents. Other definitions may be in the individual Sections of the Standard Specifications to which they apply, in the Special Provisions, and in OAR 731-005 and OAR 731-007.

Act of God or Nature - A natural phenomenon of such catastrophic proportions or intensity as would reasonably prevent performance.

Addendum - A written or graphic modification, issued before the opening of Bids, which revises, adds to, or deletes information in the Solicitation Documents or previously issued Addenda.

Additional Work - Increased quantities of any Pay Item, within the scope of the Contract, for which a unit price has been established.

Advertisement - The public announcement (Notice to Contractors, Invitation to Bid or Advertisement for Bids) inviting Bids for Work to be performed or Materials to be furnished.

Agency - The City of Tigard, a municipal corporation of the State of Oregon, which has entered into a Contract with the Contractor.

Agency-Controlled Lands - Lands owned by the Agency, or controlled by the Agency under lease or agreement, or under the jurisdiction and control of the Agency for the purposes of the Contract.

Aggregate - Rock of specified quality and gradation.

Attorney-in-Fact - An Entity appointed by another to act in its place, either for some particular purpose, or for the transaction of business in general.

Award - Written notification to the Bidder that the Bidder has been awarded a Contract.

Base - A Course of specified material of specified thickness placed below the Pavement.

Bid - A competitive offer, binding on the Bidder and submitted in response to an invitation to bid.

Bid Bond - The Surety bond for Bid guarantee.

Bid Booklet - The information included in the Solicitation Documents that contain the information identified in 00120.10.

Bid Closing - The date and time after which Bids, Bid modifications, and Bid withdrawals will no longer be accepted.

Bid Documents - See under Solicitation Documents.

Bid Opening - The date and time Bids are opened.

Bid Schedule - The list of Pay Items, their units of measurement, and estimated quantities. (When a Contract is awarded, the Bid Schedule becomes the Schedule of Items.)

Bid Section - The portion of the Bid Booklet containing all pages after the Bidder's checklist and before the appendix.

Bidder - An Entity that submits a Bid in response to an invitation to bid.

Bike Lane - A lane in the Traveled Way, designated by striping and Pavement markings for the preferential or exclusive use of bicyclists.

Borrow - Material lying outside of planned or required Roadbed excavation used to complete Project earthwork.

Boulders - Particles of rock that will not pass a 12-inch square opening.

Bridge - A single or multiple span Structure, including supports, that carries motorized and non-motorized vehicles, pedestrians, or utilities on a Roadway, walk, or track over a watercourse, Highway, Railroad, or other feature.

Buttress - A Rock fill placed at the toe of a landslide or potential landslide in order to resist slide movement.

Calendar Day - Any Day shown on the calendar, beginning and ending at midnight.

Camber - A slight arch in a surface or Structure to compensate for loading.

Change Order - A written order issued by the Engineer to the Contractor modifying Work required by the Contract, or adding Work within the scope of the Contract, and, if applicable, establishing the basis of payment for the modified Work, or otherwise modifying the Contract.

Changed Work - Work included in a Pay Item and within the scope of the Contract that is different from that reflected in the Contract Documents. (See 00140.30)

Class of Project - A designation based on a Project's funding source, i.e., State or Federal-aid.

Class of Work - A designation referring to the type of Work in which Bidders must be prequalified, if prequalification is required.

Clay - Soil passing a No. 200 sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents.

Clear Zone - Roadside border area, starting at the edge of the Traveled Way, available for safe use by errant vehicles. Establishing a minimum width Clear Zone implies that rigid objects and certain other hazards within the Clear Zone should be relocated outside the Clear Zone, or shielded, or remodeled to make them break away on impact or be safely traversable.

Close Conformance - Where working tolerances are given on the Plans or in the Specifications, Close Conformance means compliance with those tolerances. Where working tolerances are not given, Close Conformance means compliance, in the Engineer's judgment, with reasonable and customary manufacturing and construction tolerances.

Coarse Aggregate - Crushed Rock or crushed Gravel retained on a 1/4-inch sieve, with allowable undersize.

Cobbles - Particles of Rock, rounded or not, that will pass a 12-inch square opening and be retained on a 3-inch sieve.

Commercial Grade Concrete - Concrete furnished according to Contractor proportioning, placed in minor Structures and finished as specified.

Conduct Disqualification - A disqualification under ORS 279C.440.

Contract - The written agreement between the Agency and the Contractor, including, without limitation, all Contract Documents, describing the Work to be completed and defining the rights and obligations of the Agency and the Contractor.

Contract Amount (Contract Price) - Sum of the Pay Item amounts computed by multiplying the Pay Item quantities by the unit prices in the Schedule of Items.

Contract Day - A day counted for purposes of charging Contract Time.

Contract Documents - Solicitation Documents, Specifications, Plans, Standard and Project Drawings, Contract booklet, Change Orders, Force Account Work orders, pay documents issued by the Agency, Materials certifications, Project Work schedules, final estimate, written orders and authorizations issued by the Agency, Material source development and reclamation plans, and permits, orders and authorizations obtained by the Contractor or Agency applicable to the Project, as well as all documents incorporated by reference therein.

Contract Time - The amount of time allowed to complete the Work under the Contract.

Contractor - The Entity awarded the Contract according to the solicitation.

Correction Period - Period from Second Notification to Final Acceptance as per Subsection 00170.85.B.

Course - A specified Surfacing Material placed in one or more Lifts to a specified thickness.

Coverage - One Pass by a piece of Equipment over an entire designated area.

Cross Section - The exact image formed by a plane cutting through an object, usually at right angles to a central axis, to determine area.

Day - A Calendar Day including weekdays, weekends, and holidays, unless otherwise specified.

Defective - An adjective which when modifying the word “Work” refers to work that: (1) is unsatisfactory, faulty or deficient; (2) does not conform to the Contract Documents; (3) does not meet the requirements of any inspection, test for approval referred to in the Contract Documents; or (4) has been damaged prior to Engineer’s recommendation for final payment.

Design Professional - The individual or entity named in the Special Provisions who designed part or all of the Project and who, by contract, has been assigned duties and responsibilities to assist Agency and Project Manager in administration of the Contract.

Digital Signature - A form of electronic signature that is registered with a certification authority, e.g., VeriSign or similar digital signature software company, which requires a password to be entered in order to generate the digital signature upon the electronic document. Once the digital signature is applied, any alteration of the document results in the elimination of the digital signature on the document.

Disqualification - The preclusion of a Person from contracting with a Contracting Agency for a period of time in accordance with OAR 137-049-0370.

Drawings (Plans) - Standard and Project Drawings, and approved unstamped and reviewed and accepted stamped Shop Drawings and Deferred Submittals. (See 00150.10 and 00150.35)

Durable Rock - Rock that has a slake durability index of at least 90% based on a two-cycle slake durability test, according to ASTM D4644. In the absence of test results, the Engineer may evaluate the durability visually.

Emulsified Asphalt - Emulsified asphalt cement.

Emulsified Asphalt Concrete - A mixture of Emulsified Asphalt and graded Aggregate.

Engineer - Project Manager – See Project Manager.

Entity - A natural person capable of being legally bound, sole proprietorship, limited liability company, corporation, partnership, limited liability partnership, limited partnership, profit or nonprofit unincorporated association, business trust, two or more persons having a joint or common economic interest, or any other person with legal capacity to contract, or a government or governmental subdivision.

Equipment - All machinery, tools, manufactured products, and fabricated items needed to complete the Contract or specified for incorporation into the Work.

Establishment Period - The time specified to assure satisfactory establishment and growth of planted Materials.

Existing Surfacing - Pavements, slabs, curbs, gutters, walks, driveways, and similar constructions of bricks, blocks, portland cement concrete, bituminous treated materials, and granular surfacing materials on existing Highways.

Extra Work - Work not included in the Contract, but deemed by the Engineer to be necessary to complete the Project.

Field Order – A written order issued by the Engineer which requires minor changes in the Work but which may not involve a change in the Contract Amount or the Contract Times.

Final Acceptance - Written confirmation by the Agency that the Project has been completed according to the Contract including all corrective work identified by the Agency during the Correction Period, with the exception of latent defects and Warranty obligations, if any, and has been accepted.

Final Inspection - The inspection conducted by the Engineer to determine that the Project has been completed according to the Contract.

Fine Aggregate - Crushed Rock, crushed Gravel, or Sand that passes a 1/4-inch sieve, with allowable oversize.

First Notification - Written Notice to Proceed issued to the Contractor by the Engineer.

Force Account Work - Items of Extra Work ordered by the Engineer that are to be paid according to Section 00197.

Granular Material - Graded and selected free-draining material composed of particles of Rock, Sand, and Gravel.

Gravel - Particles of Rock, rounded or not, that will pass a 3-inch sieve and be retained on a No. 4 sieve.

Highway - Every road, street, thoroughfare and place, including Bridges, viaducts and other Structures within the boundaries of the State, open, used or intended for use by vehicular traffic.

Incidental - A term identifying those acts, services, transactions, property, Equipment, labor, Materials, or other items for which the Agency will make no separate or additional payment.

Inspector - The representative of the Engineer authorized to inspect and report on Contract performance.

Leveling - Placing a variable-thickness Course of Materials to restore horizontal and vertical uniformity to existing Pavements, normally continuous throughout the Project.

Lift - The compacted thickness of Material placed by Equipment in a single Pass.

Local Contracting Review Board – The City Council of the City of Tigard (Agency).

Mandatory Source - A Material source provided by the Agency from which the Contractor is required to obtain Materials. (see 00160.00.B and 00160.40)

Materials - Any natural or manmade substance specified for use in the construction of the Project or for incorporation into the Work.

Median - The portion of a divided Highway separating traffic traveling in opposite directions.

Milestone - A principal event or activity specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

Multiple Course Construction - Two or more Courses, exclusive of Patching or Leveling, placed over the entire Roadway width.

Multi-Use Path - That portion of the Highway Right-of-Way or a separate Right-of-Way, physically separated from motor vehicle traffic and designated for use by pedestrians, bicyclists and other non-motorized users.

Neat Line - Theoretical lines specified or indicated on the Plans for measurement of quantities.

Nondurable Rock - Rock that has a slake durability index of less than 90% based on a two-cycle slake durability test, as tested by ASTM D4644, or Rock that is observed to readily degrade by air, water, and mechanical influence.

Notice to Contractors - The public announcement inviting Bids for Work to be performed or Materials to be provided.

Notice to Proceed - Written notice authorizing the Contractor to begin performance of the Work.

On-Site Work - Any Work taking place on the Project Site, including designated staging areas adjacent to the Project Site, except for installation of covered temporary signs according to Section 00225.

Organic Soil - A Soil with sufficient organic content to influence the Soil properties.

Panel - The width of specified Material being placed by Equipment in a single Pass.

Pass - One movement of a piece of Equipment over a particular location.

Patching - Placing a variable-thickness Course of Materials to correct sags, dips, and/or bumps to the existing grade and Cross Section, normally intermittent throughout the Project.

Pavement - Asphalt concrete or portland cement concrete placed for the use of motor vehicles, bicycles, or pedestrians on Roadways, Shoulders, Multi-Use Paths and parking areas.

Pay Item (Contract Item) - A specific unit of Work for which a price is provided in the Contract.

Payment Bond - The approved security furnished by the Contractor's Surety as a guaranty of the Contractor's performance of its obligation to pay promptly in full all sums due for Materials, Equipment, and labor furnished to complete the Work.

Peat - A Soil composed primarily of vegetative matter in various stages of decomposition, usually with an organic odor, dark brown to black color, and a spongy consistency.

Performance Bond - The approved security furnished by the Contractor's Surety as a guaranty of the Contractor's performance of the Contract.

Project - The sum of all Work to be performed under the Contract.

Project Drawings - The Agency-prepared detailed drawings for Work or methods of construction that are Project specific, and are denoted by title in the Project title block.

Project Manager – The Agency’s representative assigned by the Agency to administer the Contract and who assumes the responsibilities, duties and authorities of the Project Manager (Engineer) as indicated throughout the Contract Documents.

Project Site - The geographical dimensions of the real property on which the Work is to be performed, including designated contiguous staging areas.

Prospective Source - A Material source provided by the Agency, from which the Contractor has the option of obtaining Materials. (See 00160.00.A and 00160.40)

Publicly-Owned Equipment - Equipment acquired by a state, county, municipality or political subdivision primarily for use in its own operations.

Public Traffic - Vehicular or pedestrian movement, not associated with the Contract Work, on a public way.

Railroad - Publicly or privately-owned rail carriers, including passenger, freight, and commuter rail carriers, their tenants, and licensees. Also, Utilities that jointly own or use such facilities.

Right-of-Way - Land, property, or property interest, usually in a strip, acquired for or devoted to transportation or other public works purposes.

Roadbed - Completed excavations and embankments for the Subgrade, including ditches, side slopes, and slope rounding, if any.

Roadside - The area between the outside edges of the Shoulders and the Right-of-Way boundaries. Unpaved median areas between inside Shoulders of divided Highways and infield areas of interchanges are included.

Roadway - That portion of a Highway improved, designed, or ordinarily used for vehicular travel, exclusive of the berm or Shoulder. If a Highway includes two or more separate Roadways, the term “Roadway” refers to any such Roadway separately, but not to all such Roadways collectively. (See Traveled Way)

Rock - Natural deposit of solid material composed of one or more minerals occurring in large masses or fragments.

Schedule of Items - The list of Pay Items, their units of measurement, estimated quantities, and prices.

Schedule of Values - The breakdown of the values of the component elements comprising a lump sum Pay Item.

Second Notification - Written acknowledgment by the Engineer of the Substantial Completion of a Milestone or of the Work according to 00180.50.G.

Shoulder - The part of a Roadbed contiguous to the Traveled Way or Roadway, whether paved or unpaved, for accommodating stopped vehicles, for emergency use and for lateral support of Base and surface Courses.

Silt - Soil passing a No. 200 sieve that is nonplastic or exhibits very low plasticity.

Single Course Construction - A wearing Course only, not including patching or leveling Courses or partial width Base Course.

Slope - Vertical distance to horizontal distance, unless otherwise specified.

Soil - Accumulations of particles produced by the disintegration of Rock, which sometimes contains organic matter. Particles may vary in size from Clay to Boulders.

Solicitation Documents - Documents which define the procurement of a public improvement Project, including, but not limited to, the Bid Booklet, Contract Booklet, Agency-provided Plans, Standard Specifications, Special Provisions, Addenda, and which includes all documents incorporated by reference. May also be called Bid Documents.

Special Provisions - The special directions, provisions, and requirements specific to a Project that supplement or modify the Standard Specifications. Permits and orders governing the Project that are issued directly to the Agency by a governmental or regulatory authority are considered to be part of the Special Provisions, to the extent and under the conditions stipulated in the Special Provisions.

Specifications - The Standard Specifications and Special Provisions, together with all provisions of other documents incorporated therein by reference.

Standard Drawings - The Agency-prepared detailed drawings for Work or methods of construction that normally do not change from project to project.

Standard Specifications – The “General Conditions for Construction for the City of Tigard” published by the Agency, and the “2021~~8~~ Oregon Standard Specifications for Construction”, Parts 00200 through 03000, “Technical Specifications”, published by the Oregon Department of Transportation as amended by the Agency. It provides directions, provisions, and requirements necessary for performing public improvement projects.

State - The State of Oregon.

Structures - Bridges, retaining walls, endwalls, cribbing, buildings, culverts, manholes, catch basins, drop inlets, sewers, service pipes, underdrains, foundation drains, and other similar features which may be encountered in the Work.

Subbase - A Course of specified material of specified thickness between the Subgrade and a Base.

Subcontractor - An Entity having a direct contract with the Contractor or another Subcontractor, to perform a portion of the Work.

Subgrade - The top surface of completed earthwork on which Subbase, Base, Surfacing, Pavement, or a Course of other Material is to be placed.

Substantial Completion – The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete in

accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended.

Substructure - Those parts of a Structure which support the Superstructure, including bents, piers, abutments, and integrally built wing walls, up to the surfaces on which bearing devices rest. Substructure also includes portions above bearing surfaces when those portions are built integrally with a Substructure unit (e.g., backwalls of abutments). When Substructure and Superstructure elements are built integrally, the division between Substructure and Superstructure is considered to be at the bottom soffit of the longitudinal or transverse beam, whichever is lower. Culverts and rigid frames are considered to be entirely Substructure.

Superstructure - Those parts of a Structure above the Substructure, including bearing devices.

Supplier - The Entity that furnishes goods to be incorporated into the Work.

Surety - The Entity that issues the bond.

Surfacing - The Course or Courses of material on the Traveled Way, auxiliary lanes, Shoulders, or parking areas for vehicle use.

Third Notification - Written acknowledgment by the Engineer, subject to Final Acceptance, that as of the date of the notification the Contractor has achieved Final Completion of the Project according to the Contract, including, without limitation, completion of all minor corrective work, Equipment and plant removal, site clean-up, and submittal of all certifications, bills, forms and documents required under the Contract.

Ton - One short ton of 2,000 pounds (Ton, ton, Tn, or T).

Topsoil - Soil ready for use in a planting bed.

Traffic Lane - That part of the Traveled Way marked for moving a single line of vehicles.

Traveled Way - That part of the Highway for moving vehicles, exclusive of berms and Shoulders.

Typical Section - That Cross Section established by the Plans which represents in general the lines to which the Contractor shall work in the performance of the Contract.

Unsuitable Material - Frozen material, or material that contains organic matter, muck, humus, Peat, sticks, debris, chemicals, toxic matter, or other deleterious materials not normally suitable for use in earthwork.

Utility - A line, facility, or system for producing, transmitting, or distributing communications, power, electricity, heat, gas, oil, water, steam, waste, stormwater not connected with highway drainage, or any other similar commodity which directly or indirectly serves the public. The term may also mean the utility company, district, or cooperative owning and operating such facilities, including any wholly-owned or controlled subsidiary.

Warranty Bond - The approved security furnished by the Contractor's, Subcontractor's, Manufacturer's, Installer's or Supplier's Surety as a guaranty of performance of their respective warranty obligations.

Work - The furnishing of all Materials, Equipment, labor, and Incidentals necessary to successfully complete any individual Pay Item or the entire Contract, and the discharge of duties and obligations imposed by the Contract.

Work Change Directive - A written statement to the Contractor, issued on or after the Date of the Agreement and signed by Agency and recommended by Engineer, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Amount or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Amount or Contract Times.

Work Day - Every Calendar day excluding Saturdays, Sundays and legal holidays as listed in ORS 187.010.

Worker - Any person performing work under the contract, including employees of the Contractor or Subcontractor, and persons having full or partial ownership of the Contractor or Subcontractor. (This definition is not intended to nor does it alter the definition or meaning of the term “worker” as used in any applicable laws or regulations, including but not limited to for purposes of paying prevailing wage rates.)

Working (Shop) Drawings - Supplemental Plans, not furnished by the Agency, that the Contractor is required to submit to the Engineer. (See 00150.35)

Workplace Violence - Any act of physical, verbal or written aggression by an individual in or related to the work place and/or project sites. This includes, but is not limited to, verbal abuse, threats or intimidation and physical intimidation, assault or battery by a worker or former worker. Work place violence may also include destruction or abuse of property.

Section 00120 - Bidding Requirements and Procedures

00120.01 Receipt of Bids; Opening

See Special Provisions.

00120.02 Prequalification of Bidders

See Special Provisions.

00120.03 Request for Solicitation Documents

See Special Provisions.

00120.04 Pre-Bid Meeting

See Special Provisions.

00120.10 Bid Booklet

The Bid Booklet may include, but is not limited to:

- Advertisement for Bids
- Bidder's checklist
- Bid Section
- Appendix, which includes required time-sensitive forms, DBE information, sample forms, and other informational pages

The Bid Section includes all pages after the Bidder's checklist and before the appendix. The Bid Section may include, but is not limited to:

- Description and location of the proposed Project
- Time, date, and location for opening Bids
- Project completion time
- Class of Project (i.e., Federal-aid or State)
- Class of Work
- Bid statement
- Certificate of non-collusion
- Certificate of Nondiscrimination
- Certificate of noninvolvement in any debarment or suspension (for Federal-aid Projects)
- Certificate regarding lobbying activities (for Federal-aid Projects)
- Certificate of residency (for State Projects)
- Certificate of compliance with Oregon tax laws
- Bid Schedule
- Acknowledgement of Addenda
- Identification of Bidder(s) and Sureties
- Bid signature page
- Bid Bond form
- First-tier Subcontractor Disclosure form

Depending on the Class of Project, other certificates or statements may be bound within the Bid Section. Plans, Specifications, and other documents referred to in the Bid Section will be considered part of the Bid.

00120.15 Examination of Work Site and Solicitation Documents; Consideration of Conditions to be Encountered

Before submitting a Bid, Bidders shall make a careful visual examination of the site of the proposed Work, the Bid Booklet, Plans, and Specifications. Bidders shall also review any subsurface investigation material referenced in 00120.25 that may be available and conduct additional investigation of any unusual condition apparent during the visual site examination. As soon as reasonably practicable after noting any such unusual condition, Bidder shall notify Agency, in writing, of any such unusual condition and the additional investigation undertaken by Bidder. Submission of a Bid will constitute confirmation that the Bidder has examined the Project Site and finds the Plans and Specifications to be sufficiently detailed and accurate to enable Bidder to properly perform the Work, and understands the conditions to be encountered in performing the Work and all requirements of the Contract.

The Bidder is responsible for loss or unanticipated costs suffered by the Bidder because of the Bidder's failure to fully examine the site and become fully informed about all conditions of the Work, or failure to request clarification of Plans and Specifications Bidder believes to be erroneous or incomplete.

Any clarification of Plans and Specifications needed by the Bidder shall be requested in writing by e-mail through the Engineer. Requests shall be made in sufficient time for the Agency's reply to reach all Bidders before Bid Closing. Oral explanations or interpretations given before receiving Bids for a Project will not be binding. To be binding, interpretation of the Plans and Specifications by the Agency must be made by written Addendum furnished to all Holders of Bidding Plans according to 00120.30. Notification of erroneous or incomplete Plans or Specifications shall also be submitted to the Engineer. Such notification shall also be made in sufficient time for the Agency to make any necessary modifications and issue Addenda to Bidders prior to Bid Closing. Unless the procurement period is shorter than one week, notifications and requests for changes or clarification shall be submitted at least seven Days prior to the date of Bid Closing. The Agency will respond to each request at least 72 hours prior to the date of Bid Closing. If the Procurement period is less than seven Days, requests shall be submitted within one Day after the Procurement is issued and the Agency will issue its response to each such request at least 24 hours prior to Bid Closing. Failure to timely request clarification or changes shall be deemed acceptance of all of the terms and conditions of the Procurement.

00120.16 Material, Equipment, and Method Substitutions

When the Contract specifies certain Materials, Equipment, products, and/or methods, the Bidder shall include those Materials, Equipment, products, and/or methods in the Bid. Substitution after execution of the Contract is specified in 00180.31.B, 00180.31.C, and 00180.31.D.

00120.17 Use of Agency-Owned Land for Staging or Storage Areas

The Contractor may use Agency-owned property for staging or storage areas, subject to the following limitations:

- A. Within Normal Right-of-Way Limits** - If approved by the Engineer, the Contractor may use available property within the normal Right-of-Way limits for the purpose of constructing improvements under the Contract as long as such use does not unduly impede other legitimate users of the Right-of-Way or adjacent properties. Where the Agency owns, or has rights to, other adjacent properties in the Project area, "normal Right-of-Way" is limited to a line drawn across that property connecting the normal Right-of-Way limits on either side of the property.
- B. Outside Normal Right-of-Way Limits** - The Contractor may not use Agency-owned property outside of normal Right-of-Way limits for the Project without the approval of the Engineer.

If a Bidder obtains approval before submitting a Bid, use of the property will be at no cost to the Contractor, or at a cost stated by the Engineer upon granting approval, as confirmed by Addendum.

If approval is not obtained before submitting a Bid, and the Contractor proposes to use Agency-owned property outside the normal Right-of-Way limits, then use of the property may be approved by the Engineer, but the Contractor will be assessed fair market value, as determined by the Engineer, for use of the property.

C. Restrictions on Use - Contractors shall comply with all applicable laws, ordinances, and regulations pertaining to use of Agency-owned property, and shall:

- Not cause unreasonable impacts on traffic and other facility users.
- Clean up all hazardous materials deposited by, or resulting from, Contractor operations.
- Be responsible for all costs associated with use of the property.

00120.18 Contractor-Obtained Land for Staging or Storage Areas

Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities, or storage or staging of materials and equipment.

Within five (5) days of Contractor executing an agreement with property owners of land for Contractor's use, provide Agency with a copy of such agreement.

In the event of claims or disputes between Contractor and property owner, Contractor shall indemnify and defend the Agency, its officers, agents, and employees in conformance with the Public Improvement Contract, Article 7 - Indemnification.

00120.20 Interpretation of Quantities in Bid Schedule

Quantities appearing in the Bid Schedule are approximate and are provided only for comparison of Bids. The Agency does not warrant that the actual individual items, amount of Work, or quantities will correspond to those shown in the Bid Schedule. Payment to the Contractor will be made only for actual quantities of Work performed and accepted or Materials furnished and accepted, as required by the Contract. Quantities of Work to be performed and Materials to be furnished may each be increased, decreased, or omitted as provided in 00120.30 and 00140.30.

00120.25 Subsurface Investigations

If the Agency or its consultant has conducted subsurface or geologic investigations of the proposed Project Site or contiguous to the Project Site, the results of the investigations may be included in written geotechnical data reports. If geotechnical data reports have been prepared, such reports may be included in the Solicitation Documents (see Special Provisions) and shall be considered as part of the Contract Documents to the extent that the Contractor may rely upon the accuracy of the technical data contained in such reports. If the Agency has retained subsurface samples, they will also be available for inspection. Bidders and the Contractor may make arrangements for viewing the samples through the Engineer's office.

It is Agency's policy that if a geotechnical data report is prepared for a Project, it may be provided to Bidders/Contractor and if so provided, it is considered a Contract Document. If provided, Special Conditions need to be developed to identify such geotechnical data reports (i.e., report title, date, and author) and reports should be included in the Contract Documents (perhaps in an appendix). It is also Agency policy that geotechnical evaluation/investigation reports are not to be provided to Bidders/Contractor as they are for design-related purposes only.

The availability of subsurface information from the Agency is solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risk, duty to make examinations and investigations as required by 00120.15, or other responsibility under the Contract Documents. It is mutually agreed to by all parties that:

- The subsurface investigations made by the Agency are for the purpose of obtaining data for planning and design of the Project.
- The data for individual test boring logs apply only to that particular boring and is not intended to be conclusive as to the character of any material between or around test borings.
- If Bidders use this information in preparing a Bid, it is used at their own risk, and Bidders are responsible for all conclusions, deductions, and inferences drawn from this information.
- Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, consultants, or subcontractors with respect to any Contractor interpretation of or conclusion drawn from any technical data or any such other data, interpretations, opinions, or information.

00120.30 Changes to Plans, Specifications, or Quantities before Opening of Bids

The Agency reserves the right to issue Addenda making changes or corrections to the Plans, Specifications, or quantities. Only holders of Solicitation Documents obtained from the Agency's office who have been identified by the Agency as Holders of Bidding Plans will be notified of these Addenda by e-mail, or delivery service, sent to the Bidder's address as it appears in the Agency's files.

The Agency may extend Bid Closing if Agency determines prospective Bidders need additional time to review and respond to Addenda. Agency will not, except to the extent required by a countervailing public interest, issue Addenda less than 72 hours before Bid Closing unless the Addendum also extends Bid Closing.

Bidders shall acknowledge Addenda by submitting the "Acknowledgment of Addendum" in the Bid Booklet with their Bids. The Agency will not be responsible for failure of Bidders to receive Addenda sent as described in the preceding paragraph. Bids shall incorporate all Addenda. Bids may be rejected if opened and found by the Agency to not be based on all Addenda issued before Bid Closing.

00120.40 Preparation of Bids

Bids not in compliance with the requirements of this Subsection will be considered non-responsive.

A. General:

1. **Bids** - The Bidders shall not alter, in any manner, the documents within the Bid Section. Bidders shall complete the certifications and statements included in the Bid Section of the Bid Booklet according to the instructions. Signature of the Bidder's authorized representative thereon constitutes the Bidder's confirmation of and agreement to all certifications and statements contained in the Bid Booklet. Entries on the documents in the Bid Section shall be in black or blue ink or typed. Signatures and initials shall be in black or blue ink.

The Bidder shall properly complete and bind all the documents in the Bid Section, as specified in 00120.10, between the front and back covers of the Bid Booklet, except that the Bid Bond is not required if another permissible type of Bid guaranty is provided. (see 00120.40.D)

B. Bid Schedule Entries:

1. **Bid Schedule Entries** - Using figures, Bidders shall fill in all blank spaces in the Bid Schedule. For each item in the Bid Schedule, Bidders shall enter the unit price and the product of the unit price multiplied by the quantity given. The unit price shall be greater than zero, shall contain no more than two decimal places to the right of the decimal point, and shall be expressed in U.S. dollars and cents (for example, \$150.25 or \$0.37). Unit prices submitted which contain more than two decimal places will be truncated by the Agency at the second decimal place to determine the product of the unit price and quantity. No rounding will be considered or paid. Bidder's Bid shall also enter the total amount of the Bid obtained by adding amounts for all items in the Bid Schedule. Corrections

or changes of item entries shall be in ink, with incorrect entry lined out and correct entry entered and initialed in ink by the person signing the Bid.

C. Bidder's Address and Signature Pages - Bidders shall include in the Bid the address to which all communications concerning the Bid and Contract should be sent. The Bid must be signed by a duly authorized representative of the Bidder.

D. Bid Guaranty - All Bids shall be accompanied by a Bid guaranty in the amount of 10% of the total amount of the Bid.

1. **Bid Guaranty** - The Bid guaranty shall be either a Surety bond, irrevocable letter of credit issued by an insured institution as defined in ORS 706.008 or security in the form of a cashier's check or certified check made payable to the Agency. (See ORS 279C.365(4))

If a Surety bond is submitted, Bidders shall use the Agency's standard Bid Bond form included with the Bid Booklet or an alternative Bid Bond form acceptable to the Agency. Bidders shall submit the bond with original signatures and the Surety's seal affixed. The Bid guaranty shall be submitted by mail, delivery service, or hand delivered to the offices and addresses, and at the times given in the Bid Booklet.

Acceptable Surety companies are limited to those authorized to do business in the State of Oregon.

Forfeiture of Bid guaranties is covered by 00130.60, and return of guaranties is covered by 00130.70.

E. Disclosure of First-Tier Subcontractors - If the Bidder's Bid exceeds \$100,000, or without regard to the amount of a Bidder's Bid if the Agency's cost estimate for a public improvement Project as indicated in the Advertisement for Bids exceeds \$100,000, the Bidder shall, within 2 working hours of the time Bids are due to be submitted, submit to the Agency, on a form provided by the Agency, a disclosure identifying any first-tier Subcontractors that will furnish labor or labor and Materials, and whose contract value is equal to or greater than:

- 5% of the total Project Bid, but at least \$15,000; or
- \$350,000, regardless of the percentage of the total Project Bid.

For each Subcontractor listed, Bidders shall state:

- The name of the Subcontractor;
- The dollar amount of the subcontract; and
- The category of Work that the Subcontractor would be performing.

If no subcontracts subject to the above disclosure requirements are anticipated, a Bidder shall so indicate by entering "NONE" or by filling in the appropriate check box. For each Subcontractor listed, Bidders shall provide all requested information. An incomplete form will be cause for rejection of the Bid.

The Subcontractor Disclosure Form may be submitted for a Bid either by:

- Filling out the Subcontractor Disclosure Form included in the Bid Booklet and submitting it together with the Bid at the time and place designated for receipt of Bids; or
- Removing it from the Bid Booklet, filling it out and submitting it separately to the Agency at the address given in the Bid Booklet.

Subcontractor Disclosure Forms submitted by any method will be considered late if not received by the Agency within two 2 working hours of the time designated for receiving Bids.

In the event that multiple Subcontractor Disclosure Forms are submitted, the last version received prior to the deadline will be considered to be the intended version.

THE AGENCY MUST REJECT A BID IF THE BIDDER FAILS TO SUBMIT THE DISCLOSURE FORM WITH THIS INFORMATION BY THE STATED DEADLINE. (See OAR 137-049-0360)

00120.45 Submittal of Bids

Bids shall be submitted by mail, parcel delivery service, or hand delivery to the Agency, in the manner and at the times given in the Special Provisions. Submit Bids in a sealed envelope. If a delivery or courier service is used, the Bidder shall place the sealed envelope containing the Bid inside the delivery or courier service's envelope.

Bids submitted after Bid Closing time will not be opened or considered. The Agency assumes no responsibility for the receipt and return of late Bids.

Preparation and submission of Bids is at the sole risk and expense of the Bidder and is not a cost of Contract performance.

All Bid material submitted by Bidder shall become the property of the Agency and is public record unless otherwise specified. A Bid that contains any information that is considered trade secret under ORS 192.501(2) should be segregated and clearly identified as such. This information will be kept confidential and shall not be disclosed except in accordance with the Oregon Public Records Law, ORS 192. The above restrictions may not include cost or price information, which must be open to public inspection.

00120.60 Modification or Withdrawal of Bids

A. Modification - Once submitted, bids may be modified in writing prior to the time and date set for Bid Closing and submitted to the place designated for receipt of Bids. Any modifications shall be prepared on the company letterhead, signed by an authorized representative, and state that the new document supersedes or modifies the prior Bid. The Bid modification shall be delivered in a sealed envelope and shall be marked as follows:

BID MODIFICATION

Bid Title and Closing Date and Time

B. Withdrawal - Once submitted, bids may be withdrawn by written notification on company letterhead signed by an authorized representative and received prior to the time and date set for Bid Closing and submitted to the place designated for receipt of Bids. Bids also may be withdrawn in person prior to the scheduled Bid Closing upon presentation of appropriate identification.

Requests to withdraw Bids shall be marked as follows:

BID WITHDRAWAL

Bid Title and Closing Date and Time

No Bid can be withdrawn after having been opened.

00120.65 Opening and Comparing Bids

Bids will be opened and the total price for each Bid will be read publicly at the time and place indicated in the Advertisement for Bids. Bidders and other interested parties are invited to be present.

Bids for each Project will be compared on the basis of the total amount of each Bid. The total amount of the Bid will be the total sum computed from quantities listed in the Bid Schedule and unit prices entered by the Bidder.

In case of conflict between the unit price and the corresponding extended amount, the unit price shall govern, and the Agency may make arithmetic corrections on extension amounts.

Error(s) discovered after Bid Opening cannot be corrected by the Bidder and the Contractor will be required to perform work at the unit price if its Bid is accepted.

00120.67 Bid Mistakes

A. General - Under extraordinary circumstances, a Bid may be withdrawn after the Bid Closing because of an inadvertent nonjudgmental mistake. If the mistake is attributable to an error in judgment, the Bid may not be withdrawn or corrected. Correction or withdrawal by reason of nonjudgmental mistake is permissible but only to the extent it is not contrary to the interest of the Agency or the fair treatment of other Bidders.

B. Mistakes Discovered after Bid Closing but before Award - This section applies to situations where mistakes in Bids are discovered after the submission deadline but before Award.

1. Minor Informalities - Minor informalities are matters of form rather than substance that are evident from the Bid Documents, or insignificant mistakes that can be waived or corrected promptly without prejudice to other Bidders or the Agency. That is, the informality does not affect price, quantity, quality, delivery, or contractual conditions except in the case of informalities involving unit prices. Examples include, but are not limited to, the failure of a Bidder to:

- Return the number of signed Bids or number of other documents required by the Bid Documents;
- Sign the Bid Form in the designated block so long the Bid Documents evidence an intent to be bound; or
- Acknowledge receipt of an Addendum to the Bid Documents, but only if:
 - It is clear from the Bid that the Bidder received the Addendum and intended to be bound by its terms; or
 - The Addendum involved did not affect price, quantity, quality, or delivery.

C. Mistakes Where Intended, Correct Bid is Evident - If the mistake and the intended correct Bid are clearly on the face of the Bid Form, or can be substantiated from accompanying documents, the Agency may accept the Bid. Examples of mistakes that may be clearly evident on the face of the Bid Form are typographical errors, errors in extending unit prices, transposition errors, and arithmetical errors. Mistakes that are clearly evident on the face of the Bid Form also may include instances in which the intended correct Bid is made clearly evident by simple arithmetic calculations. For example, a missing unit price may be established by dividing the total Bid or proposal item by the quantity of units for that item, and a missing or incorrect total Bid price for an item may be established by multiplying the unit price by the quantity when those figures are available on the Bid. For discrepancies between unit prices and extended prices, unit prices shall normally prevail.

D. Mistakes Where Intended, Correct Bid is Not Evident - The Agency may not accept a Bid in which a mistake is clearly evident on the face of the Bid Form but the intended correct Bid is not clearly evident or cannot be substantiated from accompanying documents.

00120.68 Low Tie Bids

- A. Definition** - Low tie Bids are low responsive Bids from responsible Bidders that are identical in price, fitness, availability, and quality and which meet all the requirements and criteria set forth in the Bid Documents.
- B. Award:** If low tie Bids are received, then a preference shall be given to goods and services that have been manufactured or produced in Oregon as follows:
1. If the bids remain tied after application, preference shall be given to the Bidder whose principal offices or headquarters are located in Oregon.
 2. If the Bids remain tied after application and Subsection 00120.68.B.1, then the Award shall be made by drawing lots among any tied Oregon Bidders. Such Bidders shall be given notice and an opportunity to be present when the lots are drawn.
 3. If there are no Oregon Bidders after application and Subsections 00120.68.B.1 and 00120.68.B.2, then the Award of the contract shall be made by drawing lots. Such Bidders shall be given notice and an opportunity to be present when the lots are drawn.

00120.70 Rejection of Nonresponsive Bids

A Bid will be considered irregular and will be rejected if the irregularity is deemed by the Agency to render the Bid non-responsive. Examples of irregularities include, without limitation:

- The Bid Section documents provided are not properly used or contain unauthorized alterations.
- The Bid is incomplete or incorrectly completed.
- The Bid contains improper additions, deletions, alternate Bids, or conditions.
- The Bid or Bid modifications are not signed by a person authorized to submit Bids or modify Bids, as required by 00120.40 and
- The Bid is submitted on documents not obtained directly from the Agency, or is submitted by a Bidder who has not been identified by the Agency as a Holder of Bidding Plans, as required by 00120.05.
- A member of a joint venture and the joint venture submit Bids for the same Project. Both Bids may be rejected.
- The Bid has entries not typed or in ink, or has signatures or initials not in ink.
- Each change or correction is not individually initialed.
- White-out tape or white-out liquid is used to correct item entries.
- The price per unit cannot be determined.
- The Bid guaranty is insufficient or improper.
- The original Bid Bond form is not used or is altered.
- The Oregon Construction Contractors Board registration number and expiration date are not shown on the Bid if required in the Solicitation Document. This requirement applies to Agency and State-funded Projects, with the exception of Aggregate production and landscape Projects. (not required on Federal-aid Projects)
- A disclosure of first-tier Subcontractors, if required under 00120.40.E, is not received within 2 working hours of the time Bids are due to be submitted, or the disclosure form is not complete.
- The Bidder has not complied with the DBE requirements of the solicitation.
- The Bid does not acknowledge all issued Addenda.
- The Bid contains entries that are not greater than zero.
- The Bid entries are not expressed in U.S. dollars and cents.
- The Agency determines that any Pay Item is significantly unbalanced to the potential detriment of the Agency.

In addition, the Agency may reject all Bids and suspend the project in the event all Bids exceed the funds the Agency has appropriated for the project or for good cause upon its finding that it is in the public interest to do so. The Agency may also waive minor informalities or irregularities.

00120.80 Reciprocal Preference for Oregon Resident Bidders

This Subsection applies only to Contracts for Projects financed without federal funds.

Bidders shall complete the certificate of residency provided by the Agency in the Bid Booklet. Failure to properly complete the form will be cause to reject the Bid.

As used in the certificate of residency and this Subsection, “Resident Bidder” means a Bidder who has:

- Paid unemployment taxes or income taxes in the State of Oregon during any of the 12 calendar months immediately preceding submission of the Bid;
- A business address in the State of Oregon; and
- Certified in the Bid that the Bidder qualifies as a Resident Bidder.

“Nonresident Bidder” means a Bidder who is not a Resident Bidder as defined above.

In determining the lowest Bid, the Agency will, for the purpose of awarding the Contract, add a percentage increase to the Bid of a Nonresident Bidder equal to the percentage, if any, of the preference given to that Bidder in the state in which the Bidder resides (ORS 279A.120). The percentage preference applied in each state will be published on or before January 1 of each year by the Oregon Department of Administrative Services. The Agency may rely on these percentages without incurring liability to any Bidder (ORS 279A.120).

This increase will only be applied to determine the lowest Bid, and will not cause an increase in payment to the Contractor after Award of the Contract.

00120.90 Disqualification of Bidders

The Bid(s) of a disqualified Bidder will be rejected. Any of the following reasons is sufficient to disqualify a Bidder:

- More than one Bid is submitted for the same Work by an Entity under the same or different name(s).
- Evidence of collusion among Bidders. Participants in collusion will be found not responsible, and may be subject to criminal prosecution.
- Any of the grounds for disqualification cited in ORS 279C.440.

A Bidder will be disqualified if the Bidder has:

- Not been prequalified if required by 00120.02;
- Been declared ineligible by the Commissioner of the Bureau of Labor and Industries under ORS 279C.860;
- Not been registered (licensed) by the Oregon Construction Contractors Board (CCB) or has not been licensed by the State Landscape Contractors Board before submitting a Bid (ORS 279C.365(1)(k), ORS 701.021, ORS 701.026, and ORS 671.530). The Bidder’s registration number and expiration date shall be shown in the Bid form, if requested. Failure to furnish the registration number, if requested, will render the Bid non-responsive and subject to rejection. (Not required on Federal-aid projects); or
- Been determined by the CCB under ORS 701.227 not to be qualified to hold or participate in a public contract for a public improvement.

00120.91 Rejection of Bid on Grounds of Nonresponsibility of Bidder

The Bid of a Bidder who is found to be nonresponsible according to the criteria listed in 00130.10 or ORS 279C.375(3) will be rejected.

Section 00130 - Award and Execution of Contract

00130.00 Consideration of Bids

After opening and reading Bids, the Agency will check them for correct extensions of unit prices and totals. (see 00120.65) The total of extensions, corrected where necessary, will be used by the Agency for Award purposes. Discrepancies between words and figures will be resolved in favor of words. In selecting the lowest responsive Bid, the Agency reserves the right to take into consideration any or all alternatives called for in the Bid Form.

The Agency reserves the right to waive minor informalities and irregularities, and to reject any or all Bids for irregularities under 00120.70 or for good cause after finding that it is in the public interest to do so (ORS 279C.395). An example of good cause for rejection in the public interest is the Agency's determination that any of the unit Bid prices are materially unbalanced to the Agency's potential detriment. A materially unbalanced Bid is defined as "a Bid which generates a reasonable doubt that award to the Bidder submitting a mathematically unbalanced Bid will result in the lowest cost to the Agency". The Agency may correct obvious errors, when the correct information can be determined from the face of the document, if it finds that the best interest of the Agency and the public will be served thereby.

00130.10 Award of Contract

After the Bids are opened and a determination is made that a Contract is to be awarded, the Contract will be awarded to the lowest responsible Bidder. For the purposes of this Section, "lowest responsible Bidder" means the responsible Bidder that submitted the lowest responsive Bid, who is not on the list created by the Construction Contractors Board according to ORS 701, and who has:

- Substantially complied with all prescribed public bidding procedures and requirements.
- Available the appropriate financial, Materials, Equipment, facility and personnel resources and expertise, or ability to obtain the resources and expertise, necessary to indicate the capability of the prospective Bidder to meet all contractual responsibilities.
- A satisfactory record of performance. In evaluating a Bidder's record of performance, the Agency may consider, among other things, whether the Bidder completed previous contracts of a similar nature with a satisfactory record of performance. For purposes of evaluating a Bidder's performance on previous contracts of a similar nature, a satisfactory record of performance means that to the extent that the costs associated with and time available to perform a previous contract remained within the Bidder's control, the Bidder stayed within the time and budget allotted for the procurement and otherwise performed the contract in a satisfactory manner.
- A satisfactory record of integrity. In evaluating a Bidder's record of integrity, the Agency may consider, among other things, whether the Bidder has previous criminal convictions for offenses related to obtaining or attempting to obtain a contract or subcontract or in connection with the Bidder's performance of a contract or subcontract.
- Qualified legally to contract with the Agency.
- Supplied all necessary information in connection with the Agency's inquiry concerning responsibility. If a prospective Bidder fails to promptly supply information requested by the Agency concerning responsibility, the Agency shall base the determination of responsibility upon any available information, or may find the prospective Bidder not to be responsible.
- Not been disqualified by the public contracting agency under ORS 279C.440.

If the Bidder is found not to have a satisfactory record of performance or integrity, the Agency will document the record and the reasons for the unsatisfactory finding.

The Agency will mail the Notice of Intent to Award to the Bidders, and may provide Notice of Intent to Award on the Agency's website.

The Award will not be final until the later of the following:

- Seven working days after the Notice of Intent to Award has been posted as specified in the advertised solicitation or Addendum thereto; or
- The Agency has provided a written response to each timely protest, denying the protest and affirming the Award.

If the Agency accepts a Bid and awards a Contract, the Agency will send the successful Bidder written notice of acceptance and Award.

Notice of Award and Contract booklets ready for execution will be sent within 60 Calendar Days of the opening of Bids or within the number of Calendar Days specified in the Special Provisions or a written mutual agreement between successful Bidder and Agency.

The Contractor will not automatically be entitled to extra compensation because the commencement of Work is delayed by failure of the Agency to send the Contract for execution. However, if more Calendar Days elapse between the date the Bid is opened and the date the Agency sends the Contract to be executed, as specified in 00130.10, the Agency will consider granting an adjustment of time for completion of the Work to offset any actual delay to Contract completion resulting directly from delay in commencement.

00130.15 Right to Protest Award

Adversely affected or aggrieved Bidders, limited to the three apparent lowest Bidders and any other Bidder directly in line for Contract Award, may submit to the Agency a written protest of the Agency's intent to Award within seven Calendar days following the date of the Notice of Intent to Award. The protest shall specify the grounds upon which it is based.

An aggrieved Bidder may protest an award only if the Bidder alleges, in its written protest, that it should have received the award because:

- A. All lower Bids are non-responsive;
- B. The Agency failed to conduct the Bid process as described in the Bid Document;
- C. The Agency has abused its discretion in rejecting the protestor's Bid as non-responsive or non-responsive; or
- D. The Agency's evaluation of Bids or subsequent determination of award is otherwise in violation of ORS Chapters 279A and 279C or the Agency's public contracting rules.

The written protest must describe the facts that support the protest. The Agency may not consider late protests or protests that do not describe facts that would support a finding that the Bidder is aggrieved for one of the reasons in clauses A through D above.

00130.20 Cancellation of Award

Without liability to the Agency, the Agency may for good cause cancel Award at any time before the Contract is executed by all parties to the Contract, as provided by ORS 279C.395 for rejection of Bids, upon finding it is in the public interest to do so.

00130.30 Contract Booklet

The Contract booklet may include but is not limited to:

- Public Improvement Contract
- Performance Bond
- Payment Bond
- Prevailing Wage Rates

- Special Provisions

00130.40 Contract Submittals

Before the Agency will execute the Contract, the successful Bidder shall furnish the following:

- A. Performance and Payment Bonds** - When Awarded the Contract, the successful Bidder shall furnish a Performance Bond and a Payment Bond of a Surety authorized to do business in the State of Oregon.

The successful Bidder shall submit the standard bond forms, which are bound in the Contract booklet or alternative bond forms acceptable to the Agency. Faxed or photocopied bond forms will not be accepted. The amount of each bond shall be equal to the Contract Amount. The Performance Bond and the Payment Bond must be signed by the Surety's authorized Attorney-in-Fact, and the Surety's seal must be affixed to each bond. A power of attorney for the Attorney-in-Fact shall be attached to the bonds in the Contract booklet, which must include bond numbers, and the Surety's original seal must be affixed to the power of attorney. Bonds shall not be canceled without the Agency's consent, nor will the Agency normally release them, prior to Contract completion. The amount of the Performance and Payment Bonds shall be increased to equal the new Contract Amount whenever the Contract Amount is increased for any reason.

- B. Certificates of Insurance** - The successful Bidder shall furnish the Agency certificates of insurance applicable to the Project, according to the Public Improvement Contract.

For specified Contracts, certified copies, and in some instances the original, of insurance policies may be required by the Special Provisions.

C. Registration Requirements:

1. ORS 701.021, ORS 701.026, and ORS 671.530 require that Bidders be registered with the Oregon Construction Contractors Board or licensed by the State Landscape Contractors Board prior to submission of a Bid on a Project not involving federal funds. Registration with the Construction Contractors Board or licensing by the State Landscape Contractors Board is not a prerequisite to bidding on Federal-aid Projects; however, the Agency will not execute a Contract until the Contractor is so registered or licensed.
2. Bidders must be registered with the Corporation Division, Oregon Secretary of State, if bidding as a corporation, limited liability company, joint venture, or limited liability partnership, or if operating under an assumed business name and the legal name of each person carrying on the business is not included in the business name.
3. A Contractor registered under ORS 701 may bid on a landscaping project or perform a construction project that includes landscape contracting as a portion of the project if the landscape contracting is subcontracted to a licensed landscaping business as defined in ORS 671.520.
4. A landscaping business may bid on a Project or perform a Contract that includes the phase of landscape contracting for which it is not licensed if it employs a landscape contractor, or subcontracts with another licensed landscaping business, licensed for that phase.

- D. Tax Identification Number** - The successful Bidder shall furnish the Agency the Bidder's Federal Tax Identification Number.

00130.50 Execution of Contract and Bonds

A. By the Bidder - The successful Bidder shall deliver the required number of Contract booklets with the properly executed Contract, Performance Bond, Payment Bond, certification of workers' compensation coverage, and the required certificates of insurance, to the Agency within 10 Calendar Days after the date on which the Contract booklets are sent or otherwise conveyed to the Bidder under 00130.10. The Bidder shall return the originals of all documents received from the Agency and named in this Subsection, with original signatures. Certificates of insurance shall also be originals. No copies of these documents will be accepted by the Agency.

Proper execution requires that:

- If the Contractor is a partnership, limited liability partnership, joint venture, or limited liability company, an authorized representative of each Entity comprising it shall sign the Contract, Performance Bond, and Payment Bond, and an authorization to sign shall be attached.
- If the Contractor is a corporation, the President and the Secretary of that corporation shall sign the Contract, Performance Bond, and Payment Bond. However, if other corporate officers are authorized to execute contracts and bonds, the successful Bidder shall furnish with those documents a certified, true and correct copy of the corporate bylaws or minutes stating that authority. If only one officer is signing, then the bylaws or minutes must include the authority to sign without the signature of others. The successful Bidder shall also include the title(s) or corporate office(s) held by the signer(s).

B. By the Agency - Within 10 Working Days after the Agency has received and verified the properly executed documents specified in 00130.50.A, and received legal sufficiency approval from the Agency's attorney (if required), the Agency will execute the Contract. The Agency will then send a fully-executed original Contract booklet to the successful Bidder, who then officially becomes the Contractor.

00130.60 Failure to Execute Contract and Bonds

Failure of the successful Bidder to execute the Contract and provide the required certificates, certifications, and bonds may be cause for cancellation of the Award, and may be cause for forfeiture of the Bid guaranty under ORS 279C.385.

Award may then be made to the next lowest responsible Bidder, the Project may be re-advertised, or the Work may be performed otherwise as the Agency decides.

The forfeited Bid guaranty will become the Agency's property, not as a penalty but as liquidation of damages resulting from the Bidder's failure to execute the Contract and provide the certificates, certifications, and bonds as required by these Specifications.

00130.70 Release of Bid Guaranties

Bid guaranties will be released and checks returned 7 Calendar Days after Bids are opened, except for those of the three apparent lowest Bidders on each Project. The guaranties of the three apparent lowest Bidders will be released and checks returned to unsuccessful Bidders within 7 Days of the Agency's execution of the Contract.

00130.80 Project Site Restriction

Until the Agency sends the Contractor written Notice to Proceed with the Work, and the Contractor has filed the public works bonds required in 00170.20, the Contractor shall not move Materials, Equipment, or workers onto that Project Site.

00130.85 Tigard Business License

Contractor shall obtain a Tigard Business License or Metro License for builders and landscape contractors prior to delivering services under this Contract.

00130.90 Notice to Proceed

Notice to Proceed will be issued within 5 Calendar Days after the Contract is executed by the Agency.

Should the Agency fail to issue the Notice to Proceed within 5 Calendar Days of Contract execution, the Contractor may apply for an adjustment of Contract Time according to 00180.80.C.

Section 00140 - Scope of Work

00140.00 Purpose of Contract

The purpose of the Contract is to set forth the rights and obligations of the parties and the terms and conditions governing completion of the Work. The Contractor's obligations shall include without limitation the following:

- The Contractor shall furnish all Materials, Equipment, labor, transportation, and Incidentals required to complete the Work according to Plans, Specifications, and terms of the Contract.
- The Contractor shall perform the Work according to the lines, grades, Typical Sections, dimensions, and other details shown on the Plans, as modified by written order.
- The Contractor shall contact the Engineer for any necessary clarification or interpretation of the Contract.

00140.10 Typical Sections

The Typical Sections are intended to apply in general. At other locations where the Typical Section is not appropriate, the Contractor shall perform construction to the identified alignment as directed by the Engineer.

00140.20 Thickness

The thickness of Courses of Materials shown on the Plans, given in the Specifications, or established by the Engineer is considered to be the compacted thickness. Minor variations are acceptable when within tolerances specified in the Specifications or Plans, or when approved by the Engineer.

00140.30 Agency-Required Changes in the Work

Changes to the Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of Project construction.

Without impairing the Contract, the Agency reserves the right to require changes it deems necessary or desirable within the scope, which in the Specifications means general scope, of the Project. These changes may modify, without limitation:

- Specifications and design
- Grade and alignment
- Cross Sections and thicknesses of Courses of Materials
- Method or manner of performance of Work
- Project Limits

or may result in:

- Increases and decreases in quantities
- Additional Work
- Elimination of any Contract item of Work
- Acceleration or delay in performance of Work

Upon receipt of a Change Order, the Contractor shall perform the Work as modified by the Change Order. If the Change Order increases the Contract Amount, the Contractor shall notify its Surety of the increase and direct the Surety to increase the amount of the performance and payment bonds to equal the new Contract Amount. If requested, the Contractor shall provide the Agency with a copy of the modified bond documents within 15 calendar days of receipt of the Change Order. The Contractor's performance of Work according to Change Orders shall neither invalidate the Contract nor release the Surety. Payment for changes in the Work will be made according to 00195.20. Contract Time adjustments, if any, will be made according to

00180.80. A Change Order signed by the Contractor is the agreement that the adjustment in the Contract Amount or Contract Time indicated is full compensation for all change order items including the impact of the change order on the balance of the Work to be accomplished.

00140.40 Differing Site Conditions

The following constitute differing Project Site conditions provided such conditions are discovered at the Project Site after commencement of the Work:

- **Type 1** - Subsurface or latent physical conditions that could not have been discovered by careful examination of the Project site, utility locations, and available records as described in 00120.15 and that differ materially from those indicated in the Contract Documents; or
- **Type 2** - Unknown physical conditions of unusual nature that differ materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract.

The party discovering such a condition shall promptly notify the other party, in writing, of the specific differing conditions before they are disturbed and before the affected Work is performed. The Contractor shall not continue Work in the affected area until the Engineer has inspected such condition according to 00195.30 to determine whether an adjustment to Contract Amount or Contract Time is required.

Payment adjustments due to differing Project Site conditions, if any, will be made according to 00195.30. Contract Time adjustments, if any, will be made according to 00180.80.

00140.50 Environmental Pollution Changes

ORS 279C.525 will apply to any increases in the scope of the Work required as a result of environmental or natural resources laws enacted or amended after the submission of Bids for the Contract. The Contractor shall comply with the applicable notice and other requirements of ORS 279C.525. The applicable rights and remedies of that statute will also apply.

In addition to ORS 279C.525, the Agency has compiled a list at 00170.01 of those federal, State, and local agencies, of which the Agency has knowledge, that have enacted ordinances, rules, or regulations dealing with the prevention of environmental pollution and the preservation of natural resources that may affect the performance of Agency contracts.

00140.60 Extra Work

If directed by the Engineer's written order, the Contractor shall perform work not included in the Contract. The Contractor shall perform this work according to:

- Standard Specifications
- Standard Drawings
- Other Plans and Specifications issued by the Engineer

Payment for Extra Work will be made according to Section 00196. Contract Time adjustments, if any, will be made according to 00180.80.

00140.65 Disputed Work

The Contractor may dispute any part of a Change Order, written order, or an oral order from the Engineer by the procedures specified in Section 00199.

00140.70 Cost Reduction Proposals

The Contractor may submit written proposals to the Engineer that modify Plans, Specifications, or other Contract Documents for the sole purpose of reducing the total cost of construction. Unless otherwise agreed to in writing by the Agency, a proposal that is solely or primarily a proposal to reduce estimated quantities or

delete Work, as determined by the Engineer, is not eligible for consideration as a cost reduction proposal and will instead be addressed under 00140.30, whether proposed or suggested by the Agency or the Contractor.

A. Proposal Requirements - The Agency will not adopt a cost reduction proposal that impairs essential functions or characteristics of the Project, including, but not limited to service life, economy of operation, ease of maintenance, designed appearance, or design and safety standards.

To conserve time and funds, the Contractor may first submit a written request for a feasibility review by the Engineer. The request should contain a description of the proposal together with a rough estimate of anticipated dollar and time savings. The Engineer will, within a reasonable time, advise the Contractor in writing whether or not the proposal would be considered by the Agency, should the Contractor elect to submit a detailed cost reduction proposal.

A detailed cost reduction proposal shall include without limitation the following information:

- A description of existing Contract requirements for performing the Work and the proposed change;
- The Contract items of Work affected by the proposed change, including any quantity variation caused by the proposed change;
- Pay Items affected by the proposed change including any quantity variations;
- A detailed cost estimate for performing the Work under the existing Contract and under the proposed change. Cost estimates shall be made according to Section 00197. Costs of re-design, which are incurred after the Agency has accepted the proposal, will be included in the cost of proposed work; and
- A date by which the Engineer must accept the proposal in order to accept the proposed change without impacting the Contract Time or cost reduction amount.

B. Continuing to Perform Work - The Contractor shall continue to perform the Work according to Contract requirements until the Engineer issues a Change Order incorporating the cost reduction proposal. If the Engineer fails to issue a Change Order by the date specified in the proposal, the proposal shall be deemed rejected.

C. Consideration of Proposal - The Engineer is not obligated to consider any cost reduction proposal. The Agency will not be liable to the Contractor for failure to accept or act upon any cost reduction proposal submitted.

The Engineer will determine in its sole discretion whether to accept a cost reduction proposal as well as the estimated net savings in construction costs from the adoption of all or any part of the proposal. In determining the estimated net savings, the Engineer may disregard the Schedule of Items. The Engineer will establish prices that represent a fair measure of the value of Work to be performed or to be deleted as a result of the cost reduction proposal.

D. Sharing Investigation Costs - As a condition for considering a Contractor's cost reduction proposal, the Agency reserves the right to require the Contractor to share in the Agency's costs of investigating the proposal. If the Agency exercises this right, the Contractor shall provide written acceptance of the condition to the Engineer. Such acceptance will authorize the Agency to deduct its share of investigation costs from payments due or that may become due to the Contractor under the Contract.

E. Acceptance of Proposal Requirements - If the Contractor's cost reduction proposal is accepted in whole or in part, acceptance will be made by a Change Order that will include without limitation the following:

- Statement that the Change Order is made according to 00140.70;
- Revised Contract Documents that reflect all modifications necessary to implement the approved cost reduction measures;
- Any conditions upon which the Agency's approval is subject;
- Estimated net savings in construction costs attributable to the approved cost reduction measures; and
- A payment provision according to which the Contractor will be paid 50% of the estimated net savings amount as full and adequate consideration for performance of the Work of the Change Order.

The Contractor's cost of preparing the cost reduction proposal and the Agency's costs of investigating the proposal, including any portion paid by the Contractor, will be excluded from determination of the estimated net savings in construction costs. Costs of re-design, which are incurred after the Agency has accepted the proposal, will be included in the cost of the Work attributable to cost reduction measures.

If the Agency accepts the cost reduction proposal, the Change Order that authorizes the cost reduction measures will also address any Contract Time adjustment.

F. Right to General Use - Once submitted, the cost reduction proposal becomes the property of the Agency. The Agency reserves the right to adopt the cost reduction proposal for general use without additional compensation to the Contractor when it determines that a proposal is suitable for application to other contracts.

00140.80 Use of Publicly Owned Equipment

The Contractor is prohibited from using publicly-owned Equipment except in the case of emergency. In an emergency, the Contractor may rent publicly-owned Equipment provided that:

- The Engineer provides written approval that states that such rental is in the public interest; and
- Rental does not increase the Project cost.

00140.90 Final Trimming and Cleanup

Before Final Inspection as described in 00150.90, the Contractor shall neatly trim and finish the Project and remove all remaining unincorporated Materials and debris. Final trimming and cleanup shall include without limitation the following:

- The Contractor shall retrim and reshape earthwork, and shall repair deteriorated portions of the Project Site.
- Where the Work has impacted existing facilities or devices, the Contractor shall restore or replace those facilities to their pre-existing condition.
- The Contractor shall clean all drainage facilities and sanitary sewers of excess Materials or debris resulting from the Work.
- The Contractor shall clean up and leave in a neat, orderly condition, Rights-of-Way, Materials sites, and other property occupied in connection with performance of the Work.
- The Contractor shall remove temporary buildings, construction plants, forms, falsework and scaffolding, surplus and discarded Materials, and rubbish.
- The Contractor shall dispose of Materials and debris including, without limitation, forms, falsework, scaffolding, and rubbish resulting from clearing, grubbing, trimming, clean-up, removal, and other Work. These Materials and debris become the property of the Contractor. The Contractor shall dispose of these Materials and debris immediately.
- The Contractor shall restore and replant or resurface adjoining properties to match existing grades and existing surfaces.

- The Contractor shall install erosion and sediment control as needed to stabilize the Project site.

Unless the Contract specifically provides for payment for this item, the Agency will make no separate or additional payment for final trimming and cleanup.

00140.95 -“As-Built” Drawings

The Contractor shall maintain a current and accurate record of Work completed during the course of this Contract and make available to the Engineer updated copies of the project “As-Built” for Engineer’s review at any time. These “As-Built” drawings shall be kept by accurately marking a designated set of the Contract plans with the specified information as Work proceeds. Accurate, complete and current “As-Built” drawings are a specified requirement for monthly progress payments of the Work completed. “As-Built” shall be reviewed for completeness before recommendation of payment is granted. Incomplete or insufficient “As-Built” will be returned to the Contractor and recommendation for progress payment denied. At project completion and as a condition of final payment, the Contractor shall deliver an acceptable complete and legible set of “As-Built” drawings to the Engineer.

The “As-Built” drawings shall show the information listed below at a minimum. Where the term “locate” or “location” is used, it shall mean record of position with respect to both the construction vertical datum and either construction horizontal datum or a nearby permanent improvement.

- As-built location of underground and surface services and utilities as installed;
- As-built location of existing underground and surface utilities and services that are to remain and that are encountered during the course of the Work;
- As-built changes in dimension, location, grade or detail to that shown on plan;
- As-built changes made by change order;
- As-built details not in original plans; and
- As-built fully completed shop drawings reflecting all revisions.

Upon completion of the construction, the Contractor shall review and certify the construction set of “As-Built” drawings for completeness and accuracy of representation of any changes. Final payment will not be processed until “As-Built” drawings have been submitted and approved.

Section 00150 - Control of Work

00150.00 Authority of the Engineer (Project Manager)

The Engineer has authority over the Work and its suspension. (See Section 00180) The Contractor shall perform all Work to the complete satisfaction of the Engineer. The Engineer's determination shall be final on all matters, including but not limited to the following:

- Quality and acceptability of Materials and workmanship
- Measurement of unit price Work
- Timely and proper prosecution of the Work
- Interpretation of Contract Documents
- Payments due under the Contract

The Engineer's decision is final and except as provided in Section 00180.80 for adjustments of Contract Time and Section 00199 for claims for additional compensation, may be challenged only through litigation.

The Contractor shall direct all requests for clarification or interpretation of the Contract, in writing, to the Engineer. The Engineer will respond within a reasonable time. Contract clarification or interpretation obtained from persons other than the Engineer.

Work performed under the Contract will not be considered complete until it has passed Final Inspection by the Engineer and has been accepted by the Agency.

Interim approvals issued by the Engineer, including, but not limited to, Final Acceptance, will not discharge the Contractor from responsibility for errors in prosecution of the Work, for improper fabrication, for failure to comply with Contract requirements, or for other deficiencies, the nature of which are within the Contractor's control.

The Engineer shall have the authority to appoint Inspectors and other personnel as required to assist in the administration of the Contract.

The authority stated in this Subsection is subject to the individual's delegated authority by the Agency. If the individual does not have the State authority, the Subsection reference shall include Agency personnel that have such authority.

00150.02 Inspector's Authority and Duties

To the extent delegated under 00150.01, Inspectors are authorized to represent the Engineer and Project Manager to perform the following:

- Inspect Work performed and Materials furnished, including, without limitation, the preparation, fabrication, or manufacture of Materials to be used;
- Orally reject defective Materials and to confirm such rejection in writing;
- By oral order, temporarily suspend the Work for improper prosecution pending the Engineer's decision; and
- Exercise additional delegated authority.

Inspectors are not authorized to:

- Accept Work or Materials.
- Alter or waive provisions of the Contract.
- Give instructions or advice inconsistent with the Contract Documents.

00150.10 Coordination of Contract Documents

The Contract Documents, including, but not limited to, Contract Change Orders, the Special Provisions, the Plans, and the Standard Specifications are intended to collectively describe all of the items of Work necessary to complete the Project. The Contract Documents are complementary; what is required by one is as binding as if required by all.

A. Order of Precedence - The Engineer will resolve any discrepancies between these documents in the following order of precedence:

1. Permits from outside agencies;
2. Contract (Agreement)
3. Addenda;
4. Bid Schedule;
5. Project Drawings;
6. Standard Drawings;
7. Special Provisions;
8. General Conditions;
9. Standard Specifications;
10. Geotechnical Data Reports;
11. Reviewed and accepted, stamped Working (Shop) Drawings (including Deferred Submittals);
12. Approved Unstamped Working (Shop) Drawings.

Change Orders, Work Change Directives, Field Orders, and Engineer's written interpretation and clarifications, in precedence listed, will take precedence over all other Contract Document components referenced herein.

Notes on a drawing shall take precedence over drawing details. Dimensions shown on the drawings, or that can be computed, shall take precedence over scaled dimensions. The Drawings with the higher level of detail take precedence over less detailed Drawings.

B. Immaterial Discrepancies - The Contract Documents specify details for the construction and completion of the Work. If Contract Documents describe portions of the Work in sufficient detail but are silent in some minor respect, the Contractor may proceed utilizing the current best industry practices.

C. Material Discrepancies - If the Contractor identifies a discrepancy, error, or omission in the Contract Documents that cannot be resolved by the approach specified in 00150.10.B above, the Contractor shall immediately request clarification from the Engineer

00150.15 Construction Stakes, Lines, and Grades

A. Agency Responsibilities - The Engineer will provide the location of the existing benchmarks and horizontal control locations used to design the project and prepare the Plans.

B. Contractor Responsibilities - The Contractor shall:

- Accurately measure detailed dimensions, elevations, and slopes from the Engineer's benchmarks and horizontal control locations;
- Provide all labor, Materials, and Equipment to properly stake out the Project so that it can be constructed in accordance with the Contract Documents. Any changes made shall be recorded and the changed vertical and horizontal locations incorporated into the "As-Built" drawings.

- Inform the Engineer of any property corners, monuments, and/or survey markers that are not shown on the Plans and are found during construction activities prior to disturbing the monuments. Allow the Agency 2 Work days for referencing all found markers before they are removed. Monuments that are noted on the Plans are to be protected and if they are disturbed by the Contractor's activities shall be replaced by the Contractor's surveyor at the Contractor's expense in accordance with ORS Chapter 209.

00150.20 Inspection

- A. Inspection by the Engineer** - The Engineer may test Materials furnished and inspect Work performed by the Contractor to ensure Contract compliance. The Contractor shall notify the Engineer 48 hours (two full Work Days) in advance for inspection of each portion of the Work.

Contractor shall not begin placing successive Courses or portions of Work until preceding Courses or portions of the Work have been inspected and approved by the Engineer.

If the Contractor performs Work without the Engineer's inspection or uses Materials that the Engineer has not approved, the Engineer may order affected portions of the Work removed at the Contractor's expense.

At the Engineer's direction, any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore these portions of Work to the standard required by the Contract. If the Engineer rejects Work due to Materials or workmanship, or if the Contractor performed such Work without providing sufficient advance request for inspection to the Engineer, the Contractor shall bear all costs of uncovering and restoring the Work. If the Engineer accepts the uncovered Work, and the Contractor performed the Work only after providing the Engineer with sufficient advance notice, the costs of uncovering and restoring the Work will be paid for by the Agency according to 00195.20.

- B. Inspection Facilities** - The Contractor shall furnish walkways, railings, ladders, shoring, tunnels, platforms, and other facilities necessary to permit the Engineer to have safe access to the Work to be inspected. The Contractor shall require producers and fabricators to provide safe inspection access as requested by the Engineer.
- C. Sampling** - When directed by the Agency, the Contractor shall furnish the Engineer with samples of Materials that the Engineer will test. All of the Contractor's costs related to this required sampling are Incidental.
- D. Inspection by Third Parties** - Where third parties have the right to inspect the Work, the Contractor shall coordinate with the Engineer and shall provide safe inspection access.
- E. Contractor's Duty to Make Corrections** - The Contractor shall perform all Work according to the Contract Documents. The Contractor shall correct Work that does not comply with the Contract Documents at its own expense. Inspection of the Work by the Engineer does not relieve the Contractor of responsibility for improper prosecution of the Work.

00150.25 Acceptability of Materials and Work

The Contractor shall furnish Materials and shall perform Work in Close Conformance to the Contract Documents. If the Engineer determines that the Materials furnished or the Work performed are not in Close Conformance with the Contract Documents, the Engineer may:

- Reject the Materials or Work and order the Contractor, at the Contractor's expense, to remove, replace, or otherwise correct any non-conformity; or

- Accept the Materials or Work as suitable for the intended purpose, adjust the amount paid for applicable Pay Items to account for diminished cost to the Contractor or diminished value to the Agency, document the adjustment, and provide written documentation to the Contractor regarding the basis of the adjustment.

The Engineer's decisions concerning acceptability of Materials or Work will be final.

00150.30 Delivery of Notices

Written notices to the Contractor by the Engineer or the Agency will be delivered:

- In person;
- By U.S. Postal Service certified or registered mail (return receipt requested), to the current office address as shown in the records of the Agency; or
- By overnight delivery service of a private industry courier, to the current office address as shown in the records of the Agency.

Notices shall be considered as having been received by the Contractor:

- At the time of actual receipt when delivered in person;
- At the time of actual receipt or 7 Calendar Days after the postmarked date when deposited for delivery by certified or registered mail, whichever is earlier; or
- At the time of actual receipt or 3 Calendar Days after deposit with a private industry courier for overnight delivery service, whichever is earlier.

Written notices to the Engineer or the Agency by the Contractor shall be delivered to the Agency address shown in the Special Provisions, unless a different address is agreed to by the Engineer, and shall be delivered:

- In person;
- By U.S. Postal Service certified or registered mail (return receipt requested); or
- By overnight delivery service of a private industry courier.

Notices will be considered as having been received by the Agency:

- At the time of actual receipt when delivered in person;
- At the time of actual receipt or 7 Calendar Days after the postmarked date, when deposited for delivery by certified or registered mail, whichever is earlier; or
- At the time of actual receipt or 3 Calendar Days after deposit with a private industry courier for overnight delivery service, whichever is earlier.

00150.35 Submittals

A. Description - Submittals covered by these requirements include manufacturers' information, Shop Drawings, test procedures, test results, samples, and miscellaneous Work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, Materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and warranty information and other instructions as specifically required in the Contract Documents to demonstrate fully that the Materials and Equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents.

B. Contractor's Responsibilities -

- The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of Equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where his submittal may affect the work of another contractor or the Agency. The Contractor shall coordinate submittals among its subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in applicable technical sections.
- The Contractor shall coordinate submittals with the Work so that Work will not be delayed. It shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with Work related to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Contractor with the indication “No Exceptions Taken” or “Make Corrections Noted”.
- Submittals shall be carefully reviewed by an authorized representative of the Contractor prior to submission to the Engineer. Each submittal shall be dated and signed by the Contractor as being correct and in strict conformance with the Contract Documents. In the case of Shop Drawings, each sheet shall be so dated and signed. Any deviations from the Contract Documents shall be noted by the Engineer and Agency. The Engineer will only review submittals that have been so verified by the Contractor. Non-verified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.
- The Contractor shall certify on each submittal document that it has reviewed the submittal, verified field conditions, and complied with the contract documents.
- The Contractor may authorize in writing a material or equipment supplier to deal directly with the Engineer or with the Agency with regard to a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the Work.

C. Shop Drawings and Product Submittals

- Wherever called for in the Contract Documents or where required by the Engineer, the Contractor shall furnish to the Engineer for review, five (5) copies plus one reproducible copy or electronic file, of each Shop Drawing or Product submittal. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. If a list, graph, catalog sheet, data sheet, etc. includes more than one item, clearly mark which item is the subject of the submittal. Shop Drawings shall bear the signature and seal of an engineer registered in the appropriate branch and in the state of Oregon, unless otherwise indicated. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state of Oregon, unless otherwise indicated.
- Shop Drawing and Product submittals shall be accompanied by the Engineer’s standard submittal transmittal form, a reproducible copy of which is available from the Engineer. A submittal without the form or where applicable items on the form are not completed will be returned for resubmittal.
- Organization

- a. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components. Example: if a pump section references other sections for the motor, shop-applied protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be acceptable. A single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.
 - b. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.
 - c. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents
- Format
 - a. Minimum sheetsize shall be 8.5 inches by 11 inches. Maximum sheet size shall be 22 inches by 34 inches. Every page in a submittal shall be numbered in sequence. Each copy of a submittal shall be collated and stapled or bound, as appropriate. The Engineer will not collate sheets or copies.
 - b. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
 - c. Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially, and the submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number (e.g., 25). If submittal “25” requires a resubmittal, the first resubmittal will bear the designation “25.A” and the second resubmittal will bear the designation “25.B” and so on.
 - d. If there is a follow-up submittal related to a previously submitted class of material or type of equipment (e.g., follow-up submittal to submittal “25”), it shall be assigned the number “25.1”. If submittal “25.1” requires a resubmittal, the first resubmittal will bear the designation “25.1.A” and the second resubmittal will bear the designation “25.1.B” and so on
 - Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.
 - Except as may otherwise be indicated, the Engineer will return prints of each submittal to the Contractor with comments noted thereon, within 21 Days following receipt by the Engineer. It is considered reasonable that the Contractor will make a complete and acceptable submittal to the Engineer by the first resubmittal on an item. The Owner reserves the right to withhold monies due to the Contractor to cover additional costs of the Engineer’s review beyond the first resubmittal. Engineer’s cost for submittal review beyond the first resubmittal is provided in the Special Provisions. The Engineer’s maximum review period for each submittal or resubmittal will be 21 Days.
 - If a submittal is returned to the Contractor marked “NO EXCEPTIONS TAKEN”, formal revision and resubmission will not be required.
 - If a submittal is returned marked “MAKE CORRECTIONS NOTED”, Contractor shall make the corrections on the submittal, but formal revision and resubmission will not be required, except where specifically required by Engineer as indicated on the submittal review form.

- If a submittal is returned marked “AMEND - RESUBMIT”, the Contractor shall revise it and shall resubmit the required number of copies to the Engineer for review. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as “AMEND - RESUBMIT”, the submittal as a whole is deemed “AMEND - RESUBMIT”, and 10 drawings are required to be resubmitted.
- If a submittal is returned marked “REJECTED - RESUBMIT”, it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with the General Conditions. In the first 2 cases, the Contractor shall prepare a new submittal and shall submit the required number of copies to the Engineer for review. In the latter case, the Contractor shall submit the substitution request according to the General Conditions.
- Resubmittal of rejected portions of a previous submittal will not be allowed. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.
- Fabrication of an item may commence only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED”. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the Contract requirements.
- Corrections or comments made on the Contractor’s Shop Drawings during review do not relieve the Contractor from compliance with Contract Drawings and Specifications. Review is for conformance to the design concept and general compliance with the Contract Documents only. The Contractor is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating Work with the trades, and satisfactory and safe performance of the Work.

D. Quality Control (QC) Submittals

- Quality control submittals are defined as those required by the Specifications to present documentary evidence to the Engineer that the Contractor has satisfied certain requirements of the Contract Documents.
- Unless otherwise indicated, QC submittals shall be submitted:
 - a. Before delivery and unloading, for the following types of submittals:
 - Manufacturers’ installation instructions
 - Manufacturers’ and Installers’ experience qualifications
 - Ready mix concrete delivery tickets
 - Design calculations
 - Affidavits and manufacturers’ certification of compliance with indicated product requirements
 - Laboratory analysis results
 - Factory test reports
 - b. For the following types of submittals, the manufacturer’s field representative shall submit a draft certification prior to leaving the Project site and a final certification within 7 days of the event documented.
 - Manufacturers’ field representative certification of proper installation

- c. Within 30 Days of the event documented for the following types of submittals:
 - Field measurement
 - Field test reports
 - Receipt of permit
 - Receipt of regulatory approval
- The Engineer will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

E. Deferred Submittals to Agency

- For the purposes of this section, Deferred Submittals are defined as those portions of the Project that are Contractor-designed and must be submitted to the Agency's building official for approval and to meet Building Permit plan review requirements.
- The Engineer will schedule a pre-submittal conference with the Contractor and Agency's building official to discuss proposed Deferred Submittal items, requirements, and review schedule.
- The Contractor shall list the Deferred Submittals on the title or cover sheet of the Drawings for submission to the Agency and shall state the design criteria/assumptions of the Deferred Submittal items on the plans. Deferred Submittals shall include details for connection of materials to the structure and calculations showing that the specified structural requirements are met.
- The Contractor shall submit Deferred Submittals to the Engineer for review for general conformance to the design of the structure. Neither the Agency nor the Engineer is responsible for coordination of Deferred Submittal components with Contract Documents. Review does not lessen nor shift burden or responsibility from Contractor or assigned subcontractor/supplier to the Agency or Engineer. The Engineer, upon confirming the Deferred Submittals are in general conformance with the design, shall forward the Deferred Submittals to the building official. Contractor is responsible, with no exceptions, to ensure that building official's Deferred Submittal review will not adversely affect Project's construction schedule. The Deferred Submittal items shall not be installed by the Contractor until the design and Deferred Submittals have been approved by the building official.

F. Effect of Review of Contractor's Submittals

- Review of Contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of its responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Engineer or the Agency, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. An indication of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Agency or Engineer has no objection to the Contractor, upon its own responsibility, using the plan or method of Work proposed, or providing the materials or equipment proposed.

00150.37 Equipment Lists and Other Submittals

The Contractor shall submit Equipment lists, and other required submittals for approval by the Engineer. With each submittal, the Contractor shall clearly identify the applicable specification Subsection and the product make, model, size and proposed options.

00150.40 Cooperation and Superintendence by the Contractor

The Contractor is responsible for full management of all aspects of the Work, including superintendence of all Work by Subcontractors, Suppliers, and other providers. The Contractor shall appoint a single Superintendent and may also appoint alternate Superintendents as necessary to control the Work. The form of appointment of the alternate shall state, in writing, the alternate's name, duration of appointment in the absence of the Superintendent, and scope of authority. The Contractor shall:

- Provide for the cooperation and superintendence on the Project by:
 - Furnishing the Engineer all data necessary to determine the actual cost of all or any part of the Work; added Work; or changed Work.
 - Allowing the Engineer reasonable access to the Contractor's books and records at all times. To the extent permitted by public records laws, the Engineer will make reasonable efforts to honor the Contractor's Request for protection of confidential information.
 - Keeping one complete set of Contract Documents on the Project Site at all times, available for use by all the Contractor's own organization, and by the Engineer if necessary.
- Appoint a single Superintendent and any alternate Superintendent who shall meet the following qualifications:
 - Appointees shall be competent to manage all aspects of the Work.
 - Appointees shall be from the Contractor's own organization.
 - Appointees shall have performed similar duties on at least one previous project of the size, scope and complexity as the current Contract.
 - Appointees shall be experienced in the types of Work being performed.
 - Appointees shall be capable of reading and thoroughly understanding the Contract Documents.
- The appointed single Superintendent, or any alternate Superintendent shall:
 - Be present for all On-Site Work, regardless of the amount to be performed by the Contractor, Subcontractors, Suppliers, or other providers, unless the Engineer provides prior approval of the Superintendent's or alternate Superintendent's absence.
 - Be equipped with a two-way radio or cell phone capable of communicating throughout the Project during all the hours of Work on the Project Site and be available for communication with the Engineer.
 - Have full authority and responsibility to promptly execute orders or directions of the Engineer.
 - Have full authority and responsibility to promptly supply the Materials, Equipment, labor, and Incidentals required for performance of the Work.
 - Coordinate and control all Work performed under the Contract, including, without limitation, the Work performed by Subcontractors, Suppliers, and owner/operators.
 - Diligently pursue progress of the Work according to the schedule requirements of Section 00180.
 - Cooperate in good faith with the Engineer, Inspectors, and other contractors in performance of the Work.
 - Provide all assistance reasonably required by the Engineer to obtain information regarding the nature, quantity, and quality of any part of the Work.
 - Provide access, facilities and assistance to the Engineer in establishing such lines, grades and points as the Engineer requires.
 - Carefully protect and preserve the Engineer's benchmarks and horizontal control locations.

Any Superintendent or alternate Superintendent who repeatedly fails to follow the Engineer's written or oral orders, directions, instructions, or determinations, shall be subject to removal from the Project.

If the Contractor fails or neglects to provide a Superintendent, or an alternate Superintendent, and no prior approval has been granted, the Engineer has the authority to suspend the Work according to 00180.70. Any continued Work by the Contractor, Subcontractors, Suppliers, or other providers may be subject to rejection

and removal. The Contractor's repeated failure or neglect to provide the superintendence required by these provisions constitutes a material breach of the Contract, and the Engineer may impose any remedies available under the Contract, including but not limited to Contract termination.

00150.50 Cooperation with Utilities

A. General - As specified in the Special Provisions or as shown on the Plans, existing Utilities requiring adjustment may be adjusted by the Utility before, during, or after Project construction. "Adjustment of Utilities" shall mean the alteration, improvement, connection, disconnection, relocation, or removal of existing Utility lines, facilities, or systems in temporary or permanent manner.

B. Contractor's Responsibilities - The Contractor shall:

- Follow applicable rules adopted by the Oregon Utility Notification Center;
- Contact Utility owners after the Contract is awarded to verify all Utilities' involvement on the Project Site;
- Coordinate Project construction with the Utilities' planned adjustments, take all precautions necessary to prevent disruption of Utility service, and perform its Work in the manner that results in the least inconvenience to the Utility owners;
- Include all Utility adjustment work, whether to be performed by the Contractor or the Utilities, on the Contractor's Project Work schedule submitted under 00180.41;
- Protect from damage or disturbance any Utility that remains within the area in which Work is being performed;
- Not disturb an existing Utility if it requires an unanticipated adjustment, but shall protect it from damage or disturbance and promptly notify the Engineer; and
- Report to the Engineer any Utility owner who fails to cooperate or fails to follow the planned Utility adjustment.

Subject to the Engineer's approval, the Contractor may propose adjustments to the Utilities by asking the Utility owners to move, remove, or alter their facilities in ways other than as shown on the Plans or in the Special Provisions. The Contractor shall conduct all negotiations, make all arrangements, and assume all costs that arise from such changes.

C. Notification - This Project is located within the Oregon Utility Notification Center area which is a Utilities notification system for notifying owners of Utilities about Work being performed in the vicinity of their facilities. The Utilities notification system telephone number is 811 (or use the old number which is 1-800-332-2344).

The Contractor shall comply with the rules of the Oregon Utility Notification Center, OAR 952-001-0010 through OAR 952-001-0090, and ORS 757.993. The Contractor may contact the Oregon Utility Notification Center at 503-232-1987 about these rules.

00150.53 Utilities and Existing Improvements

A. General - Information shown on the Plans as to the location of existing water courses and utilities has been compiled from available sources and may not be accurate. The Contractor shall determine the location and nature of affected water courses, utilities and underground improvements prior to commencing Work.

The Contractor shall provide for the flow of water courses and essential utilities that may be interrupted during the progress of the Work and shall restore such water courses or utilities after completion of the Work.

The Contractor shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of utilities which may interfere with Work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's progress. When such exploratory excavations show the utility location as shown on the Plans to be in error, the Contractor shall so notify the Engineer.

The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility. Unless otherwise provided in the Special Provisions, all potholing and exploratory work shall be incidental to the Work and no separate payment shall be made therefore.

The Contractor shall coordinate project construction with the adjustment of utilities, take all necessary precautions to prevent disturbing the utilities, and perform work so that utility owners and users are caused a minimum of inconvenience.

The Contractor shall protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Plans. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

To ease or streamline the work, the Contractor may desire to adjust the utilities by asking the utility owners to move, remove, or alter their equipment in ways other than those shown on the Plans or in the Contract Documents. The Contractor shall conduct the negotiations, make the arrangements, and pay all costs that arise from such changes.

- B. Utilities to be Removed or Relocated** - Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of the property of any public utility or franchise holder, such utility company or franchise holder shall be notified by the Contractor to remove or relocate such property within a specified reasonable time. When utility lines that are to be removed or relocated are encountered within the area of operations, the Contractor shall notify the utility company and the Engineer a sufficient time in advance for the necessary measures to be taken to prevent the interruption of service.
- C. Underground Utilities and Improvements Indicated** - Existing utility lines and underground improvements that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines and underground improvements that are encountered during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the Contractor, unless otherwise repaired by the owner of damaged utility. If the owner of the damaged facility performs its own repairs, the Contractor shall reimburse said owner for the costs of repair.
- D. Underground Utilities and Improvements Not Indicated** - In the event that the Contractor damages existing utility lines or underground improvements that are not indicated in the Plans or marked in the field, or are not indicated or marked with reasonable accuracy, or the locations of which are not made known to the Contractor prior to excavation, the Contractor shall immediately provide a verbal report of such damage to the Engineer, and provide a written report thereof promptly thereafter. The Contractor shall immediately notify the owner of the damaged utility. If directed by the Engineer, repairs shall be made by the Contractor under the provisions for changes and extra work contained in the General Conditions.

This subsection applies only to main line utilities. For service lines to private properties, see Subsection 00150.53.E.

For purposes of this section, “reasonable accuracy” is defined as within two (2) feet from the outside lateral dimensions of both sides of an underground utility or facility from actual location. No representation shall be made concerning the accuracy of vertical elevations of existing utilities, even if indicated in the plans, and no additional payment will be made for damage to utilities encountered at depths differing from those indicated.

E. Underground Services Indicated or Not - If service lines are encountered, whether shown, marked or not, the Contractor shall take precautions to carefully work around them and repair them if they are damaged by the Contractor, at no additional cost to the Agency.

F. Approval of Repairs - All repairs to a damaged utility or improvement shall be accepted and approved by an authorized representative of the utility or improvement owner and accepted by the Agency before being concealed by backfill or other Work.

G. Agency’s Right of Access - The right reserved to the Agency and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.

00150.55 Cooperation with Other Contractors

The Agency reserves the right to perform other work on or near the Project Site, including, without limitation, any Materials site, with forces other than those of the Contractor.

If such work takes place on or near the Project Site, the Contractor shall have the following obligations:

- The Contractor shall coordinate Work with other contractors or forces.
- The Contractor shall cooperate in good faith with all other contractors or forces.
- The Contractor shall perform the Work specified in the Contract in a way that will minimize interference and delay for all forces involved.
- The Contractor shall place and dispose of the Materials being used so as not to interfere with the operations of other forces.
- The Contractor shall join the Work with that of other forces in a manner acceptable to the Engineer or the Agency, and shall perform it in the accepted sequence with the work of the other force.

The Engineer will resolve any disagreements under this Subsection that may arise among the Contractor and other work forces, or between the Contractor and the Agency. The Engineer’s decision in these matters is final, as provided in 00150.00.

When the schedules for Work of the Contractor and the work of other forces overlap, each contractor involved shall submit a current, realistic progress schedule to the Engineer. Before the Engineer accepts the schedule, each party shall have the opportunity to review all schedules. After this review and any necessary consultations, the Engineer will determine acceptable schedules.

The Contractor waives any right it may have to make claims against the Agency for any damages or claims that may arise because of inconvenience, delay, or loss due solely to the presence of other contractors working on or near the Project Site.

If the Contract gives notice of work to be performed by other forces that may affect the Contractor’s Work under the Contract, the Contractor shall include any costs associated with coordination of the Work in the appropriate Pay Item or as a portion of a Pay Item.

In an emergency, the Contractor most immediately able to respond may repair a facility or Utility of another contractor in order to prevent further damage to the facility, Utility, or other Structure as a result of the emergency.

00150.60 Construction Equipment Restrictions

A. Load and Speed Restrictions for Construction Vehicles and Equipment - The Contractor shall comply with legal weight and speed restrictions when moving Materials or Equipment beyond the limits of the Project Site.

The Contractor shall control vehicle and Equipment loads and speeds within the Project Site according to the following restrictions, unless the Special Provisions provide otherwise:

1. The Contractor shall restrict loads and speeds as necessary to avoid displacement or loss of Materials on Subgrades and Aggregate Bases.
2. The Contractor shall restrict weights to legal loads, and shall travel at speeds of no more than 45 mph or the posted construction speed, whichever is less, on treated Bases, Pavement, or wearing Courses.
3. The Contractor shall not cross Bridges or other Structures with Equipment or vehicles exceeding the legal load limit without prior written permission of the Engineer. The Contractor shall make any such request in writing, describing the loading details and the arrangement, movement, and position of the Equipment on the Structure. The Contractor shall comply with any restrictions or conditions included in the Engineer's written permission.

B. Protection of Buried Items - The Contractor shall use temporary fill or other methods to avoid overload of pipes, box culverts, and other items that are covered, or to be covered, by fill or backfill.

C. Responsibility for Damages - The Contractor shall assume responsibility for damages caused by excessive Equipment speed or loads while performing the Work, both inside and outside the Project Site. The Engineer's permission to cross Bridges and other Structures, according to 00150.60.A, will not relieve the Contractor from responsibility for load-caused damages.

00150.70 Detrimental Operations

The Contractor shall avoid operations whose methods, conditions, or timing may injure people or damage property or the Work. Damage may include, without limitation, staining surfaces with mud or asphalt, or damaging utilities, structures or foundations. (See also 00150.60, 00150.75, and Section 00170)

When any such damage occurs, the Engineer will determine if it is to be corrected by repair, replacement, or compensatory payment by the Contractor. If compensatory payment is required, the Engineer will determine the amount. Compensatory payment may be deducted from monies due or to become due to the Contractor under the Contract.

00150.75 Protection and Maintenance of Work During Construction

The Contractor shall protect and maintain the Work during construction and until Third Notification has been issued, unless otherwise provided in the Contract. For the purposes of this Subsection, "maintenance" shall include measures to prevent deterioration of Roadway and Structures at the Project Site, and to keep them in good condition at all times during the prosecution of the Work. The Contractor shall continuously allocate sufficient Equipment and workers to achieve such maintenance.

If the Contract requires the placement of a Course upon a previously constructed Course or Subgrade, the Contractor shall maintain the previous Course or Subgrade during all construction operations.

The Contractor shall include costs of protecting and maintaining the Work during construction in the unit prices bid for the various Pay Items. The Contractor will not be paid an additional amount for this Work, unless otherwise specified.

The Engineer will timely notify the Contractor of Contractor's noncompliance with this Subsection. If the Contractor fails to remedy unsatisfactory protection or maintenance within 24 hours after receipt of such notice, the Engineer may proceed to remedy the deficiency, and deduct the entire cost from monies due or to become due the Contractor under the Contract.

00150.80 Removal of Unacceptable and Unauthorized Work

The Contractor shall correct or remove unacceptable Work and remove unauthorized work, as directed by the Engineer in writing. The Contractor shall replace such work with Work and Materials conforming to the requirements of the Contract.

For the purposes of this Subsection, "unauthorized work" shall include without limitation the following:

- Work that extends beyond lines shown on the Plans or otherwise established by the Engineer;
- Work that is contrary to the Engineer's instructions; and
- Work that is conducted without the Engineer's written authorization.

The Agency will not pay the Contractor for unacceptable Work, except as provided in 00150.25, or unauthorized work. The Engineer may issue a written order for the correction or removal of such work at the Contractor's expense.

If, when ordered by the Engineer, the Contractor fails to correct or remove unacceptable Work or unauthorized work, the Engineer may have the correction, removal or removal and replacement, done by others and deduct the entire cost from monies due or to become due the Contractor under the Contract.

00150.90 Final Inspection

A. On-site Construction Work - The Engineer will inspect the Project at a time close to the completion of On-Site Work for Contractor's compliance with the Contract Documents.

When all On-Site Work on the Project is completed, including but not limited to, Change Order Work and Extra Work, the Engineer will issue Second Notification as specified in 00180.50.G including notification of required corrective work (punch list) to be completed prior to Engineer's issuance of Third Notification (Final Completion).

Within 15 Calendar Days after the Engineer receives the Contractor's written notification that all punch list items, final trimming and cleanup according to 00140.90 have been completed, the Engineer will inspect the Project and notify the Contractor that all Work is complete, or within 15 Calendar Days of inspection will give the Contractor written instruction regarding incomplete or unsatisfactory Work.

B. All Contract Work - The Engineer will issue the Third Notification when the Contractor has satisfactorily accomplished all of the following:

- The Contractor has completed all On-Site Work required under the Contract, including the punch list items from 00150.90.A above;
- The Contractor has removed all Equipment; and
- The Contractor has submitted all required certifications, bills, forms, warranties and other documents.

- The Contractor has submitted complete and acceptable “As-Built” drawings as specified in 00140.95.

00150.91 Post-Construction Review

The Contractor or the Engineer may request a Post-Construction Review meeting, to be held at a time prior to issuance of Third Notification but not earlier than 15 Days following the date of Second Notification. The meeting may be held if agreed to by both parties. The party making the request will conduct the meeting, and will announce the time and place of the meeting at least 15 Days prior to the meeting date. The purpose of this meeting is to examine the Project for possible process improvements that may benefit future projects.

00150.95 Final Acceptance

After the Engineer completes Final Inspection of all Work including all corrective work identified by the Agency during the Correction Period, the Agency will acknowledge Final Acceptance. The Agency will notify the Contractor in writing of the date of Final Acceptance within 7 Calendar Days after Final Acceptance, or as soon thereafter as is practicable.

00150.96 Maintenance Warranties and Guarantees

Prior to Second Notification, the Contractor shall transfer to the Agency all unexpired manufacturers’, suppliers’ and installers’ warranties and guarantees for Materials and Equipment installed on the Project. Such warranties and guarantees shall recite that they are enforceable by the Agency.

00150.97 Responsibility for Materials and Workmanship

- A. The Contractor shall perform the Work according to the terms, conditions, and requirements of the Contract.
- B. Until the Agency’s Final Acceptance of the Work, the Contractor shall be responsible for:
 - Correcting or repairing any defects in, or damage to, the Work which results from the use of improper or defective materials or workmanship; or
 - Replacing, in its entirety, the Work affected by the use of improper or defective materials or workmanship to the extent provided by law; and
 - Correcting or repairing any Work, Materials, Structures, Existing Surfacings, Pavement, Utilities, or sites, including without limitation Wetlands, damaged or disturbed in that correction, repair, or replacement. (See 00170.80 to 00170.85).

Section 00160 - Source of Materials

00160.00 Definitions

The following definitions apply to Section 00160:

- A. Prospective Source** - Agency-furnished Materials source, use of which by the Contractor is optional. The Agency makes no guarantee or representation, by implication or otherwise, of the land use status, quantity, quality, or acceptability of Materials available from it, except as may be stated in the Special Provisions.
- B. Mandatory Source** - Agency-furnished Materials source, use of which by the Contractor is required.

00160.01 Notification of Source of Supply and Materials

- A. All Materials** - The Contractor shall notify the Engineer in writing of all proposed Materials sources of supply, including, without limitation, any steel or other fabricators within the following time frames:
- At least 15 Calendar Days before using or fabricating Materials, if source is within the State; or
 - At least 45 Calendar Days before using or fabricating Materials, if source is outside the State
- B. Prospective Source Materials** - When given an option to use Prospective Sources of Materials to be incorporated into the Work, the Contractor shall notify the Engineer in writing of the option selected within 15 Calendar Days from date of Notice to Proceed. Otherwise, such Materials sources may become unavailable.
- C. Approval Required** - Before allowing production or delivery of Materials to begin from any source, the Contractor must obtain the Engineer's approval. Approval to use any source does not imply that Materials from that source will be accepted. If approved sources do not provide Materials that meet Specifications, the Materials will be rejected. The Contractor will then be responsible for locating other sources and obtaining the Engineer's approval.
- D. Terms Required** - The Contractor shall comply with 00170.07.

00160.05 Qualified Products List (QPL)

The QPL is a listing of manufactured products available on the market (shelf items) that ODOT has evaluated and found suitable for a specified use in construction. The QPL is available from ODOT's Construction Section website at:

www.oregon.gov/ODOT/construction/pages/qualified-products.aspx

The current version of the QPL at the time of Bid Closing is the version in effect for the Project. The Engineer may approve for use a conditionally qualified product, or a product qualified for inclusion in a later edition of the QPL, if the Engineer finds the product acceptable for use on the Project.

Use of listed products shall be restricted to the category of use for which they are listed. The Contractor shall install all products as recommended by the manufacturer. The Contractor shall replace qualified products not conforming to Specifications or not properly handled or installed at the Contractor's expense.

00160.10 Ordering, Producing, and Furnishing Materials

The Contractor shall not place orders for or produce full quantities of Materials anticipated to be required to complete the Work until the Work has advanced to a stage that allows the quantities to be determined with reasonable accuracy.

A. Contractor's Duties - In purchasing, producing, or delivering Materials, the Contractor shall take into account the following:

- Kind of work involved;
- Amount of work involved;
- Time required to obtain Materials; and
- Other relevant factors.

B. Quantity of Materials - Materials quantities shown on the Plans, or indicated by quantities and Pay Items, are subject to change or elimination. The Contractor is responsible for payment for excess Materials delivered to the Project Site or storage sites. Unless otherwise specified in the Contract, the Agency will not be responsible for:

- Materials the Contractor may deliver or produce in excess of Contract requirements;
- Extra expense the Contractor may incur because Materials were not ordered or produced earlier; or
- The Contractor's expenses related to Materials ordered by the Contractor that are not subsequently approved for use.

00160.20 Preferences for Materials

A. Buy America - If federal highway funds are involved on the Project, the Contractor shall limit the quantity of foreign Materials incorporated into the Work as follows. Section 635.410 of Title 23, Code of Federal Regulations, and the Intermodal Surface Transportation Efficiency Act require that all iron or steel manufacturing processes, including, without limitation, the casting of ingots, for iron or steel Materials permanently incorporated into the Project shall occur in the United States, unless the cost of foreign-origin iron or steel Materials does not exceed one-tenth of one percent (0.1%) of the Contract Amount or \$2,500, whichever is greater. The Contractor shall not incorporate foreign-origin iron or steel Materials in excess of this amount into the Project. All foreign-origin iron or steel Materials incorporated in the Project in excess of the amount indicated above shall be removed and replaced with domestic iron or steel Materials at the Contractor's expense. For purposes of this Specification, the cost of foreign-origin iron or steel Materials shall be the value of the iron or steel products as of the date they are delivered to the Project Site.

Manufacturing processes include without limitation the application of coatings to finished iron or steel products or components. Coatings include epoxy coating, galvanizing, painting, and any other coating that protects or enhances the value of the steel or iron product or component.

The Contractor shall provide the Engineer with a Certificate of Materials Origin, on a form furnished by the Engineer, before incorporating any iron or steel products into the Project. Unless a Certificate of Materials Origin has been provided to the Engineer, the Materials shall be considered of foreign origin.

The Contractor shall retain manufacturers' certificates verifying the origin of all domestic iron or steel Materials for 3 years after the date of final payment for the Project, and shall furnish copies to the Engineer upon request.

B. Buy Oregon - According to ORS 279A.120, the Contractor shall give preference to goods or services produced in Oregon if price, fitness, availability, and quality are equal. This provision does not apply to Contracts financed wholly or in part by federal funds.

C. Recycled Materials - According to ORS 279A.010, ORS 279A.125, ORS 279A.145, ORS 279A.150, and ORS 279A.155, and subject to the approval of the Engineer, the Contractor shall use recycled products to the maximum extent economically feasible.

00160.30 Agency-Furnished Materials

Unless otherwise specified in the Special Provisions, Materials listed as Agency-furnished will be available to the Contractor free of charge.

The Contractor shall be responsible for all Materials furnished by the Agency and shall pay all demurrage and storage charges. The Contractor shall replace at its expense Agency-furnished Materials lost or damaged due to any cause.

The locations at which Agency-furnished Materials are available will be specified in the Special Provisions. If the locations are not listed in the Special Provisions, the Agency-furnished Materials will be furnished to the Contractor at the Project Site. In either case, all costs of handling, hauling, unloading, and placing Agency-furnished Material shall be considered included in the price paid for the Pay Item involving such Material.

All Agency-furnished Materials not incorporated into the Work remains the property of the Agency. The Contractor shall deliver such Materials as directed by the Engineer.

00160.50 Agency-Controlled Land; Limitations and Requirements

A. General - The Contractor shall have no property rights in, or right of occupancy on, Agency-Controlled Land. Nor shall the Contractor have the right to sell, use, remove, or otherwise dispose of any material from Agency-Controlled Land, areas, or property, except as specified in the Special Provisions or by the written authorization of the Engineer.

Unless authorized in the Contract, the Contractor shall not disturb any material within Rights-of-Way without written authorization from the Engineer.

Unless otherwise specified in the Contract, the ownership of all materials originating on Agency-Controlled Lands will at all times vest in, and remain within the control of, the Agency.

B. Waste, Excess, and By-Product Materials - All waste, excess, and by-product materials, collectively referred to in this Subsection as "By-Products", from the manufacture or production of Materials from Agency-Controlled Lands shall remain Agency property. Unless otherwise ordered by the Engineer in writing, By-Products shall be placed as required in the Special Provisions:

- In stockpiles at designated locations;
- At locations and in shapes that are readily accessible; and
- In such a manner as to avoid fouling areas containing useable materials, or interfering with future plant setups to use materials from the property.

The Agency will not compensate the Contractor for handling and stockpiling By-Products according to the Special Provisions requirements. If by written order the Engineer directs the Contractor to stockpile or place designated By-Products at alternate sites, the By-Products designated shall be loaded, hauled, and placed as directed, and this work will be paid for according to 00195.20.

00160.60 Contractor-Furnished Materials and Sources

A. General - The Contractor shall furnish, at its own expense, all products and Materials required for the Project from sources of its own choosing, unless such sources have been specified in the Special

Provisions or Plans as Prospective or Mandatory Sources.

B. Acquisition of Sources - The Contractor shall acquire, at its own expense, the rights of access to, and the use of, all sources the Contractor chooses which are not Agency-controlled and made available by the Agency to the Contractor.

C. Additional Requirements - Except for continuously-operated commercial sources, Work shall not begin, nor will any Materials be accepted by the Engineer, until the Contractor has:

- Given to the Engineer a copy of permits from, or proof that permits are not required from:
 - The Department of Geology and Mineral Industries, as required under ORS 517.790;
 - The Department of State Lands, as required under ORS 196.815 (when removing material from the bed or banks of any waters or from any Wetland); and
 - Local governmental authorities having jurisdiction over land use at the source location.
- Furnished to the Engineer written approval of the property owner, if other than the Contractor, for the Contractor's proposed plans of operation in, and reclamation of, the source. The Contractor shall include in the document containing the property owner's written approval a summary of the requirements of the permits described above, which shall be subject to the Engineer's approval.

00160.70 Requirements for Plant Operations

Before operating mixing plants, Rock crushers, or other Equipment, the Contractor shall provide the Engineer copies of all applicable discharge permits for noise, air contaminants, and water pollutants from DEQ or applicable local jurisdictions, or a letter from DEQ or the local jurisdiction stating that no permits are required for the use of the Equipment and sites.

00160.80 Requirements for Sources of Borrow and Aggregate

The Contractor shall conduct operations according to all applicable federal, State, and local laws (including, without limitation, ORS 517 and OAR 632-030) when developing, using, and reclaiming all sources of Borrow material and Aggregate. The Contractor shall provide erosion control at Borrow sources that are not within the Project Site. The Contractor shall not operate in Wetlands except as allowed by permit. The Contractor shall comply with all requirements for pollution and sediment control, including, without limitation, the National Pollutant Discharge Elimination System where applicable.

Except for continuously-operated commercial sources, the Contractor shall also conform to the following:

- A. If a natural growth of trees or shrubs is present, preserve a border of such to conceal land scars.
- B. Excavate Borrow sources and Aggregate sources, except for those in streams and rivers, to provide:
 - Reasonably uniform depths and widths;
 - Natural drainage so no water stands or collects in excavated areas, when practicable;
 - Slopes trimmed to blend with the adjacent terrain upon completion of operations;
 - Slopes covered with native Soil, or acceptable plant rejects to support plant growth, if required by Specifications, Plans, or permits; and
 - A vegetative cover that blends with the adjacent natural growth.
- C. Excavate in quarries so that:
 1. Faces will not be steeper than vertical (no overhang);
 2. Vertical faces conform to Oregon OSHA standards, Division 3, and as shown on an approved development plan;

3. Floors or benches are excavated to a uniform Slope free of depressions and will drain and not interfere with the downland owner's property; and
 4. Upon completion, the quarry is left appearing neat and compatible with surrounding terrain.
- D. Obliterate haul roads specifically built for access to sources, and restore the areas disturbed by these roads as nearly as practicable to the conditions that existed before the roads were built, unless otherwise directed by the landowner or regulatory body.

Section 00165 - Quality of Materials

00165.00 General

The Contractor shall incorporate into the Work only Materials conforming to the Specifications and approved by the Engineer. The Contractor shall incorporate into the Work only manufactured products made of new materials unless otherwise specified in the Contract. The Agency may require additional testing or retesting to determine whether the Materials or manufactured products meet Specifications.

Materials or manufactured products not meeting the Specifications at the time they are to be used are unacceptable and must be removed immediately from the Project Site, unless otherwise directed by the Engineer.

00165.01 Rejected Materials

The Engineer may reject any Materials that appear to be defective (See 00150.25) or that contain asbestos. The Contractor shall not incorporate any rejected Materials into the Work. Rejected Materials whose defects have been corrected may not be incorporated into the Work until the Engineer has approved their use. The Engineer may order the removal and replacement by the Contractor, at Contractor's expense, of any defective Materials. (See also 00150.20)

00165.03 Testing by Agency

When testing Materials, the Agency will conduct the tests in laboratories designated by the Engineer, even though certain AASHTO, ASTM, and other Materials specifications may require testing at the place of manufacture. Results of the Agency's tests will be made available to the Contractor.

00165.04 Costs of Testing

When the Contract requires that the Agency performs the testing, the testing will be at the Agency's expense.

Unless otherwise provided in the Contract, all testing required to be performed by the Contractor will be at the Contractor's expense.

00165.10 Materials Acceptance Guides

Unless otherwise specified elsewhere in the Contract, Materials will be accepted according to the following guides:

- A. Field-Tested Materials** - Field-tested Materials will be accepted according to the ODOT Manual of Field Test Procedures (MFTP) unless otherwise specified in the Special Provisions. The MFTP is published once per year and is available from the ODOT Construction Section, 800 Airport Road SE; Salem, OR 97301-4798; phone 503-986-3000. The MFTP is also available on the ODOT Construction Section web site.
- B. Nonfield-Tested Materials** - Nonfield-tested Materials will be accepted according to the ODOT Nonfield Tested Materials Acceptance Guide (NTMAG), unless otherwise specified in the Special Provisions. The NTMAG is available on the ODOT Construction Section web site.

00165.20 Materials Specifications and Test Method References

References to Materials specifications and test methods of ODOT, WAQTC, AASHTO, ASTM, other governmental agencies, or other recognized organizations mean those officially adopted and in current use by the Agency or organization on the first date of Advertisement for Bids.

If there are conflicting references, or if no reference is made to Materials specifications or test method, Materials must meet the Materials specifications or test methods required by the first applicable of the following agencies and organizations:

- A. Field-Tested Materials:
 1. Special Provisions;
 2. Standard Specifications; and
 3. MFTP.

- B. Nonfield-Tested Materials:
 1. Contract Change Orders;
 2. Special Provisions; and
 3. Standard Specifications.

- C. Material test methods:
 1. ODOT;
 2. WAQTC;
 3. AASHTO;
 4. ASTM;
 5. Other recognized national organizations, such as ANSI, AWPA, IMSA, and UL; and
 6. Industry standards in the location where the Work is being performed.

If there are conflicting references in the Contract to required sampling and testing frequencies, the Contractor shall sample and test the Materials according to the first applicable of the following:

- A. Special Provisions;
- B. Standard Specification; and
- C. MFTP.

00165.30 Field-Tested Materials

- A. Acceptance of Field-Tested Materials** - The Contractor's test results for field-tested Materials may be verified by the Agency. Materials will be analyzed as determined by the Engineer for acceptance before the Engineer will accept them for incorporation into the Work. Incorporated Materials that do not meet Specifications will be evaluated according to 00165.01 and 00150.25.

If the Agency's verification testing reveals that the Contractor's data is incorrect, the Agency may require additional testing to determine whether the Materials meet Specifications. The Contractor shall perform additional quality control testing or provide split samples to the Agency for additional testing as directed. If the Materials do not meet Specifications, the Contractor shall reimburse the Agency for the cost of the additional testing, which may be deducted from monies due or to become due the Contractor under the Contract. Incorporated Materials that do not meet Specifications will be evaluated according to 00165.01 and 00150.25. If the Materials meet Specifications, the Agency will pay the cost for the additional testing.

00165.35 Nonfield-Tested Materials

Materials will be subject to acceptance testing if the Engineer so elects. The Engineer may reject damaged or non-Specification Materials regardless of the Materials Test Results and Quality Compliance Certificates furnished.

- A. Test Results Certificate** - The Certificate shall:

- Be from the manufacturer verifying that the Material furnished has been sampled and tested and the test results meet the Specifications.
- Include, or be accompanied by, a copy of the specified test results (ODOT, AASHTO, ASTM, UL or other).
- Identify the independent testing agency and the representative responsible for the test results.

- Permit positive determination that Material delivered to the Project is the same Material covered by the test results.
- Be delivered to the Engineer with the shipment of the material.

B. Quality Compliance Certificate - The Certificate from the manufacturer shall:

- Verify that the Material meets the Specifications, and identify by number the specified test methods used, (ODOT, AASHTO, ASTM, UL, or other)
- Permit positive determination that Material delivered to the Project is the same Material covered by the certificate,
- Be delivered to the Engineer with the shipment of the Material, or be an identification plate or mark, decal, sticker, label, or tag attached to the container or Material,

C. Equipment List and Drawings - These consist of lists of proposed Equipment and Materials, such as:

- Shop drawings
- Material lists
- Equipment lists
- Catalog description sheets
- Manufacturer's brochures

Submit these lists to the Engineer for review of conformance with the Specifications.

D. Certificate of Origin of Steel Materials - When specified, complete this document (ODOT Form 734-2126) as required by 00160.20 for Federal-aid projects.

00165.50 Acceptance Sampling and Testing

The Contractor shall sample and test Materials for acceptance, as required by the Contract. Materials will be analyzed as determined by the Engineer for acceptance before the Engineer will accept them for incorporation into the Work. When the Engineer determines the Materials or Work does not conform to the Specifications the Engineer may accept the Materials or Work with pay adjustments or reject the Materials or Work per 00150.25.

00165.70 Use of Materials without Engineer's Acceptance

A. General - The Contractor shall not incorporate Materials into the Project prior to acceptance by the Engineer. The Engineer may waive this requirement temporarily if Materials are necessary for immediate traffic safety.

B. Materials Incorporated for Immediate Traffic Safety - If Materials are incorporated into the Project for immediate traffic safety before acceptance by the Engineer, no payment will be made for the value of the Materials, or the costs of incorporating them, until Materials are accepted by the Engineer, or the Materials are otherwise found through testing to comply with Specifications.

00165.75 Storage and Handling of Materials

The Contractor shall store and handle Materials so as to preserve their quality and fitness for incorporation into the Work. The Contractor shall restore all storage sites to their original condition according to 00140.90, or to comply with any applicable permits, orders, or agreements, at the Contractor's expense.

Stored Materials:

- Shall be readily accessible for inspection;
- May be stored on approved parts of the Right-of-Way; and
- May be stored on private property if written permission of the owner or lessor is obtained.

00165.80 Measurement

No separate measurement will be made of Work performed under this Section.

00165.90 Incidental Basis

No separate or additional payment will be made for sampling, testing, certification, or other associated Work performed under this Section, whether performed by the Contractor, manufacturer, producer or supplier. No payment will be made for providing quality control personnel.

Section 00170 - Legal Relations and Responsibilities

00170.00 General

The Contractor shall comply with all laws, ordinances, codes, regulations and rules, (collectively referred to as “Laws” in this Section) that relate to the Work or to those engaged in the Work. Where the provisions of the Contract are inconsistent or in conflict, the Contractor shall comply with the more stringent standard.

The Contractor shall indemnify, defend, and hold harmless the Agency and its representatives from liability arising from or related to the violation of Laws by those engaged in any phase of the Work. This provision does not apply to Work performed by Agency employees.

In any litigation, the entire text of any order or permit issued by a governmental or regulatory authority, as well as any documents referenced or incorporated therein by reference, shall be admissible for the purpose of Contract interpretation.

The Contract shall not be construed against either party regardless of which party drafted it. Other than as modified by the Contract, the applicable rules of contract construction and evidence shall apply. This Contract shall be governed by and construed according to the laws of the State of Oregon without regard to principles of conflict of laws.

Any dispute between the Agency and the Contractor that arises from or relates to this Contract and that is not resolved under the provisions of Section 00199 shall be brought and conducted solely and exclusively within the Circuit Court for the State of Oregon in the county where the Agency’s main office is located; provided, however, if a dispute must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this Subsection be construed as a waiver by the State of Oregon on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States, or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR BY EXECUTION OF THE CONTRACT HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION.

00170.01 Other Agencies Affecting Agency Contracts

Representatives of regulatory bodies or units of government whose Laws may apply to the Work shall have access to the Work according to 00150.20.D. These may include but are not limited to those in the following A, B, C, and D.

A. Federal Agencies:

- Agriculture, Department of
 - Forest Service
 - Natural Resource Conservation Service
- Army, Department of the
 - Corps of Engineers
- Commerce, Department of
 - National Marine Fisheries Service
- Defense, Department of
- Energy, Department of
- Environmental Protection Agency (EPA)
- Federal Energy Regulatory Commission
- Geology Survey
- Health and Human Services, Department of
- Homeland Security, Department of
 - U.S. Coast Guard (USCG)

Housing and Urban Development, Department of
 Interior, Department of
 Heritage, Conservation, and Recreation Service
 Bureau of Indian Affairs
 Bureau of Land Management
 Bureau of Mines
 Bureau of Reclamation
 Geological Survey
 Minerals Management Service
 Office of Surface Mining, Reclamation, and Enforcement
 Minerals Management Service
 National Oceanic and Atmospheric Administration
 Solar Energy and Energy Conservation Bank
 U.S. Fish and Wildlife Service
 Labor, Department of
 Mine Safety and Health Administration
 Occupational Safety and Health Administration (OSHA)
 Transportation, Department of
 Federal Highway Administration
 Water Resources Council

B. State of Oregon Agencies:

Administrative Services, Department of
 Agriculture, Department of
 Natural Resources Division
 Soil and Water Conservation District
 Columbia River Gorge Commission
 Consumer and Business Services, Department of
 Insurance Division
 Oregon Occupational Safety and Health Division (OR-OSHA)
 Energy, Office of
 Environmental Quality, Department of (DEQ)
 Fish and Wildlife, Department of
 Forestry, Department of
 Geology and Mineral Industries, Department of
 Human Resources, Department of
 Labor and Industries, Bureau of
 Land Conservation and Development Department
 Parks and Recreation, Department of
 State Lands, Department of
 Water Resources Department

C. Local Agencies:

City Councils
 County Courts
 County Commissioners, Boards of
 Design Commissions
 Historical Preservation Commissions
 Lane Regional Air Pollution Authority (LRAPA)
 Planning Commissions
 Port Districts

Special Districts

D. Oregon Federally Recognized Tribal Governments:

Burns Paiute Tribe
 Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians
 Confederated Tribes of Grand Ronde
 Confederated Tribes of Siletz
 Confederated Tribes of Umatilla Indian Reservation
 Confederated Tribes of Warm Springs
 Coquille Tribe
 Cow Creek Band of Umpqua Indians
 Klamath Tribe

00170.02 Permits, Licenses, and Taxes

As required to accomplish the Work, the Contractor shall do the following:

- Obtain all necessary permits and licenses, except for those noted in 00170.03;
- Pay all applicable charges, fees and taxes, except for those noted in 00170.03;
- Give all notices required by applicable Laws, or under the terms of the Contract;
- Comply with ORS 274.530 relating to lease of stream beds by Oregon Division of State Lands;
- License, in the State of Oregon, all vehicles subject to licensing;
- Comply with ORS 477.625 and ORS 527.670 relating to clearing and fire hazards on forest lands; and
- Comply with all orders and permits issued by a governmental authority, whether local, State, or federal.

00170.03 Furnishing Rights-of-Way, Easements and Permits

Unless required to be obtained in the name of the Contractor, the Agency will obtain and pay for the following when they are required by the applicable Laws or by Plans or Specifications:

- All necessary Rights-of-Way, Easements and Rights-of-Entry;
- Permits required for crossing or encroaching upon navigable streams;
- Permits required for removing materials from or depositing materials in waterways;
- Permits required for operating in Agency-controlled source of Materials or disposal area;
- System development fees charged by local units of government;
- Building construction permits, not including specialty work such as heating, ventilation, air conditioning, or electrical;
- Cost of referencing and replacing endangered survey monuments; and
- Environmental permits, including erosion control permits.

If, after the Bid Closing date, the Agency obtains any Permits, Rights-of-Way, or Easements which require changes to the Work and thereby causes an increase or decrease in the cost of, or the time required for the performance of the Work, the Contractor shall submit information sufficient for the Engineer to determine the extent of the effects on the cost and/or schedule. If the Engineer agrees the cost and/or schedule will be affected by such changes, such effects will be handled in accordance with the General Conditions. The Engineer will provide the Contractor with a copy of any such Permits, Rights-of-Way or Easements.

00170.04 Patents, Copyrights, and Trademarks

Prior to use of designs, devices, materials, or processes protected by patent, copyright, or trademark, the Contractor shall obtain from the Entity entitled to enforce the patent, copyright, or trademark all necessary evidence of legal right to use such design, device, material or process.

The Contractor shall indemnify, defend and hold harmless the Agency and all third parties and political subdivisions having a possessory or ownership interest or regulatory authority over the Project or Project Site from claims of patent, copyright or trademark infringement, and from costs, expenses and damages the Contractor or Agency may be obligated to pay as a result of such infringement during or after completing the Work.

00170.05 Assignment of Antitrust Rights

The Contractor irrevocably assigns to the Agency any claim for relief or cause of action the Contractor acquires during the term of the Contract, or which may accrue thereafter, by reason of any violation of:

- Title 15 (Commerce and Trade), United States Code;
- ORS 646.725; or
- ORS 646.730.

In connection with this assignment, it is an express obligation of the Contractor to take no action that would in any way impair or diminish the value of the rights assigned to the Agency according to the provisions of this Subsection. Further, it is the express obligation of the Contractor to take all action necessary to preserve the rights assigned. It is an express obligation of the Contractor to advise the Agency's legal counsel:

- In advance, of its intention to commence any action involving such claims for relief or causes of action;
- Immediately upon becoming aware of the fact that an action involving such claims for relief or causes of action has been commenced by some other person or persons;
- The date on which it notified the obligor(s) of any such claims for relief or causes of action of the fact of the Contractor's assignment to the Agency according to the provisions of this Subsection; and
- Immediately upon the discovery of any such antitrust claim for relief or cause of action.

In the event any payment is made to the Contractor under any such claims for relief, the Contractor shall promptly pay the full sum over to the Agency. In the event the Contractor fails to make such payment, the Agency may deduct the amount from monies due or to become due the Contractor under the Contract.

00170.07 Record Requirements

For purposes of this Subsection, the term "Contractor" includes the Contractor, all Subcontractors, Material Suppliers, and providers of rented operated Equipment (except non-DBE truck drivers), at all tiers, for all subcontracts with first-tier Subcontractors, all subcontracts between the first-tier Subcontractors and their subcontractors and any other lower tier subcontracts, and "Related Entities" as that term is defined in OAR 734-010-0400. The Material Suppliers included in this definition are those for Aggregates, asphalt cement concrete, portland cement concrete and the supply and fabrication of structural steel items or Material Suppliers that provide quotes.

A. Records Required - The Contractor shall maintain all records, whether created before or after execution of the Contract, or during Contract performance, or after Contract completion, to clearly document:

- The Contractor's performance of the Contract or a subcontract;
- The Contractor's ability to continue performance of the Contract or a subcontract; and
- All claims arising from or relating to performance under the Contract or a subcontract.

These records shall include all records, including fiscal records, regardless of when created for the Contractor's business. The records for the Contractor's business include without limitation:

- Bidding estimates and records, worksheets, tabulations or similar documents.

- Job cost detail reports, including monthly totals.
- Payroll records (including, without limitation, the ledger or register, and tax forms) and all documents which establish the periods, individuals involved, the hours for the individuals, and the rates for the individuals.
- Records that identify the Equipment used by the Contractor and Subcontractors in the performance of the Contract or subcontracts, including, without limitation, Equipment lists, rental contracts and any records used in setting rental rates.
- Invoices from vendors, rental agencies, and Subcontractors.
- Material quotes, invoices, purchase orders and requisitions.
- Contracts with Subcontractors and contracts with Material Suppliers, Suppliers and providers of rented equipment.
- Contracts or documents of other arrangements with any Related Entity as defined in OAR 734-010-0040.
- General ledger.
- Trial Balance.
- Financial statements (including, without limitation, the balance sheet, income statement, statement of cash flows, and financial statement notes).
- Income tax returns.
- All worksheets used to prepare bids or claims, or to establish the cost components for the Pay Items, including, without limitation, the labor, benefits and insurance, Materials, Equipment, and Subcontractors.

The following are examples, but not an exhaustive list, of records that would be included, if generated by the Contractor. If the Contractor generates such records, or equivalent records, they are included among the records subject to 00170.07.

- Daily time sheets and supervisor's daily reports.
- Collective bargaining agreements.
- Earnings records.
- Journal entries and supporting schedules.
- Insurance, welfare, and benefits records.
- Material cost distribution worksheet.
- Subcontractors' and lower tier subcontractors' payment certificates.
- Payroll and vendor's cancelled checks.
- Cash disbursements journal.
- All documents related to each and every claim together with all documents that support the amount of damages as to each claim.
- Additional financial statements (including, without limitation, the balance sheet, income statement, statement of cash flows, and financial notes) preceding the execution of the Contract and following final payment of the Contract.
- Depreciation records on all business Equipment maintained by the business involved, its accountant, or other Entity. (If a source other than depreciation records is used to develop cost for the Contractor's internal purposes in establishing the actual cost of owning and operating Equipment, all such other source documents.)

The Contractor shall maintain all fiscal records in material compliance with generally accepted accounting principles, or other accounting principles that are accepted accounting principles and practices for the subject industry and adequate for the nature of the Contractor's business, and in such a manner that providing a complete copy is neither unreasonably time consuming nor unreasonably burdensome for the

Contractor or the Agency. Failure to maintain the records in this manner shall not be an excuse for not providing the records.

The Contractor shall include in its subcontracts, purchase orders, and all other written agreements, a provision requiring all Subcontractors, Material Suppliers and providers of rented operated Equipment (except non-DBE truck drivers), at all tiers, to comply with 00170.07. The Contractor shall also require all Subcontractors, Material Suppliers, and providers of rented operated Equipment (except non-DBE truck drivers), at all tiers, and Related Entities to include in their contracts, purchase orders, and all other written agreements, a provision requiring all lower tier subcontractors, Material Suppliers and providers of rented operated Equipment (except non-DBE truck drivers) to comply with 00170.07. The Material Suppliers to which this applies are those for Aggregates, asphalt cement concrete, portland cement concrete and the supply and fabrication of structural steel items or Material Suppliers that provide Material quotes and Related Entities as defined in OAR 734-010-0400.

B. Access to Records - The Contractor shall provide the Engineer access to or a copy of all Contractor records upon request. A Project Manager's authority to request or access records is subject to OAR 734-010-0400(9). During the record retention period the Engineer, employees of the Agency, representatives of the Agency, or representatives of regulatory bodies or units of government may:

1. Inspect, examine and copy or be provided a copy of all Contractor records;
2. Audit the records, a Contract or the performance of a Contract;
3. Inspect, examine and audit the records when, in the Agency's sole discretion, the records may be helpful in the resolution of any claim, litigation, administrative proceeding or controversy arising out of or related to a Contract.

Reasons for access to audit, inspect, examine and copy records include without limitation, general auditing, reviewing claims, checking for collusive bidding, reviewing or checking payment of required wages, performance and contract compliance, workplace safety compliance, evaluating Related Entities, environmental compliance, and qualifications for performance of the Contract, including the ability to perform and the integrity of the Contractor.

Where such records are stored in a computer or in other digital media, the Engineer may request, and the Contractor shall provide, a copy of the data files and such other information or access to software to allow the Engineer review of the records.

Nothing in 00170.07 is intended to operate as a waiver of the confidentiality of any communications privileged under the Oregon Evidence Code. Nothing in 00170.07 limits the records or documents that can be obtained by legal process.

C. Record Retention Period - The Contractor shall maintain the records and keep the records accessible and available at reasonable times and places for at least 3 years from the date of final payment under the Contract, or until the conclusion of all audits, litigation, administrative proceedings, disputes and claims arising out of or related to the Contract, whichever date is later.

D. Public Records Requests - If records provided under this section contain any information that may be considered exempt from disclosure as a trade secret under either ORS 192.501(2) or ORS 646.461(4), or under other grounds specified in Oregon Public Records Law, ORS 192.410 through ORS 192.505, the Contractor shall clearly designate on or with the records the portions which the Contractor claims are exempt from disclosure, along with a justification and citation to the authority relied upon. Entire records or documents should not be designated as a trade secret or otherwise exempt from disclosure. Only specific information within a record or document should be so designated.

To the extent allowed by the Oregon Public Records Law or other applicable law related to the disclosure of public records, Agency will not disclose records or portions of records the Contractor has designated as trade secrets to a third party, who is not a representative of the Agency, to the extent the records are exempt from disclosure as trade secrets under the Oregon Public Records Law or other applicable law, except to the extent the Agency is ordered to disclose in accordance with the Oregon Public Records Law or by a court of competent jurisdiction. Application of the Oregon Public Records Law or other applicable law shall determine whether any record, document or information is actually exempt from disclosure.

In addition, in response to a public records request, the Agency will not produce or disclose records so identified as exempt by the Contractor to any person other than representatives of the Agency, and others with authorized access under 00170.07.B, without providing the Contractor a copy of the public records request, unless:

- The Contractor consents to such disclosure; or
- Agency is prohibited by applicable law or court order from providing a copy of the public records request to the Contractor.

00170.10 Required Payments by Contractors

The Contractor shall comply with ORS 279C.505 and ORS 279C.515 during the term of the Contract.

A. Prompt Payment by Contractor for Labor and Materials - As required by ORS 279C.505, the Contractor shall:

- Make payment promptly, as due, to all Entities supplying labor or Materials under the Contract;
- Pay all contributions or amounts due the Industrial Accident Fund, whether from the Contractor or a Subcontractor, incurred in the performance of the Contract;
- Not permit any lien or claim to be filed against the State or any political subdivision thereof, on account of any labor or Material furnished in performance of the Contract; and
- Pay to the Department of Revenue all sums withheld from employees according to ORS 316.167.

B. Prompt Payment by Contractor to First-Tier Subcontractor(s) - According to ORS 279C.580(3)(a), after the Contractor has determined and certified to the Agency that one or more of its Subcontractors has satisfactorily performed subcontracted Work, the Contractor may request payment from the Agency for the Work, and shall pay the Subcontractor(s) within 10 Calendar Days out of such amounts as the Agency has paid to the Contractor for the subcontracted Work.

C. Interest on Unpaid Amount - If the Contractor or a first-tier Subcontractor fails, neglects, or refuses to make payment to an Entity furnishing labor or Materials in connection with the Contract within 30 Days after the Contractor's receipt of payment, the Contractor or first-tier Subcontractor shall owe the Entity the amount due plus interest charges that begin at the end of the 10 day period within which payment is due under ORS 279C.580(3) and that end upon final payment, unless payment is subject to a good-faith dispute as defined in ORS 279C.580(5)(b). The rate of interest on the amount due shall be in accordance with ORS 279C.515(2). The amount of interest shall not be waived.

D. Agency's Payment of the Contractor's Prompt Payment Obligations - If the Contractor fails, neglects or refuses to make prompt payment of any invoice or other demand for payment for labor or services furnished to the Contractor or a Subcontractor by any Entity in connection with the Contract as such payment becomes due, the Agency may pay the Entity furnishing the labor or services and charge the amount of the payment against monies due or to become due the Contractor under the Contract. (The Agency has no obligation to pay these Entities, and Agency will not normally do so, but will refer them to the Contractor and the Contractor's Surety.)

The payment of a claim by the Agency in the manner authorized in this Subsection shall not relieve the Contractor or the Contractor's Surety from obligations with respect to any such claims.

E. Right to Complain to the Construction Contractors Board - If the Contractor or a Subcontractor fails, neglects, or refuses to make payment to an Entity furnishing labor or Materials in connection with the Contract, the Entity may file a complaint with the Construction Contractors Board, unless payment is subject to a good-faith dispute as defined in ORS 279C.580(5)(b).

F. Notice of Claim Against Bond - An Entity (which by definition includes a natural person) claiming not to have been paid in full for labor or Materials supplied for the prosecution of the Work may have a right of action on the Contractor's Payment Bond as provided in ORS 279C.600 and ORS 279C.625.

The Commissioner of the Bureau of Labor and Industries (BOLI) may have a right of action on the Contractor's and Subcontractors' public works bonds and Payment Bonds for workers who have not been paid in full, as provided in ORS 279C.600 and ORS 279C.605.

00170.20 Public Works Bond

If the original Contract Amount is \$100,000 or greater, then before starting Work, or if the Contract Amount is amended to a Contract Amount \$100,000 or greater, and unless otherwise exempt under ORS 279C.836(4), (7) – (9), the Contractor, shall file a public works bond with the Oregon Construction Contractors Board in the amount required by ORS 279C.836 [\$30,000 (1970)] before starting or continuing Work on the Project. Further, the Contractor shall then include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the Oregon Construction Contractors Board in the amount required by ORS 279C.836 [\$30,000 (1970)] before starting Work, or if the Contract Amount is amended to \$100,000 or above, before continuing Work on the Project. ORS 279C.830(3)(A,B). The Contractor shall verify Subcontractors have filed a public works bond before the Subcontractor begins Work.

00170.32 Protection of Navigable Waters

The Contractor shall comply with all applicable Laws, including, without limitation, the Federal River and Harbor Act of March 3, 1899 and its amendments.

The Contractor shall not interfere with waterway navigation or impair navigable depths or clearances, except as U.S. Coast Guard or Corps of Engineer permits allow.

00170.60 Safety, Health, and Sanitation Provisions

The Contractor shall comply with all Laws concerning safety, health, and sanitation standards. The Contractor shall not require workers to perform Work under conditions that are hazardous, dangerous, or unsanitary.

Workers exposed to traffic shall wear upper body garments or safety vests that are highly visible and meet the requirements of 00225.25.

Workers exposed to falling or flying objects or electrical shock shall wear hard hats.

Upon their presentation of proper credentials, the Contractor shall allow inspectors of the U.S. Occupational Safety and Health Administration (OSHA) and the Oregon Occupational Safety and Health Division (OR-OSHA) to inspect the Work and Project Site without delay and without an inspection warrant.

According to ORS 468A.715 and ORS 468A.720, the Contractor or a Subcontractor who performs Project Work involving asbestos abatement shall possess a valid DEQ asbestos abatement license.

00170.61 Industrial Accident Protection

A. Workers' Compensation - The Contractor shall provide workers' compensation coverage for on-the-job injuries as required by 00170.70.A.

00170.62 Labor Nondiscrimination

The Contractor shall comply with all Laws concerning equal employment opportunity, including, without limitation, those prohibiting discrimination because of race, religion, color, sex, disability, or national origin. It is a material term of this Contract that the Contractor certifies by entering into this Contract that the Contractor has a written policy and practice that meets the requirements described in Chapter 212, Oregon Laws 2017 (House Bill 3060) for preventing sexual harassment, sexual assault and discrimination against employees who are members of a protected class and that the Contractor shall maintain the policy and practice in force during the entire term of this contract.

00170.63 Payment for Medical Care

According to ORS 279C.530, the Contractor shall promptly, as due, make payment to any person, co-partnership, association or corporation furnishing medical, surgical and hospital care services or other needed care and attention, incident to sickness or injury, to the employees of the Contractor, of all sums that the Contractor agrees to pay for the services and all moneys and sums that the Contractor has collected or deducted from the wages of employees under any law, contract or agreement for the purpose of providing or paying for the services.

00170.65 Minimum Wage and Overtime Rates for Public Works Projects

A. General - The Contractor is responsible for investigating local labor conditions. The Agency does not imply that labor can be obtained at the minimum hourly wage rates specified in State or federal wage rate publications, and no increase in the Contract Amount will be made if wage rates paid are more than those listed.

B. State Prevailing Wage Requirements - The Contractor shall comply with the prevailing wage provisions of ORS 279C.800 through ORS 279C.870.

1. **Minimum Wage Rates** - The Bureau of Labor and Industries (BOLI) determines and publishes the existing State prevailing wage rates in the publication "Prevailing Wage Rates for Public Works Contracts in Oregon". The Contractor shall pay workers not less than the specified minimum hourly wage rate according to ORS 279C.838 and ORS 279C.840 and shall include this requirement in all subcontracts.

See the Project Wage Rates page included with the Contract Booklet for additional information about which wage rates apply to the Project and how to access the applicable wage rates.

2. **Payroll and Certified Statements** – As required in ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Engineer on the form prescribed by the Commissioner of BOLI in OAR 839-025-0010 certifying compliance with wage payment requirements and accurately setting out the Contractor's or subcontractor's weekly payroll records for each worker employed upon the Project.

The Contractor and Subcontractors shall preserve the certified statements for a period of 6 years from the date of completion of the Contract.

3. Additional Retainage:

- a. **Agency** - As required in ORS 279C.845(7) the Agency will retain 25% of any amount earned by the Contractor on the Project until the Contractor has filed the certified statements required in ORS 279C.845 and in FHWA Form 1273, if applicable. The Agency will pay to the Contractor

the amount retained within 14 Days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements.

b. Contractor - As required in ORS 279C.845 (8) the Contractor shall retain 25% of any amount earned by a first-tier Subcontractor on the Project until the first-tier Subcontractor has filed with the Agency the certified statements required in ORS 279C.845 and in FHWA Form 1273, if applicable. Before paying any amount retained, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement. Within 14 Days after the first-tier Subcontractor files the required certified statement, the Contractor shall pay the first-tier Subcontractor any amount retained.

4. Owner/Operator Data - For a project funded by the FHWA, the Contractor shall furnish data to the Engineer for each owner/operator providing trucking services. Furnish the data before the time the services are performed and include without limitation for each owner/operator:

- Drivers name;
- Copy of driver license;
- Vehicle identification number;
- Copy of vehicle registration;
- Motor vehicle license plate number;
- Motor Carrier Plate Number;
- Copy of ODOT Motor Carrier 1A Permit; and
- Name of owner/operator from the side of the truck.

C. State Overtime Requirements - As a condition of the Contract, the Contractor shall comply with the pertinent provisions of ORS 279.520 and 279C.540.

1. Maximum Hours of Labor and Overtime Pay - According to ORS 279C.540, no person shall be employed to perform Work under this Contract for more than 10 hours in any 1 Day, or 40 hours in any 1 week, except in cases of necessity, emergency, or where public policy absolutely requires it. In such instances, the Contractor shall pay the employee at least time and a half pay:

- For all overtime in excess of 8 hours a day or 40 hours in any 1 week when the work week is 5 consecutive days, Monday through Friday; or
- For all overtime in excess of 10 hours a day or 40 hours in any 1 week when the work week is 4 consecutive days, Monday through Friday; and
- For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

For additional information on requirements for overtime and establishing a work schedule see OAR 839-025-0050 and OAR 839-025-0034.

2. Notice of Hours of Labor - The Contractor shall give written notice to employees of the number of hours per day and days per week the employees may be required to work. Provide the notice either at the time of hire or before commencement of work on this Contract, or by posting a notice in a location frequented by employees.

3. Exception - The maximum hours of labor and overtime requirements under ORS 279C.540 will not apply to the Contractor's Work under this Contract if the Contractor is a party to a collective bargaining agreement in effect with any labor organization. For a collective bargaining agreement to be in effect it shall be enforceable within the geographic area of the project, and its terms shall extend to workers who are working on the project (see OAR 839-025-0054).

D. State Time Limitation on Claim for Overtime - According to ORS 279C.545, any worker employed by the Contractor is foreclosed from the right to collect any overtime provided in ORS 279C.540 unless a claim for payment is filed with the Contractor within 90 Days from the completion of the Contract, provided the Contractor posted and maintained a circular as specified in this provision. Accordingly, the Contractor shall:

- Cause a circular, clearly printed in boldfaced 12-point type containing a copy of ORS 279C.545, to be posted in a prominent place alongside the door of the timekeeper's office or in a similar place which is readily available and freely visible to any or all workers employed to perform Work; and
- Maintain such circular continuously posted from the inception to the completion of the Contract on which workers are or have been employed.

E. Additional Requirements When Federal Funds are Involved - When federal funds are involved, the following requirements shall apply in addition to the requirements of 00170.65.A through 00170.65.D. The Contractor shall include these provisions in all subcontracts as well as ensure that all Subcontractors include these provisions in their lower tier subcontracts.

1. **FHWA Requirements** - For Federal-aid projects, the Contractor shall comply with the provisions of FHWA Form 1273, "Required Contract Provisions Federal-aid Construction Contracts".
2. **Minimum Wage Rates** - The Contractor shall pay each worker in each trade or occupation employed to perform any work under the contract not less than the existing State (BOLI) prevailing wage rate or the applicable federal prevailing wage rate required under the Davis-Bacon Act (40 U.S.C. 3141 et seq.), whichever is higher. The Contractor shall include this provision in all subcontracts.

See the Project Wage Rates page included with the Contract Booklet for additional information about which wage rates apply to the Project and how to access the applicable wage rates.

The applicable Davis-Bacon and BOLI wage rates will be included in the Contract.

3. **Payroll and Certified Statements** - In addition to providing the payroll information and certified statements required under ORS 279C.845 (see 00170.65.B.2), the Contractor and every Subcontractor shall submit written certified statements that also meet the requirements in Section IV of FHWA Form 1273, except the Contractor and every Subcontractor shall preserve the certified statements for a period of 6 years from the date of completion of the Contract.
4. **Overtime** - With regard to overtime pay, the Contractor shall comply with the overtime provision affording the greatest compensation required under FHWA Form 1273 and ORS 279C.540.

00170.70 Insurance

A. Insurance Coverages - The Contractor shall obtain, at its expense, and keep in effect during the term of the Contract, the insurance coverages in accordance with the Public Improvement Contract in the Contract Booklet and comply with all insurance provisions thereof. The insurance coverages shall also be maintained throughout the Contractor's Correction Period as defined in 00170.85.B.

00170.71 Independent Contractor Status

The service or services to be rendered under this Contract are those of an independent contractor. The Contractor is not an officer, employee, or agent of the Agency as those terms are used in ORS 30.265.

00170.74 Employee Drug Testing Program

As required by ORS 279C.505(2), the Contractor shall have in place, and maintain during the period of the Contract, an employee drug-testing program. The Agency retains the right to audit and/or monitor the program. On request by the Engineer, the Contractor shall furnish a copy of the employee drug-testing program.

00170.75 Oregon Tax Laws

The Contractor shall comply with Oregon tax laws as required by ORS 305.385.

00170.76 Subcontractors Nondiscrimination

The Contractor shall comply with ORS 279A.110 as to nondiscrimination as to relations with Subcontractors.

00170.78 Conflict of Interest

The Contractor shall not give or offer any gift, loan, or other thing of value to any member of the Agency's governing body or employee of the Agency in connection with the award or performance of any Contract.

The Contractor shall not rent, lease, or purchase Materials, supplies, or Equipment, with or through any Agency employee or member of the Agency's governing body.

No ex-employee of the Agency who has worked for the Agency on any phase of the Project within the prior 2 years may be employed by the Contractor to perform Work on the Project.

00170.79 Third Party Beneficiary

There are no third-party beneficiaries of the Contract, unless federal transportation funding is involved then the State of Oregon, the Oregon Transportation Commission and the Oregon Department of Transportation and their respective officers and members and employees, are third-party beneficiaries of the Contract.

00170.80 Responsibility for Damage to Work

A. Responsibility for Damage in General - The Contractor shall perform Work, and furnish Materials and Equipment for incorporation into the Work, at the Contractor's own risk, until the entire Project has been completed and until Final Completion as determined by the Agency. The Contractor shall repair all damages to Work performed, Materials supplied, and Equipment incorporated into the Work, except as otherwise provided in this Section.

B. Repair of Damage to Work - Until Final Completion, the Contractor shall promptly rebuild, repair, restore, and make good damages to all portions of the permanent or temporary Work. The Contractor shall perform all repairs of damage to Work at no additional cost to the Agency, except for repairs necessitated by damage caused by:

- Acts of God or Nature, as defined in Section 00110; or
- Actions of governmental authorities.

C. Vandalism and Theft - Vandalism includes damage to or destruction of Work or portions of Work that remain on the Project Site resulting from vandalism, criminal mischief, arson, or other criminal or illegal behavior.

The Contractor shall provide reasonable protection of the Work from vandalism until Final Completion.

Theft includes the loss of Work or portions of Work that are lost or stolen or otherwise unaccounted for from the Project Site or from Materials or fabrication locations. The Contractor shall remain solely responsible for all losses caused by theft, including without limitation theft that occurs in conjunction with vandalism.

00170.82 Responsibility for Damage to Property and Facilities

A. In General - As used in this Subsection, the term “Contractor” shall include the Contractor’s agents, Subcontractors, and all workers performing Work under the Contract; and the term “damage” shall include without limitation soiling or staining surfaces by tracking or splashing mud, asphalt, and other materials, as well as damage of a more serious nature.

The Contractor shall be solely responsible for damages arising from:

- The Contractor’s operations;
- The Contractor’s negligence, gross negligence, or intentional wrongful acts; and
- The Contractor’s failure to comply with any Contract provision.

The Agency may withhold funds due the Contractor or the Contractor’s Surety until all lawsuits, actions, and claims for injuries or damages are resolved, and satisfactory evidence of resolution is furnished to the Agency.

B. Protection and Restoration of Agency Property and Facilities - The following requirements apply to Highways, Highway Structures and other improvements that are existing, under construction, or completed. The Contractor shall:

- Provide adequate protection to avoid damaging Agency property and facilities;
- Be responsible for damage to Agency property and facilities caused by or resulting from the Contractor’s operations; and
- Clean up and restore such damage by repair, rebuilding, replacement, or compensation, as determined by the Engineer.

C. Protection and Restoration of Non-Agency Property and Facilities - The Contractor shall determine the location of properties and facilities that could be damaged by the Contractor’s operations, and shall protect them from damage. The Contractor shall protect monuments and property marks until the Engineer has referenced their location and authorized their removal. The Contractor shall restore property or facilities damaged by its operations to the condition that existed before the damage, at no additional compensation.

The Contractor shall provide temporary facilities when needed, e.g., to maintain normal service or as directed by the Engineer, until the required repair, rebuilding, or replacement is accomplished.

The Contractor shall protect specific service signs, e.g., business logos, and tourist-oriented directional signs (TODS) from damage, whether the signs are to remain in place or be placed on temporary supports. The Contractor shall repair or replace damaged signs at no cost to the Agency. Liquidated damages will be assessed against the Contractor in the amount of \$200 per Day for each sign out of service for more than 5 Calendar Days because of the Contractor’s operations.

00170.85 Responsibility for Defective Work

The Contractor shall make good any defective Work, Materials or Equipment incorporated into the Work, according to the provisions of Section 00150.

A. Latent Defects - The Contractor shall remain liable for all latent defects resulting from causes other than fraud or gross mistakes that amount to fraud until the expiration of all applicable statutes of limitation and ultimate repose, the Performance Bond, Warranty Bond, or Correction Period, whichever expires last. The Contractor shall remain liable for all latent defects resulting from fraud or gross mistakes that amount

to fraud regardless of when those latent defects may be discovered, and regardless of whether such discovery occurs outside any applicable statutes of limitation or ultimate repose or any applicable Performance Bond, Warranty Bond, or Correction Period.

B. Correction Period for Agency Projects - The Contractor shall warrant all Work and workmanship, including Changed Work, Additional Work, Incidental Work, On-Site Work, and Extra Work, and Materials and Equipment incorporated in the Work, for one year from the date of Second Notification (Correction Period), except that manufacturers', installers' or suppliers' warranties and extended warranties according to 00170.85.C shall not be abridged. The Correction Period warranty described herein shall include extension of the Performance Bond for a period of one year from the date of Second Notification.

The Contractor shall be responsible for meeting the technical and performance Specifications required, making good the Work, and for all repairs of damage to the Work and other improvements, natural and artificial structures, systems, equipment, and vegetation caused by, or resulting in whole or in part from occurrences beginning during the warranty period and are the result of defects in Materials, Equipment, and workmanship. The Contractor shall be responsible for all costs associated with completing the repair of the defects and for associated Work including, but not limited to, permitting, mobilization, traffic control, erosion control, surface restoration, site cleanup and remediation caused by, or resulting in whole or in part from, defects in Materials, Equipment, or workmanship, and other Work determined by the Engineer to be necessary to complete the repair of the defects.

Within 10 Calendar Days of the Agency's written notice of defects, the Contractor, or the Contractor's Surety, shall vigorously and continuously correct and repair the defects and all related damage. If the Contractor or the Contractor's Surety fails to correct and repair the defects, the Agency may have the correction and repair done by others. The Contractor or Contractor's Surety shall promptly reimburse the Agency for all expenses incurred to correct and repair the defects.

In the event of an emergency, where delay could result in serious loss or damage, the Agency may make emergency corrections and repairs without written notice. The Contractor or Contractor's Surety shall promptly reimburse the Agency for all expenses incurred to correct and repair the defects.

Corrections, repairs, replacements or changes shall be warranted for an additional 1 year period beginning on the date of the Agency's acceptance of the corrections, repairs, replacements or changes.

Without limiting the general applicability of other survival clauses under the Contract, this warranty provision shall survive expiration or termination of the Contract.

C. Manufacturer, Supplier or Installer Warranties and Guarantees:

1. Manufacturer, Supplier or Installer Warranties - For those Specification Sections referencing 00170.85.C.1, the Contractor shall furnish Warranties from the Manufacturer, Supplier or Installer and signed by the respective authorized Representative.

The warranty period will be specified in the applicable Specification Section for which it applies.

The warranty period will begin on the date the Engineer issues Second Notification unless otherwise specified in the Contract.

Corrections, repairs, replacements or changes shall be warranted for an additional Warranty period beginning on the date of the Agency's acceptance of the corrections, repairs, replacements or changes.

When the Agency makes written notification to the Manufacturer, Supplier or Installer of failure of an item covered by this warranty, the warranty period will stop for the effected item or the portion of the effected item that failed, as applicable, until the required repairs or replacements are made and accepted. All repaired or replaced items shall meet current specifications, unless otherwise specified in the Contract, and will be warranted for the remaining warranty period.

Warranty work shall be performed when weather permits. If, in the opinion of the Engineer, temporary repairs are necessary, the temporary repairs will be made by the Agency or an independent contractor at the Manufacturer's, Supplier's or Installer's expense. The Manufacturer, Supplier or Installer shall replace all temporary repairs at no additional cost to the Agency.

The Manufacturer, Supplier or Installer shall provide all required traffic control during repair or replacement of failed items at no additional cost to the Agency.

2. **Trade Practice Guarantees** - For those Items installed on the Project that have customary trade practice guarantees, the Contractor shall furnish the guarantees to the Engineer at the completion of the Contract.

00170.89 Protection of Utility, Fire-control, and Railroad Property and Services; Repair; Roadway Restoration

- A. **Protection of Utility, Fire-Control, and Railroad Property and Services; Coordination** - The Contractor shall avoid damaging the properties of Utilities, Railroads, railways, and fire-control authorities during performance of the Work. The Contractor shall cooperate with and facilitate the relocation or repair of all Utilities and Utility services, as required under 00150.50, and of Railroad and fire-control property and railways.

The Contractor shall conduct no activities of any kind around fire hydrants until the local fire-control authority has approved provisions for continued service.

The Contractor shall immediately notify any Utility, Railroad, or fire-control authority whose facilities have been damaged.

If an Entity has a valid permit from the proper authority to construct, reconstruct, or repair Utility, Railroad, or fire-control service in the Roadway, the Contractor shall allow the permit holder to perform the work.

- B. **Restoration of Roadway after Repair Work** - The Contractor shall restore the Roadway to a condition at least equal to that which existed before the repair work addressed under this Subsection was performed, as directed by the Engineer. All restoration work required as a result of Contractor's failure to protect Utilities, Railroads, railways and fire-control facilities shall be at the Contractor's expense. Restoration which constitutes Extra Work will be paid as Extra Work.

00170.92 Fencing, Protecting Stock, and Safeguarding Excavations

The Contractor shall be responsible for loss, injury, or damage that results from its failure to restrain stock and persons.

- A. **At the Contractor's Expense** - The Contractor shall restrain stock to lands on which they are confined using temporary fences or other adequate means. The Contractor shall provide adequate temporary fences or other protection around excavations to prevent animals and unauthorized persons from entering.

The Contractor shall repair, at Contractor's expense and to the Engineer's satisfaction, fences damaged by the Contractor's operations and the operations of the Contractor's agents, employees and Subcontractors.

- B. At the Agency's Expense** - The Contractor shall construct fences, or move and reconstruct fences, as shown on the Contract Documents or as directed by the Engineer. The Contractor shall tear down and remove fencing within the Right-of-Way when no longer needed, as part of the removal Work described in and paid for according to Section 00310.

00170.93 Trespass

The Contractor shall be responsible for its own, its agents' and employees', and its Subcontractors' trespass or encroachment upon, or damage to, property during performance of the Contract.

00170.94 Use of Explosives

The Contractor shall comply with all Laws pertaining to the use of explosives. The Contractor shall notify anyone having facilities near the Contractor's operations of Contractor's intended use or storage of explosives. The Contractor shall be responsible for all damage resulting from its own, its agents' and employees', and its Subcontractors' use of explosives. (See 00330.41(e) and Section 00335).

Section 00180 - Prosecution and Progress

00180.00 Scope

This Section consists of requirements for assignment of the Contract, subcontracting, time for performance, Contract responsibility, suspensions, terminations, and related provisions.

00180.05 Assignment/Delegation of Contract

Unless the Agency gives prior written consent, the Contractor shall not assign, delegate, sell, or transfer to any Entity, or otherwise dispose of any Contract rights or obligations, including without limitation:

- The power to execute or perform the Contract; or
- Any of its right, title or interest in the Contract.

Any attempted assignment, delegation, or disposition without prior Agency consent shall be void.

Such Agency consent will not normally be given except for the assignment of funds due under the Contract, as provided in 00180.06.

If written Agency consent is given to assign, delegate, or otherwise dispose of any Contract rights or obligations, it shall not relieve the Contractor or its Surety of any part of their responsibility under the Contract.

00180.06 Assignment of Funds Due under the Contract

Assignment of funds due or to become due under the Contract to the Contractor will not be permitted unless:

- The assignment request is made on the form acceptable to the Agency;
- The Contractor secures the written consent of the Contractor's Surety to the assignment; and
- The Engineer approves the assignment.

00180.10 Responsibility for Contract

The Contractor shall direct and coordinate the operations of its employees, Subcontractors and agents performing Work, and see that the Engineer's orders are carried out promptly. The Contractor's failure to direct, supervise and control its employees, Subcontractors and agents performing Work will result in one or more of the following actions, or other actions as the Engineer deems appropriate:

- Suspension of the Work;
- Withholding of Contract payments, as necessary to protect the Agency;
- Ordering removal of individuals from the Project Site; or
- Termination of the Contract.

00180.15 Agency's Right to Do Work at Contractor's Expense

Except as otherwise provided in 00150.75 and 00220.60, if the Contractor neglects to prosecute the Work properly or fails to perform any provision of the Contract, the Agency may, after 2 Calendar Days' written notice, correct the deficiencies at the Contractor's expense. In situations where the Engineer reasonably believes there is danger to life or property, the Agency may immediately and without notice correct the deficiencies at the Contractor's expense.

Action by the Agency under this provision will not prejudice any other remedy it may have.

00180.20 Subcontracting Limitations

- A. General** - The Contractor's own organization shall perform Work amounting to at least the percentage of the original Contract Amount as indicated in the Special Provisions. The value of subcontracted Work is the full compensation to be paid to the Subcontractor(s) for all pay items in the subcontract(s).
- B. Own Organization** - The term "own organization", as used in Section 00180, includes only employees of the Contractor, Equipment owned or rented by the Contractor, Incidental rental of operated Equipment, and Materials and Equipment to be incorporated into the Work purchased or produced by the Contractor.
- C. Rental of Operated Equipment** – The Agency will not allow a Disadvantaged Business Enterprise (DBE) firm to provide services without a subcontract covering all Work to be performed by the DBE firm.

00180.21 Subcontracting

- A. Substitution of Disclosed Subcontractors** - The Contractor may only substitute a previously undisclosed first-tier Subcontractor according to the provisions of ORS 279C.585. The Contractor shall provide the Engineer with a written notification that identifies the name of the proposed new Subcontractor and the reason for the substitution. Authorized reasons for substitution are limited to the following circumstances (see ORS 279C.585(1) through ORS 279C.585(10)):
- The disclosed Subcontractor fails or refuses to execute a written contract that is reasonably based either upon the Project Plans and Specifications, or the terms of the Subcontractor's written Bid, after having had a reasonable opportunity to do so;
 - The disclosed Subcontractor becomes bankrupt or insolvent;
 - The disclosed Subcontractor fails or refuses to perform the contract;
 - The disclosed Subcontractor fails or refuses to meet the bond requirements of the prime Contractor that had been identified prior to the Bid submittal;
 - The Contractor demonstrates to the Agency that the Subcontractor was disclosed as the result of an inadvertent clerical error;
 - The disclosed Subcontractor does not hold a license from the Construction Contractors Board and is required to be licensed by the board;
 - The Contractor determines that the Work performed by the disclosed Subcontractor is not in substantial compliance with the Plans and Specifications, or that the Subcontractor is substantially delaying or disrupting the progress of the Work;
 - The disclosed Subcontractor is ineligible to work on a public improvement according to the applicable statutory provisions;
 - The substitution is for "good cause" as defined by State Construction Contractors Board rule; or
 - The substitution is reasonably based on the Contract alternates chosen by the Agency.
- B. Terms of Subcontracts** - Subcontracts shall provide that work performed under the subcontract shall be conducted and performed according to the terms of the Contract. Compliance with 00170.07 is required. All subcontracts, including Contractor's with the first-tier Subcontractors and those of the first-tier Subcontractors with their Subcontractors, and any other lower-tier subcontracts shall contain a clause or condition that if the Contractor or a Subcontractor fails, neglects, or refuses to make payment to an Entity furnishing labor or Materials in connection with the Contract, the Entity may file a complaint with the Construction Contractors Board, unless payment is subject to a good-faith dispute as defined in ORS 279C.580. Additionally, according to the provisions of ORS 279C.580, subcontracts shall include:
1. A payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under the subcontract within 10 Calendar Days out of amounts the Agency pays to the Contractor under the Contract.

2. A clause that requires the Contractor to provide the first-tier Subcontractor with a standard form that the first-tier Subcontractor may use as an application for payment or as another method by which the Subcontractor may claim a payment due from the Contractor.
3. A clause that requires the Contractor, except as otherwise provided in this Subsection, to use the same form and regular administrative procedures for processing payments during the entire term of the subcontract. The Contractor may change the form or the regular administrative procedures the Contractor uses for processing payments if the Contractor:
 - Notifies the Subcontractor in writing at least 45 Calendar days before the date on which the Contractor makes the change; and
 - Includes with the written notice a copy of the new or changed form or a description of the new or changed procedure.
4. An interest penalty clause that obligates the Contractor, if the Contractor does not pay the first-tier Subcontractor within 30 Calendar Days after receiving payment from the Agency, to pay the first-tier Subcontractor an interest penalty on amounts due in each payment the Contractor does not make in accordance with the payment clause included in the subcontract under 00180.21.B.1. The Contractor or first-tier Subcontractor is not obligated to pay an interest penalty if the only reason that the Contractor or first-tier Subcontractor did not make payment when payment was due is that the Contractor or first-tier Subcontractor did not receive payment from the Agency or the Contractor when payment was due. The interest penalty applies to the period that begins on the day after the required payment date and ends on the date on which the amount due is paid; and shall be computed at the rate specified in 00170.10.C.
5. A clause that requires the Contractor's first-tier Subcontractor to include a payment clause and an interest penalty clause that conform to the standards of ORS 279C.580 (see 00180.21.B.1 and 00180.21.B.4) in each of the first-tier Subcontractor's subcontracts and to require each of the first-tier Subcontractor's Subcontractors to include such clauses in their subcontracts with each lower-tier Subcontractor or Material supplier.

These payment clauses shall require the Contractor to return all retainage withheld from the Subcontractor, whether held by the Contractor or the Agency, as specified in 00195.50.D.

As required by ORS 279C.800 through ORS 279C.870, subcontracts shall include:

- A provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work on the Project, unless exempt.
- A provision requiring that the workers shall be paid not less than the specified minimum hourly rate of wage.

C. Contractor's Responsibilities - Whether or not stated in the subcontract agreement itself, the Contractor shall remain solely responsible for administration of the subcontract, including, but not limited to:

- Performance of subcontracted Work;
- Progress of subcontracted Work;
- Payments for accepted subcontracted Work; and
- Disputes and claims for additional compensation regarding subcontracted Work.

It shall be the direct responsibility of the Contractor to ensure that each and every Subcontractor will not only be issued a complete and current set of Plans and Specifications, but also that these Plans and Specifications are on the Project Site and in use by the Subcontractor when it is performing its portion of the project.

Subcontracted Work shall not create a contract between the Agency and the Subcontractor, will not convey to the Subcontractor any rights against the Agency, and will not relieve the Contractor or the Contractor's Surety of any of their responsibilities under the Contract.

D. Failure to Comply - Failure to comply with 00180.21 will be cause for the Engineer to take action reasonably necessary to obtain compliance. This action may include, but is not limited to:

- Suspension of the Work;
- Withholding of Contract payments as necessary to protect the Agency; and
- Termination of the Contract.

00180.22 Payments to Subcontractors and Agents of the Contractor

To the extent practicable, the Contractor shall pay in the same units and on the same basis of measurement as listed in the Schedule of Items for subcontracted Work or other Work not done by the Contractor's own organization. The Agency will not be responsible for any overpayment or losses resulting from overpayment by the Contractor to Subcontractors and to its other agents, work providers, service providers, and trucking service providers.

If requested in writing by a first-tier Subcontractor, the Contractor shall send to the Subcontractor, within 10 Calendar Days of receiving the request, a copy of that portion of any invoice or request for payment submitted to the Agency, or pay document provided by the Agency to the Contractor, specifically related to any labor, Equipment, or Materials supplied by the first-tier Subcontractor.

00180.30 Materials, Equipment, and Work Force

The Contractor shall furnish suitable and sufficient Materials, Equipment, and personnel to properly prosecute and complete the Work. The Contractor shall use only Equipment of adequate size and condition to meet the requirements of the Work and Specifications, and to produce a satisfactory quality of Work. Upon receipt of the Engineer's written order, the Contractor shall immediately remove, and not use again on the Project without the Engineer's prior written approval, Equipment that, in the Engineer's opinion, fails to meet Specifications or produce a satisfactory product or result.

The work force shall be trained and experienced for the Work to be performed. Upon receipt of the Engineer's written order, the Contractor shall immediately remove from the Project Site, and shall not employ again on the Project without the Engineer's prior written approval, any supervisor or employee of the Contractor or any Subcontractor who, in the Engineer's opinion, does not perform satisfactory Work or whose conduct interferes with the progress of the Work.

If the Contractor fails to remove Equipment or persons as ordered, or fails to furnish suitable and sufficient Materials, Equipment and personnel for the proper prosecution of the Work, the Engineer may suspend the Work by written notice until such orders are complied with and such deficiencies are corrected, or the Engineer may terminate the Contract under the provisions of 00180.90.A.

00180.31 Required Materials, Equipment, and Methods

The Engineer's decisions under this Section are final.

A. General - When the Equipment and methods to be used are not specified in the Contract, any Equipment or methods that accomplish the Work as required by the Contract will be permitted.

When the Contract specifies certain Equipment or methods, the Contractor shall use the Equipment or methods specified unless otherwise authorized by the Engineer in writing.

B. Substitution of Materials and Equipment to be Incorporated into the Work - After execution of the Contract, the Engineer may approve substitution of Materials and Equipment to be incorporated into the Work as follows:

- **Reasons for Substitution** - The Engineer will consider substitution only if:
 - a. In the judgement of the Engineer, the proposed Materials or Equipment are equal to or superior to the specified items in construction, efficiency and utility; or
 - b. Due to reasons beyond the control of the Contractor, the specified Materials or Equipment cannot be delivered to the Project in sufficient time to complete the Work in proper sequence.
- **Submittal of Request** - The Contractor shall submit requests for substitution to the Engineer, including manufacturers' brochures and other information needed to verify equality of the proposed item(s).

C. Substitution of Equipment Specified to Perform Work - The Agency encourages development of new or improved Equipment and innovative use of Equipment. When the Specifications require Equipment of a particular size or type to be used to perform certain portions of the Work, the Contractor may submit a request to the Engineer to use Equipment of a different size or type. The request will not be considered as a cost reduction proposal under 00140.70. The request shall:

- Be in writing and include a full description of the Equipment proposed and its intended use;
- Include the reasons for requesting the substitution; and
- Include evidence, obtained at the Contractor's expense and satisfactory to the Engineer, that the proposed Equipment is capable of functioning as well as or better than the specified Equipment.

The Engineer will consider the Contractor's request and will provide a written response to the Contractor, either permitting or denying use of the proposed Equipment.

Permission may be granted on a trial basis to test the quality of Work actually produced, subject to the following:

- There will be no cost to the Agency, either in Contract Amount or in Contract Time;
- The permission may be withdrawn by the Engineer at any time if, in the Engineer's opinion, the Equipment is not performing in all respects equivalent to the Equipment specified in the Contract;
- If permission is withdrawn, the Contractor shall perform the remaining Work with the originally-specified Equipment; and
- The Contractor shall remove and replace non-specification Work resulting from the use of the Contractor's proposed Equipment, or otherwise correct it as the Engineer directs, at no additional compensation.

D. Substitution of Methods - The Agency encourages development of new, improved, and innovative construction methods. When the Plans or Specifications require a certain construction method for a portion of the Work, the Contractor may submit a request for a change by following the provisions of 00140.70, "Cost Reduction Proposals".

00180.40 Limitation of Operations

A. In General - The Contractor shall comply with all Contract provisions and shall:

- Conduct the Work at all times so as to cause the least interference with traffic, and

- Not begin Work that may allow damage to Work already started.

B. On-Site Work - The Contractor shall not begin On-Site Work until the Contractor has:

- Received Notice to Proceed;
- Filed with the Construction Contractors Board the public works bond as required in 00170.20;
- An approved Project Work schedule;
- An approved Traffic Control Plan;
- An approved Spill Prevention Control and Countermeasure Plan, if required;
- An approved Pollution Control Plan;
- An approved Erosion and Sediment Control Plan;
- Met with the Engineer at the required preconstruction conference; and
- Assembled all Materials, Equipment, and labor on the Project Site, or has reasonably assured that they will arrive on the Project Site, so the Work can proceed according to the Project Work schedule.

00180.41 Project Work Schedules

The Contractor shall submit a Project Work schedule meeting the requirements of this Subsection to the Engineer. The Project Work schedule is intended to identify the sequencing of activities and time required for prosecution of the Work. The schedule is used to plan, coordinate, and control the progress of construction. Therefore, the Project Work schedule shall provide for orderly, timely, and efficient prosecution of the Work, and shall contain sufficient detail to enable both the Contractor and the Engineer to plan, coordinate, analyze, document, and control their respective Contract responsibilities. Sufficient detail shall also include all required double shifts, overtime work, or combination of both necessary to complete Contract Work within the Contract Time.

The Contractor shall submit a schedule or plan for each activity that is behind schedule showing, in sufficient detail, the proposed corrective action to complete Contract Work within the Contract Time. Sufficient detail shall include all required double shifts, overtime work, or combination of both.

Contractor's activity related to developing, furnishing, monitoring, and updating these required schedules is Incidental.

The Contractor shall submit a supplemental "look ahead" Project Work schedule to the Engineer prior to or at each Project progress meeting. The "look ahead" Project Work schedule is supplemental to the Type A, B, or C schedule specified below. The supplemental "look ahead" Project Work schedule shall:

- Identify the sequencing of activities and time required for prosecution of the Work.
- Provide for orderly, timely, and efficient prosecution of the Work.
- Contain sufficient detail to enable both the Contractor and the Engineer to plan, coordinate, analyze, document, and control their respective Contract responsibilities.

The supplemental "look ahead" Project Work schedule shall be written in common terminology and show the planned Work activities broken down into logical, separate activities by area, stage, and size and include the following information:

- The resources the Contractor, Subcontractors, or services will use.
- The locations of each activity that will be done including the limits of the work by mile posts, stations, or other indicators.
- The time frames of each activity by Calendar Days, shifts, and hours.
- All anticipated Shoulder, lane, and road closures.

At a minimum, the Contractor shall prepare a bar chart that:

- Shows at least 3 weeks of activity including the week the bar chart is issued.
- Uses a largest time scale unit of 1 Calendar Day. Smaller time scale units may be used if needed.
- Is appropriate to the activities.
- Identifies each Calendar Day by month and day.

Include the Contract name, Contract number, Contractor's name, and date of issue on each page of the bar chart.

The Contractor shall submit the supplemental "look ahead" Project Work schedule starting at First Notification and continuing until Second Notification has been issued and all punch list items and final trimming and clean-up has been completed. The Contractor shall meet with the Engineer to review the supplemental "look ahead" Project Work schedule. If the Engineer or the Contractor determines that the current supplemental "look ahead" Project Work schedule requires changes or additions, either notations can be made on the current schedule or the Engineer may require the submittal of a revised supplemental "look ahead" Project Work schedule. Review of the current and subsequent supplemental "look ahead" Project Work schedules does not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

One of the following Type "A", "B", or "C" schedules will be required under the Contract. The type of schedule will be identified in the Special Provisions.

A. Type "A" Schedule - When a Type "A" schedule is required, the Contractor shall do the following:

1. **Schedule** - 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Engineer four copies of a Project Work schedule, including a time-scaled bar chart and narrative, showing:
 - Expected beginning and completion dates of each activity, including all staging; and
 - Elements of the Traffic Control Plan as required under 00225.05.

The schedule shall show detailed Work activities as follows:

- Construction activities;
- The time needed for completion of the Utility relocation work;
- Submittal and approval of Materials samples and shop drawings;
- Fabrication, installation, and testing of special Materials and Equipment; and
- Duration of Work, including completion times of all stages and their sub phases.

For each activity, the Project Work schedule shall list the following information:

- A description in common terminology;
- The quantity of Work, where appropriate, in common units of measure;
- The activity duration in Calendar Days; and
- Scheduled start, completion, and time frame shown graphically using a time-scaled bar chart.

The schedule shall show the Work broken down into logical, separate activities by area, stage, or size. The duration of each activity shall be verifiable by manpower and Equipment allocation, in common units of measure, or by delivery dates.

The bar chart shall be prepared as follows:

- The length of bar shall represent the number of workdays scheduled.
- The time scale shall be appropriate for the duration of the Contract.
- The time scale shall be in Calendar Days.
- The smallest unit shown shall be 1 Calendar Day.
- The first day and midpoint of each month shall be identified by date.
- Distinct symbols shall be used to denote multiple shift, holiday, and weekend Work.

Each page of the bar chart shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the bar chart shall be drawn on a reasonable size of paper up to a maximum of 36 inch by 36 inch, using multiple sheets when needed.

Within 7 Calendar Days after the preconstruction conference, the Engineer and the Contractor shall meet to review the Project Work schedule as submitted. The Engineer will review the schedule for compliance with all Contract Time limitations and other restraints. Review of this and subsequent schedules by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract. Within 10 Calendar Days of this meeting, the Contractor shall resubmit to the Engineer four copies of the Project Work schedule, including required revisions.

2. **Review by the Engineer** - The Project Work schedule may need revision as the Work progresses. Therefore, the Contractor shall periodically review the Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the Project Work schedule no longer represents the Contractor's own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the Project Work schedule.

The Contractor shall compile an updated Project Work schedule incorporating any changes to the Project completion time(s). The bar chart shall reflect the updated information. The Contractor shall submit four copies of the updated Project Work schedule to the Engineer within 7 Calendar Days after the meeting. The report shall include without limitation the following:

- Sufficient narrative to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule; and
- Proposed corrective actions.

B. Type "B" Schedule - When a Type "B" Schedule is required, the Contractor shall do the following:

1. **Initial Schedule** - 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Engineer four copies of a time-scaled bar chart Project Work schedule showing:

- Expected beginning and completion date of each activity, including all staging; and
- Elements of the Traffic Control Plan as required under 00225.05.

The initial schedule shall show all Work intended for the first 60 Days of the Contract to the level of detail described in 00180.41.B.2 below, and shall show the priority and interdependence (sequencing and network logic) of all major segments of the remainder of the Work.

- 2. Detailed Schedule** - In addition to the above requirements, and within 30 Calendar Days after the Notice to Proceed, the Contractor shall provide the Engineer one digital copy and four paper copies of a detailed time-scaled bar chart Project Work schedule indicating the critical course of the Work. The digital copy shall be compatible with MS Project 2003, Primavera P3, SureTrak Project Manager 3.0, or another scheduling program approved by the Engineer.

Detailed work schedule activities shall include the following:

- Construction activities;
- The time needed for completion of the Utility relocation work;
- Submittal and approval of Material samples and shop drawings;
- Procurement of critical Materials;
- Fabrication, installation, and testing of special Material and Equipment; and
- Duration of Work, including completion times of all stages and their sub phases.

For each activity, the Project Work schedule shall list the following information:

- A description in common terminology;
- The quantity of Work, where appropriate, in common units of measure;
- The activity duration in normal workdays; and
- Scheduled start, completion, and time frame shown graphically using a time-scaled bar chart.

The schedule shall show the Work broken down into logical, separate activities by area, stage, or size. The duration of each activity shall be verifiable by manpower and Equipment allocation, in common units of measure, or by delivery dates.

The bar chart shall be prepared as follows:

- The length of bar shall represent the number of normal workdays scheduled.
- The time scale shall be appropriate for the duration of the Contract.
- The time scale shall be in normal workdays (every day except Saturday, Sunday, and legal holidays).
- The smallest unit shown shall be 1 Calendar Day.
- The first day and midpoint of each month shall be identified by date.
- Distinct symbols shall be used to denote multiple shift, holiday, and weekend Work.

The bar chart drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the bar chart shall be drawn on a reasonable size of paper up to a maximum of 36 inch x 36 inch, using multiple sheets when needed.

Within 10 Calendar Days after submission of the Project schedule the Engineer and the Contractor shall meet to review the Project schedule as submitted. Within 10 Days of the review meeting, the Contractor shall resubmit to the Engineer one digital and four paper copies of the Project schedule, including required revisions.

The accepted Project schedule shall represent all Work, as well as the planned sequence and time for the Work. Review of this and subsequent schedules by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

3. Review and Reporting - The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

- a. Review with the Engineer** - The Contractor shall perform ongoing review of the Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the Project Work schedule no longer represents the Contractor's own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the Project Work schedule.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include commencement and completion dates on activities started or completed, or if still in progress, the remaining time duration.

The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it.

The Contractor shall evaluate this information and compare it with the Contractor's project schedule. If necessary, the Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal workdays remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit one digital and four paper copies of the updated bar chart to the Engineer within 7 Days after the progress meeting, along with a progress report as required by 00180.41.B.3.b below.

- b. Progress Report** - The Contractor shall submit a progress report to the Engineer each month. The report shall include the following:

- Sufficient narrative to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule; and
- Proposed corrective actions.

C. Type "C" Schedule - When a Type "C" Schedule is required, the Contractor shall do the following:

- 1. Initial Schedule** - 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Engineer one digital copy and four paper copies of a time-scaled bar chart Project Work schedule. The digital copy shall be compatible with MS Project 2003, Primavera P3, SureTrak Project Manager 3.0, or another scheduling program approved by the Engineer. The initial schedule shall show:

- The expected beginning and completion date of each activity, including all stages and phases;
- The time needed for completion of the Utility relocation work; and

- The elements of the traffic control plan as required under 00225.05.

A logic diagram and a time-scaled bar chart will be acceptable in lieu of a time-scaled logic diagram.

The initial schedule shall show all Work intended for the first 60 Days of the Contract to the level of detail described in (2) below, and shall show the priority and interdependence (sequencing and network logic) of all major segments of the remainder of the Work.

- 2. Detailed Project Work Schedule** - In addition to the above requirements, and within 30 Calendar Days after First Notification, the Contractor shall provide the Engineer one digital copy and four paper copies of a detailed time-scaled critical path method (CPM) network Project Work schedule and computer analysis printout, both clearly indicating the critical path. The digital copy shall be compatible with MS Project 2003, Primavera P3, SureTrak Project Manager 3.0, or another scheduling program approved by the Engineer. The first submitted detailed time-scaled critical path method (CPM) network Project Work schedule shall also contain a listing of the quantity of Work for each activity, when appropriate, in common units of measure.

Detailed work schedule activities shall include the following:

- Construction activities;
- Any limitations of operation specified in 00180.40;
- The time needed for completion of the Utility relocation work;
- Implementation of TCP for each stage and phase;
- Submittal and approval of Material samples, mix designs, and shop drawings;
- Agency timeframes to process and return Contractor submitted plans, Working Drawings, Equipment lists and other submittals;
- Procurement of critical Materials;
- Fabrication, installation, and testing of special Material and Equipment;
- Duration of Work, including completion times of all stages and their sub-phases; and
- Specified cure times for all concrete elements.

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable and consistent with the description in the Project narrative required in 00180.41.C.3 below.

Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. In the restraints, include those activities from any Project Work schedule that initiated the sub-network as well as those restrained by it.

The time scale used on the Contractor's detailed time-scaled critical path method (CPM) network Project Work schedule shall be appropriate for the duration of the activities and the Project duration. The time scale shall be in normal workdays, defined as every day except Saturday, Sunday and legal holidays, with calendar dates identified no less than the first and midpoint of each calendar month. The smallest unit shown shall be 1 Day. The network shall show the length of the activity or part scaled to accurately represent the number of normal workdays scheduled. Distinct symbols or graphics shall be used to show multiple shift, holiday, or weekend work.

The schedule network drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the drawings shall

be on a reasonable size of paper up to a maximum of 36 inch x 36 inch, using multiple sheets when needed.

The Contractor shall include a tabulation of each activity in the computer mathematical analysis of the network diagram. The following information represents the minimum required for each activity:

- Event (node) number(s) for each activity;
- Maintain event (node) numbers throughout the Project;
- Activity description;
- Original duration of activities (in normal workdays);
- Estimated remaining duration of activities (in normal workdays);
- Earliest start date and actual start date (by calendar date);
- Earliest finish date and actual finish date (by calendar date);
- Latest start date (by calendar date);
- Latest finish date (by calendar date); and
- Slack or float time (in workdays).

Computer print-outs shall consist of at least a node sort and an “early start/total-float” sort.

Within 14 Calendar Days after submission of the detailed time-scaled critical path method (CPM) network Project Work schedule, the Engineer and the Contractor shall meet to review the detailed time-scaled critical path method (CPM) network Project Work schedule as submitted. Within 7 Calendar Days of the meeting, the Contractor shall resubmit to the Engineer one digital and four paper copies of the detailed time-scaled critical path method (CPM) network Project Work schedule, including required revisions.

This first accepted detailed time-scaled critical path method (CPM) network Project Work schedule, also called the accepted Project Work schedule, shall represent all Work, as well as the planned sequence and time for the Work. Review and acceptance of any Project Work schedules and Project narratives by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

- 3. Project Narrative** - In addition to the above requirements, and within 30 Calendar Days after First Notification, the Contractor shall provide to the Engineer a final written Project narrative that discusses the planning, coordinating, scheduling and resourcing of the Work. The Project narrative shall include the following written description:

- Plans for staging the project.
- All critical activities.
- All near critical activities defined as those with less than 30 Days of float.
- All Subcontractor activities that are critical, near critical, and those that are greater than two weeks in duration.
- Labor resourcing, by stage and phase, to include the number of crews, average crew size and planned night/weekend shifts including that of subcontractors.
- Equipment allocation, by stage and phase to include mobilization, demobilization and planned activities including that of Subcontractors.
- Notifications required under the Contract during each stage and phase which may include but is not limited to road closures, lanes closures, night work, cold plane Pavement removal, and pile driving.

- Provide discussion on addressing reasonably predictable weather conditions and their impact on all weather sensitive activities. Also, provide discussion on other weather limitations that may affect the Project schedule.
- Submittal and approval of material samples, mix designs, and shop drawings.
- Procurement of critical materials.
- Plans for dealing with “unique” construction items.
- Coordination of utilities and any immediate concerns for impacts/delays.
- Constructability issues.
- Cost Reduction Proposals and/or immediate requests for changes to the Specifications.
- Concerns/issues that need to be addressed within the first 90 Days following First Notification.

The accepted Project narrative shall represent all critical and near critical Work, as well as the planned sequence and time for the Work.

4. Review and Reporting - The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

- a. Review with the Engineer** - The Contractor shall perform ongoing review of the accepted Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the accepted Project Work schedule no longer represents the Contractor’s own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the accepted Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the accepted Project Work schedule and associated Project narrative. Upon acceptance by the Engineer, this will become the new accepted Project Work schedule and associated Project narrative.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include actual start and completion dates on activities started or completed, or if still in progress, the remaining time duration.

The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it. The procedure for acceptance of the revised or updated Project Work schedule as the new accepted Project Work schedule will be as provided above.

The Contractor shall evaluate this information each month and compare it with the accepted Project Work schedule. The Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal workdays remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit, digitally and in paper, copies of the updated bar chart to the Engineer within 7 Days after the progress meeting, along with a progress report as required by 00180.41.C.4.b. below.

b. Progress Report - Each month the Contractor shall submit a progress report and an update of the Project Work schedule to the Engineer. The report and updated schedule shall be submitted both digitally and in paper copy and shall include the following:

- A sufficient description, in narrative form, to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule;
- Proposed corrective actions;
- Proposals to keep the Project on schedule in the event of a delay; and
- Any changes to the logic as compared to the accepted Project Work schedule.

D. Substitution of Schedules - When a Type “A” schedule is required, a Type “B” or Type “C” schedule may be substituted for the Type “A” schedule.

When a Type “B” schedule is required, a Type “C” schedule may be substituted for the Type “B” schedule.

E. Specified Contract Time Not Superseded by Schedule Revisions - The completion dates in any Project Work schedule and any revised or updated Project Work schedules shall be within the Contract Time(s) specified for the Project, or within adjusted Contract Times approved according to 00180.80.C. Acceptance of any Project Work schedule or any revised or updated Project Work schedules shall not constitute approval of any completion dates that exceed such Contract Time(s). If the Contractor believes that additional Contract Time is due, the Contractor shall submit, with a revised Project Work schedule, a request for adjustment of Contract Time according to 00180.80.C. A request for an adjustment of Contract Time will be evaluated using the most recently accepted Project Work schedule.

F. Float Time - Float time shown on the Project Work schedule, including any time between a Contractor’s scheduled completion date and the specified Contract Time(s), does not exist for the exclusive use of either party to the Contract and belongs to the Project.

G. Schedules Do Not Constitute Notice - Submittal of a Project Work schedule, with supporting Project narrative, does not constitute or substitute for any notice the Contractor is required under the terms of the Contract to give the Agency.

H. Failure to Provide Schedule - The Project Work schedule is essential to the Agency. The Contractor’s failure to provide the schedule, schedule information, progress reports, Project narratives, or schedule updates when required will be cause to suspend the Work, or to withhold Contract payments as necessary to protect the Agency, until the Contractor provides the required information to the Engineer.

00180.42 Preconstruction Conference

Unless otherwise approved in writing by the Engineer, before any Work is performed and within 7 Calendar Days of the Notice to Proceed, the Contractor shall meet with the Engineer for a preconstruction conference at a time mutually agreed upon.

00180.43 Commencement and Performance of Work

From the time of commencement of the Work to the time of Final Acceptance the Contractor shall:

- Provide adequate Materials, Equipment, labor, and supervision to perform and complete the Work;
- Perform the Work as vigorously and as continuously as conditions permit, and according to a Project Work schedule that ensures completion within the Contract Time or the adjusted Contract Time;
- Not voluntarily suspend or slow down operations without prior written approval from the Engineer; and

- Not resume suspended Work without the Engineer's written authorization.

00180.44 Project Meetings

The Contractor shall participate in conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest to the Contractor, Engineer and Agency.

A. Meeting Participants - Representative of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1. Meet in Agency's meeting room facility, or in a location otherwise agreed to by Agency and Contractor.
2. Engineer will distribute to each anticipated participant written notice and agenda of each meeting at least 4 days before meeting.
3. Require attendance of Contractor's superintendent and project manager, and Subcontractors who are or are proximate to be actively involved in the Work, or who are necessary to agenda.
4. Engineer will invite agencies, utility companies or others when the Work affects their interests, and others necessary to agenda.
5. Engineer will record minutes of meeting and distribute copies of minutes within 3 days of meeting to participants and interested parties. Contractor shall advise Engineer within two days of receipt of meeting minutes if Contractor does not agree with content of minutes.

B. Progress Meetings

1. Purpose of Progress Meetings: To expedite Work of Subcontractors or other organizations that are not meeting scheduled progress, resolve conflicts, and coordinate and expedite execution of the Work.
2. Attend regularly scheduled bi-weekly progress meetings conducted by Engineer.
3. Review progress of the Work, Progress Scheduled, 3-week look-ahead schedule, narrative report, Application for Payment, record documents, and additional items of current interest that are pertinent to execution of the Work.
4. Verify:
 - Actual start and finish dates of completed activities since last progress meeting.
 - Durations and progress of activities not completed.
 - Reason, time, and cost data for Change Order Work that will be incorporated into Progress Schedule and Application for Payment.
 - Percentage completion of items on Application for Payment
 - Reasons for required revisions to Progress Schedule and their effect on Contract Time and Contract Amount.
5. Review status of Requests for Clarification/Information and Submittals review.
6. Discuss Project safety and security.
7. Discuss traffic control.

8. Discuss potential problems which may impede scheduled progress and corrective measures.

C. Coordination Meetings

1. Purpose of Coordination Meetings: To coordinate the Work of this Contract with the Work of the Agency and with the Work of other Contractors.

D. Pre-Event Meetings

1. Prior to start of critical activities, the Contractor shall schedule a meeting with Engineer to review applicable specifications and drawings, coordination of inspection requirements and other key activities.

E. Pre-Survey Conference

1. The Contractor, applicable Subcontractors, Contractor's surveyor, Agency and Agency's surveyor shall meet with the Engineer two weeks prior to beginning survey work. The purpose of the meeting is to discuss methods and practices of accomplishing the survey work.

F. Other Meetings

1. The Contractor shall prepare for and attend other meetings as identified elsewhere in the Contract Documents.

00180.50 Contract Time to Complete Work

A. General - The time allowed to complete the Work or Pay Item is stipulated in the Special Provisions, and will be known as the "Contract Time". (See 00110.20)

B. Kinds of Contract Time - The Contract Time will be expressed in one or more of the following ways

1. **Fixed Date Calculation** - The calendar date on which the Work or Pay Item shall be completed;
2. **Calendar Day Calculation** - The number of Calendar Days from a specified beginning point in which the Work or Pay Item shall be completed; or
3. **Work Day Calculation** - The number of Work Days from a specified beginning point in which the Work or Pay item shall be completed.

C. Beginning of Contract Time - When the Contract Time is stated in Calendar Days, counting of Contract Calendar Days will begin with the first Calendar Day following the date of the Notice to Proceed. When the Contract Time is stated in Work Days, counting of Contract Work Days will begin with the first Work day following the date of the Notice to Proceed.

D. Recording Contract Time - All Contract Time will be recorded and charged to the nearest one-half Day.

Contract Times may be extended because of delays in the completion of the Work due to abnormal weather conditions provided that the Contractor shall, within 10 days of the beginning of such delay, notify Engineer in writing of the cause of the delay and request an extension of time. Such requests shall be accompanied with supporting documentation referenced to the NOAA INDEX weather in the Project vicinity. Engineer will make recommendations to Agency to extend the Contract Times for completing the Work when, in Engineer's judgment, the findings of facts and extent of delay justify such an extension. Contractor shall not be entitled to any additional compensation of any kind arising out of or relating to abnormal weather conditions.

On Contracts with Calendar Day or Work Day counts, the Engineer will furnish the Contractor a weekly statement of Contract Time charges. The statement will show the number of Calendar Days counted for the preceding week and the number of Calendar Days remaining prior to the established completion date.

For Contracts with fixed completion dates or fixed milestone completion dates for Pay Items, the Engineer will furnish the Contractor a weekly statement of Contract Time charges only after expiration of the Contract Time. The statement will show the number of Calendar Days of liquidated damages that have been assessed, if any.

These statements will include any exclusions from, or adjustments to, Contract Time.

E. Exclusions from Contract Time - Regardless of the way Contract Time is expressed in the Contract, certain Calendar Days will not be charged against Contract Time. These exclusions will be allowed when the Contractor is prevented from performing Work due to one of the following reasons, resulting in delay:

- Acts of God or Nature;
- Court orders enjoining prosecution of the Work;
- Strikes, labor disputes or freight embargoes that, despite the Contractor's reasonable efforts to avoid them, cause a shutdown of the entire Project or one or more major operations. "Strike" and "labor dispute" may include union action against the Contractor, a Subcontractor, a Materials supplier, or the Agency; or
- Suspension of the Work by written order of the Engineer for reasons other than the Contractor's failure or neglect.

F. Time Calculation Protest - In the event the Contractor disputes the accuracy of the statement of Contract Time charges, it shall immediately contact the Engineer and attempt to resolve the dispute. If the dispute cannot be resolved informally, the Contractor shall submit a formal written protest to the Engineer within 7 Calendar Days of the date the Engineer mailed or delivered the statement. Failure to submit a formal written protest within the 7 Calendar Day period constitutes the Contractor's approval of the time charges, or adjusted time charges, itemized in the statement.

G. End of Contract Time - When the Engineer determines that the On-Site Work has been completed, except for the items listed below, the Engineer will issue a Second Notification.

The Second Notification will list:

- The date the time charges stopped;
- Final trimming and cleanup tasks (see 00140.90);
- Equipment to be removed from the Project Site;
- Minor corrective work (punch list) not involving additional payment to be completed; and
- Submittals, including, without limitation, all required certifications, bills, forms, warranties, certificate of insurance coverage (00170.70), and other documents, required to be provided to the Engineer before Third Notification will issue.

The Contractor shall complete all tasks listed in the Second Notification in an expeditious manner within the time frame specified for Final Completion.

00180.60 Notice of Delay

The Contractor shall notify the Engineer of any delay that will likely prevent completion of the Work or a Pay Item by the date specified in the Project Work schedule. The notice shall be in writing and shall be submitted within 7 Calendar Days of when the Contractor knew or should have known of the delay. The notice shall include, to the extent available, the following:

- The reasons or causes for the delay;
- The estimated duration of the delay and the estimated resulting cumulative delay in Contract completion;
- Except for 00180.50.E and 00180.65 delays, whether or not the Contractor expects to request an adjustment of Contract Time due to the delay;
- Whether or not the Contractor expects to accelerate due to the delay; and
- Whether or not the Contractor expects to request additional compensation due to the delay. Except for 00180.50.E and 00180.65 delays, failure to include this information will constitute waiver of the Contractor's right to later make such a request.

00180.65 Rights-of-Way and Access Delays

Right-of-Way and access delays will be taken into consideration in adjusting Contract Time, and in approving additional compensation if the performance of the Work is delayed because of the Agency's failure to make available to the Contractor:

- Necessary Rights-of-Way;
- Agency-owned or Agency-controlled Materials sources that are offered in the Contract for the Contractor's use; or
- Access to, or rights of occupancy of, buildings and other properties the Contractor is required to enter or to disturb according to Contract requirements.

If the duration and time period of an anticipated delay is stated in the Special Provisions, only the delay occurring beyond that duration and time period will be considered for adjusting Contract Time or providing additional compensation.

00180.70 Suspension of Work

A. General - The Engineer has authority to suspend the Work, or part of the Work, for any of the following causes:

- Failure of the Contractor to correct unsafe conditions;
- Failure of the Contractor to carry out any provision of the Contract;
- Failure of the Contractor to carry out orders issued by the Engineer, the Agency, or any regulatory authority;
- Existence of conditions unsuitable to proper or safe performance of the Work; or
- Any reason considered by the Agency to be in the public interest.

When Work has been suspended for any reason, the Contractor shall not resume Work without the Engineer's written authorization.

B. Contractor's Responsibilities during and after Suspension - During periods of suspension of the Work, the Contractor shall continue to be responsible for protecting and repairing the Work according to 00170.80, and for ensuring that a single designated representative responsible for the Project remains available according to 00150.40.B.

When Work is resumed after suspension, unless otherwise specified in the Contract, the Contractor shall perform the following at no additional compensation:

- Replace or repair any Work, Materials, and Equipment to be incorporated into the Work that was lost or damaged because of the temporary use of the Project Site by the public; and

- Remove Materials, Equipment, and temporary construction necessitated by temporary maintenance during the suspension, as directed by the Engineer.

C. Compensation and Allowances for Suspension - Compensation and allowance of additional Contract Time due to suspension of any portion of the Work will be authorized only for Agency-initiated suspensions for reasons other than the Contractor's failure or neglect. (See 00180.50.E, 00180.65, and 00195.40)

00180.80 Adjustment of Contract Time

A. General - Contract Time established for the Work will be subject to adjustment, either by increase or decrease, for causes beyond the control of the Contractor, according to the terms of this Subsection. After adjustment, the Contract Time will become, and be designated as, the "Adjusted Contract Time". Except as provided in 00180.65 and 00195.40, an adjustment of Contract Time shall be the Contractor's only remedy for any delay arising from causes beyond the control of the Contractor.

B. Contractor's Request Not Required - The Engineer may increase or decrease the Contract Time or the Adjusted Contract Time if Change Orders or Extra Work orders issued actually increase or decrease the amount of time required to perform the Work. The Engineer may also increase Contract Time in the event of Right-of-Way and Access delays (see 00180.65), and those delays due to causes beyond the Contractor's control specified in 00180.50.E. The Engineer will promptly inform the Contractor of adjustments made to Contract Time according to this Subsection, and will include the reasons for adjustment.

If the Agency anticipates delay during performance of the Contract, and specifies its expected duration and time period in the Special Provisions, the Engineer will only consider additional delay beyond the stipulated duration and time period in determining whether to adjust Contract Time.

C. Contractor's Request Required - In the event the Contractor believes that additional Contract Time is due, the Contractor shall submit to the Engineer a timely request for adjustment of Contract Time. The Engineer will not consider untimely requests. The Agency regards as timely only those requests for adjustment of Contract Time that:

- Accompany a proposed revised Project Work schedule submitted according to 00180.41, for comparison with the last revision of the Project Work schedule; or
- Are not otherwise deemed waived and are submitted within 15 Days after the date of Second Notification, if Second Notification has been issued.

The Engineer will not grant an adjustment of Contract Time for events that occurred prior to the date of the last revision of the Project Work schedule. The Engineer will not authorize, nor the Agency pay, acceleration costs incurred by the Contractor prior to its submittal of a request for adjustment of Contract Time to which the acceleration costs relate.

The Contractor's request for adjustment of Contract Time shall be submitted to the Engineer on a form provided by, or in a format acceptable to, the Engineer, and shall include a copy of the written notice required under 00180.60. The request shall include without limitation:

- Consent of the Contractor's Surety if the request totals more than 30 Calendar Days of additional Contract Time;
- Sufficient detail for the Engineer to evaluate the asserted justification for the amount of additional Contract Time requested;

- The cause of each delay for which additional Contract Time is requested, together with supporting analysis and data;
- Reference to the Contract provision allowing Contract Time adjustment for each cause of delay;
- The actual or expected duration of delay resulting from each cause of delay, expressed in Calendar Days; and
- A schedule analysis based on the current approved Project Work schedule for each cause of delay, indicating which activities are involved and their impact on Contract completion.

D. Basis for Adjustment of Contract Time - In the adjustment of Contract Time, the Engineer will consider causes that include, but are not limited to:

- Failure of the Agency to submit the Contract and bond forms to the Contractor for execution within the time stated in 00130.50, or to submit the Notice to Proceed within the time stated in 00130.90;
- Errors, changes, or omissions in the Project Drawings, quantities, or Specifications;
- Performance of Extra Work;
- Failure of the Agency or Entities acting for the Agency to act promptly in carrying out Contract duties and obligations;
- Acts or omissions of the Agency or Entities acting for the Agency that result in unreasonable delay referenced in 00195.40;
- Causes cited in 00180.50.E; and
- Right-of-way and access delays referenced in 00180.65.

The Engineer will not consider requests for adjustment of Contract Time based on any of the following:

- Contentions that insufficient Contract Time was originally specified in the Contract;
- Delays that do not affect the specified or Adjusted Contract Time;
- Delays that affect the Contractor's planned early completion, but that do not affect the specified or adjusted Contract Time;
- Shortage or inadequacy of Materials, Equipment or labor;
- Late delivery of Materials and Equipment to be incorporated into the Work, except under those conditions referenced in 00180.50.E;
- Different area of Material source in 00160.40.A;
- Substitution of Equipment in 00180.31.C;
- Reasonably predictable weather conditions;
- Other matters within the Contractor's control or Contract responsibility;
- Work stoppage required by the Engineer to determine the extent of Work defects; or
- Time for the Contractor to correct the Work defects from date of notification of the defects until the correction work is completed and has been approved by the Engineer.

E. Consideration and Response by Agency - The Engineer will only consider a Contractor's request for Contract Time adjustment submitted according to the requirements of 00180.80.C. The Engineer may elect not to consider claimed delays that do not affect the specified or adjusted Contract Time required to complete the Work.

The Engineer may adjust Contract Time for causes not specifically identified by the Contractor in its request.

The Engineer will review a properly submitted request for Contract Time adjustment, and within a reasonable time will advise the Contractor of the Engineer's findings. If the Contractor disagrees with

the Engineer's findings, the Contractor may request review according to the procedure specified in 00199.40.

00180.85 Failure to Complete on Time; Liquidated Damages

A. Time is of the Essence - Time is of the essence in the Contractor's performance of the Contract. Delays in the Contractor's performance of the Work may inconvenience the traveling public, interfere with business and commerce, and increase costs to the Agency. It is essential and in the public interest that the Contractor prosecute the Work vigorously to Contract completion and within Contract Time or adjusted Contract Time.

The Agency does not waive any rights under the Contract by permitting the Contractor to continue to perform the Contract, or any part of it, after the Contract Time or adjusted Contract Time has expired.

B. Liquidated Damages - The Agency will sustain damage if the Work is not completed within the specified Contract Time. However, in certain Agency projects it may be unduly burdensome and difficult to demonstrate the exact dollar value of such damages. The Agency will identify such Projects in the Special Provisions related to them. In these Projects, the Contractor agrees to pay to the Agency, not as a penalty but as liquidated damages, the amount specified in the Special Provisions for each Calendar Day the Contractor expends performing the Contract in excess of the Contract Time or adjusted Contract Time.

Payment by the Contractor of liquidated damages does not release the Contractor from its obligation to fully and timely perform the Contract according to its terms. Nor does acceptance of liquidated damages by the Agency constitute a waiver of the Agency's right to collect any additional damages it may sustain by reason of the Contractor's failure to fully perform the Contract according to its terms. The liquidated damages shall constitute payment in full only of damages incurred by the Agency due to the Contractor's failure to complete the Work on time.

If the Contract is terminated according to 00180.90.A, and if the Work has not been completed by other means on or before the expiration of Contract Time or adjusted Contract Time, liquidated damages will be assessed against the Contractor for the duration of time reasonably required to complete the Work.

00180.90 Termination of Contract and Substituted Performance

A. Termination for Default - Termination of the Contract for default may result if the Contractor:

- Fails to comply with the requirements for records;
- Violates any material provision of the Contract;
- Disregards applicable laws and regulations or the Engineer's instructions;
- Refuses or fails to supply enough Materials, Equipment or skilled workers for prosecution of the Work in compliance with the Contract;
- Fails to make prompt payment to Subcontractors;
- Makes an unauthorized general assignment for the benefit of the Contractor's creditors;
- Has a receiver appointed because of the Contractor's insolvency;
- Is adjudged bankrupt and the court consents to the Contract termination; or
- Otherwise fails or refuses to faithfully perform the Contract according to its terms and conditions.

If the Contract is terminated by the Agency, upon demand the Contractor and the Contractor's Surety shall provide the Engineer with immediate and peaceful possession of the Project Site, and of all Materials and Equipment to be incorporated into the Work, whether located on and off the Project Site, for which the Contractor received progress payments under 00195.50.

If the Contract is terminated for default, neither the Contractor nor its Surety shall be:

- Relieved of liability for damages or losses suffered by the Agency because of the Contractor's breach of Contract; or
- Entitled to receive any further progress payments until the Work is completed. However, progress payments for completed Work that remain due and owing at the time of Contract termination may be made according to the terms of 00195.70, except that the Engineer will be entitled to withhold sufficient funds to cover costs incurred by the Agency as a result of the termination. Final payment to the Contractor will be made according to the provisions of Section 00195.

If a termination under this provision is determined by a court of competent jurisdiction to be unjustified, the termination shall be deemed a termination for public convenience.

B. Substituted Performance - According to the Agency's procedures, and upon the Engineer's recommendation that sufficient cause exists, the Agency, without prejudice to any of its other rights or remedies and after giving the Contractor and the Contractor's Surety 10 Calendar Days' written notice, may:

- Terminate the Contract;
- Substitute the Contractor with another Entity to complete the Contract;
- Take possession of the Project Site;
- Take possession of Materials on the Project Site;
- Take possession of Materials not on the Project Site, for which the Contractor received progress payments under 00195.50;
- Take possession of Equipment on the Project Site that is to be incorporated into the Work;
- Take possession of Equipment not on the Project Site that is to be incorporated into the Work, and for which the Contractor received progress payments under 00195.70; and
- Finish the Work by whatever method the Agency deems expedient.

If, within the 10 Calendar Day notice period provided above, the Contractor and/or its Surety corrects the basis for declaration of default to the satisfaction of the Engineer, or if the Contractor's Surety submits a proposal for correction that is acceptable to the Engineer, the Contract will not be terminated.

C. Termination for Public Convenience - The Engineer may terminate the Contract for convenience in whole or in part whenever the Engineer determines that termination of the Contract is in the best interest of the public and for, but not limited to, the following reasons:

- If work under the Contract is suspended by an order of a public agency for any reason considered to be in the public interest other than by a labor dispute or by reason of any third-party judicial proceeding relating to the Work other than a suit or action filed in regard to a labor dispute;
- If the circumstances or conditions are such that it is impracticable within a reasonable time to proceed with a substantial portion of the Contract;
- If Agency funding from federal, state, local, or other sources is not obtained and continued at levels sufficient to allow for the purchase of the indicated quantity of services, then this Contract may be modified to accommodate a reduction in funds; or
- If Federal or State regulations or guidelines are modified, changed, or interpreted in such a way that the services are no longer allowable or appropriate for purchase under this Contract.

The Engineer will provide the Contractor and the Contractor's Surety 7 Calendar Days' written notice of termination for public convenience. After such notice, the Contractor and the Contractor's Surety shall

provide the Engineer with immediate and peaceful possession of the Project Site, and of Materials and Equipment to be incorporated into the Work, whether located on and off the Project Site, for which the Contractor received progress payments under 00195.50.

Termination under any provision of this Subsection shall not affect any right, obligation, or liability of Contractor or Agency, which accrued prior to such termination.

If the Contract is terminated for public convenience, neither the Contractor nor its Surety shall be relieved of liability for damages or losses suffered by the Agency as a result of defective, unacceptable or unauthorized Work completed or performed.

Compensation for Work terminated by the Engineer under this provision will be determined according to the provisions of 00195.70.B.

Section 00190 - Measurement of Pay Quantities

00190.00 Scope

The Engineer will measure pay quantities for accepted Work according to the United States standard measure unless otherwise provided in the Contract. Unless otherwise specified in the Contract, the Engineer will round off all quantity computations using the following convention:

- The final significant digit will not be changed when the succeeding digit is less than 5.
- The final significant digit will be increased by one when the succeeding digit is 5 or greater.

The measurement provisions contained in the Specifications for each Pay Item will supplement or modify the above convention by:

- Imposing measurement limitations
- Describing measurement or computation procedures
- Giving conversion factors or adjustment conditions
- Providing for determination of reasonably accurate and representative Pay Item quantities

Measurements required or allowed to be made by the Contractor will be subject to the Engineer's verification. The Engineer's decision about measurement is final.

00190.10 Measurement Guidelines

Measurement of quantities will be made on the following basis, unless otherwise specified in the Contract.

- A. Unit Basis** - Unit will be each, unless otherwise specified in the Contract and will be determined by actual count of units in place.
- B. Length Basis** - Length will be feet or mile, unless otherwise specified in the Contract and will be determined by measuring the length at least to the nearest 0.1 foot or at least to the nearest 0.1 mile, as applicable, unless otherwise specified in the Contract. Measurements will be limited to the dimensions shown or specified, or as directed by the Engineer.
- C. Area Basis** - Area will be square foot, square yard, or acre, unless otherwise specified in the Contract and will be determined by measuring the width and the length (or height) at least to the nearest 0.1 foot and computed at least to the nearest 0.1 square foot, nearest 0.1 square yard, or nearest 0.1 acre, as applicable, unless otherwise specified in the Contract.
- D. Weight Basis** - Weight will be pound or ton, unless otherwise specified in the Contract and will be determined as follows:
 - 1. Pound** - Pound weight will be determined by the net weight identified on the manufacturer's packaged labels, subject to periodic check weighing. Weight by pound will be measured at least to the nearest 1.0 pound unless otherwise specified in the Contract.

Provide a certificate with each shipment together with a certified copy of the weight of each delivery. If the check weight is less than the manufacturer weight by more than 0.4%, the discrepancy will be resolved by the Engineer.

- 2. Ton** - Ton weight will be determined on Contractor-provided scales as required under 00190.20 unless otherwise allowed by the Specifications. Weight by ton will be measured at least to the nearest 0.01 ton unless otherwise specified in the Contract.

If bituminous materials, portland cement, lime, and similar bulk Materials are shipped by truck or rail, the supplier's shipping invoice with net scale weights, or volumes converted to weights, may be used for Pay Item quantity determination in place of weights determined on the Contractor-provided vehicle scales.

Shipping invoice weights of the supplier's truck or transport shall be subject to periodic check weighing on the Contractor's vehicle scales, or other scales designated, according to 00190.20. If the check weight is less than the supplier weight by more than 0.4%, the discrepancy will be resolved by the Engineer.

No payment will be made:

- For quantities in excess of the supplier weight
- When Materials have been lost, wasted, or otherwise not incorporated into the Work
- For additional hauling costs resulting from the check weighing

E. Volume Basis - Volume will be cubic yard truck measure or in-place measure, gallons, foot board measure (FBM), or thousand foot board measure (MFBM), unless otherwise specified in the Contract and will be measured at least to the nearest 0.1 cubic yard, nearest 1.0 gallon, nearest 0.1 FBM, or nearest 0.1 MFBM, as applicable, unless otherwise specified in the Contract.

Truck measure will be the measured and calculated maximum "water level" capacity of the vehicle. Quantities will be determined at the point of delivery, with no allowance for settlement of Material during transit. When required to facilitate measurement, the vehicle load shall be leveled at the point of delivery. Payment will not be made for Material in excess of the maximum "water level" capacity. Deductions will be made for loads below the maximum "water level" capacity.

When bituminous materials are measured by volume, the volume will be measured at 60 °F or will be corrected to the volume at 60 °F using the correction factors found in the MFIP (ODOT TM 321).

F. Time Basis - Time will be hour, Day, or year, unless otherwise specified in the Contract, and will be measured to at least the nearest 0.5 hour, nearest 1.0 Day, or nearest 1.0 year, as applicable, unless otherwise specified in the Contract.

G. Standard Manufactured Items - If standard manufactured items, such as fence, wire, plates, rolled shapes, pipe, conduit and other similar items are specified in the Contract by properties such as gauge, unit weight, or section dimensions, the manufacturing tolerances established by the industry involved will be accepted unless more stringent tolerances are cited in the Contract.

H. Lump Sum Basis - Lump sum, when used, means the Work described shall be completed and accepted without measurement unless changes are ordered in writing by the Engineer.

00190.20 Contractor to Provide Vehicle Weigh Scales

A. General - If the Specifications require measurement by weighing on vehicle weigh scales, the Contractor shall provide vehicle weigh scales and shall transport Materials to the scales. Subject to the Engineer's approval, weights may be determined by plant or hopper scales according to 00190.30.

Contractor-provided scales shall be furnished, installed and maintained by the Contractor or its supplier, or, subject to the Engineer's approval, may be commercial scales located in the vicinity of the Project.

Unless otherwise provided in the Contract, Pay Items to be measured by weight shall include all Contractor costs for providing, maintaining, inspecting, and testing scales; for furnishing appropriate weigh tickets; for self-printing scales; and for transporting Materials to the scales or to check weighing.

B. Requirements - The scales shall conform to ORS 618, or the laws of the state in which they are located, and NIST Handbook 44, and shall be:

- Licensed by the Oregon Department of Agriculture, or by the analogous regulatory body for scales located outside the State;
- Technically suitable for weighing the Materials;
- Properly installed and maintained; and
- Accurate to the required tolerances.

The weight of any Materials weighed by anyone other than the Engineer will be subject to check weighing as the Engineer directs.

C. Approaches - Vehicle scale approaches shall be:

- At each end of the scale platform;
- Straight and in line with the platform; and
- Long enough to accommodate combination vehicles longer than the scale platform so that they are level and allow release of brakes before weighing.

D. Inspections - Contractor shall have all scales certified, that is inspected and their accuracy tested, by the Oregon Department of Agriculture, an analogous regulatory body for scales located outside the State, or a scale service company as follows:

- Before use if installed at a new site;
- 60 Calendar Days after initial inspection;
- Every 6 months thereafter; and
- When the Engineer directs additional inspections.

No Materials weighed on scales without current certifications according to this Subsection will be accepted. The Contractor shall provide a copy of all required certifications to the Engineer.

Testing by a scale service company within the State of Oregon shall comply with ORS 618.

If additional inspections directed by the Engineer confirm that the scale accuracy is within the required tolerances, the Agency will pay the cost for inspecting and testing the scales. If the scale accuracy is not within these tolerances, the Contractor shall pay the cost for inspecting and testing the scales.

E. Inspection Results - If an inspection indicates the scales have been under-weighing (indicating less than the true weight), the Agency will make no additional payment to the Contractor for Materials previously weighed.

If an inspection indicates the scales have been over-weighing (indicating more than the true weight), the weights will be reduced for Materials received after the time the Engineer determines the overweighing began or, if that is not possible, after the last acceptable certification of the scales. The reduction will be the amount of error in excess of the 0.2% maintenance tolerance allowed in the Contract.

F. Contractor-Provided Weigh Technician - The Contractor shall provide a technician to operate Contractor-provided vehicle weigh scales. The Agency may observe procedures and require check weighing according to the following:

1. **Scale with Automatic Printer** - If the scales have an automatic weigh memo printer that does not require manual entry of gross weight information, the Agency may periodically have a representative at the scales to observe the weighing procedures. In addition, the Engineer may periodically check the weight for a load of Materials by directing the haul vehicle to reweigh on a different scale that has been inspected and certified according to 00190.20.B and 00190.20.D.

If a different scale is not available within a 30-mile round trip from the regular haul route, the Agency will allow check weighing on an approved alternate basis. Check weights within 0.4% of the Contractor-provided weight are acceptable.

The Engineer will resolve discrepancies found by check weighing. Agency employee costs will be paid by the Agency. The Contractor shall pay all other costs resulting from the check weighings, including, without limitation, the use of other scales.

If more than 50 tons per Day of all types of Materials are received from a scale, the Contractor shall make random check weighings at least every tenth Day on which more than 50 tons is received or at each interval that 10,000 tons has been weighed, whichever occurs first, or as directed by the Engineer. The Contractor shall make at least one check weighing on projects where more than 2,000 tons of all types of Materials are received from a scale. The Contractor shall provide the Engineer with the results of the check weighing.

2. **Scale Without Automatic Printer** - If the scales require manual entry of gross weight information, the Agency may periodically have a representative weigh witness at the scales to observe the weighing procedures. The Contractor shall inform the Engineer of his intent to use a scale without an automatic printer at least 3 working Days before weighing begins or before the Contractor changes to a scale that does not have an automatic printer. The Contractor shall pay costs for the weigh witness. The hourly cost of the weigh witness will be as stated in the Special Provisions. In addition, the Engineer may periodically check the weight for a load of Materials by directing the haul vehicle to reweigh on a different scale that has been inspected and certified according to 00190.20.B and 00190.20.D.

If a different scale is not available within a 30-mile round trip from the regular haul route, the Agency will allow check weighing on an approved alternate basis. Check weights within 0.4% of the Contractor-provided weight are acceptable.

The Engineer will resolve discrepancies found by check weighing. Agency employee costs for check weighings will be paid by the Agency. The Contractor shall pay all other costs resulting from the check weighings, including, without limitation, the use of other scales.

If more than 50 tons per Day of all types of Materials are received from a scale, the Contractor shall make random check weighings at least every tenth day on which more than 50 tons is received or at each interval that 10,000 tons has been weighed, whichever occurs first, or as directed by the Engineer. The Contractor shall make at least one check weighing on all projects where materials are received from a scale without an automatic printer. The Contractor shall provide the Engineer with the results of the check weighing.

3. **Duties of Weigh Technician** - The Contractor's weigh technician shall:

- Determine twice a Day, or as otherwise directed by the Engineer, the empty haul weights (tare weights) of hauling vehicles, unless vehicles are tared before each load;

- Furnish daily a listing of the tare weights if 10 or more loads are hauled during that Day;
- Furnish a note listing the net weight for each consecutive ten loads with the following load;
- Furnish a daily listing of the net weights and total weight for each type of Material hauled during that Day; and
- Furnish a legible, serially numbered weigh memo for each load of Materials to the Agency's Materials receiver at the point of delivery, or as directed by the Engineer. The memo shall identify the Project, the Materials, the date, net weight (gross and tare as appropriate), and identification of vehicle, driver and weigh technician.

G. Agency-Provided Weigh Technician - If the Contractor provides vehicle weigh scales without a weigh technician meeting the requirements of this Subsection, the Agency will provide a weigh technician at the Contractor's expense. The hourly cost for the weigh technician will be as stated in the Special Provisions. The Contractor shall provide a weighhouse for the weigh technician according to Section 00205. The Agency's weigh technician will:

- Determine tare weights;
- Prepare weigh memos for each load;
- Compile the weigh records; and
- Not participate in the production of Materials or the loading of haul vehicles.

00190.30 Plant Scales

The Contractor, with the Engineer's written approval, may weigh plant-mixed Materials on scales that have either:

- An automatic weight batching and mixing control printer system; or
- A weigh hopper printer system.

Any additional costs resulting from the use of these scales shall be borne by the Contractor. Check weighing will be done according to 00190.20.F.

Except for 00190.20.C regarding approaches, the Contractor's use of plant scales shall comply with all provisions of 00190.20.

The Engineer's approval for the Contractor's use of plant scales to determine pay weights will be rescinded if check weighing or scale inspections indicate the scales do not consistently determine weights within the tolerances allowed by state law.

Section 00195 – Payment

00195.00 Scope and Limit

- A. General** - The Agency will pay only for measured Pay Item quantities incorporated into the Work or performed according to the terms of the Contract. The Contractor understands and agrees that Pay Item quantities listed in the Schedule of Items do not govern payment.

Payment constitutes full compensation to the Contractor for furnishing all Materials, Equipment, labor, and Incidentals necessary to complete the Work; and for risk, loss, damage, and expense arising from the nature or prosecution of the Work or from the action of the elements, subject to the provisions of 00170.80. The Contractor shall include the costs of bonds and insurance for the Project in the unit price for each Pay Item of Work to be performed.

- B. Essential or Incidental Materials or Work** - When the Specifications state that the unit price for a Pay Item is compensation for certain Materials or Work essential or Incidental to the Pay Item, the same Materials or Work will not be measured or paid under any other Pay Item.

00195.10 Payment For Changes in Materials Costs

On certain projects, as identified in the Special Provisions, an escalation/de-escalation clause with respect to asphalt cement will be in effect during the life of the Contract.

00195.13 Asphalt Cement Material Price Escalation/De-Escalation Clause

Subsections 00195.13.A, 00195.13.B, 00195.13.C, and 00195.13.D contain the price escalation/de-escalation clause relating to asphalt cement materials (as defined in 00195.13.D).

- A. Monthly Asphalt Cement Material Price (MACMP)** - The Monthly Asphalt Cement Material Price (MACMP) will be established by the Agency each month and will be based on the published prices of PG 64 22 asphalt cement furnished by Poten & Partners, Inc. The MACMP will be based on the average prices for the Pacific Northwest, Portland, Oregon area. Each MACMP for a given month will be the average of the published prices for that MACMP for each Friday in that month. For information regarding the calculation of the MACMP, and for the actual MACMP, go to the ODOT website at:

<http://www.oregon.gov/ODOT/HWY/Business/Pages/Asphalt-Fuel-Price.aspx>

If the ODOT selected index ceases to be available for any reason, the Agency in its discretion will select and begin using a substitute price source or index to establish the MACMP each month. The MACMP will apply to all asphalt cement including but not limited to paving grade, polymer modified, and emulsified asphalts, and recycling agents. The Agency does not guarantee that asphalt cement will be available at the MACMP.

- B. Base Asphalt Cement Material Price (Base)** - The Base price for this Project is the MACMP published on the ODOT website for the month immediately preceding the bid opening date.
- C. Monthly Asphalt Cement Adjustment Factor** - The Monthly Asphalt Cement Adjustment Factor will be determined each month as follows:

- If the MACMP is within $\pm 5\%$ of the Base, there will be no adjustment.
- If the MACMP is more than 105% of the Base, then:
 - Adjustment Factor = (MACMP) - (1.05 x Base)
- If the MACMP is less than 95% of the Base, then:
 - Adjustment Factor = (MACMP) - (0.95 x Base)

D. Asphalt Cement Price Adjustment - If specified in the Special Provisions, an asphalt cement escalation/de-escalation clause will be in effect during the life of the Contract. A price adjustment will be made for each pay item in the bid schedule containing asphalt cement. The price adjustment as calculated in 00195.13.C above will use the MACMP for the month the asphalt is incorporated into the Project. The price adjustment will be determined by multiplying the asphalt incorporated during the month for subject Pay Items by the Adjustment Factor. The Agency reserves all of its rights under the Contract, including, but not limited to, its rights for suspension of the Work under 00180.70 and its rights for termination of the Contract under 00180.90, and this escalation/de-escalation provision shall not limit those rights.

00195.20 Changes to Plans or Character of Work

- A. Insignificant Changed Work** - If the changes made under 00140.30 do not significantly change the character, quantity or unit cost of the Work to be performed under the Contract, the Agency will pay for such work at the Pay Item price.
- B. Significant Changed Work** - If the changes made under 00140.30 significantly alter the character, unit cost, or lump sum cost of the Work, the Agency will adjust the Contract. The Contractor shall not be entitled to compensation for any loss in profits resulting from elimination of, reduction of, or other change to, a part of the Work.

Any such adjustments may be less than, but will not be more than the amount justified by the Engineer on the basis of the established procedures set out in Section 00197 for determining rates for Extra Work, but those procedures shall account for the decrease or elimination of Work as well as for increases in the Work. This does not limit the application of Section 00199.

The term "Significant Changed Work" shall apply only to that circumstance in which the character of the Work, as changed, differs materially in kind, nature, or unit cost from that involved or included in the originally proposed construction.

For purposes of this Section, "Significant" is defined as:

- An increase or decrease of more than 25 percent of the total cost of the Work calculated from the original proposal quantities and the unit contract prices; or,
- An increase or decrease of more than 25 percent in the quantity of any one major contract item. A major item is defined as any item that amounts to 10 percent or more of the original total contract price.

00195.30 Differing Site Conditions

Upon written notification, as required in 00140.40, the Engineer will investigate the identified conditions. If the Engineer determines that the conditions are differing Project site conditions under 00140.40 and cause an increase or decrease in the cost or time required to perform any Work under the Contract, an adjustment in the Contract Amount or Contract Time, excluding loss of anticipated profits, will be made, and the Contract modified accordingly, in writing. The Engineer will notify the Contractor as to whether or not an adjustment of the Contract is warranted.

No Contract adjustment which benefits the Contractor will be allowed unless the Contractor has provided the required written notice. Any such adjustments will be made according to 00195.20.

00195.40 Unreasonable Delay by the Agency

If the Contractor believes that performance of all or any portion of the Work is suspended, delayed, or interrupted for an unreasonable period of time in excess of that originally anticipated or customary in the construction industry, due to acts or omissions of the Agency, or persons acting for the Agency, and that

additional compensation, Contract Time, or both, are due the Contractor because of the suspension, delay or interruption, the Contractor shall immediately file a written notice of delay according to 00180.60. The Contractor shall then promptly submit a properly supported request for any additional compensation, Contract Time, or both, according to the applicable provisions in 00180.60 through 00180.80 and Section 00199.

The Engineer will promptly evaluate a properly submitted request for additional compensation. If the Engineer determines that the delay was unreasonable, and that the cost required for the Contractor to perform the Contract has increased as a result of the unreasonable suspension, delay or interruption, the Engineer will make an equitable adjustment, excluding profit, and modify the Contract in writing accordingly. The Engineer will notify the Contractor of the determination and whether an adjustment to the Contract is warranted.

Under this provision, no Contract adjustment will be allowed:

- Unless the Contractor has provided the written notice required by 00180.60;
- For costs incurred more than 10 Calendar Days before the Engineer receives the Contractor's properly submitted written request;
- For any portion of a delay that the Engineer deems to be a reasonable delay, or for which an adjustment is provided for or excluded under other terms of the Contract; or
- To the extent that performance would nevertheless have been suspended, delayed or interrupted by causes other than those described in this Subsection.

00195.50 Progress Payments and Retained Amounts

A. Progress Payments - The Agency's payment of progress payments, or determination of satisfactory completion of Pay Items or Work or release of retainage under 00195.50.D, shall not be construed as Final Acceptance or approval of any part of the Work, and shall not relieve the Contractor of responsibility for defective Materials or workmanship or for latent defects and warranty obligations.

The estimates upon which progress payments are based are not represented to be accurate estimates. All estimated quantities are subject to correction in the final estimate. If the Contractor uses these estimates as a basis for making payments to Subcontractors, the Contractor assumes all risk and bears any losses that result.

Progress payments shall be determined through the use of forms developed by the Engineer.

1. Progress Estimates - At the same time each month, the Engineer will make an estimate of the amount and value of Pay Item Work completed. The amount of Work completed will be the sum of the estimated number of units completed for unit price Pay Items plus the estimated percentage completed of lump sum Pay Items.

The estimated value of the Work completed will be determined by using the Contract unit price for unit price Pay Items, and by using one of the following methods to determine the value of the lump sum Pay Items:

- A Contractor-submitted, Engineer-approved Schedule of Values; or
- Engineer's determination, when there is no approved, Contractor-submitted Schedule of Values.

The amounts to be allowed for lump sum Pay Items in progress payments will not exceed the reasonable value of the Work performed, as determined by the Engineer.

Incidentals such as formwork, falsework, shoring, and cribbing shall be included in the unit prices for the various Pay Items requiring their use, unless specified as a separate Pay Item. No payment will be made for Pay Items that include Incidentals until units or portions of such Pay Item Work are in place and completed. The costs of Incidentals will be paid in proportion to the percentage of Pay Item Work completed.

2. **Value of Materials on Hand** - If payment for Materials on Hand is allowed in the Special Provisions, the Engineer will also make an estimate of the amount and value of acceptable Materials on hand, i.e., already delivered and stored according to 00195.60.A, to be incorporated into the Work.
3. **Value of Work Accomplished** - The sum of the values in 00195.50.A.1 and 00195.50.A.2 above will be collectively referred to in this Subsection as the “value of Work accomplished”, subject to 00195.50.A.4 below.
4. **Limitations on Value of Work Accomplished** - In determining the “value of Work accomplished”, the Engineer’s estimate will be based on the unit prices for the various Pay Items. Any amounts not included in progress payments due to substantial mathematical unbalancing of Pay Item prices will be included in the final payment issued according to 00195.90.B.
5. **Reductions to Progress Payments** - With each progress payment, the Contractor will receive a Contract payment voucher and summary setting forth the value of Work accomplished reduced by the following:
 - Amounts previously paid;
 - Amounts deductible or owed to the Agency for any cause specified in the Contract;
 - Additional amounts retained to protect the Agency’s interests according to Subsection (e) below.

- B. Retainage** - The amount to be retained from progress payments will be 5% of the value of Work accomplished, and will be retained in one of the forms specified in Subsection 00195.50.C below.

As provided in 00170.65.B.3.a additional retainage of 25% of amounts earned will be withheld and released according to ORS 279C.845 when the Contractor fails to file the certified statements required in ORS 279C.845, FHWA Form 1273, and 00170.65.

- C. Forms of Retainage** - Moneys retained by the Agency under ORS 279C.570(7) shall be retained in a fund by the Agency and paid to the Contractor in accordance with ORS 279C.570. Upon written request from the Contractor, other forms of acceptable retainage are specified below in Subsections 00195.50.C.1 through 00195.50.C.3. “Cash, Alternate A” is the Agency-preferred form of retainage. If the Agency incurs additional costs as a result of the Contractor’s election to use a form of retainage other than Cash, Alternate A, the Agency may recover such costs from the Contractor by a reduction of the final payment.

1. **Cash, Alternate A** - Retainage will be deducted from progress payments and held by the Agency until final payment is made according to 00195.90, unless otherwise specified in the Contract.

The Agency will deposit the cash retainage withheld in an interest-bearing account in a bank, trust company, or savings association for the benefit of the Agency, as provided by ORS 279C.560(5). Interest earned on the account shall accrue to the Contractor. Amounts retained and interest earned will be included in the final payment made according to 00195.90.

Any retainage withheld on Work performed by a Subcontractor will be released to the Contractor according to 00195.50.D.

- 2. Cash, Alternate B (Retainage Surety Bond)** - Upon receipt of an approved retainage surety bond, the Agency will limit the amount of cash retainage withheld to \$10,000. The surety bond must be in the bond form provided by the Agency. The bond must be provided by the same Surety that provides the Performance and Payment Bonds.

If the Contractor elects this form of retainage, the Agency will withhold from progress payments up to 5% of the value of the Work accomplished as cash retainage until the retained amount equals \$10,000. After that amount is retained, no further cash retainage will be withheld until the additional required retainage that would have been withheld exceeds the face amount of the retainage surety bond provided. Thereafter, retainage will be withheld from progress payments according to these Specifications. According to 00195.50.B, if at any time the Agency determines that satisfactory progress is not being made on the Work, the Agency may withhold up to 5% of the value of the Work accomplished from subsequent progress payments.

If an acceptable retainage surety bond is provided, the Contractor shall notify all Subcontractors of the existence of the retainage surety bond and shall advise them of their rights under ORS 279C.560(7) and ORS 701.435.

Amounts of retainage withheld under the provision will be included in the final payment according to 00195.90.

Any retainage withheld on Work performed by a Subcontractor shall be released to the Contractor according to 00195.50.D.

- 3. Bonds, Securities, and Other Instruments** - In accordance with ORS 279C.560, unless the Agency finds in writing that accepting a bond, security or other instrument poses an extraordinary risk that is not typically associated with the bond, security or other instrument, the Agency will approve the Contractor's written request to deposit bonds, securities or other instruments with the Agency or in a custodial account or other account satisfactory to the Agency with an approved bank or trust company, to be held instead of cash retainage for the benefit of the Agency. In such event, the Agency will reduce the cash retainage by an amount equal to the value of the bonds, securities and other instruments. Interest or earnings on the bonds, securities and other instruments shall accrue to the Contractor.

Bonds, securities and other instruments deposited instead of cash retainage shall be assigned to or made payable to the Agency and shall be of a kind approved by the Director of the Oregon Department of Administrative Services, including but not limited to:

- Bills, certificates, notes or bonds of the United States;
- Other obligations of the United States or agencies of the United States;
- Obligations of a corporation wholly owned by the federal government;
- Indebtedness of the Federal National Mortgage Association;
- General obligation bonds of the State of Oregon or a political subdivision of the State of Oregon;
- Irrevocable letters of credit issued by an insured institution, as defined in ORS 706.008.

The Contractor shall execute and provide such documentation and instructions respecting the bonds, securities and other instruments as the Agency may require to protect its interests. When the Engineer determines that all requirements for the protection of the Agency's interest have been fulfilled, the bonds and securities deposited instead of cash retainage will be released to the Contractor.

D. Reduction of Retainage - As the Work progresses, the amounts to be retained under 00195.50.B of this Subsection are subject to reduction in the Engineer's sole discretion. Retainage reductions will be considered only as follows:

- When the Work is 97.5% or more completed, the Engineer may, without application by the Contractor, reduce the retained amount to 100% of the value of the Work remaining.
- For a project funded by the FHWA, when a Subcontractor has satisfactorily completed all of its Work, it may request release of retainage for that Work from the Contractor. The Contractor shall request reduction of retainage in the amount withheld for the Subcontractor's Work after certifying to the Agency that the Subcontractor's Work is complete, and that all contractual requirements pertaining to the Subcontractor's Work have been satisfied. Within 60 Calendar Days of the end of the month in which the Agency receives the Contractor's certification regarding the Subcontractor's Work, the Agency will either notify the Contractor of any deficiencies which require completion before release of retainage, or verify that the Subcontractor's Work complies with the Contract and release all retainage for that Work with the next scheduled progress payment. Within 10 Calendar Days of receipt of retainage, the Contractor shall pay to the Subcontractor all such retainage released except for latent defects or warranty.
- The Agency will only release retainage for satisfactorily completed portions of the Work represented by Pay Items in the Schedule of Items, or by Pay Items added by Change Order. Work not represented by a Pay Item, but which constitutes part of an uncompleted Pay Item, will not be regarded as satisfactorily completed Work for the purposes of this Subsection.

If retainage has been reduced or eliminated, the Agency reserves the right to protect its interests by retaining amounts from further progress payments at the rates provided in 00195.50.B.

E. Withholding Payments - In addition to any other rights the Agency may have to withhold payments under other provisions of the Contract, the Engineer may withhold such amounts from progress payments or final payment as may reasonably protect the Agency's interests until the Contractor has:

- Completed all Final Trimming and Cleanup according to 00140.90 and Punch List work according to 00150.90.A. An amount of up to twice the Engineer's estimated value of Final Trimming and Punch List work may be withheld.
- Complied with all orders issued by the Engineer according to the Specifications; and
- Satisfied all legal actions filed against the Agency, the Agency's governing body and its members, and Agency employees that the Contractor is obliged to defend. (See 00170.72)

Notwithstanding ORS 279C.555 or ORS 279C.570 or 00195.50.D, if a Contractor is required to file statements on the prevailing rate of wages, but fails to do so, the Agency will retain 25% of any amount earned as required in 00170.65.

F. Prompt Payment Policy - Payments shall be made promptly according to ORS 279C.570.

00195.60 Advance Allowance for Materials on Hand

A. General - If the total value of Materials on Hand is at least \$1,000, or the total value of a single class of Materials on Hand is at least \$500, the Engineer may authorize an advance allowance for the Materials in the progress payments. The Agency will not make advance allowances on the Materials unless the following three conditions are satisfied:

1. **Request for Advance Allowance** - If Materials on Hand meet the requirement of 00195.60.A.2 below, an advance allowance will be made if:

- A written request for advance allowance for Materials on hand has been received by the Engineer at least 5 Calendar Days before the pay period cutoff date; and
- The request is accompanied by written consent of the Contractor's Surety, if required by the Agency.

2. Stored or Stockpiled Conditions - The Materials shall have been delivered and/or acceptably stored or stockpiled according to the Specifications and as follows:

- At the Project Site;
- On Agency-owned property;
- On property in the State of Oregon on which the property owner has authorized storage in writing. The written authorization must allow the Agency to enter upon the property and remove Materials for at least 6 months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Agency; or
- On property outside the State of Oregon on which the property owner has authorized storage in writing, provided that such storage location is authorized in writing by the Engineer. The permit must allow the Agency to enter upon the property and remove Materials for at least 6 months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Agency.

To be eligible for advance allowance, the Materials shall:

- Meet Specification requirements;
- Have the required Materials conformance and quality compliance documents on file with the Engineer (see Section 00165);
- Be in a form ready for incorporation into the Work; and
- Be clearly marked and identified as being specifically fabricated, or produced, and reserved for use on the Project.

3. Responsibility for Protection - The Contractor has full control and responsibility for the protection of Materials on Hand from the elements and against damage, loss, theft, or other impairment until the entire Project has been completed and accepted by the Agency.

If Materials are damaged, lost, stolen, or otherwise impaired while stored, the monetary value advanced for them, if any, will be deducted from the next progress payment.

If these conditions in 00195.60.A.1 through 00195.60.A.3 have been satisfied, the amount of advance allowance, less the retainage described in 00195.50, will be determined by one of the following methods as elected by the Engineer:

- Net cost to the Contractor of the Materials, f.o.b. the Project Site or other approved site; or
- Price (or portion of it attributable to the Materials), less the cost of incorporating the Materials into the Project, as estimated by the Engineer.

B. Proof of Payment - The Contractor shall provide the Engineer with proof of payment to the materials Suppliers for purchased Materials prior to the date of the progress payment that includes the advance allowance.

If proof of payment is not provided, sums advanced will be deducted from future progress payments, and the Engineer will not approve further prepayment advance allowance requests.

- C. Terminated Contract** - If the Contract is terminated, the Contractor shall provide the Agency immediate possession of all Materials for which advance allowances have been received, as provided above. If, for any reason, immediate possession of the Materials cannot be provided, the Contractor shall immediately refund to the Agency the total amount advanced for the Materials. The Agency may deduct any amount not so refunded from final payment.

00195.70 Payment under Terminated Contract

Payment for Work performed under a Contract that is terminated according to the provisions of 00180.90 will be determined under 00195.70.A or 00195.70.B of this Subsection.

- A. Termination for Default** - Upon termination of the Contract for the Contractor's default, the Agency will make no further payment until the Project has been completed. The Agency will make progress payments to the party to whom the Contract is assigned, but may withhold an amount sufficient to cover anticipated Agency costs, as determined by the Engineer, to complete the Project.

Upon completion of the Project, the Engineer will determine the total amount that the defaulting Contractor would have been entitled to receive for the Work, under the terms of the Contract, had the Contractor completed the Work (the "cost of the completed Work").

If the cost of the Work, less the sum of all amounts previously paid to the Contractor, exceeds the expense incurred by the Agency in completing the Work, including without limitation expense for additional managerial and administrative services, the Agency will pay the excess to the Contractor, subject to the consent of the Contractor's Surety.

If the expense incurred by the Agency in completing the Work exceeds the Contract Amount, the Contractor or the Contractor's Surety shall pay to the Agency the amount of the excess expense.

The Engineer will determine the expense incurred by the Agency and the total amount of Agency damage resulting from the Contractor's default. That determination will be final as provided in 00150.00.

If a termination for default is determined by a court of competent jurisdiction to be unjustified, it shall be deemed a termination for public convenience, and payment to the Contractor will be made as provided in Subsection 00195.70.B below.

B. Termination for Public Convenience:

- 1. General** - Full or partial termination of the Contract shall not relieve the Contractor of responsibility for completed or performed Work, or relieve the Contractor's Surety of the obligation for any just claims arising from the completed or performed Work.
- 2. Mobilization** - If mobilization is not a separate Pay Item, and payment is not otherwise provided for under the Contract, the Agency may pay the Contractor for mobilization expenses, including moving Equipment to and from the Project Site. If allowed, payment of mobilization expenses will be based on cost documentation submitted by the Contractor to the Engineer.
- 3. All Other Work** - The Agency shall pay the Contractor at the unit price for the number of Pay Item units of completed, accepted Work. For units of Pay Items partially completed, payment will be as mutually agreed, or, if not agreed, as the Engineer determines to be fair and equitable. No claim for loss of anticipated profits will be allowed. The Agency will purchase Materials left on hand according to 00195.80.

00195.80 Allowance for Materials Left on Hand

A. Purchase of Unused Materials - If Materials are delivered to the Project Site, or otherwise acceptably stored at the order of the Engineer, but not incorporated into the Work due to complete or partial elimination of Pay Items, changes in Plans, or termination of the Contract for public convenience according to 00180.90, and it is not commercially feasible for the Contractor to return them for credit or otherwise dispose of them on the open market; the Agency may purchase them according to the formula and conditions specified in Subsection 00195.80.B below.

B. Purchase Formula and Conditions:

1. **Formula** - The Agency will apply the following formula in determining the Contractor's allowance for Materials left on hand:

Contractor's Actual Cost, plus 5% Overhead Allowance, minus Advance Allowances under 00195.60, but no markup or profit.

2. **Conditions** - The Agency will not purchase the Contractor's Materials left on hand unless the Contractor satisfies the following conditions:

- Requests the Agency's purchase of unused Materials;
- Shows acquisition of the Materials according to 00160.10;
- Shows that the Materials meet Specifications;
- Provides receipts, bills and other records of actual cost of Materials delivered to the designated delivery points; and
- Demonstrates to the satisfaction of the Engineer that the materials cannot be returned for credit or otherwise disposed of on the open market.

00195.90 Final Payment

A. Final Estimate - As soon as practicable after Final Inspection of the Project, as provided in 00150.90, the Engineer will prepare a final estimate of the quantities of the Pay Items completed. With this estimate of quantities as a base, the total amount due the Contractor will be determined according to the terms of the Contract, including, without limitation, any amounts due for Extra Work performed.

B. Final Payment - The amount of final payment will be the difference between the total amount due the Contractor and the sum of all payments previously made. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

After computation of the final amount due, and after Engineer's issuance of the Third Notification, final payment will be mailed to the Contractor's last known address as shown in the records of the Agency.

Beginning 30 Calendar Days after the date of Third Notification, interest will begin to accrue at the rate established by ORS 279C.570 on any money due and payable to the Contractor as final payment, determined as described above. No interest will be paid on money withheld due to outstanding amounts owed by the Contractor under the provisions of 00170.10.

C. No Waiver of Right to Make Adjustment - The fact that the Agency has made any measurement, estimate, determination or certification either before or after completion of the Project, Final Acceptance, Agency assumption of possession of the Project Site, determination of satisfactory completion of Pay Items or Work or release of retainage under 00195.50.D or payment for any part of the Work, shall not prevent either party from:

- Showing the true amount and character of the Work;
- Showing that any measurement, estimate, determination or certification is incorrect;
- Recovering from the other party damages that may have been suffered because the other party failed to comply with the Contract.

D. Evidence of Contractor Payments - As a condition of final payment, the Agency may require the Contractor to submit evidence, satisfactory to the Engineer, that all payrolls, Material bills, and other indebtedness connected with the Project have been paid, except that in case of any disputed indebtedness or liens, the Contractor may submit in lieu of evidence of payment, a surety bond satisfactory to the Agency guaranteeing payment of all such disputed amounts when adjudicated in cases where such payment has not already been guaranteed by surety bond.

00195.95 Error in Final Quantities and Amounts

A. Request for Correction of Compensation - If the Contractor believes the quantities and amounts detailed in the final Contract payment voucher, prepared by the Engineer according to 00195.90, to be incorrect, the Contractor shall submit an itemized statement to the Engineer detailing all proposed corrections.

This statement must be submitted to the Engineer within 90 Calendar Days from the date the voucher was mailed to the Contractor, according to 00195.90.B. Any request for compensation not submitted and supported by an itemized statement within the 90 Calendar Day period will not be paid by the Agency. This does not limit the application of Section 00199.

B. Acceptance or Rejection of Request:

- 1. Consideration of Request** - The Engineer will consider and investigate the Contractor's request for correction of compensation submitted according to 00195.95.A, and will promptly advise the Contractor of acceptance or rejection of the request in full or in part.
- 2. Acceptance of Request** - If the Engineer accepts the Contractor's request(s) in full or in part, the Engineer will prepare a post-final Contract payment voucher, including all accepted corrections, and will forward it to the Contractor.
- 3. Rejection of Request** - If the Engineer rejects the request(s) in full, the Engineer will issue a written notice of rejection and mail it to the Contractor.
- 4. Contractor Objection to Revised Voucher or Notice of Rejection** - If the Contractor disagrees with the revised voucher or notice of rejection, the Contractor may seek review and resolution according to the procedure specified in 00199.40. If the Contractor fails to submit a request for 00199.40 review within 30 Calendar Days after the Engineer mails a post-final Contract payment voucher or notice of rejection, the Contractor waives all rights to a claim based on errors in quantities and amounts.

If the Engineer rejects the Contractor's request on the basis that the issue was not one that qualified for treatment under this Section, no review according to 00199.40 will be allowed.

Section 00196 - Payment for Extra Work

00196.00 General

Only work not included in the Contract as awarded but deemed by the Engineer to be necessary to complete the Project (see 00140.60) will be paid as Extra Work. Regardless of alterations and changes, any item of Work provided for in the Contract will not constitute Extra Work. Payment for alterations and changes to Work will be made according to 00195.20.

Compensation for Extra Work will be paid only for Work authorized in writing by the Engineer and performed as specified. Work performed before issuance of the Engineer's written authorization shall be at the Contractor's risk. Extra Work will be paid as determined by the Engineer, according to 00196.10 and 00196.20.

00196.10 Negotiated Price

If the Engineer can reasonably determine a price estimate for Extra Work, the Engineer may then give written authorization to the Contractor to begin the Extra Work. As soon as practicable, but within 10 Calendar Days after that authorization, the Contractor shall respond in writing to the Engineer's Extra Work price estimate by submitting to the Engineer an Extra Work price quote. The price quote shall detail the following items related to the Extra Work:

- Types and amounts of Materials
- Hours of Equipment use and hours of labor
- Travel
- Overhead and profit
- Other costs associated with the proposed Extra Work

Pending approval of the price quote, the Engineer will maintain Force Account records of the Extra Work. As soon as practicable, but within 10 Calendar Days of receipt of a properly supported price quote, the Engineer will review the price quote and advise the Contractor if it is accepted or rejected. The Engineer will not accept a price quote that cannot be justified on a Force Account basis. If the Contractor's price is accepted, the Engineer will issue a Change Order, and the Extra Work will be paid at the accepted price.

00196.20 Force Account

If the Engineer and the Contractor cannot agree on a price for the Extra Work, the Engineer may issue a Force Account Work order requiring the Extra Work to be paid as Force Account Work. Force Account Work records and payment will be made according to Section 00197.

Section 00197 - Payment for Force Account Work

00197.00 Scope

The Materials, Equipment and Labor rates and procedures established in this Section apply only to Extra Work ordered by the Engineer to be performed as Force Account Work.

00197.01 Extra Work on a Force Account Basis

Before ordering Force Account Work, the Engineer will discuss the proposed work with the Contractor, and will seek the Contractor's comments and advice concerning the formulation of Force Account Work specifications. The Engineer is not bound by the Contractor's comments and advice, and has final authority to:

- Determine and direct the Materials, Equipment and Labor to be used on the approved Force Account Work; and
- Determine the time of the Contractor's performance of the ordered Force Account Work.

Force Account Work performed by Subcontractors will be measured and paid for on the same basis and in the same manner as Force Account Work performed directly by the Contractor.

If the Engineer orders the performance of Extra Work as Force Account Work, the Engineer will record, on a daily basis, the Materials, Equipment, and labor used for the Force Account Work during that day. The Engineer and the Contractor shall sign the record daily to indicate agreement on the Materials, Equipment, and labor used for the Force Account Work performed on that day.

The following shall be reflected on the daily record:

- Materials used in the Force Account Work as directed by the Engineer, except those furnished and paid under rental rates for use of Equipment;
- Equipment which the Engineer considers necessary to perform the Force Account Work. Equipment hours will be recorded to the nearest quarter hour;
- Labor costs, including that of Equipment operators and supervisors in direct charge of the specific operations while engaged in the Force Account Work; and
- The Engineer's and Contractor's signatures confirming its accuracy.

00197.10 Materials

- A. General** - The Contractor will be paid for Materials actually used in the Force Account Work as directed by the Engineer, except for those furnished and paid for under rental rates included with the use of Equipment. Payments will be at actual cost, including transportation costs to the specified location, from the supplier to the purchaser, whether the purchaser is the Contractor, a Subcontractor, or other forces. All costs are subject to the provisions of this Subsection.
- B. Trade Discount** - If a commercial trade discount is offered or available to the purchaser, it shall be credited to the Agency, even though the discount may not have actually been taken. The Agency will not take any discounts for prompt or early payment, whether or not offered or taken.
- C. Not Directly Purchased From Supplier** - If Materials cannot be obtained by direct purchase from and direct billing by the supplier, the cost shall be considered to be the price billed to the purchaser less commercial trade discounts, as determined by the Engineer, but not more than the purchaser paid for the Materials. No markup other than actual handling costs will be permitted.

D. Purchaser-Owned Source - If Materials are obtained from a supply or source wholly or partly owned by the purchaser, the cost shall not exceed the price paid by the purchaser for similar Materials furnished from that source on Pay Items, or the current wholesale price for the Materials delivered to the Project Site, whichever is lower.

00197.20 Equipment

A. General - Equipment approved by the Engineer to perform the Force Account Work will be eligible for payment at the established rates only during the hours it is operated or on standby if so ordered by the Engineer. Equipment hours will be recorded on the daily record to the nearest quarter hour.

Except as modified by these provisions, Equipment use approved by the Engineer will be paid at the rental rates given in the most current edition of the Rental Rate Blue Books for Construction Equipment (“Blue Book”), Volumes 1, 2, and 3, published by Penton Media, Inc., and available from EquipmentWatch (phone 1-800-669-3282).

B. Equipment Description - On the billing form for Equipment costs, the Contractor shall submit to the Engineer sufficient information for each piece of Equipment and its attachments to enable the Engineer to determine the proper rental rate from the Blue Book.

C. Rental Rates (without Operator):

1. Rental Rate Formula - Rental rates for Equipment will be paid on an hourly basis for Equipment and for attachments according to the following formula:

$$\text{Hourly Rate} = \frac{\text{Monthly Base Rate} * \text{Rate Adjustment Factor}}{176 \text{ hours/month}} + \text{Hourly Operating Rate}$$

Some attachments are considered “standard Equipment” and are already included in the monthly base rate for the Equipment. That information can be obtained from EquipmentWatch.

2. Monthly Base Rate - The monthly base rate used above for the machinery and for attachments represents the major costs of Equipment ownership, such as depreciation, interest, taxes, insurance, storage, and major repairs.

3. Rate Adjustment Factor - The rate adjustment factor used above will be determined by applying only the Model Year Adjustment to the Blue Book Rates. The Regional and User Defined Ownership/Operating Adjustments shall not apply.

4. Hourly Operating Rate - The hourly operating rate used above for the machinery and for attachments represents the major costs of Equipment operations, such as fuel and oil, lubrications, field repairs, tires or ground engaging components, and expendable parts.

5. Limitations - If multiple attachments are included with the rental Equipment, and are not considered “standard Equipment”, only the attachment having the higher rental rate will be eligible for payment, provided the attachment has been approved by the Engineer as necessary to the Force Account Work.

Rental will not be allowed for small tools that have a daily rental rate of less than \$5, or for unlisted Equipment that has a fair market value of \$400 or less.

The above rates apply to approved Equipment in good working condition. Equipment not in good working condition, or larger than required to efficiently perform the work, may be rejected by the Engineer or accepted and paid for at reduced rates.

D. Moving Equipment - If it is necessary to transport Equipment located beyond the Project Site exclusively for Force Account Work, the actual cost to transport the Equipment to, and return it from, its On-Site Work location will be allowed as an additional item of expense. However, the return cost will not exceed the original delivery cost. These costs will not be allowed for Equipment that is brought to the Project Site for Force Account Work if the Equipment is also used on Pay Item or related Work.

If transportation of such Equipment is by common carrier, payment will be made in the amount paid for the freight. No markups will be allowed on common carrier transportation costs. If the Equipment is hauled with the Contractor's own forces, transportation costs will include the rental rate of the hauling unit and the hauling unit operator's wage. If Equipment is transferred under its own power, the rental rate allowed for transportation time will be 75% of the appropriate hourly rate for the Equipment, without attachments, plus the Equipment operator's wage.

E. Standby Time - If ordered by the Engineer, standby time will be paid at 40% of the hourly rental rate calculated according to this Subsection, excluding the hourly operating rate. Rates for standby time that are calculated at less than \$1 per hour will not be paid. Payment will be limited to not more than 8 hours in a 24-hour period or 40 hours in a 1 week period. Standby Time provisions shall also apply to Section 00195 - Payment.

F. Blue Book Omissions - If a rental rate has not been established in the Blue Book, the Contractor may:

- If approved by the Engineer, use the rate of the most similar model found in the Blue Book, considering such characteristics as manufacturer, capacity, horsepower, age and fuel type;
- Request EquipmentWatch to furnish a written response for a rental rate on the Equipment, which shall be presented to the Engineer for approval; or
- Request that the Engineer establish a rental rate.

G. Outside Rental Equipment - If Contractor-owned or Subcontractor-owned Equipment is not available, and Equipment is rented from outside sources, payment will be based on the actual paid invoice. Approval of the Engineer to rent from outside sources must be obtained prior to renting the equipment.

If the invoice specifies that rental rate does not include fuel, lubricants, field repairs, and servicing, an amount equal to the Blue Book hourly operating cost may be added for those items that were excluded.

The Agency may reduce the payment when the invoice amount plus allowance is higher than the amount authorized under 00197.20.C through 00197.20.F of this Subsection.

00197.30 Labor

The Contractor will be paid for all labor engaged directly on Force Account Work, including Equipment operators and supervisors in direct charge of the specific Force Account operations, as follows:

- A. Wages** - The actual wages paid to laborers and supervisors, if those wages are paid at rates not more than those for comparable labor currently employed on the Project, or at the recognized, current, prevailing rates in the locality of the Project.
- B. Required Contributions** - The actual cost of industrial accident insurance, unemployment compensation contributions, payroll transit district taxes, and social security for old age assistance contributions incurred or required under statutory law and these Specifications. The actual cost of industrial accident insurance is the National Council on Compensation Insurance (NCCI) rate for the assigned risk pool for the appropriate work class multiplied by the experience modification factor for the Contractor.

C. Required Benefits - The actual amount paid to, or on behalf of, workers as per diem and travel allowances, health and welfare benefits, pension fund benefits, or other benefits when such other benefits are required by a collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the Project.

D. Overtime - No overtime will be compensated unless authorized in advance of performing the Work by the Engineer.

00197.80 Percentage Allowances

To the Contractor’s actual costs incurred, as limited in this Section 00197, amounts equal to a percentage markup of such costs will be allowed and paid to the Contractor as follows:

Subsection	Percent
00197.10 Materials	17
00197.20 Equipment	17
00197.30 Labor	22

When a Subcontractor performs ordered Force Account Work, the Contractor will be allowed a supplemental markup of 8% on each Force Account Work order.

These allowances made to the Contractor will constitute complete compensation for bonds, insurance, overhead, general and administrative expense, profit, and all other Force Account Work costs that were incurred by the Contractor, or by other forces that the Contractor furnished. No other reimbursement, compensation, or payment will be made.

00197.90 Billings

Billings for Force Account Work by the Contractor shall be submitted for the Engineer’s approval on forms provided by the Agency or approved by the Engineer. Billings for Materials (other than Incidental items out of the inventory of the Contractor or Subcontractors), rental Equipment from sources other than the Contractor or Subcontractors, and Special Services, shall be accompanied by copies of invoices for the goods and services. The invoices shall be fully itemized showing dates, quantities, unit prices, and complete descriptions of goods and services provided. Invoices for amounts of \$10 or less per invoice are not required, unless requested by the Engineer.

Costs included on the billings shall comply with 00197.01 and 00197.10 through 00197.30. When a billing for Force Account Work has been paid at the Project level, no further corrections will be made because of further review if those corrections amount to less than \$10.

Section 00199 - Disagreements, Protests, and Claims

00199.00 General

This Section details the process through which the parties agree to resolve any disagreement concerning additional compensation or concerning a combination of additional compensation and Contract Time. (See 00180.80 for disagreements and claims concerning additional Contract Time only, and 00195.95 for disagreements and claims concerning correction of final compensation.) The Agency will not consider direct disagreements, protests, or claims from Subcontractors, Suppliers, or any other Entity not a party to the Contract.

00199.10 Procedure for Resolving Disagreements

When disagreements occur concerning additional compensation or a combination of additional compensation and Contract Time, the Contractor shall first pursue resolution through the Engineer of all issues in the dispute, including, without limitation, the items to be included in the written notice in 00199.20. If the discussion fails to provide satisfactory resolution of the disagreement, the Contractor shall follow the protest procedures outlined in 00199.20. If the Engineer denies all or part of the Contractor's protest, and the Contractor desires to further pursue the issues, the Contractor shall submit a claim for processing according to 00199.30.

00199.15 Inappropriate Protest or Claim

It shall be presumed that the Contractor submits a protest or claim for additional compensation in good faith, based upon facts which reasonably support the Contractor's position and with full knowledge and understanding of the injury done to the Agency when notice of differing Project Site conditions or claims for additional compensation are not submitted in a timely manner as required under the Contract. Accordingly, the submission of a protest or claim without the concurrent submission of evidence that reasonably supports the protest or claim, or the submission of a protest or claim in an untimely manner will constitute a waiver of the protest or claim.

00199.20 Protest Procedure

If the Contractor disagrees with anything required in a Change Order or other written or oral order from the Engineer, including any direction, instruction, interpretation, or determination, or if the Contractor asserts a disagreement or dispute on any other basis, except 0195.95, that, in the Contractor's opinion, entitles or would entitle the Contractor to additional compensation or a combination of compensation and Contract Time, the Contractor shall do all of the following in order to pursue a protest and preserve its claim:

- A. **Oral Notice** - Give oral notice of protest to the Engineer and outline the areas of disagreement before starting or continuing the protested Work.
- B. **Written Confirmation of Oral Notice** – Not later than the end of the next business day following the day that oral notice of protest is given, deliver written documentation to the Engineer of the oral notice that includes the notice of protest and the areas of disagreement.
- C. **Written Notice** - File a proper written notice of protest with the Engineer within 7 Calendar Days after receiving the protested order. In the notice the Contractor shall:
 - Describe the acts or omissions of the Agency or its agents that allegedly caused or may cause damage to the Contractor or to the Project, citing specific facts, persons, dates and Work involved;
 - Describe the Contractor's proposed alternative to the Work ordered, if any, which will avoid damage to Contractor or to the Project;
 - Describe the nature of the damages;
 - Cite the specific Contract provision(s), if any, that support the protest;

- Include the estimated dollar cost, if any, of the protested Work, and furnish a list of estimated Materials, Equipment and labor for which the Contractor might request additional compensation; and
- If additional compensation is estimated to be due, include the estimated amount of additional time required, if any.

FAILURE TO COMPLY WITH THIS NOTICE REQUIREMENT RENDERS THE NOTICE IMPROPER AND SHALL CONSTITUTE A WAIVER OF ANY CLAIM FOR ADDITIONAL COMPENSATION OR A COMBINATION OF ADDITIONAL COMPENSATION AND CONTRACT TIME FOR ANY PART OF THE PROTESTED WORK.

- D. Engineer's Record and Response** - The Engineer will file a copy of each written notice of protest in the Project records and will issue a written response to the protest within seven (7) Work Days of receipt of a timely filed written notice of protest. The Engineer has no responsibility to evaluate the protest unless the Contractor has timely filed a proper notice submitting all of the above information.
- E. Final Documentation of Claim** - Within 60 Calendar Days following completion of the protested work, Contractor shall provide the Engineer with complete documentation of protested work, listing exact Materials, Equipment and labor used for the work and the dollar amount requested for each. If the claim is accepted, no additional compensation will be awarded based on documentation submitted after this deadline. If the claim is denied or if the Contractor is not satisfied with the decision by the Engineer, the amount claimed by the Contractor in any subsequent Step or proceeding may not exceed the dollar amount requested under this Subsection.
- F. Records** - Keep complete records of all costs and time incurred throughout the protested Work, and allow the Engineer access to those and other supporting records. Provide daily records of protested Work, on a weekly basis, on a schedule to be set by agreement with the Engineer.
- G. Comparison of Records** - Provide the Engineer adequate facilities for keeping cost and time records of the protested Work. The Contractor and the Engineer will compare records and either bring them into agreement at the end of each day, or record and attempt to explain any differences.
- H. Work to Proceed** - In spite of any protest, proceed promptly with the Work ordered by the Engineer.
- I. Evaluation of Protest** - The Engineer has no responsibility for evaluating a protest that is not timely filed, or for which adequate supporting documentation has not been made available to the Engineer. Provided the procedures above are followed, the Engineer will promptly evaluate all protests, after the Contractor has fully complied with the requirements described in 00199.20.C. If the protest is denied, the Engineer will notify the Contractor in writing of the reasons for full or partial denial. If a protest is found to be valid, the Engineer will, within a reasonable time, make an equitable adjustment of the Contract. Adjustment of time will be evaluated according to 00180.80.

The Engineer has no responsibility for evaluating and may reject a protest that does not comply with 00199.20.C. If the protest is rejected, the Engineer will notify the Contractor in writing of the reasons for rejection.

- J. Protest Evaluation by Third Party Neutral** - If the Engineer agrees that the Contractor has fully complied with the requirements described in 00199.20.C, and if the Engineer fully or partially denies, in writing, the Contractor's protest according to 00199.20.E, the Contractor may request that a mutually selected Third Party Neutral review the protest. Procedures for selecting, using, and paying for the cost of the Third Party Neutral will be specified by Change Order.

If the Contractor does not accept the Engineer's evaluation of the protest, or either the Contractor or Engineer disagrees with the resolution recommended by the Third Party Neutral, the Contractor may pursue a claim as described in 00199.30.

00199.30 Claims Procedure

- A. General** - If the Contractor believes that additional compensation is due, or a combination of additional compensation and Contract Time, and has pursued and exhausted all the procedures provided in 00199.10 and 00199.20 to resolve a disagreement and protest, the Contractor may file a claim.

The Agency's Contract is with the Contractor. There is no contractual relationship between the Agency and any Subcontractors, Suppliers or any Entity other than the Contractor. It is the Contractor's responsibility to fully evaluate any claim before presenting it to the Agency. In addition, when a claim includes Work done or costs incurred by any Subcontractors, Suppliers, or any Entity other than the Contractor, the Contractor remains solely responsible for presenting the claim to the Agency.

Claims that include Work done or costs incurred by Subcontractors, Suppliers, or any Entity other than the Contractor will not be considered by the Agency unless the Contractor has:

- Completed and provided its own written evaluation of the claim;
- Verified by its own independent review and evaluation of the amount of compensation sought; and
- Certified the claim in accordance with 00199.30.B (Part 10).

- B. Claims Requirements** - At any time during the progress of the Work, but not later than 45 Calendar Days following the date of the Second Notification, the Contractor shall submit to the Engineer in writing, claims for additional compensation or a combination of additional compensation and Contract Time additional to that specified in the Contract. For a claim not submitted within the 45-day limit, that has not met the requirements of 00199.20, or is not filed as provided in 00199.30, the Contractor waives any claim for additional compensation or for additional compensation and Contract Time, and the Agency may reject the claim.

Written claims to the Engineer or the Agency by the Contractor shall be delivered to the Agency address shown in the Public Improvement Contract, unless a different address is agreed to by the Engineer, and shall be delivered:

- By U.S. Postal Service first class mail or priority mail (which at the sender's option may include certified or registered mail return receipt requested); or
- By overnight delivery service of a private industry courier.

Claims will be considered as having been received by the Agency:

- At the time of actual receipt or 7 Calendar Days after the postmarked date when deposited for delivery by first class or priority mail, whichever is earlier; or
- At the time of actual receipt or 3 Calendar Days after deposit with a private industry courier for overnight delivery service, whichever is earlier.

The Agency reserves the right at any time and at any step in the claim decision or review process to request additional information, records or documentation related to the claim or the Contract either directly or through agents working toward resolution of the disputed or claimed events and issues.

Claims shall be made in writing, and shall include all information, records and documentation necessary for the Agency to properly and completely evaluate the claim.

To be considered, claims for additional compensation, or for additional compensation and Contract Time, shall be completed according to 00199.30 and shall be submitted with the required information and in the format below and labeled as required below for each claimed issue:

(Part 1) Summary (label page 1.1 through page 1.X) - In the summary, include a detailed, factual statement of the claim for additional compensation and Contract Time, if any, with necessary dates and locations of Work involved in the claim and the dates of when the event arose. Also include detailed facts supporting the Contractor's position relative to the Engineer's decision (see 00199.20.F);

(Part 2) Proof of notice (label page 2.1 through page 2.X) - Submit a copy of the written notice, with all attachments, that was given to the Agency. Include the date when that written notice and the date when oral notice was given:

(Part 3) Copies of the Contract Specifications that support the Contractor's claim (label page 3.1 through page 3.X);

(Part 4) Theory of entitlement supporting the claim (label page 4.1 through page 4.X) - Include a narrative of how or why the specific Contract Specifications support the claim and a statement of the reasons why such Specifications support the claim;

(Part 5) Itemized list of claimed amounts (label page 5.1 through page 5.X) - Claimed damages that resulted from the event with a narrative of the theories and records and documents used to arrive at the value of the damages;

(Part 6) Additional Contract Time requests (label page 6.1 through page 6.X) - If the claim is for a combination of additional compensation and Contract Time, submit a copy of the schedule that was in effect when the event occurred and a detailed narrative which explains how the event impacted Contract Time. In addition, if an Agency-caused delay is claimed:

- Include the specific days and dates under claim;
- Provide detailed facts about the specific acts or omissions of the Agency that allegedly caused the delay, and the specific reasons why the resulting delay was unreasonable; and
- Provide a schedule evaluation that accurately describes the impacts of the claimed delay.

Also see 00180.80 for additional requirements regarding claims for Contract Time and causes that are eligible and ineligible for consideration;

(Part 7) Copies of actual expense records (label page 7.1 through page 7.X) - Include documents that contain the detailed records and which support and total to the exact amount of additional compensation sought. Include the information and calculations necessary to support that amount. That amount may be calculated on the basis of Section 00197, if applicable, or may be calculated using direct and indirect costs presented in the following categories:

- Direct Materials;
- Direct Equipment. The rate claimed for each piece of Equipment shall not exceed the actual cost. In the absence of actual Equipment costs, the Equipment rates shall not exceed 75 percent of those calculated under the provisions of 00197.20. For each piece of Equipment, the Contractor shall include a detailed description of the Equipment and attachments, specific days and dates of use or standby, and specific hours of use or standby;

- Direct labor;
- Job overhead;
- General and administrative overhead; and
- Other categories as specified by the Contractor or the Agency;

(Part 8) Supporting records and documents (label page 8.1 through page 8.X) - Include copies of, or excerpts from the following:

- Any documents that support the claim, such as manuals standard to the industry and used by the Contractor; and
- Any daily reports or diaries related to the event, photographs or media that help explain the issue or event (optional), or all other information the Contractor chooses to provide (optional);

(Part 9) Certification (label page 9.1 through 9.X) - A certified statement, signed by a person authorized to execute Change Orders, by the Contractor, Subcontractor, Supplier, or Entity, originating the claim, as to the validity of facts and costs with the following certification:

Under penalty of law for perjury or falsification, the undersigned, (Name), (Title), (Company) certifies that this claim for additional compensation for Work on the Contract is a true statement of the actual costs incurred (in the amount of \$_____, exclusive of interest) and is fully documented and supported under the Contract between the parties.

Signature: _____

Date: _____, 20__

Subscribed and sworn before me this ____ day of _____, 20__

Notary Public

My commission expires _____.

(Part 10) Contractor evaluation of a lower-tier claim (label page 10.1 through 10.X) - If the claim includes Work done or costs incurred by any Subcontractors, Suppliers, or any Entity other than the Contractor, the following are required:

- Data required by the other Subsections of 00199.30.B;
- Copies of the Contractor's, Subcontractor's, Supplier's and Entity's, at all tiers above the level of which the claim originates, separate evaluation of entitlement;
- Copies of the Contractor's, Subcontractor's, Supplier's and Entity's, at all tiers above the level of which the claim originates, independent verification and evaluation of the amount of damages sought; and
- A person authorized to execute Change Orders on behalf of the Contractor, subcontractor, Supplier and Entity, at all tiers above the level of which the claim originates, must sign a statement with the following certification:

Under penalty of law for perjury or falsification, the undersigned, (Name) (Title), (Company) certifies that this claim originating from the subcontractor, Supplier or Entity (Company) for additional compensation for Work on the Contract is a reasonable statement, independently verified, of the costs incurred (in the amount of \$_____, exclusive of interest) and is fully documented and supported under the Contract between the parties.

Signature: _____

Date: _____, 20__

Subscribed and sworn before me this ____ day of _____, 20__

Notary Public

My commission expires _____.

If the Engineer determines that additional information, records or documentation is needed to allow proper evaluation of the claim submittal, the Engineer will request the information, records or documentation. The Contractor shall submit to the Engineer within 14 Calendar Days, or as otherwise agreed by the parties, the required additional information, records and documentation.

If the Engineer determines that the claim submittal with the additional information, records and documentation submitted is incomplete and not accepted as a claim, the Engineer will notify the Contractor in writing and the submittal will be rejected and will not be considered under 00199.40.

C. Records Requirements - The Contractor shall comply with 00170.07.

D. Compliance Required - Full compliance by the Contractor with the provisions of this Section is a condition precedent to the commencement of any lawsuit by the Contractor to enforce any claim.

00199.40 Claim Decision; Review; Exhaustion of Administrative Remedies

The Agency intends to resolve all claims at the lowest possible administrative level. The Engineer will also determine whether multiple claims should be advanced separately or together.

If the Engineer denies the claim for additional compensation or a combination of additional compensation and Contract Time, in full or in part, according to 00199.40.A, the Contractor may request review of the denial. The disputed claim for additional compensation or a combination of additional compensation and Contract Time may then be resolved, in full or in part, at any of the progressive steps of claim review procedure as specified in 00199.40.B through 00199.40.C of this Subsection.

If the Engineer has denied a claim, in full or in part, for Contract Time only according to 00180.80, or has denied a claim, in full or in part, for correction of final compensation according to 00195.95, those disputed claims may then be resolved, in full or in part, at either of the two progressive steps of claim review procedure as specified in 00199.40.B through 00199.40.C of this Subsection.

A person authorized by the Contractor to execute Change Orders on behalf of the Contractor must be present and attend all claim hearings. For all claims, all of the actions and review under each step of the review process shall occur before the review can be advanced to the next higher step.

If, at any step in the claim decision or review process, the Contractor fails to promptly submit requested information or documentation that the Agency deems necessary to analyze the claim, the Contractor is deemed to have waived its right to further review, and the claim will not be considered properly filed and preserved.

A. Decision by the Engineer - The Engineer will, as soon as practicable, consider, investigate, and evaluate a Contractor’s claim for additional compensation, or for a combination of additional compensation and Contract Time, if submitted as required by 00199.30.

Once the Engineer determines the Agency is in receipt of a properly submitted claim, the Engineer will arrange a meeting, within 21 Calendar Days or as otherwise agreed by the parties, with the Contractor in order to present the claim for formal review and discussion.

If the Engineer determines that the Contractor must furnish additional information, records or documentation to allow proper evaluation of the claim, the Engineer will schedule a second meeting, to be held within 14 Calendar Days or as otherwise agreed by the parties, at which the Contractor shall present the requested information, records and documentation.

The Engineer will provide a written decision to the Contractor within 30 Calendar Days of the last Engineer-level meeting.

If the Contractor does not accept the Engineer's decision, the Contractor may, within 10 Calendar Days of receipt of the written decision, request in writing that the Engineer arrange a review at Step 1 (see 00199.40.B below).

- B. Step 1: Public Works Director Level Review** - The Contractor shall request that the Engineer arrange a meeting with the Public Works Director or the Public Works Director's designee, as determined by the Public Works Director, in order to present the denied or partially denied claim for formal review and discussion. The meeting will take place within 21 Calendar Days of the Agency's receipt of the request, or as otherwise agreed by the parties.

If the Public Works Director (or designee) determines that the Contractor must furnish additional information, records or documentation to allow proper evaluation of the claim, the Public Works Director (or designee) will schedule a second meeting, to be held within 14 Calendar Days, or as otherwise agreed by the parties, at which the Contractor shall present the requested information, records and documentation.

The Public Works Director (or designee) will provide a written decision to the Contractor within 30 Calendar Days of the last meeting with the Public Works Director (or designee).

The claim is subject to 00199.60, if not all of the records requested by the Public Works Director (or designee) were furnished. If applicable, advancement of the claim is subject to the provisions of 00199.60 regarding waiver and dismissal of the claim or portions of the claim.

If the Contractor does not accept the decision, the Contractor may, within 180 Calendar Days from the date of receipt of the Public Works Director (or designee) written decision or within 90 Calendar Days of the date of Second Notification, whichever is later, initiate Step 2 as set forth in Subsection 00199.40.C below.

- C. Step 2: Arbitration and Litigation** - The Contractor must follow each step in order, and exhaust all available administrative remedies before resorting to arbitration and litigation. Litigation of a claim that cannot be resolved in Step 1 shall be initiated by filing a complaint in the Circuit Court for the State of Oregon in the county where the Agency's main office is located that contains a stipulation to arbitration under ORS 36.410. The claim and all cross and counter-claims filed in response to the complaint shall be submitted to the Court Arbitration Program set forth in ORS 36.400 to 36.425, Chapter 13 of the Oregon Uniform Trial Court Rules and the Circuit Court supplemental local rules concerning arbitration. Either party may seek, and shall be entitled to, an order directing the other party to submit to arbitration as provided herein and to judgment for its costs, expenses and attorney fees in obtaining and enforcing the order.

In no event shall this Subsection be construed as a waiver by the Agency or by the State of Oregon on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court.

D. Payment of Costs, Expenses and Attorney’s Fees - The prevailing party shall be entitled to an award for reasonable costs and expenses incurred after the initiation of Step 2, including costs and expenses incurred for arbitration, trial de novo and on appeal. Costs and Expenses shall include, but shall not be limited to, reasonable attorney fees and expenses, arbitrator fees and expenses, and costs of discovery.

As used in this Subsection 00199.40.D, “prevailing party” for an arbitration award means (1) a Contractor who has received an arbitration award, exclusive of interest, costs and expenses, that is more than the dollar amount claimed by the Contractor in its Final Documentation of Claim under 00199.20.D or (2) the Agency if there is no arbitration award to the Contractor or if the arbitration award to the Contractor, exclusive of interest, costs and expenses, is less than the dollar amount of the award in the Step 1 decision. For all other arbitration awards, there shall not be a “prevailing party”.

The award of costs and expenses after trial de novo shall be made as provided for in ORS 36.425. The award of costs and expenses after appeal from a judgment entered after trial de novo shall be to the prevailing party designated as such by the appeals court.

The Contractor shall comply with 00170.00.

00199.50 Mediation

Notwithstanding the formal claims procedure specified above, the parties may enter into nonbinding mediation by mutual agreement at any time, in which case the parties may also agree to suspend the time requirements in Section 00199 pending the outcome of the mediation process. The rules, time and place for mediation, as well as selection of the mediator, shall be established by mutual agreement. Costs shall be divided equally between the Contractor and the Agency. Either party may terminate mediation at any time upon 5 Calendar Days’ notice to the other, after which the time requirements of Section 00199 shall be automatically reinstated and shall resume from the point at which the time requirements were suspended.

00199.60 Review of Determination Regarding Records

If not all of the records requested by the Agency under 00199.40.C Step 2 were provided, then the Agency will determine:

- If the records are of the type described in 00170.07; and
- If the records have not been maintained or the records, or access to the records, has not been provided to the Agency as required by 00170.07 and this Section; and
- If the records are material and necessary for proper evaluation of part or all of the claim; and
- The portions of the claim for which the records are material and necessary for proper evaluation.

If the Agency makes the foregoing determinations, then subject to the review process described below, all portions of the claim for which the Agency determined the records are material and necessary for proper evaluation are immediately waived and irrevocably dismissed.

Even if the records have not been maintained or the records, or access to the records, have not been provided to the Agency in a given instance, the Agency may determine that sufficient records have been provided for the Agency to properly evaluate the claim in that instance. If the Agency makes this determination, the claim or portions of the claim will not be waived or dismissed under this provision.

If the Contractor does not accept the Agency’s written determination that the records are material and necessary for proper evaluation of part or all of the claim, and the portions of the claim for which the records are material and necessary, the Contractor may, within 14 Calendar Days of receipt of the Agency’s determination, request, in writing, a review of such determination by the Public Works Director (or designee). If the Contractor does not request a review of the Agency’s determination, the Agency’s determination shall then become the Agency’s final determination as of the expiration of the time limit to request review.

If the Contractor requests the review, the Public Works Director (or designee) will schedule a review meeting within 14 Calendar Days, or as otherwise agreed by the parties, of when the Public Works Director (or designee) receives the written review request. The Agency and the Contractor will each have an opportunity to explain their respective positions at the review meeting in a manner determined by the Public Works Director (or designee).

Within 10 Calendar Days of the review meeting, the Public Works Director (or designee) will issue a written proposed finding of whether the records not maintained or not provided to the Agency, or for which access was not provided to the Agency, are material and necessary for proper evaluation of part or all of the claim. If the Public Works Director (or designee) makes that finding, then the Public Works Director (or designee) will also make a proposed written finding as to what portions of the claim the records are material and necessary and, therefore, waived and irrevocably dismissed.

Even if the records have not been maintained or the records, or access to the records, have not been provided to the Agency in a given instance, the Public Works Director (or designee) may determine that sufficient records have been provided for the Agency to properly evaluate the claim in that instance. If the Public Works Director (or designee) makes this determination, then the claim or portions of the claim will not be waived or dismissed under this provision.

The Public Works Director's (or designee) findings will be submitted to the Contractor. The Public Works Director's (or designee) findings are the Agency's final determination.

If the Agency's final determination is that the records are material and necessary for proper evaluation of part or all of the claim, then the claim or that portion of the claim for which the records are material and necessary is waived and irrevocably dismissed, unless the Contractor provides the records, or access to the records, to the Agency within 5 Calendar Days of the Agency's final determination. If the Contractor provides the records, or access to the records, within this time limit, the Agency will schedule a meeting with the Contractor within 14 Calendar Days or as otherwise agreed by the parties, to discuss the records.

The Agency's final determination that records are material and necessary for proper evaluation of part or all of the claim, and the Agency's final determination of the portions of the claim for which the records are material and necessary, shall be final and binding.

If the entire claim is waived and irrevocably dismissed pursuant to the Agency's final determination there will be no further decision by the Agency on the claim or further review of the claim under 00199.40 and the claim will not be eligible for mediation under 00199.50. If only portions of the claim are waived and irrevocably dismissed pursuant to the Agency's final determination, the Agency will provide a written decision to the Contractor regarding the remaining portions of the claim within 30 Calendar Days of the final Step 2 meeting, or the Agency's final determination regarding the records, whichever is later. There will be no further decision by the Agency on or further review under 00199.40 of the portions of the claim waived and irrevocably dismissed pursuant to Agency's final determination and those portions will not be eligible for mediation under 00199.50.

**ATTACHMENT L – SPECIAL PROVISIONS
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

The Work to be done under this Contract consists of construction of the ASR 3 Well House, improvements to Reservoir 4, and improvements to ASR 2, and other miscellaneous improvements as shown on the plan entitled:

ASR 3 & 2 WELLHOUSE IMPROVEMENTS: #96053

AUTHORITY OF CONSULTANT

The Owner will be directly in charge of the Project. However, the Owner’s Representative’s authority on this Project is as designated in the City of Tigard’s General Condition Section 00150 as the Project Manager, or as designated by the Engineer.

APPLICABLE SPECIFICATIONS

The Specifications that are applicable to the work on this project are the APWA/ODOT 2021 edition of the “Oregon Standard Specifications for Construction” and the Technical Specifications included in Attachment M. All number references in these special provisions shall be understood to refer to the Sections and subsections of the Standard Specifications bearing like numbers and to Sections and subsections contained herein in their entirety. Standard Specifications not specifically addressed in these Special Provisions shall be complied with if applicable. In case of conflict between the General Conditions/Special Provisions and Technical Specifications, it will be resolved per City General Conditions Section 00150.10-A. The Contractor shall immediately request clarification from the Engineer to resolve any discrepancies.

SECTION 00110 - ORGANIZATION, CONVENTIONS, ABBREVIATIONS AND DEFINITIONS

Comply with Section 00110 of the City of Tigard General Conditions, modified as follows:

00110.00 - Organization of Specifications – Delete the first bulleted list and replace with the following:

- The “General Conditions for Construction for the City of Tigard”, published by the Agency, which contain Part 00100 “General Conditions”, which deal with the solicitation process and contractual relationships;
- The “2021-Oregon Standard Specifications for Construction”, published by the Oregon Department of Transportation, which contain Parts 00200 through 03000 which contain the detailed “Technical Specifications” involved in prosecution of the Work, organized by subject matter;
- The Special Provisions; and
- The Technical Specifications

Bidders will submit Bids by email before the deadline stated in the Advertisement for Bid.

Add the following item:

Owner’s Representative - Representative for the Owner on project, explicitly Murraysmith, Inc. (Murraysmith).

SECTION 00120 – BIDDING REQUIREMENTS AND PROCEDURES

Comply with Section 00120 of the City of Tigard General Conditions, modified as follows:

00120.01 Receipt of Bids; Opening - Replace this subsection, except for the subsection number and title, with the following:

Bidders will submit Bids by email before the deadline stated in the Advertisement for Bid.

00120.02 Prequalification of Bidders - Delete this subsection.

00120.03 Request for Solicitation Documents - Replace this subsection, except for the subsection number and title, with the following:

Informational Plans and Specifications are available online at www.tigard-or.gov/business/bids.php

Copies of the Oregon Standard Specifications are available for download or purchase at: http://www.oregon.gov/odot/Business/Specs/2021_STANDARD_SPECIFICATIONS.pdf.

a). **Bids** - Bidders must obtain Solicitation Documents online at www.tigard-or.gov/business/bids.php. Each request must include both the name of the person ordering or obtaining the Solicitation Documents, and the name of the Entity intending to use them. (The City will add the name of the Entity intending to use the Solicitation Documents to the list of Holders of Bidding Plans.) Bidders are cautioned that only Solicitation Documents obtained from the City of Tigard may be used to submit Bids.

b). **Standards and Specifications** - The work embraced herein shall be done in accordance with the following standards and specifications.

City of Tigard Public Improvement Design Standards..... Download from the City’s web site
CWS Design and Construction Standards R&O 19-22.....www.cleanwaterservices.org
2021 Oregon Standard Specifications for Construction..... Available from ODOT

Copies of these standards and specifications can be found at the locations stated above.

00120.17(a) Within Normal Right-of-Way Limits - Add the following to the end of this subsection:

The limits of the site which may be used for construction, storage, materials handling, parking of vehicles, and other operations related to the project include the project site as shown on the drawings and adjacent public rights-of-way subject to permission of the public owner of that right-of-way. The limits of work also include rights of access obtained by the Contractor, subject to all public laws and regulations as well as rights of access by utility companies and other holders of easement rights.

00120.17(b) Outside Normal Right-of-Way Limits - Add the following to the end of this subsection:

The Agency does not own, or have rights to, other adjacent properties in the Project area for use in stockpiling operations. The Contractor shall acquire, at its own expense, the rights of access to, and the use of, all stockpiling locations that the Contractor chooses that are not Agency-controlled. Contractor shall furnish to the Agency the property owner’s written approval for the Contractors use of its land.

00120.17(c) Restrictions on Use - Add the following to the end of the bulleted list:

- No equipment and/or materials shall be stored outside the immediate work area on public right-of-way, in the following locations, or in the following manner. The immediate work area is the area where work is taking place or will be taking place within one calendar day. The Contractor shall immediately move stored material or equipment which causes a nuisance or creates complaints.
 - In any maintained landscaped or lawn area.

- In a manner that would eliminate an individual resident's street parking.
- In front of any business.

SECTION 00150 – CONTROL OF WORK

Comply with Section 00150 of the City of Tigard General Conditions, modified as follows:

00150.10(a) Coordination of Contract Documents – Replace this subsection with the following subsection:

A. Order of Precedence – The Engineer will resolve any discrepancies between these documents in the following order of precedence:

1. Permits from outside agencies;
2. Contract (Agreement);
3. Addenda;
4. Bid Schedule;
5. Project Drawings;
6. Standard Drawings;
7. Special Provisions;
8. General Conditions;
9. Standard Specifications;
10. Technical Specifications;
11. Geotechnical Data Reports;
12. Reviewed and accepted, stamped Working (Shop) Drawings (including Deferred Submittals);
13. Approved Unstamped Working (Shop) Drawings.

Change Orders, Work Change Directives, Field Orders, and Engineer's written interpretation and clarifications, in precedence listed, will take precedence over all other Contract Document components referenced herein.

Notes on a drawing shall take precedence over drawing details. Dimensions shown on the drawings, or that can be computed, shall take precedence over scaled dimensions. The Drawings with the higher level of detail take precedence over less detailed Drawings.

00150.30 Delivery of Notices – Replace this subsection with the following subsection:

For purposes of this subsection, the time zone is Pacific Standard Time (PST) to determine time of receipt of notices and other documents. For purposes of this subsection, non-business days are Saturdays, Sundays and legal holidays as defined by ORS 187.010 and 187.020.

Following Notice to Proceed, all notices and other documents submitted to the Contractor by the Engineer, or to the Engineer by the Contractor, electronically under 00170.08:

Claims must be submitted on paper documents according to Section 00199.

Add the following subsection:

00150.38 Project Health and Safety Program

- A. Develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. The written Safety Program shall be provided within 30 days after the receipt of the written Notice to Proceed. The Plan shall be assembled to address project specific

health and safety issues to both the public and on-site personnel. The plan shall include at a minimum the following items when they apply:

1. Employee orientation
2. Safety inspections
3. Instruction and training
4. Accident reporting
5. Signs and barricades
6. Fire prevention and protection
7. Welding, cutting, and burning
8. Painting and surface treatment
9. Electricity
10. Machinery and mechanized equipment
11. Excavations
12. Sanitation
13. Chlorine safety
14. Hazardous materials
15. Hazardous communications program
16. Job hazard analysis
17. First aid/medical facilities
18. Personal protective equipment
19. Confined space entry plan
20. Shoring plan
21. Fall protection plan
22. Emergency Action Plan
23. Housekeeping
24. Safety training requirements and certification
25. Pedestrian access around work site during construction and after hours
26. Neighboring residences/community access and safety
27. COVID-19 safety measures, exposure prevention, and required communications

- B. If the project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Program. The Program shall subsequently be distributed to and implemented by the Contractor's personnel, as well as its Subcontractors and Suppliers, the Owner and Engineer. The Contractor shall fully implement and comply with the Safety Program and shall submit to the Owner a letter signed by Contractor's owner/president affirming such implementation and compliance within 15 days after on-site work has started. The Contractor shall notify the Owner and Engineer when safety meetings will be held so that Owner's and Engineer's personnel may attend. A copy of the Health and Safety Program must be maintained onsite at all times during the life of the Project.

Add the following subsection:

00150.39 Operation and Maintenance (O&M) Instructions

- A. Submit preliminary O&M materials for review by Engineer. The equipment manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Reviewed shop drawings and submittal data
2. Model, type, size, and serial numbers of equipment furnished
3. Equipment and driver nameplate data
4. List of parts showing replacement numbers
5. Recommended list of spare parts
6. Complete operating instructions including start-up; shutdown, adjustments, cleaning, etc.
7. Maintenance and repair requirements including frequency and detailed instructions
8. Name, address and phone numbers of local representative and authorized repair service.

B. Following review of the preliminary O&M materials by the Engineer and before acceptance of the Work, submit electronic copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in PDF format for inclusion in the Project's electronic O&M Manual.

00150.50(b) Agency Responsibilities – Replace this subsection, except for the subsection number and title, with the following:

The Agency has listed the known utilities, their owners, and contact information. The Plans will not normally show the anticipated new location of utilities that have been or will be adjusted.

00150.50(c) Contractor's Responsibilities – Add the following bulleted items:

- Meet with each utility agency prior to the preconstruction meeting that has or may have utilities within the limits of the Work on this Project.
- Check on-site locations of each utility against known location data, if any, and notify the utility of any discrepancies before starting the Work.

Add the following:

In accepting the above responsibilities, both stated and implied, the Contractor understands that it is highly likely that there will be interfering utilities, i.e., service laterals, drains, pipe and conduits (ducts), and related structures which are not shown or are not accurately indicated on the Plans or have not been previously discovered at the project site.

Utilities that are in the way of or in close proximity to the work, known as potential conflicts, may require a change in the Contractor's operations and should be reflected in the Contractor's Bid and in the project schedule.

Existing utilities may affect the work causing additional time or cost. Reasonable delays or resulting cost increases will be considered as part of the normal progress of work and will not be cause for extra compensation to the Contractor. The Contractor agrees to provide for a reasonable amount of additional time or cost in the Bid.

Locating, such as potholing, excavations, or boring, deemed necessary to determine the exact location(s) of any utility which may interfere with the work shall be done prior to the start of construction at no additional cost to the Agency unless otherwise indicated or provided for in these Contract Documents.

00150.50(d) Delays – Delete this subsection.

Add the following subsection:

00150.50(f) Utility Information:

Contact those utilities having buried facilities and request that they locate and mark them for their protection prior to construction. The Utilities notification system telephone number is 811 or (800) 332-2344.

There are no anticipated conflicts with the Utilities listed below unless specifically noted. Minor adjustments of manholes, or boxes may need to be adjusted to finish grade by the Utility owner and the Contractor shall coordinate this work to be completed during construction. The Contractor shall provide two (2) weeks advance notice to those Utilities that have adjustment work indicated on the Contract Plans.

The Contractor shall contact those Utilities having buried facilities and request that they locate and mark them for their protection prior to construction. Additionally, the Contractor shall notify all utility owners which may be affected by the construction operation at least 48 hours in advance when their services may be affected by the work, and coordinate with affected utilities as necessary. The Contractor must coordinate electrical work with PGE. See Table 00150.50(f) for contact information and Utility Job Numbers. See Appendix A for PGE Construction Drawings.

It is the Contractor’s responsibility to adjust utility structures and maintain adequate access to those utilities (in the judgment of the Engineer) regardless of cooperation (or lack thereof) from affected utilities.

Table 00150.50(f)-1

Utility	Utility Contact Person’s Name, Email, and Phone Number	Location	Utility Job Number
PGE	Rico Torres Solis, Rodrigo.solis@pgn.com , 503.403.9084	ASR 3 Streetlights	M3018307
	Hap English, Hap.english@pgn.com , 503.672.5489	ASR 3 Removal of Existing Service	M2997883
		ASR 3 Install of Upgraded Service	M2977928

Furnish and install a meter base approved by the serving Utility (with cover by the Utility), where shown.

00150.60(a) Load and Speed Restrictions for Construction Vehicles and Equipment - Add the following at the end of the numbered list:

1. The Contractor shall follow approved truck routes when hauling all materials and equipment beyond the limits of the Project Site. The proposed truck routes to be used by the Contractor shall be submitted to the Engineer for review and approval prior to the start of work.
2. The Contractor shall restrict the combined weights of construction vehicles, Equipment, and Materials on Bridges according to 00220.45.

00150.70 Detrimental Operations - Add the following to the end of the subsection:

Portions of this project will be constructed in close proximity to existing private improvements. All private improvements disturbed by the Contractor’s operations shall be repaired or replaced to equal or better conditions at the Contractor’s expense.

SECTION 00160 – SOURCE OF MATERIALS

Comply with Section 00160 of the City of Tigard General Conditions, modified as follows:

00160.50 (b) Waste, Excess, and By-Product Materials – Replace this subsection, except for the subsection number and title, with the following:

All waste, excess, castings, pipe, equipment, demolition debris, spoil, and by-product materials, collectively referred to in this subsection as “By-Products”, from the manufacture or production of Materials from Agency-Controlled Lands shall become the property of the Contractor and shall be disposed of in a manner compliant with applicable Federal, State, and local laws and regulations governing disposal of such waste products, unless otherwise indicated on the drawings. No burning of debris or any other discarded material will be permitted.

SECTION 00170 – LEGAL RELATIONS AND RESPONSIBILITIES

Comply with Section 00170 of the City of Tigard General Conditions, modified as follows:

00170.01(b) State of Oregon Agencies - Add the following to the list of State of Oregon Agencies:

Oregon Department of Transportation (ODOT)

00170.01(c) Local Agencies - Add the following to the list of Local Agencies:

Washington County Land Use and Transportation (LUT)
Clean Water Services (CWS)

00170.02 Permits, Licenses, and Taxes – Add the following to the end of the bulleted list:

- Environmental permits, including erosion control permits.

Add the following paragraph at the end of this subsection:

The Contractor must have current licenses and permits required to perform the work, including but not limited to a current water well construction operator’s licenses for the State of Oregon.

00170.03 Furnishing Rights-of-Way, Easements and Permits – Delete the following item from the bulleted list.

- Environmental permits, including erosion control permits.

00170.08 Electronic Document Management - The requirements of this Subsection do not apply to claims. Claims must be submitted on paper documents according to Section 00199.

00170.60 Safety, Health, and Sanitation Provisions - Add the following to the end of this subsection:

The Contractor shall provide and maintain proper portable sanitary facilities for their employees and their subcontractors’ employees during day and night shifts that will comply with the regulations of the local and State departments of health and as directed by the Engineer.

The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be

limited to normal working hours. The required and/or implied duty of the Engineer to conduct construction review of the Contractor's performance does not, and is not intended to, include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

The Contractor shall comply with the safety standard provisions of applicable laws and building and construction codes. The Contractor shall exercise every precaution at all times for the prevention of accidents and protection of persons, including employees, and property. During the execution of the work, the Contractor shall provide and maintain all guards, railing, lights, warnings, and other protective devices which are required by law or which are reasonably necessary for the protection of persons and property from injury or damage.

The Contractor shall be solely responsible for the health and safety of its employees and subcontractors. The Contractor shall develop and maintain a safety plan that will effectively incorporate and implement all required safety provisions addressing all work elements of this project for the duration of this Contract. A copy of the Contractor's health and safety plan shall be submitted to the Owner and Owner's Representative prior to mobilizing to the work site and the Contractor shall keep a copy of the health and safety plan on site at all times.

The Contractor shall maintain a first aid kit, fire extinguisher, Safety Data Sheets (SDSs), and other necessary safety equipment required for the work on site at all times. The Contractor shall ensure that employees working at the site(s) during chemical

00170.70(b) Additional Insured - Add the following subsection:

Add the following as Additional Insureds under the Section 11 of the Public Improvements Contract in the Contract Booklet:

- Murraysmith, Inc.

00170.72 Indemnification - Add the following subsection:

Add the following paragraph and bullets under Section 10 of the Public Improvement Contract in the Contract Booklet:

Extend indemnity, defense and hold harmless to the Agency and the following:

- Murraysmith, Inc.

00170.94 Use of Explosives - Replace this subsection, except for the subsection number and title, with the following:

The use of explosives shall not be allowed on this project.

SECTION 00180 – PROSECUTION AND PROGRESS

Comply with Section 00180 of the City of Tigard General Conditions, modified as follows:

00180.40(a) In General - Add the following at the end of the bulleted list:

- Conduct the Work between the hours of 7:00 AM to 7:00 PM, Monday through Friday, unless otherwise indicated in Section 00220.40(e-1).
- The Contractor may make a request to the Owner for extended work hours or weekend work; however, the approval of extended work hours or weekend work is at the discretion of the Owner.

Add the following subsections:

00180.40(c) Specific Limitations - Limitations of operations specified in these Special Provisions include, but are not limited to, the following:

Limitations	Subsection
Cooperation with Utilities	00150.50
Cooperation with Other Contractors	00150.55
On-Site Work	00180.40(b)
Contract Completion Time	00180.50(h)
Traffic Lane Restrictions	00220.40(e)
Special Events	00220.40(e)
Maintenance Under Traffic	00620.43

The Contractor shall be aware of and subject to schedule limitations in the Standard Specifications that are not listed in this subsection.

00180.41 Project Work Schedules - After the paragraph that begins "One of the following Type..." add the following paragraphs:

A Type "A" schedule as detailed in the City of Tigard General Conditions is required for this contract.

Prior to performing each specific work task, the Contractor is required to inform the Agency's inspector specifically what tasks will be performed and precisely when and where those tasks will be performed. Work performed without providing advance notice to the Agency's inspector may be rejected for failure to provide advance notice, even if no other reason is documented for such rejection.

00180.42 Preconstruction Conference - Supplement this section with the following:

The Contractor is required to contact the Agency to schedule the preconstruction conference.

In addition to the Contractor, the intended project superintendents, foremen, subcontractor foremen and major suppliers – those who will actually be involved in construction activities – should attend the preconstruction conference. The Contractor must be prepared for a thorough discussion and review, as well as revision, which may be deemed necessary in the opinion of the Engineer, of the following:

(Note: These materials SHALL be brought to the preconstruction conference for discussion followed by Engineer review. Some items may also require submittal in advance of the preconstruction meeting per the specifications.)

- Contractor's plan of operation and progress schedule (3+ copies)
- List of 24-hour emergency phone numbers for the project manager and site foreman
- List of subcontractors, names, addresses and phone numbers
- List of quality control subcontractor(s), name(s), address(s) and phone number(s)
- List of materials fabricated or manufactured off the project
- Material sources for the project
- Names of principal suppliers
- Detailed equipment list
- "Project Labor List" for all employee classifications anticipated to be used on project

- Cost percentage breakdown for lump sum bid item(s)
- Shop drawings (bring preliminary list)
- Erosion and Sediment Control Plan (3+ copies)
- Pollution Control Plan (3+ copies)
- Proposed site for waste material disposal and any necessary permits required for placing this material
- Proposed truck haul route

During the preconstruction conference, be prepared to discuss the following items:

- Bonds and Insurance
- Weekly project meetings – schedule and responsibilities
- Provision for inspection for materials from outside sources
- Responsibility for locating utilities
- Responsibility for damage
- Time schedule for relocations, if by other than Contractor (coordinate with utilities)
- Compliance with Contract Documents
- Hours of work
- Acceptance and approval of work
- Labor compliance, payrolls, and certifications
- Safety regulations for Contractor’s and Owner’s employees and representatives
- Suspension of work, time extensions
- Change order procedures
- Progress estimates – procedures for payment
- Special requirements of funding agencies
- Construction engineering, advance notice of special work
- Any interpretation of the Contract Documents requested by the Contractor
- Any conflicts or omissions in the Contract Documents
- Any other problems or questions concerning the work
- Processing and administration of public complaints
- Rights-of-way, Easements and Temporary Construction Easements

00180.43 Commencement and Performance of Work - Add the following bulleted item to the end of this Section:

- Conduct the work at all times in a manner and sequence that will ensure minimal interference with traffic. The Contractor shall not begin work that will interfere with work already started. If it is in the City’s best interest to do so, the City may require the Contractor to finish a portion or unit of the project of which work is in progress or to finish a construction operation before work is started on an additional portion or unit of the project.

00180.50(c) Beginning of Contract Time - Replace this subsection, except for the subsection number and title, with the following:

When the Contract Time is stated in Calendar Days, counting of Contract Calendar Days will begin with the issuance of the Notice to Proceed.

Add the following subsection:

00180.50(h) Contract Time

Work to be done under this project shall be completed by December 31, 2023.

00180.85 (b) Liquidated Damages - Add the following paragraph to the end of this subsection:

The liquidated damages for failure to complete the Work on time required by 00180.50(h) will be \$1,000 per Calendar Day.

SECTION 00195 – PAYMENT

Comply with Section 00195 of the City of Tigard General Conditions modified as follows:

00195.50(a)(2) Value of Materials on Hand - Delete this subsection.

**ATTACHMENT M – TECHNICAL SPECIFICATIONS
CITY OF TIGARD
ASR 3 & 2 WELLHOUSE IMPROVEMENTS**

The Work to be done under this Contract consists of construction of the ASR 3 Well House, improvements to Reservoir 4, and improvements to ASR 2; and other miscellaneous improvements as detailed in the contract documents entitled:

ASR 3 & 2 WELLHOUSE IMPROVEMENTS: #96053

All number references in these Technical Specifications shall be understood to refer to the Sections and subsections of the Construction Specifications Institute (CSI) MasterFormat bearing like numbers and to Sections and subsections contained in these Technical Specifications in their entirety.

SECTION 00 01 07 - SEALS PAGE
FOR
ASR 3 & 2 WELLHOUSE IMPROVEMENTS
FOR
CITY OF TIGARD

ADAM N. BLAIR = ANB
ETHAN D. ALTON = EDA
SAMUEL M. RUSSUM = SMR

ANDY SZATKOWSKI = AS
JEFFERY J. MCGRAW = JJM
CARL M. SERPA = CMS



RENEWS: 12/31/23

2022.02.15 11:09:05-08'00'



RENEWS: 6/30/2022



EXPIRES 12/31/23





EXPIRES 12/31/22



EXPIRES: 6-30-2022

**TECHNICAL SPECIFICATIONS
FOR
AQUIFER STORAGE AND RECOVERY (ASR) 3 & 2
WELLHOUSE IMPROVEMENTS
FOR
CITY OF TIGARD**

TABLE OF CONTENTS

Section	Person Responsible	Title	
Division 01 - General Requirements			
01 10 00	ANB	Summary of Work	1-15
01 22 20	ANB	Unit Price Measurement and Payment	1-8
01 33 00	ANB	Submittal Procedures	1-12
01 45 00	ANB	Quality Control	1-5
01 56 39	ANB	Temporary Tree and Plant Protection	1-5
01 61 10	ANB	Seismic Requirements for Non-Structural Components	1-5
01 75 16	ANB	Testing, Training and System Start-Up	1-5
Division 02 - Existing Conditions			
02 30 00	ANB	Subsurface Investigations	1-2
02 41 00	ANB	Demolition	1-7
Division 03 - Concrete			
03 21 00	EDA	Reinforcing Steel	1-6
03 30 00	EDA	Cast-in-Place Concrete	1-34
03 60 00	EDA	Grouting	1-7
Division 04 - Masonry			
04 05 10	EDA	Masonry Mortar and Grout	1-12
04 22 00	EDA	Concrete Masonry Units	1-7
04 26 13	EDA	Masonry Veneer	1-12
Division 05 - Metals			
05 50 00	ANB	Metal Fabrications	1-18
Division 06 - Wood and Plastics			
06 05 23	EDA	Wood, Plastic, and Composite Fasteners	1-2
06 10 00	EDA	Rough Carpentry	1-5
06 1063	EDA	Exterior Rough Carpentry	1-3
06 17 53	EDA	Shop Fabricated Wood Trusses	1-6
06 61 00	EDA	Fiberglass Reinforced Plastics (FRP) Fabrications, Molded Grating	1-6

Division 07 - Thermal and Moisture Protections

07 21 00	JJM	Thermal Insulation	1-4
07 27 26	JJM	Fluid-Applied Membrane Air Barriers	1-9
07 41 13.16	JJM	Standing Seam Sheet Metal Roof Panels	1-7
07 46 46	JJM	Fiber-Cement Siding	1-5
07 92 00	JJM	Joint Sealants	1-11

Division 08 - Doors and Windows

08 11 13	JJM	Hollow Metal Doors and Frames	1-12
08 31 13	JJM	Access Doors and Frames	1-3
08 62 00	JJM	Unit Skylights	1-4
08 71 00	JJM	Door Hardware	1-17
08 80 00	JJM	Glazing	1-12
08 91 19	JJM	Louvers	1-3

Division 09 - Finishes

09 29 00	JJM	Gypsum Board	1-6
09 90 00	ANB	Painting and Coating	1-19
09 91 13	JJM	Exterior Painting	1-6
09 91 23	JJM	Interior Painting	1-7
09 91 00	JJM	Wood Stains	1-3

Division 10 - Specialties

10 14 10	ANB	Identifying Devices	1-5
10 44 16	ANB	Fire Extinguishers	1-2

Division 11 - Equipment

11 05 00	ANB	Common Work Results for Equipment	1-8
----------	-----	-----------------------------------	-----

Division 12 through Division 21

NOT USED

Division 22 - Plumbing

22 11 16	AS	Domestic Water Piping and Valves	1-4
22 11 19	AS	Domestic Water Specialties	1-4
22 13 16	AS	Sanitary Drain and Vent Piping	1-2
22 13 19	AS	Waste Pipe Specialties	1-3
22 40 00	AS	Plumbing Fixtures	1-3

Division 23 - HVAC

23 31 13	AS	Metal Ducts and Accessories	1-20
23 34 00	AS	HVAC Fans	1-8
23 82 39	AS	Convective Unit Heaters	1-2

Division 24
NOT USED

Division 25 – Integrated Automation

25 32 11	ANB	Seismic Protection Systems	1-5
25 32 13	ANB	Integrated Operation Actuators and Operators	1-16
		Supplement 1: Actuator Schedule for Butterfly Valves	1-1
		Supplement 2: Valve/Actuator Data/Test Sheet	1-2

Division 26 - Electrical

26 00 00	SMR	Electrical General Requirements	1-13
26 05 19	SMR	Low-Voltage Electrical Power Conductors and Cables	1-6
26 05 26	SMR	Grounding and Bonding for Electrical Systems	1-5
26 05 29	SMR	Hangers and Supports for Electrical Systems	1-10
26 05 33	SMR	Raceways and Boxes for Electrical Systems	1-98
26 05 53	SMR	Identification for Electrical Systems	1-5
26 05 73	SMR	Short-Circuit, Coordination, and Arc Flash Studies	1-14
26 05 88	AS	Premium Efficiency Vertical Motors	1-5
26 27 00	SMR	Service and Distribution	1-6
26 27 16	SMR	Cabinets and Enclosures	1-3
26 27 26	SMR	Wiring Devices	1-3
26 29 00	SMR	Motors and Controls	1-6
26 29 23	SMR	Variable Frequency Drives	1-13
26 32 13	SMR	Standby Power System	1-14
26 50 00	SMR	Lighting	1-4
26 50 10	SMR	Lighting Control Devices	1-4

Division 27 through Division 30
NOT USED

Division 31 - Earthwork

31 05 13	ANB	Soils for Earthwork	1-5
31 05 16	ANB	Aggregates for Earthwork	1-6
31 10 00	ANB	Site Clearing	1-8
31 22 13	ANB	Rough Grading	1-5
31 23 16	ANB	Excavation	1-9
31 23 17	ANB	Trenching	1-24
31 23 18	ANB	Rock Removal	1-4
31 23 19	ANB	Dewatering	1-4
31 23 23	ANB	Fill	1-8
31 23 24	ANB	Flowable Fill	1-7
31 37 00	ANB	Riprap	1-5

Division 32 - Exterior Improvements

32 11 23	ANB	Aggregate Base Courses	1-6
32 12 16	ANB	Asphaltic Concrete Pavement	1-5

32 31 13	ANB	Chain Link Fences and Gates	1-6
32 90 00	ANB	Planting	1-10
32 91 21	ANB	Finish Grading and Seeding	1-14

Division 33 - Utilities

33 01 30.13	ANB	Sewer and Manhole Testing	1-7
33 05 13	ANB	Manholes	1-14
33 05 17	ANB	Precast Concrete Valve Vaults and Meter Boxes	1-8
33 11 10	ANB	Water Utility Distribution & Transmission Piping	1-24
33 11 50	ANB	Existing Pipe Abandonment	1-4
33 12 13	ANB	Water Service Connections	1-12
33 12 16	ANB	Water Utility Distribution Valves	1-8
33 12 19	ANB	Fire Hydrants	1-5
33 13 00	ANB	Testing and Disinfection of Water Utility Piping	1-10
33 31 10	ANB	Sanitary Utility Sewerage Piping	1-12
33 41 10	ANB	Storm Utility Drainage Piping	1-14

Division 34 through Division 39

NOT USED

Division 40 - Process Integration

40 05 13	ANB	Common Work Results for Process Piping	1-26
40 05 23	ANB	Common Work Results for Process Valves	1-8
40 05 23.60	AS	Aquifer Storage and Recovery Valves	1-4
40 05 23.72	ANB	Miscellaneous Valves	1-9
40 05 23.73	ANB	Pressure Reducing Valves	1-4
40 05 51.15	ANB	Gate Valves	1-5
40 05 51.18	ANB	Butterfly Valves	1-4
40 05 51.24	ANB	Check Valves	1-6
40 05 65.16	AS	Globe Style Diaphragm Valves	1-6
40 91 00	CMS	Process Instrumentation and Control	1-7
40 91 01	CMS	Process Control Description	1-7
40 91 02	CMS	In-Line Instrument Flow Meter	1-3
40 91 03	CMS	Flow Detection	1-2
40 91 06	CMS	Level Sensor	1-3
40 91 07	CMS	Level Detection	1-2
40 91 09	CMS	Pressure Detection Devices	1-3
40 91 10	CMS	Hydrogen Gas Detector	1-4
40 91 11	CMS	Water Quality Analyzers	1-6
40 91 12	CMS	Intrusion Detection Devices	1-3
40 91 13	CMS	Alarm Indicators	1-2
40 91 14	CMS	Smoke Detectors	1-2
40 92 00	CMS	Control Panels and Components	1-27
40 92 01	CMS	PLC Control System Hardware and Software	1-8

Division 41 through Division 42
NOT USED

Division 43 - Process Gas & Liquid Handling

43 21 00	AS	Liquid Pumps	1-8
43 21 52	AS	Deep Well Vertical Turbine Pumps	1-7
43 21 53	AS	Sample Pumps	1-3
43 22 56	AS	Static Mixers for Liquid Processes	1-2
43 33 20	AS	Liquid Chemical Diaphragm-Type Metering Pumps	1-11
43 40 08	AS	Polyethylene Storage Tanks	1-10

Division 44 through Division 45
NOT USED

Division 46 - Water and Wastewater Equipment

46 01 00	AS	Equipment General Provisions	1-16
46 32 00	AS	Sodium Hypochlorite Generation System	1-10
46 61 40	AS	Water Softeners	1-5

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 GENERAL

This Section supplements and amplifies certain sections of the General Conditions. The General Conditions and Special Provisions shall apply except as modified herein. This Section and additional technical specifications may contain occasional requirements not pertinent to the project. However, these specifications shall apply in all particulars insofar as they are applicable to this project.

1.1 SUBMITTALS

- A. Licensing and bonding of construction operator's license for the State of Oregon (Part 1.7)

1.2 SCOPE OF WORK

The Work to be performed under these specifications and drawings consists of furnishing all labor, materials, services, and equipment necessary for the ASR 3 & 2 Wellhouse Improvements Project, including, but not limited to:

- Construction of ASR 3 Well House:
 - Construction of new ASR 3 wellhouse,
 - Installation of new seismic valve vault on Reservoir 16 inlet/ outlet piping,
 - Site stormwater and grading improvements
 - Site piping improvements
- Improvements to Reservoir 4
 - New reservoir vent installation,
 - Sealing of existing reservoir vents
 - PRV valve vault installation
 - Site piping improvements
- Improvements to ASR 2:
 - VFD Replacement,
 - Electrical and telemetry improvements
 - Water quality instrumentation replacement

1.3 ORGANIZATION AND INTERPRETATION OF CONTRACT DOCUMENTS

- A. The Work is specified in individual sections, which are listed below:

The drawings and specifications are intended to describe and provide for a complete work. Any requirement in one is as binding as if stated in all. The CONTRACTOR shall provide any work or materials clearly implied in the Contract Documents even if the Contract Documents do not mention it specifically. If there is a conflict within the Contract Documents, it will be resolved per City General Conditions section 00150.10-A. Contractor shall immediately request clarification from the Engineer to resolve and discrepancies.

Dimensions shown on the drawings or that can be computed shall take precedence over scaled dimensions. Notes on drawings are part of the drawings and govern in the order described above. Notes on drawings shall take precedence over drawing details.

The intent of the drawings and specifications is to prescribe the details for the construction and completion of the work which the CONTRACTOR undertakes to perform according to the terms of the Contract. Where the drawings or specifications describe portions of the work in general terms, but details are incomplete or silent, it is understood that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Unless otherwise specified, the CONTRACTOR shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract in a manner satisfactory to the ENGINEER.

The contract drawings are designated by general title, sheet number and sheet title. When reference is made to the drawings, the "Sheet Number" of the drawing will be used. Each drawing bears the ENGINEER's File No. 20-2799 and the general title:

CITY OF TIGARD

ASR 3 & 2 WELLHOUSE IMPROVEMENTS

The specific titles of each sheet are contained on G-2 of the Drawings.

- B. Specifications and Drawings included in these Contract Documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance.
- C. The OWNER and OWNER'S REPRESENTATIVE reserve the right to change materials and quantities specified in the following documents based on conditions encountered in the field. In addition, the OWNER reserves the right to discontinue the work on the well or eliminate certain work items at any time. In such a case, the CONTRACTOR shall be paid at the unit prices for the actual work accomplished.
- D. As the work progresses, the OWNER or OWNER'S REPRESENTATIVE may choose to eliminate certain work items, or individual components of the work specified. The CONTRACTOR is advised to prepare their bid accordingly.

- E. The work to be performed shall consist of furnishing tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, supervision, transportation, and services, including fuel, power, water, and essential communications, and performing all work as specified. The work shall be complete, and all work, materials, and services not expressly indicated or called for in these specifications which may be necessary for the complete and proper construction of the Work in good faith shall be provided by the CONTRACTOR. If the CONTRACTOR believes certain items of work are required outside of what is specified, the CONTRACTOR shall notify the OWNER'S REPRESENTATIVE and/or OWNER immediately.
- F. Upon completion and acceptance of the work, CONTRACTOR shall remove from the site the equipment, all debris, unused materials, and other miscellaneous items resulting from or used in the rehabilitation; replace or repair any facility that has been damaged or removed during construction work; restore the site to its original condition or better.

1.4 CODE REQUIREMENTS

All work shall be done in strict compliance with the requirements of:

- A. International Building Code
- B. Uniform Mechanical Code
- C. Uniform Plumbing Code
- D. National Electric Code
- E. National Electric Safety Code
- F. Oregon State Department of Labor and Industries
- G. City of Tigard
- H. Washington County
- I. Oregon Department of Water Resources
- J. Oregon Health Authority

In case of disagreement between codes or these specifications, the more restrictive shall prevail.

1.5 ACCESS TO WORK

Access to the work shall be provided as may be required by the OWNER or its representatives, and all authorized representatives of the state and federal governments and any other agencies having jurisdiction over any phase of the work, for inspection of the progress of the work, the methods of construction or any other required purposes.

1.6 COORDINATION WITH OTHER CONTRACTORS AND OWNER

Contractor shall connect and coordinate with the work and needs of Schneider Water Services for Maintenance, adjustment, and removal of a temporary pump installed on the ASR 3 Wellhead. Schneider Water Services shall be the only party operating, adjusting, and removing any parts of the temporary circulation pump unless otherwise directed by the OWNER. The CONTRACTOR under these specifications shall cooperate fully with all other contractors and OWNER and carefully fit its own work to such other work as may be directed by the Owner's representative. The contractor shall not commit or permit any act to be committed which will interfere with the performance of work by any other CONTRACTOR or the OWNER.

1.7 PERMITS AND LICENSES

The contractor must have current licenses and permits required to perform the work, including, but not limited to:

1. A current water well construction operator's license for the State of Oregon.
2. Traffic Control Plan and/or any City permits.
3. All trade permits

1.8 TEMPORARY UTILITIES FOR CONSTRUCTION PURPOSES

The CONTRACTOR shall make all arrangements necessary to provide all temporary utilities for construction purposes and shall pay all costs associated those temporary utilities. Water for construction purposes will be furnished by the OWNER at no cost. The CONTRACTOR shall furnish all valves, hoses, connections, and other devices as necessary to obtain enough water for construction and for filling and testing of water lines as required. Fire hydrant use is allowed only by permission of the utility owner. Backflow protection is required on all connections to potable water systems.

1.9 FIELD SERVICE BY MANUFACTURER'S REPRESENTATIVE

The CONTRACTOR shall furnish the services of a manufacturer's or material supplier's representative for all major equipment and materials furnished by the CONTRACTOR or OWNER under this contract, to check, place in operation and test the installation, and train operating personnel. The manufacturer's representative shall be qualified and authorized to perform repairs and maintenance on the equipment. The above gives a general scope of the services desired from the manufacturer's representative. It will be the responsibility of the CONTRACTOR and the equipment manufacturer to determine detailed requirements. Costs for services of the manufacturer's representative shall be included in the proposal of the CONTRACTOR. The operator training mentioned above shall include enough time during the

CONTRACTOR'S operation and testing period to fully explain to the operating personnel the features of the equipment and maintenance thereof.

1.10 CONSTRUCTION WITHIN PUBLIC RIGHTS-OF-WAY

When the work contemplated is wholly or partly within the right-of-way of a public agency such as a city, county or state, the CITY will obtain from these agencies any right-of-way and street opening permits and all other necessary permit(s) required for the work. The CONTRACTOR shall abide by all regulations and conditions stipulated in the permit(s). Such conditions and requirements are hereby made a part of these specifications, as fully and completely as though the same were fully set forth herein. The CONTRACTOR shall examine the permit(s) granted by any city, county, state and federal agencies and provide a copy to the OWNER for their records. Failure to do so will not relieve the CONTRACTOR from compliance with the requirements stated therein.

The CONTRACTOR shall obtain all construction permits and pay all fees or charges and furnish any bonds and insurance coverages as necessary to insure that all requirements of the city, county, state or federal agencies will be observed and the roadway and ditches are restored to their original condition or one equally satisfactory. A copy of all permits shall be kept on the work site for use of the ENGINEER. A copy of all permits shall be provided to the OWNER for their records.

1.11 NOT USED

1.12 PRIVATE ROADS AND DRIVEWAYS

No private road or driveway may be closed without approval of the ENGINEER unless written authority has been given by the owner whose property has been affected. Driveways shall be left open and ready for use at the end of the work shift. All expenses involved in providing for construction, maintenance, and use of private roads or driveways, shall be borne by the CONTRACTOR and the amount thereof absorbed in the unit prices of the CONTRACTOR'S bid.

1.13 TRAFFIC CONTROL AND PROTECTION

The CONTRACTOR shall maintain traffic control and protection in the work areas 24 hours per day. Traffic control shall conform to the standards set forth in the "Oregon Manual on Uniform Traffic Control Devices" issued by the Oregon Department of Transportation.

The CONTRACTOR shall conduct its operations to keep one lane of traffic open for public and private access at all times on City, County and Public streets, roads and highways. If required by the State, the CONTRACTOR shall conduct its operations to keep both directions of traffic open on State Highways. Permits obtained for the project may have more stringent requirements than noted in this section.

Prior to beginning construction, the CONTRACTOR shall submit a detailed street closure and traffic control plan to the ENGINEER for approval. As construction proceeds, the CONTRACTOR shall notify the ENGINEER as to the status of street closures and detours.

1.14 DECHLORINATION AND DISPOSAL OF CHLORINATED WATER

Dispose of treated water flushed from mains. Meet the requirements of the Service Provider Letter issued by Clean Water Services for this project. To protect aquatic life, de-chlorinate the treated wastewater according to AWWA C-655 standards before disposed of water into any storm drain or natural drainage channel. Dispose of disinfecting solution according to AWWA C-655 Standards and to the satisfaction of the Engineer and local authorities. If approved by the Engineer and the sanitary sewer Utility, disposal may be made to an available sanitary sewer, provided the rate of disposal will not overload the sewer.

1.15 LIMITS OF THE WORK AND STORAGE OF SPOILS

The limits of the site which may be used for construction, storage, materials handling, parking of vehicles and other operations related to the project include the project site as shown on the drawings and adjacent public rights-of-way subject to permission of the public owner of that right-of-way. The limits of work also include rights of access obtained by the CONTRACTOR, subject to all public laws and regulations and rights of access by utility companies and other holders of easement rights.

1.16 EXISTING WATER SYSTEM SHUTDOWN

If the project involves the need to shut down an existing water system, the CONTRACTOR shall coordinate the work with the utility to insure a minimum of shutdown time. The CONTRACTOR shall submit a written shutdown schedule to the ENGINEER for approval. The CONTRACTOR shall provide a minimum 72-hour notice preceding each shutdown. Contractor shall comply with City of Tigard Public Improvement Standards. Operation of valves in the Tigard Water Service Area is prohibited.

1.17 TESTING AND OPERATION OF FACILITIES

It is the intent of the OWNER to have a complete and operable facility. All the work under this contract will be fully tested and inspected in accordance with the specifications. Upon completion of the work, the CONTRACTOR shall operate the completed facilities as required to test the equipment under the direction of the ENGINEER and in coordination with the OWNER and operating staff. During this period of operation by the CONTRACTOR and in coordination with the OWNER and operating staff, the new facilities will be tested thoroughly to determine their acceptance.

1.18 PROTECTION OF EXISTING STRUCTURES AND WORK

The CONTRACTOR must take all precautions and measures necessary to protect all existing structures and work. Any damage to existing structures and work shall be repaired by

removing the damaged structure or work, replacing the work and restoring to original condition satisfactory to the ENGINEER.

1.19 SALVAGE AND DEBRIS

Unless otherwise indicated on the drawings or in the specifications, all castings, pipe, equipment, demolition debris, spoil or any other discarded material or equipment shall become the property of the CONTRACTOR and shall be disposed of in a manner compliant with applicable Federal, State, and local laws and regulations governing disposal of such waste products. No burning of debris or any other discarded material will be permitted.

1.20 SAFETY STANDARDS AND ACCIDENT PREVENTION

The CONTRACTOR shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. The required and/or implied duty of the ENGINEER to conduct construction review of the CONTRACTOR'S performance does not, and is not intended to, include review of the adequacy of the CONTRACTOR'S safety measures in, on, or near the construction site.

The CONTRACTOR shall comply with the safety standards provisions of applicable laws and building and construction codes. The CONTRACTOR shall exercise every precaution at all times for the prevention of accidents and protection of persons, including employees, and property. During the execution of the work the CONTRACTOR shall provide and maintain all guards, railing, lights, warnings, and other protective devices which are required by law or which are reasonably necessary for the protection of persons and property from injury or damage.

- A. The CONTRACTOR shall be solely responsible for the health and safety of its employees and subcontractors.
- B. The CONTRACTOR shall develop and maintain a safety plan that will effectively incorporate and implement all required safety provisions addressing all work elements of this project for the duration of this Contract.
- C. A copy of the CONTRACTOR's health and safety plan shall be submitted to the OWNER's REPRESENTATIVE prior to mobilizing to the work site and the CONTRACTOR shall keep a copy of the health and safety plan on-site at all times.
- D. The CONTRACTOR shall maintain a first aid kit, fire extinguisher, Safety Data Sheets (SDS), and other necessary safety equipment required for the work on site at all times.
- E. The CONTRACTOR shall ensure that employees working at the site(s) during chemical testing or are qualified to work with the chemicals used and the CONTRACTOR shall ensure that all necessary safety equipment is available on site.

1.21 PUBLIC SAFETY AND CONVENIENCE

General Rule: The CONTRACTOR shall ensure the safety of the public during its performance of the Work and shall minimize any public inconvenience in addition to any other requirement imposed by law. These duties include, but are not limited to, the matters listed below.

Access: The CONTRACTOR shall not unreasonably restrict access to public facilities, commercial property, fire hydrants, residential property, and other areas where the public can be expected to be present, such as sidewalks and streets without first obtaining approval of the OWNER. Driveways shall be closed only with the approval of the OWNER or after obtaining specific permission from the property owner(s). In addition, the CONTRACTOR shall not obstruct or interfere with travel over any public street or sidewalk without approval of the OWNER.

Public Transit: The CONTRACTOR shall not interfere with the normal operation of any public transit vehicles unless otherwise authorized.

Work Site: The CONTRACTOR shall keep the Project site safe in compliance with applicable laws. Safety includes, but is not limited to: 1) providing an approved type of secured and adequate barricades or fences that are easily visible from a reasonable distance around open excavations; 2) closing up or covering with steel plates all open excavations at the end of each Working Day in all street areas and in all other areas when it is reasonably required for public safety; 3) marking all open work and obstructions by lights at night; 4) installing and maintaining all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities; 5) observing any and all safety instructions received from the OWNER; and 6) following all laws and regulations concerning worker and public safety. In the event that the law requires greater safety obligations than that imposed by the OWNER, the CONTRACTOR shall comply with the law.

Emergency: Emergency vehicles, including but not limited to police, fire, and disaster units shall be provided access to the work site at all times.

Cleanliness: The CONTRACTOR shall, on a continuing basis, keep the surfaces of all public and private roadways, sidewalks, and other pathways free of dirt, mud, cold plane grindings, and other matters that the CONTRACTOR may place upon the road. The cost of performing such work shall be included in the CONTRACTOR'S Bid and no additional payment will be made for performing this task.

Parking: The CONTRACTOR shall make any necessary contacts with all applicable governmental bodies to arrange for the removal of parked automobiles, vehicles and other obstructions if they would interfere with the performance of the CONTRACTOR'S work.

Accidents: The CONTRACTOR'S Project Manager or superintendent shall be in charge of accident prevention. CONTRACTOR shall take all actions necessary to prevent damage, injury and loss to persons and property as a result of accidents.

1.22 WARRANTY PERIOD

The CONTRACTOR shall warrant all furnished materials and equipment for a period of one year from date of final acceptance of the Work by the OWNER. This warranty shall mean prompt attention to the correction and/or complete replacement of the faulty material or equipment. The expiration of the one-year warranty period shall not affect any other claims or remedy available to the OWNER. There may be other warranty provisions in these contract documents in addition to those noted above.

1.23 SANITARY FACILITIES

The CONTRACTOR shall provide and maintain sanitary facilities for its employees and its subcontractors' employees that will comply with the regulations of the local and State Departments of Health and as directed by the ENGINEER.

1.24 WORK AREA CLEANUP

The CONTRACTOR shall clean daily all dirt, gravel, construction debris, and other foreign material resulting from its operations from all streets, roads, and within the vicinity of the project work area.

1.25 VEHICLE PARKING

The vehicles of the CONTRACTOR'S and subcontractors' employees shall be parked in accordance with local parking ordinances.

1.26 PROTECTION OF QUALITY OF WATER

The work to be performed involves connections to an existing potable water system. The CONTRACTOR shall take such precautions as are necessary or as may be required to prevent the contamination of the water. Such contamination may include but shall not be limited to deleterious chemicals such as fuel, cleaning agents, paint, demolition and construction debris, sandblasting residue, etc. In the event contamination does occur, the CONTRACTOR shall, at its own expense, perform such work as may be necessary to repair any damage or to clean the affected areas of the water mains to a condition satisfactory to the ENGINEER.

The work to be performed involves the excavation, cutting, removal and modifications to an existing well casing(s). All work required under this contract shall be performed in accordance with Oregon Administrative Rules of the Oregon Water Resources Department, Chapter 690, including but not limited to OAR 690-200, Water Supply Well Construction and Maintenance and OAR 690-210, Well Construction Standards.

1.27 "OR APPROVED EQUAL" CLAUSE

In order to establish a basis of quality, certain processes, types of machinery and equipment or kinds of material may be specified on the drawings or herein by designating a manufacturer's name and referring to its brand or product designation. It is not the intent of these specifications to exclude other processes, equipment or materials of a type and quality equal to those designated. When a manufacturer's name, brand, or item designation is given, it shall be understood that the words "or approved equal" follow such name or designation, whether in fact they do so or not. If the CONTRACTOR desires to furnish items of equipment by manufacturers other than those specified, he shall secure the approval of the ENGINEER prior to placing a purchase order.

No extras will be allowed the CONTRACTOR for any changes required to adopt the substitute equipment. Therefore, the CONTRACTOR'S proposal for an alternate shall include all costs for any modifications to the drawings, such as structural and foundation changes, additional piping or changes in piping, electrical changes or any other modifications which may be necessary or required for approval and adoption of the proposed alternate equipment. Approval of alternate equipment by the ENGINEER before or after bidding does not guarantee or imply that the alternate equipment will fit the design without modifications.

1.28 WORK HOUR LIMITATIONS

All work shall be conducted Monday through Friday between the hours of 7:00 a.m. and 7:00 p.m. on non-holiday weekdays only.

The CONTRACTOR may make a request to the OWNER for extended work hours or weekend work; however, the approval of extended work hours or weekend work is at the discretion of the OWNER.

1.29 DUST PREVENTION

All unpaved streets, roads, detours, haul roads, or other areas where dust may be generated shall receive an approved dust-preventive treatment or be routinely watered to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

Dust emissions from construction activities shall be controlled to be within applicable environmental regulations. The CONTRACTOR shall be responsible for cleaning and repair of properties near the well site which may become damaged by dust emissions.

1.30 EROSION AND SEDIMENTATION CONTROL

- A. Erosion and sedimentation control shall consist of installation, maintenance and removal of temporary erosion and sedimentation control measures. Standards for these measures are published under a separate reference: Clean Water Services' (CWS) "Erosion Prevention and Sediment Control Planning and Design Manual" (EC Manual).

This publication is available from CWS' website at www.cleanwaterservices.org/permits-development/design-construction-standards.

- B. The CONTRACTOR shall submit an Erosion and Sediment Control Plan for each well site for review and acceptance by the OWNER'S REPRESENTATIVE prior to the CONTRACTOR mobilizing to the well site. The CONTRACTOR shall design the Erosion and Sediment Control Plans to meet the standards set forth in the EC Manual using measures that will best fit the CONTRACTOR'S rehabilitation sequencing and approved schedule. The CONTRACTOR shall maintain one copy of the Erosion and Sediment Control Plan at the job site.
- C. The erosion control measures shall be installed by the CONTRACTOR and inspected by the OWNER or OWNER'S REPRESENTATIVE prior to the CONTRACTOR beginning active work at each site.
- D. Installation of erosion control measures in accordance with the Erosion and Sediment Control Plans shall not relieve the CONTRACTOR of any responsibility for enforcement actions resulting from violation of the standards set forth in the EC Manual.
- E. The CONTRACTOR shall be responsible for obtaining any necessary permits relating to erosion control that are required for the CONTRACTOR'S work at each site as described in these specifications.

1.31 NOISE LIMITATIONS

Noise limits for the project (City of Tigard municipal code 6.02.430(D)) as measured at the property boundary are:

- A. 74 decibels from 7:00 AM to 10:00 PM
- B. 60 decibels from 10:00 PM to 7:00 AM

1.32 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

- A. Materials and equipment stored overnight shall be placed neatly on the job site. Unusable materials ((i.e. old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.

Provide appropriate barricades, signs, and traffic control devices in like-new condition where necessary to protect the public from any hazards associated with the storage of materials and equipment used for this project.

- B. No equipment and/or materials shall be stored outside the immediate work area on public right-of-way, in the following locations, or in the following manner:
 - 1. In any maintained landscaped or lawn area.

2. In a manner that would eliminate an individual residents' street parking.
3. In front of any business.

The “immediate work area” is the area where work is taking place or will be taking place within one calendar day. The CONTRACTOR shall immediately move stored material or equipment which causes a nuisance or creates complaints.

1.33 USE OF EXPLOSIVES

The use of explosives shall not be allowed on this project.

1.34 CONTAMINATED MATERIAL

A. General

It is possible that the CONTRACTOR may encounter contaminated material (soil and/or water) during excavation activities. This specification identifies requirements for handling and disposing contaminated media.

B. Definitions

1. “Contaminated material” is defined as soil, water, free product, Underground Storage Tanks (UST), buried abandoned utility lines containing residual or free product, solid waste, treated wood waste, chemical containers, or other solid, liquid, or gas substances with contamination levels above background levels.
2. “Hazardous substances” shall mean those substances or materials defined in the Oregon Revised Statutes (ORS) 465.200, as amended.
3. “Release” shall have the meaning as defined in ORS 465.200, as amended.
4. “Environmental laws” shall mean any applicable statute, law, ordinance, order, consent decree, judgment, permit, license, code, covenant, deed, common law, treaty, convention or other requirement pertaining to protection of the environment, health or safety, natural resources, conservation, wildlife, waste management or disposal, hazardous substances or pollution, including but not limited to regulation of releases to air, land, water, and groundwater.

C. Execution

1. Discovery of Contaminated Material

In the event that the CONTRACTOR, during the course of construction or during any other activities authorized under this contract, should encounter suspected

contaminated material or any other materials suspected of posing a threat to human health and the environment, the CONTRACTOR shall notify the ENGINEER immediately and manage according to requirements identified below.

2. Discovery of Contaminated Soil

CONTRACTOR shall note evidence of contamination (odor, visual staining of soil, free liquid product seeping from soil, sheen on groundwater, etc.) and note location of evidence on a sketch of the excavation and provide to the ENGINEER.

CONTRACTOR shall report the discovery to the ENGINEER immediately. CONTRACTOR shall stop all excavation activities and secure the site to prevent entry by the public. The excavation shall not be backfilled. Protect all open excavations with berms, plates and fencing. CONTRACTOR may continue with work in other non-contaminated areas.

CONTRACTOR shall assist ENGINEER in collecting sample(s) of suspected contaminated media for testing and characterization. CONTRACTOR shall allow 21 days, at no cost to OWNER, for testing, results and instructions as to how to proceed with contaminated materials.

The CONTRACTOR shall obtain a copy of an approved soil disposal/acceptance permit (Disposal/Treatment Facility requires transporter to have a copy of the permit.)

CONTRACTOR will transport and dispose of contaminated material at an approved disposal/treatment facility.

CONTRACTOR shall provide the ENGINEER with a copy of the contaminated soil disposal receipt.

3. Handling of Contaminated Soil

After approval from the ENGINEER, excavate the soil in a manner that prevents commingling of contaminated and non-contaminated soil. ENGINEER will make determination (based on soil saturation) if contaminated soil can be directly transported to a treatment or disposal facility, or if soil needs to be stockpiled to reduce water content. ENGINEER will determine when stockpiled soil can be transported off-site.

CONTRACTOR will be responsible for stockpiling contaminated soil in containers or on impervious surface to prevent the spread of contamination. Any water runoff from the contaminated soil stockpile area(s) must be contained by CONTRACTOR and handled as contaminated water.

Minimize movement of excavation equipment over or through contaminated soil to prevent movement of contaminated soil into areas where no contaminated soil exists.

Stockpiles will be created on an approved site and shall be surrounded by a fence to limit access. The stockpiles must be covered and bermed during periods of rainfall to prevent run-on and run-off. The stockpiles shall be covered with a minimum 10-mil high density polyethylene (HDPE) plastic during periods of strong winds, nightfall, over the weekends, or during extended work stoppages. If dust is observed coming from the stockpiles, the stockpiles shall be either covered or the dust controlled with water.

Maintain excavation equipment in good working order. Prevent spillage of oil, fuel, or hazardous substances from equipment. In particular, promptly repair oil leaks from equipment and clean up any contaminated soil.

4. Transport of Contaminated Materials

CONTRACTOR shall comply with all applicable Federal, State, or local laws, codes, and ordinances that govern or regulate contaminated substance transportation. Contaminated soils placed in stockpiles shall be loaded into trucks in a manner that prevents the spilling or tracking of contaminated soil into areas of the site with uncontaminated soil. Loose material falling onto the exterior of the truck during loading shall be removed before the truck leaves the loading area. Any material collected in the loading area shall either be placed back into the truck or back into the stockpile. If loading areas are unpaved, the surface soil shall be sampled at the conclusion of the loading activities to confirm that contaminated soil is not present. If loading areas are paved, any loose soil shall be cleaned from the pavement at the conclusion of the loading activities.

Specific truck haul routes shall be established before beginning off-site contaminated media transport. On-site truck routes shall be established to minimize or prevent movement of trucks over contaminated soils. Off-site truck routes shall be established to reduce the risk of releases of contaminated soils and impact on local traffic. The CONTRACTOR shall be responsible for ensuring that loaded truck weights are within acceptable limits. All trucks shall be covered before they leave the loading area.

The CONTRACTOR shall ensure that all drivers of vehicles transporting contaminated substances have in their possession during transport all applicable Oregon State and local vehicle insurance requirements, valid driver's license, and vehicle registration and license. The CONTRACTOR shall be responsible for informing all drivers of transport vehicle about:

- a. The nature of the material transported.

- b. Required routes to and from the off-site thermal treatment or disposal facility.
- c. Applicable County street regulations and requirements, and State of Oregon Department of Transportation codes, regulations and requirements.
- d. The County's requirement for proper handling and transportation of the substances.

The CONTRACTOR shall not allow contaminated substances to be spilled or tracked off-site at any time during the project. Trucks used for the transportation of contaminated substances off-site shall be watertight, substance compatible, licensed, insured, and permitted pursuant to federal, state, and local statutes, rules, regulations and ordinances.

If contaminated media is discarded prior to removal of contaminated material, the price per cubic yard of soil materials and price per 100 gallons of contaminated water will be negotiated with OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 22 20 - UNIT PRICE MEASUREMENT AND PAYMENT

Measurement and payment will be on a unit price basis in accordance with the prices set forth in the proposal for individual work items. Where work is required but does not appear as a separate item in the proposal, the cost for that work shall be included and absorbed in the unit prices named in the proposal. CONTRACTOR shall make a careful assessment when preparing the bid.

Part A ASR 3

- A-1. Mobilization, Bonds, Permitting, Insurance: Payment for mobilization, bonds, permitting, and insurance will be on a lump sum basis. The amounts paid for mobilization in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:
- a. When 5 percent is earned, either 100 percent of the amount for mobilization or 5 percent of the original contract amount, whichever is the least.
 - b. When all work is completed, amount of mobilization exceeding 5 percent of the original contract amount.
 - c. This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.
- A-2. Temporary Traffic Control: Payment for traffic maintenance and protection, flagging, temporary fencing and safety barricades, including all coordination, materials, and equipment, as required, will be on a lump sum basis.
- A-3. Erosion Control and Permitting: Payment for installation of approved erosion control devices (silt fencing, straw bales, and other items), as required, including all labor, materials, and equipment, as required, will be on a lump sum basis:
- A-4. Construction Survey and Staking: Payment for construction survey and staking, including all coordination, materials, labor and equipment, as required, will be on a lump sum basis, complete.
- A-5. ASR 3 Facility, Complete: Lump sum payment under this item shall cover all aquifer storage and recovery site elements of the project, whether or not specifically identified herein, in the Contract Documents, and as shown on the plans and within Part A limits show on the drawings, except as identified under a separate bid item. Payment shall be full and complete compensation for all Work within the Part A Work limits shown on the drawing and any other work not shown or indicated, but which can be reasonably assumed to be

necessary to provide complete and usable facilities including material, equipment, and labor for construction.

- A-6. Clearing and grubbing, including tree removal: Payment for clearing and grubbing including tree removal shall be on a lump sum basis and include all materials, labor, equipment, and hauling required to clear site to limits required by the Contract Documents in order to prepare the site for construction.
- A-7. Site preparation, excavation, backfill, and grading: Payment for this item shall be made on a lump sum basis and includes, but is not limited to all labor and equipment required for site excavation; offsite disposal and onsite placement of excavation spoils; imported structural fill and/or soil treatments per geotechnical requirements; removal and disposal of existing Asphalt Paving (AC) to limits shown and rough site grading.
- A-8. Furnish and Install chin link gate, fence, and anchors, complete: Payment for this item shall be on a lump sum basis and shall include all labor, materials, concrete anchor systems, and equipment needed to install fencing and access gates as shown on the plans.
- A-9. Furnish and Install seismic valve vault, complete: Payment for the seismic valve vault shall include all labor, materials, and equipment needed to construct the seismic valve vault as shown in the Contract Documents including but is not limited to the precast concrete vault, 24-inch diameter butterfly valve, DI piping as required, Copper piping as required, motorized actuator, excavation, backfill and compaction, surface restoration as required, as shown on the plans. Payment shall be made on a lump sum basis.
- A-10. Site Access Driveway, complete: Payment for site access driveway shall include all labor, materials, and equipment to construct concrete driveway apron as shown on Drawings shall be made on a square foot basis. Finish grading, sidewalk and curb restoration, and surface restoration shall be incidental to this bid item.
- A-11. Furnish and Install Street Lighting Improvements: Payment for this item shall be made on a lump sum basis and include all labor, materials, equipment, coordination and permitting required to install street lighting improvements on SW Bull Mountain Road.
- A-12. 5-foot concrete building perimeter sidewalk: Payment for this item shall be made on a square-foot basis and include all materials, labor, and equipment required to install concrete walks to the limits shown on Drawings.
- A-13. Standard Concrete Curb: Payment for this item shall be on a per linear foot basis and include all labor, materials, and equipment required to construct standard concrete curb per the Drawings.
- A-14. Asphalt Concrete (AC) Paving: Payment for AC paving shall include all labor, materials, and equipment needed to place AC paving per Drawings. Payment for the individual components shall be as follows:

- a. AC Paving, 4-inch depth: Payment shall be made on a per Ton basis.
- b. Crushed rock roadway base, 8-inch depth: Payment shall be made on a per cubic yard basis.
- c. Sawcutting: Payment shall be made on a per linear foot basis.

A-15. Furnish and Install 12-diameter Class 52 Ductile Iron (DI) Pipe: Payment for furnishing and installing Class 52 ductile iron (DI) pipe with Class B trench backfill, including all work and materials, excavation for up to 6 feet of cover, all required joint restraint systems for pipe, fittings, valves, and appurtenances, standard concrete thrust blocks (including concrete, excavation, and thrust plates), dewatering, Class B bedding and pipe zone backfill, and Class B trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings and valves. Bedding and pipe zone material is understood to be imported granular material, compacted in place as shown on the plans. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation, and backfill will be based on the horizontal length of pipe laid without deductions for valves or fittings which may be included in the end-to-end measurement of a continuous section of pipe. Where pipe is laid on a continuous slope greater than 10 percent for a distance greater than 100 feet, payment will be made upon the average slope distance between 100-foot stations. When water mains intersect, the measurement of each main shall be to the intersection of the center lines of the connecting fittings.

The unit price shall include any incidental excavation, backfill and additional work required to cutting existing piping, installation of branch-line fittings, and/or connection to existing pipelines. Unit price shall also include as incidental the removal of existing fittings and piping as shown on the plans.

Testing, flushing and disinfection of water mains shall include furnishing, installing, and removing temporary blowoff piping including miscellaneous piping, valves, fittings, and thrust restraint. Shall be incidental to pipe installation. The OWNER shall provide off-site laboratory analysis. Payment for any retesting shall be paid by the CONTRACTOR.

A-16. Remove and Re-Install Buried Valves: Payment for removing, protecting, and re-installing buried valves not included in other pay items, including valve boxes, covers, risers, and extensions if required complete will be on a per each valve basis.

A-17. Furnish and Install Ductile Iron Fittings: Payment for furnishing and installing ductile iron fittings will be made on a per pound basis. The weight of fittings used for payment will be the nominal weights listed in AWWA Standard C110 for the actual Class and type of fitting specified and shown on the plans. Fitting installation will be considered a separate pay item

from work performed under other pay items. Fitting accessories including glands, bolts, and gaskets shall be considered incidental in the fitting weights for payment.

- A-18.** Connections to existing pipes: Payment for this item shall be on a per each basis and include all labor, materials, and equipment required to make connections to existing piping not covered under other bid items and where shown on Drawings at the following locations:
- a. 713' Waterline
 - b. Pump to waste line
 - c. 24" Outlet from Reservoir 16 at Seismic Vault (2 connections)
 - d. 2" Copper reservoir washdown piping at Seismic Vault (2 connections)
- A-19.** Connection to existing structures: Payment for this item shall be on a per each basis and include all labor, materials, and equipment required to make the new connections to existing structures as shown on the Drawings at the following locations:
- a. SSMH
 - b. SDMH-5
 - c. SDMH-8
- A-20.** Furnish and install 10-inch diameter PVC storm piping, unrestrained: Payment for furnishing and installing PVC storm piping with Class B trench backfill, including all work and materials; excavations to depths shown in the Drawings; dewatering; Class B pipe bedding, pipe zone and trench backfill materials will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed as indicated on the Drawings without deduction for manholes or other structures. Pipe bedding, pipe zone, and trench backfill material is understood to be imported granular material, compacted in place as shown on the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.
- A-21.** Furnish and install catch basin: Payment for furnishing and installing catch basins complete, including catch basin/ditch inlet, frame and grate, all excavation, backfill, adjustments for setting to final grade, and other incidental work as shown on the Drawings and described in the contract documents, shall be made on a per each basis.
- A-22.** Furnish and install drainage ditch w/ ditch inlet at base of reservoir slope: Payment for furnishing and installing ditch and ditch inlet, complete, including ditch inlet, frame and grate, all excavation, backfill, geotextile fabric, crushed rock, grading, adjustments for setting to inlet to final grade, and other incidental work as shown on the Drawings and described in the contract documents, shall be made on a lump sum basis.

- A-23. Furnish and install 4-inch diameter PVC roof drain: Payment for roof drain piping shall be on a per linear foot basis and include all labor, materials, and equipment to install roof drain piping from the ASR 3 building to the storm manhole as shown on the plans including downspout connections, PVC fittings, excavation, Class B backfill and granular bedding and pipezone materials.
- A-24. Furnish and install: 4-inch diameter PVC sanitary sewer: Payment for furnishing and installing PVC sanitary piping with Class B trench backfill, including all work and materials; excavations to depths shown in the Drawings; dewatering; Class B pipe bedding, pipe zone and trench backfill materials will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed as indicated on the Drawings without deduction for manholes or other structures. Pipe bedding, pipe zone, and trench backfill material is understood to be imported granular material, compacted in place as shown on the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.
- A-25. Overexcavation and select backfill material for unsuitable foundation conditions: Payment for overexcavation and select backfill material for unsuitable foundation conditions will only be considered as approved by the Owner's Representative. When such pre-approval is obtained, payment will be made on a per cubic yard basis.
- A-26. Additional cost for rock and boulder excavation: Payment for rock and boulder excavation will only be considered as approved by the Owner's Representative. Rock excavation is defined in Section 31 23 18, Rock Removal. When such pre-approval is obtained, payment will be made on a per cubic yard basis.
- A-27. Final site grading, surface restoration, and site cleanup: Payment for general surface restoration other than streets, sidewalks and curbs including stripping and stockpiling topsoil, regrading to original contours, bark mulching planting areas, and cleanup following construction as required including resurfacing gravel surfaces as required, will be on a lump sum basis.
- A-28. Site Landscaping: Payment for landscaping will be made on a lump sum basis and will include all labor, material, and equipment required to plant site per Drawings. Plant warranty and temporary irrigation shall be incidental to this bid item.

Part B Reservoir 4

- B-1. Mobilization, Bonds, Permitting and Insurance: Measurement and payment shall be per item A-1.
- B-2. Temporary Traffic Control: Measurement and payment shall be per item A-2.
- B-3. Erosion Control and Permitting: Measurement and payment shall be per item A-3.

- B-4.** Construction Survey and Staking: Measurement and payment shall be per item A-4.
- B-5.** Removal and patching of existing reservoir vents: Payment for this item shall be made on a lump sum basis and shall include all labor, materials, and equipment required to patch existing reservoir vents per Drawings.
- B-6.** Furnish and install new roof vent w/ curb and new roof penetration: Payment for reservoir roof hatch shall include all labor, materials, and equipment required to create new roof penetration; construct concrete curb; furnish and install fabricated metal vent and all other work to complete reservoir vent as shown on drawings and shall be paid on a lump sum basis.
- B-7.** Furnish and install flow control vault, complete: Payment for furnishing and installing pressure reducing valve (PRV) flow control vault shall be on a lump sum basis. The lump sum price shall include furnishing and installing pre-cast vault, PRV, PRV appurtenances, CARV, DI piping as required, PVC drainpipe and connection to existing SD Manhole, excavation, backfill and compaction, surface restoration as required, as shown on the plans.
- B-8.** Furnish and install 8-inch diameter class 52, restrained ductile iron (DI) pipe: Measurement and payment for this bid item shall be per item A-15.
- B-9.** Furnish and install DI fittings: Measurement and payment for this item shall be per item A-17.
- B-10.** Hot tap connection, including tapping sleeve: Payment for furnishing and installing hot tap assemblies shall be on a per each basis for the size and type shown on the Drawings and shall include all costs for tapping sleeve assembly, driving, and tagging of existing water main. Hot tap isolation valve will be paid for at the unit contract price under the appropriate bid item.
- B-11.** Furnish and install buried valves: Payment for furnishing and installing buried valves not included in other pay items, including valve boxes, covers, risers and extensions if required complete will be on a per each valve basis.
- B-12.** Connection to existing pipes: Measurement and payment shall be per item A-18 where shown on the drawings and at the following connections:
- a. 560 G Zone
- B-13.** Electrical, Instrumentation, and Telemetry: Payment for this item shall include all labor, materials, and equipment required to install, integrate, and construct working electrical, instrumentation and telemetry as specified and as shown on the Drawings.
- B-14.** Pavement Restoration, AC trench repair, 4-inch thickness: Measurement and payment for trench resurfacing shall be on a per ton basis. Payment for hot mix asphaltic concrete

(HMAC) trench resurfacing shall include furnishing and installing of the asphaltic concrete and aggregate base materials, compaction, process control, acceptance testing and other incidental work required to provide permanent HMAC pavement at thicknesses as shown on the Drawings and specified in Section 321216, Asphaltic Concrete Pavement.

- B-15.** Saw cutting existing asphalt concrete (AC) pavement & concrete surfacing: Measurement and payment for saw cutting existing AC pavement and concrete surfacing shall include the trench width cuts and t-cuts as shown on the standard trench detail of the Drawings. Payment for saw cutting existing surfacing, which includes AC and concrete surfaces, for cuts up to 3 inches in depth and for each 1-inch depth beyond 3-inch thickness will be on a per linear foot basis.
- B-16.** Final site grading, surface restoration, and site cleanup: Measurement and payment shall be per item A-27.

Part C ASR 2

- C-1.** Mobilization, Bonds, Permitting, and Insurance: Measurement and payment for Mobilization, bonds, permitting, and insurance shall be per item A-1.
- C-2.** Conduits, conductors, and electrical, complete: Payment for this item shall be made on a lump sum basis and include all excavation, backfill, supports, connections, and other related work items needed to install conduits and electrical items as required to complete working system as specified and shown in the Drawings.
- C-3.** Furnish and install VFD, power distribution: Payment for this item shall be made on a lump sum basis and include all labor, materials, and equipment required to install and integrate motor control system, including electrical conductors and distribution, as required to complete a working system per plan.
- C-4.** Furnish and install water quality instrumentation: Payment for this item shall be made on a lump sum basis and include all labor, materials, and equipment required to install a complete system of working water quality instruments including integration.

Part D Extra Work as Authorized

- D-1.** Extra Work as Authorized: Extra Work as Authorized includes labor, equipment, and materials to perform additional work as directed by the OWNER or OWNER'S REPRESENTATIVE. Bid item amount pre-determined by the City.

Measurement and payment of work under this Bid item shall be on a negotiated basis between the Contractor and Engineer and agreed upon prior to the work being performed. No work under this bid item shall be aid unless authorized in writing by the OWNER or OWNER'S REPRESENTATIVE.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section contains administrative and procedural requirements for submittals for review, information, and for Project closeout.
- B. Section includes:
 - 1. Schedule of Submittals.
 - 2. Submittal requirements.
 - 3. Submittal procedures.
 - 4. Engineer review.
 - 5. Resubmittal procedures.
 - 6. Product data.
 - 7. Shop Drawings.
 - 8. Samples.
 - 9. Design data.
 - 10. Test reports.
 - 11. Certificates.
 - 12. Manufacturer's instructions.
 - 13. Manufacturer's field reports.
 - 14. Erection Drawings.
 - 15. Construction progress schedules.
 - 16. Breakdown of contract price.
 - 17. Construction photographs.
 - 18. Operation and maintenance (O&M) instructions.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SCHEDULE OF SUBMITTALS

- A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Engineer a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of manufacturer, supplier, trade name, subcontractor and model number of each

product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.
- C. The list and schedule shall be updated and resubmitted when requested by the Engineer.
- D. Contractor's Schedule of Submittals will be acceptable to the Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

- A. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - 1. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - 2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - 3. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- B. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
- C. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review of each such variation.

1.5 SUBMITTAL PROCEDURES

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review in accordance with the accepted Schedule of Submittals.

- B. Transmit each submittal with Engineer-accepted transmittal form certifying compliance with requirements of Contract Documents.
- C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.
- D. Show each Submittal with the following numbering and tracking system:
 - 1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 05 50 00 would be "05 50 00-1". Resubmittals of that submittal would be "05 50 00-1.1", followed by "05 50 00-1.2", and so on. The second product submittal for that Section would be "05 50 00-2".
 - 2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.
 - 3. Alternative method of numbering may be used if acceptable to Engineer.
- E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.
- F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- G. Coordinate submission of related items.
 - 1. All shop drawings for interrelated items shall be scheduled for submission at the same time.
 - 2. The Engineer may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Engineer will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.
- H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Engineer. Two copies of reviewed submittals will be kept by the Engineer, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.

- I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Engineer and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.
- J. For each submittal for review, allow not less than 14 days for Engineer review, excluding delivery time to and from Contractor.
- K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- L. Allow space on submittals for Contractor and Engineer review stamps or comments.
- M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.
- N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.
- O. Submittals not requested will not be recognized nor processed.
- P. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.6 ENGINEER REVIEW

- A. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- B. The Engineer's review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. The Engineer will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".
- E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Engineer's charges to Owner for its

review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

- F. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- G. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
- H. Engineer's review of a separate item as such will not indicate approval of the assembly in which the item functions.
- I. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 1.4.C and Engineer has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.
- J. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.
- K. Engineer's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
- L. Neither Engineer's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
- M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

- A. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

- B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
- C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULES

- A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. In addition to a time-scaled bar chart schedule depicting the project critical path, the Contractor shall submit a detailed CPM logic diagram. The CPM diagram and time-scaled bar chart shall include the following:

- Construction activities
- Submittal and review of material samples and shop drawings
- Procurement and delivery of critical materials
- Fabrication, installation, and testing of special material and equipment
- Duration of work, including completion times of all stages and their sub-phases

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the Contractor upon the request of the Engineer.

Detailed subnetworks will include all necessary activities and logic connectors to describe the work and all restrictions to it. In the restraints, include those activities from the project schedule which initiated the subnetwork as well as those restrained by it.

Include a tabulation of each activity in the computer mathematical analysis of the network diagram. Furnish the following information as a minimum for each activity:

- Event (node) number(s) for each activity
- Activity description
- Original duration of activities (in normal workdays)
- Estimated remaining duration of activities (in normal workdays)

- Earliest start date or actual start date (by calendar date)
- Earliest finish date or actual finish date (by calendar date)
- Latest start date (by calendar date)
- Latest finish date (by calendar date)
- Slack or float time (in workdays)

Computer printouts shall consist of at least a node sort and an “early start/total-float” sort.

- A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. A time-scaled bar chart schedule shall include the following:
 - Construction activities
 - Submittal and review of critical material samples and shop drawings
 - Procurement and delivery of critical materials
 - Duration of work, including completion times of all stages and their sub-phases
- B. Attention is drawn to typical local climatic weather patterns and Work shall be coordinated accordingly.
- C. Complete project schedule shall be revised and resubmitted to the Engineer at a minimum occurrence of every 4 weeks for review.
- D. Three Week Lookahead Schedules: Provide each week at the weekly construction meeting. The previous week’s completed work shall be shown on the schedule for a total of 4 weeks shown.

2.2 BREAKDOWN OF CONTRACT PRICE

- A. Within 10 days after the Effective Date of the Contract, submit a complete breakdown of all lump sum bid items showing the value assigned to each part of the work, including an allowance for profit and overhead adding up to the total lump sum contract price.
- B. Breakdown of lump sum bids shall be coordinated with the items in the schedule and shall be in sufficient detail to serve as the basis for progress payments during construction.
- C. Engineer will review the contract price breakdown and may request items to be further broken down or for more items be added in order to facilitate tracking of work progress for payment.
- D. Preparatory work, bonds, and insurance required in setting up the job will be allowed as a separate entry on the cost breakdown but shall not exceed 5 percent of the total base bid.

- E. Upon acceptance of the breakdown of the contract price by the Engineer, it shall be used as the basis for all requests for payment.

2.3 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
 - 1. Note submittal will be returned to Contractor without review of submittal if products, models, options, and other data are not clearly marked or identified.
- C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.4 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer licensed in the state of Project responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. All dimensioned shop drawings shall be scalable and provided as full-sized (22-inch x 34-inch) sheets. PDF electronic files shall print as scalable full-sized sheets.
- E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.5 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Engineer for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Owner selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.
- H. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.6 DESIGN DATA

- A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

2.7 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.8 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

2.9 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

2.10 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.
- B. Submit report within 48 hours of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.11 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge and records as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

2.12 PROJECT HEALTH AND SAFETY PROGRAM

- A. Develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. The written Safety Program shall be provided within 30 days after the receipt of the written Notice to Proceed. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include at a minimum the following items when they apply:
 - 1. Employee orientation
 - 2. Safety inspections

3. Instruction and training
 4. Accident reporting
 5. Signs and barricades
 6. Fire prevention and protection
 7. Welding, cutting, and burning
 8. Painting and surface treatment
 9. Electricity
 10. Machinery and mechanized equipment
 11. Excavations
 12. Sanitation
 13. Chlorine safety
 14. Hazardous materials
 15. Hazardous communications program
 16. Job hazard analysis
 17. First aid/medical facilities
 18. Personal protective equipment
 19. Confined space entry plan
 20. Shoring plan
 21. Fall protection plan
 22. Emergency Action Plan
 23. Housekeeping
 24. Safety training requirements and certification
 25. Pedestrian access around work site during construction and after hours
 26. Neighboring residences/community access and safety
- B. If the project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Program. The Program shall subsequently be distributed to and implemented by the Contractor's personnel, as well as its Subcontractors and Suppliers, the Owner and Engineer. Contractor shall fully implement and comply with the Safety Program and shall submit to the Owner a letter signed by Contractor's owner/president affirming such implementation and compliance within 15 days after on-site work has started. Contractor shall notify the Owner and Engineer when safety meetings will be held so that Owner's and Engineer's personnel may attend. A copy of the Health and Safety Program must be maintained on-site at all times during the life of the Project.
1. NOT USED

2.13 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

- A. Submit preliminary O&M materials for review by Engineer. The equipment manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials

will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Reviewed shop drawings and submittal data;
 2. Model, type, size, and serial numbers of equipment furnished;
 3. Equipment and driver nameplate data;
 4. List of parts showing replacement numbers;
 5. Recommended list of spare parts;
 6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;
 7. Maintenance and repair requirements including frequency and detailed instructions; and
 8. Name, address and phone numbers of local representative and authorized repair service.
- B. Following review of the preliminary O&M materials by the Engineer and before acceptance of the Work, submit four copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.

2.14 OTHER REQUIRED SUBMITTALS

- A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.
1. Contractor Emergency Contact List.
 2. Erosion and Sediment Control Plan.
 3. Traffic Control and Protection Plan.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 45 00 - QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 PROVISIONS

- A. Contractor's Responsibility for Testing

The CONTRACTOR shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.

- B. OWNER's Right to Perform Additional Tests

The OWNER or ENGINEER reserves the right to complete additional testing. In such cases, the CONTRACTOR shall provide safe access for the OWNER or ENGINEER and their inspectors to adequately inspect the quality of work and the conformance with project specifications.

1.3 QUALITY ASSURANCE

- A. Testing Requirements

An independently owned and operated laboratory approved by the ENGINEER shall perform all testing as specified herein.

- B. Testing

1. General

- a. All required testing of work and/or materials shall be conducted in the presence of the ENGINEER. The CONTRACTOR shall provide 48-hour notification to the OWNER and OWNER's REPRESENTATIVE prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the ENGINEER.
- b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of material to be tested shall be selected by such laboratory or agency or by the ENGINEER. The CONTRACTOR shall furnish such samples of all materials without charge to OWNER.

- c. The results from any and all tests are made for the information of the OWNER. Regardless of any test results, the CONTRACTOR is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

2. Costs of Testing

- a. The CONTRACTOR shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.
- b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the CONTRACTOR with no reimbursement by the OWNER.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by OWNER-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.
2. Promptly notify OWNER and CONTRACTOR of irregularities and deficiencies observed in the Work during performance of their services.
3. Submit certified written report of each test, inspection and similar quality control service to OWNER, CONTRACTOR and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.
5. Re-test and re-inspect corrected work.

B. CONTRACTOR'S Responsibilities

1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify OWNER, ENGINEER, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.
3. Pay for any CONTRACTOR requested testing and inspecting not required by the Contract Documents.
4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. OWNER will deduct such costs from the Contract Price.
5. Submit copies of licenses, certifications, correspondence, records and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the OWNER, ENGINEER and Special Inspectors.
6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.
7. Cooperate with Agencies performing required tests, special inspections, and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor, equipment, and materials necessary to facilitate tests and special inspections.
 - c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.
 - d. Provide facilities for storage and field curing of test samples.
 - e. Deliver samples to Testing Agencies.

8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.
9. Schedule times for tests, special inspections, obtaining samples, and similar activities. Distribute schedule to OWNER, ENGINEER, Special Inspectors, Testing Agencies, and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three copies of each report to the OWNER or OWNER's REPRESENTATIVE.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

- A. The CONTRACTOR shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the CONTRACTOR. Testing locations to be determined by the ENGINEER.

Material to be Tested	Payment Responsibility for Initial Testing	Minimum Testing Frequency
Structural Backfill	OWNER	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot elevation increments, one test per 2,500 sf of material placed. See Article 3.5, Field Quality Control of Section 31 23 23, Fill for further details on testing requirements.
Trench Backfill	CONTRACTOR	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot elevation increments, one test per 200 lineal feet of pipeline trench as measured along pipe centerline. ENGINEER may reduce frequency to one test per lift for every 1,500 lineal feet of pipeline trench when satisfied with CONTRACTOR's method of compaction. See Article 3.16, Field Quality Control of Section 31 23 17, Trenching for further details.
Asphalt Concrete	CONTRACTOR	As required when placed. See detailed requirements in Article 3.3, Field Quality Control of Section 32 12 16, Asphalt Paving.
Concrete	OWNER	As required when placed. See detailed requirements in Article 3.14, Concrete Tests of Section 03 30 00, Cast-In-Place Concrete.
Grout	OWNER	Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the ENGINEER to ensure continued compliance with Specifications. See detailed requirements in Article 3.2, Field Quality Control of Section 03 60 00, Grouting.
Masonry Mortar and Grout	OWNER	As required when placed. See detailed requirements in Section 04 05 17-1.3.
Waterline – Hydrostatic testing and disinfection	CONTRACTOR	As required. See Section 33 13 00, Testing & Disinfection of Water Utility Piping.

END OF SECTION

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes provisions for temporary protection of trees and other plant life in preparation for site or building excavation Work.
- B. Related Sections:
 - 1. Section 31 10 00 - Site Clearing
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 16 - Excavation
 - 4. Section 31 23 17 - Trenching
- C. This specification shall be applied concurrently and in conjunction with other plant material protection measures herein described and specified.

PART 2 MATERIALS - Not Used

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspect all trees specified on the Drawings for protection prior to construction.
 - 1. Document with written memorandum and photographs any unusual conditions.
 - 2. Submit copies of documentation to ENGINEER prior to beginning work.
- B. Verify all conditions on the Drawings with actual conditions at Site regarding tree protection prior to any site disturbance.
- C. The ENGINEER must be present during demolition of existing conditions occurring within the drip line of trees designated to remain.
- D. Notify ENGINEER 24 hours prior to inspections and/or tagging of protected trees.

3.2 PROTECTION

- A. Install barricades specified in the Drawings at drip lines of trees designated to remain prior to the commencement of construction.

- B. Clearly designate protected trees and clear of any material storage, personnel, or vehicular movement.
- C. Provide temporary fencing, barricades, and guards as necessary or required to protect trees designated on the Drawings to remain, from damage above and below grade.
- D. Protect root systems of trees and plant life to remain.
 - 1. Protect from damage due to noxious materials in solution caused by runoff or spillage during mixing and placement of construction materials.
 - 2. Protect from flooding, erosion, or excessive wetting resulting from dewatering operations and compaction.
 - 3. Protect against unauthorized cutting, breaking, skinning roots and branches, or bruising bark.
 - 4. Protect from smothering and compaction.
 - a. Do not store construction materials or permit vehicles to drive or park within the drip line area of any tree to remain.
 - 5. Protect from dumping of refuse in close proximity.
- E. Where cutting is necessary, review conditions with the ENGINEER before proceeding, and comply with directives of ENGINEER.

3.3 EXCAVATION AROUND TREES

- A. Excavate within drip lines of trees only where indicated on the Drawings or as directed by ENGINEER.
- B. Where trenching for utilities is required within drip lines, tunnel under or around roots by hand excavating.
 - 1. Where possible trench toward trunk of tree and tunnel under central root mass to avoid severing all lateral roots on side of trench.
 - 2. Do not cut main lateral roots or tap roots over 1-inch in diameter.
 - 3. Temporarily support and protect trees from damage until permanently covered with approved backfill.
- C. Do not allow exposed roots to dry out before backfill is placed.
 - 1. Provide temporary earth or burlap cover.

2. Water roots daily when exposed and maintain in a moist condition.
- D. Backfill roots only upon inspection approval from the ENGINEER.
1. Backfill around root excavations only with clean imported topsoil free from materials deleterious to root growth.
 2. Backfill to eliminate voids and compact only by means of manual tamping at root areas.
 3. Water sufficiently to settle topsoil and eliminate voids or air pockets around roots.
 4. Allow for natural settlement of soil surface and furnish and apply topsoil sufficient to bring to original finish grade after backfill settlement.
- E. If during excavation, any condition arises that threatens the survivability of the protected tree, or an unknown condition arises that affects the stability or integrity of the root system, notify the ENGINEER immediately.

3.4 REPAIR AND REPLACEMENT OF DAMAGED TREES

- A. In the event of damage to existing trees:
1. Immediately prune limbs smaller than 3-inch caliper or roots smaller than 2-inch caliper to repair trees damaged by construction operations.
 2. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees.
 3. Any such pruning and/or repairs shall be approved in advance and at completion by ENGINEER.
 4. The ENGINEER shall reserve the right, at cost to the CONTRACTOR, to obtain the services of a Certified Consulting Arborist with current membership in the American Society of Consulting Arborists to determine the severity of damage.
 5. The CONTRACTOR is responsible for the cost of repairs caused by their actions or by the actions of subcontractors engaged by the CONTRACTOR.
- B. Remove and replace dead or damaged trees which are determined by the ENGINEER to be incapable of restoration to normal growth patterns at no additional cost to OWNER.
1. Provide new trees of the same species as those removed or damaged, with size and/or quantity to be determined by ENGINEER.

2. Furnish replacement trees and plant life to the Site and plant, maintain, and warranty as directed by the ENGINEER.
3. If trees are not replaceable with the same species, and size, compensate the OWNER for the replacement cost of the trees based on the evaluation of a Certified Consulting Arborist.
4. The CONTRACTOR is responsible for additional costs of removing damaged trees and labor for planting new specimens.

3.5 DESIGNATED TREE REMOVAL PROCEDURES

- A. If designated tree removal is specified by ENGINEER, furnish labor, material, and equipment necessary for removing and/or salvaging existing trees, if necessary, as designated on the Drawings for removal.
 1. Verify location and species with ENGINEER prior to removal.
- B. Salable logs or timber may be sold to CONTRACTOR's benefit upon notification and prior approval of OWNER. Upon approval, remove salable logs or timber promptly from site.

3.6 DESIGNATED TREE TRANSPLANTING PROCEDURES

- A. If designated tree transplanting is specified by ENGINEER, verify and identify existing trees to be transplanted.
- B. All work shall be in accordance with the standards and practices outlined in the following: Tree and Shrub Transplanting Manual, E.B. Himelick, 1981 Ed., International Society of Arboriculture.
- C. Prior to commencement of Work, submit a coordination schedule, method of transplanting, traffic control, routing, etc., to ENGINEER, for review and approval.
- D. Warranty for transplanted trees shall be determined and directed on a case by case basis by the ENGINEER, upon contracting of specified transplanting work.
- E. Review and verify location of utilities in area of operation. Obtain location and jurisdictional approval from utilities prior to transplanting activities. Protect utilities and the public at all times.
- F. Prior to transplanting, spray trees with an anti-desiccant emulsion-type film forming agent, "Dowax" by Dow Chemical Company, "Wilt-Pruf" by Nursery Specialty Products Inc., "D-Wax", by Plant Products Inc., or approved equal, prior to digging with two separate applications allowing 48 hours apart. Use a power sprayer to provide an

adequate film over trunks, branches, stems, twigs, and foliage. Anti-desiccant must be dry prior to relocation.

- G. Dig, ball and burlap, and move designated trees for relocation to the new planting location shown on the Drawings. In the event the new planting area is not prepared, place tree in a storage area approved by the ENGINEER solely designated for healing-in of plant materials until final planting may occur. Brace in a vertical position, provide shade, wind protection, and irrigation at plant storage area. Utilize all horticulturally proper methods for plant storage. Plants shall be maintained by CONTRACTOR while in storage.

3.7 GRADING AND FILLING AROUND TREES

- A. Maintain existing grade within drip line of trees unless otherwise indicated on the Drawings or directed by the ENGINEER.

3.8 MAINTENANCE OF PROTECTIVE MEASURES

- A. Maintain protective measures throughout the construction process. Immediately repair any alteration to protection measures throughout construction process. Repair or reinstall protective measures immediately upon alteration. Monitor protective measures daily.
- B. Remove and clear area of debris and fencing, barricades, etc., upon final written approval of ENGINEER.

END OF SECTION

SECTION 01 61 10 - SEISMIC REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

- A. This section contains seismic design requirements for non-structural equipment, components and systems. The components and systems indicated below are required for immediate re-occupancy and minimization of disruption to operations following a seismic event. All elements shall meet the requirements of this section and Chapter 13 of ASCE 7-16.
- B. Applicable Specification Divisions include those with:
 - 1. Components that are part of the Designate Seismic Systems as covered in the 2019 OSSC Section 1705.13.3 and subject to the requirements of ASCE 7 Section 13.2.2.
 - 2. Components weighing more than 400 pounds that have a center of mass located 4-feet or less above the adjacent floor or roof level that supports the component.
 - 3. Components weighing more than 20 pounds, or more than 5 lbs./ft. in the case of distributed systems, located more than 4-feet above the adjacent floor or roof level that supports the component.
 - 4. Exceptions:
 - a. Furniture
 - b. Temporary or movable equipment

1.2 RELATED SECTIONS:

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. General provisions within other Specification Divisions related to hangars, anchors, supports and seismic restraint or seismic control.

1.3 ACCEPTED STANDARDS

- A. ASCE 7-16 Section 13.2.2 requires certification be provided for mechanical, electrical, and containment and storage equipment that is identified as being assigned to the Designate Seismic System. This designation requires said systems to remain operable and functional following the design earthquake ground motion. Documentation confirming suitability shall be provided as outlined in the Submittal Section.
- B. ASCE 7-16 Section 13.1.6 allows for the use of reference documents or standards for industry specific systems or components which represent acceptable procedures for

seismic design and construction. The use of these documents or standards does not alleviate the SELLER from submitting calculations, drawings and product data that show conformance to the requirements of this section.

- C. Pre-approved details meeting the requirements of ASCE 7-16 Section 13.3 may be used for this project without submitting calculations indicating compliance with the design criteria specified in Section 1.6 Design Criteria. The SELLER shall provide shop drawings detailing the product and specifying the pre-approved detail(s) to be used and their locations along with supporting documentation.

1.4 SUBMITTALS

- A. Special Certifications for the Designated Seismic System:
 - 1. For active Mechanical and Electrical Equipment, submit one of the following forms of documentation for each main component of the system.
 - a. Approved Shake Table Test results per ASCE 7 Section 13.2.5
 - b. Experience Data per ASCE 7 Section 13.2.6
 - c. Inherent Ruggedness per ASCE 7 Section 13.2.5
 - 2. For non-active Mechanical and Electrical Equipment, submit one of the following forms of documentation for each main component of the system.
 - a. Analysis per ASCE 7 Section 13.2.2
 - b. Approved Shake Table Test results per ASCE 7 Section 13.2.5
 - c. Experience Data per ASCE 7 Section 13.2.6
 - 3. For component with hazardous substances, submit one of the following forms of documentation for each main component of the system..
 - a. Analysis per ASCE 7 Section 13.2.2
 - b. Approved Shake Table Test results per ASCE 7 Section 13.2.5
 - c. Experience Data per ASCE 7 Section 13.2.6
- B. Product data: Illustrate and indicate style, material, strength, fastening provision and finish for each type and size of seismic restraint component used.
- C. Shop drawings: Submit shop drawing plans and details indicating horizontal and vertical location (with respect to floor level and grids) layout, spacing, sizes and types of seismic restraint and gravity supports for each system or component requiring bracing. The connection details shall be on similar size plan sheets and clearly presented in the electronic submittal document. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices. Shop drawings shall be stamped by a registered Structural Engineer in the State of Oregon. The shop drawings

must be clearly organized and presented such that they can be readily interpreted by the CONTRACTOR for installation and the Special Inspector. Include the following:

1. Fabricated Support: representations of field-fabricated supports not detailed on the Shop Drawings.
 2. Seismic Restraints: Detail anchorage and bracing not defined by other details or charts on the Shop Drawings. Include the following:
 3. Design: To support selection and arrangement of seismic restraints, include calculations of combined tensile, compressive and shear loads. NOTE: Anchorage to concrete shall comply with ACI 318-14, Chapter 17 assuming cracked concrete conditions.
 4. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods and spacing. Identify components, list their strengths and indicate directions and values of forces transmitted to the structure during seismic events.
- D. Calculations: Calculations shall be submitted together with the Shop Drawings. Calculations shall substantiate the design of the sizes, thicknesses, and types of seismic-restraint connections, gravity support connections, fabrication, and attachment (fastening, anchorage, welding, etc.) to the structure, including all fasteners. Calculations shall clearly indicate the loads imposed on the primary building structure, including magnitude, direction and location. Calculations shall be based upon the design requirements in Section 1.6 Design Criteria shall be stamped by a registered Structural Engineer in the State of Oregon.
- E. Welding certificates of welders performing component or system installation.
- F. Field Quality Control Reports
- G. Field Observation Reports from the Special Inspector

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in ASCE 7-16 unless requirements in this Section are more Stringent.

1.6 DESIGN CRITERIA

- A. General. Seismic Demands on Non-Structural Components per ASCE 7-16 Section 13.3 are superseded by Sections 1.6.B and 1.6.C below. Conform to all other Sections of ASCE 7-16 Chapter 13.

- B. Horizontal seismic forces. Design and detail all members and connections to meet the requirements of ASCE 7-16 based on the actual system or component operating weight. The design and evaluation of components and their support and attachments shall consider their flexibility as well as their strength. The following forces shall be used for all design and calculations.
1. Refer to Design Loads on Structural Plan Sheet No. A-S-1, Section 1603.1.5 for seismic design parameters.
- C. Vertical seismic forces. Calculate vertical seismic force by the following equation. The design force shall be applied vertically at the center of gravity of the component or distributed according to the mass distribution of the component or system. The vertical seismic force shall be combined with the horizontal seismic force as well as the Dead Load gravity force to determine the maximum force for component or anchorage design. Combine horizontal and vertical effects as indicated in ASCE 7-16, Section 13.3.1.
- $$F_{pV} = +/-0.2 S_{DS}W_p$$
- D. Seismic attachments, bracing and anchorage shall be designed such that the component force is transferred to the lateral force resisting system of the structure through a complete load path. Attachments shall not be made across expansion and contraction joints.
- E. Components with vibration isolation systems shall have snubbers in each horizontal direction and vertical restraints as necessary to resist overturning.
- F. The seismic anchorage system shall provide restraint in all directions, including vertical, for each component or system for which seismic design is required.

END OF SECTION

SECTION 01 75 16 - TESTING, TRAINING, AND SYSTEM START-UP

PART 1 GENERAL

1.1 SCOPE

This section specifies equipment and system testing and start-up, services of manufacturer's representatives, training of OWNER's personnel, and final testing requirements for the complete facility.

1.2 CONTRACT REQUIREMENTS

- A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete all testing, training, and start-up within the Contract Time(s).
- C. Furnish all necessary labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- D. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation, testing, and operator training.

1.3 START-UP PLAN

- A. Submit start-up plan for each piece of equipment and each system not less than 2 weeks prior to planned initial equipment or system start-up.
- B. Provide detailed Start-up Progress Schedule with the following activities identified:
 - 1. Manufacturer's services
 - 2. Installation certifications
 - 3. Operator training
 - 4. Submission of operation and maintenance manual
 - 5. Functional testing
 - 6. Performance testing
 - 7. Operational testing
- C. Provide testing plan with test logs for each item of equipment and/or system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
- D. Provide summary of shutdown requirements for existing systems if required, which are necessary to complete start-up of new equipment and systems.

- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.4 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.
2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
3. Flush fuel system and provide fuel for testing and start-up.
4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
7. Perform cold alignment and hot alignment to manufacturer's tolerances.
8. Adjust V-belt tension and variable pitch sheaves.
9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

B. Electrical Systems

1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.
2. Perform continuity tests on grounding systems.
3. Test and set switchgear and circuit breaker relays for proper operation.
4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.

5. Check motors for actual full load amperage draw. Compare to nameplate value.

C. Instrumentation Systems

1. Bench or field calibrate instruments and make required adjustments and control point settings.
2. Leak test pneumatic controls and instrument air piping.
3. Energize transmitting and control signal systems, verify proper operation, ranges, and settings.

1.5 FUNCTIONAL TESTING

- A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.
- B. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
- C. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- D. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.6 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of functional testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:
 1. Has been properly installed, aligned, adjusted, and lubricated.
 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 3. Is suitable for satisfactory full-time operation under full load conditions.
 4. Operates within the allowable limits for vibration.
 5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.

- B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
 - 1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 - 2. Control logic for equipment start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
- C. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.7 TRAINING OF OWNER’S PERSONNEL

- A. Provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.
- B. Coordinate training schedule with City staff. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than two sessions per week.
- C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 2 weeks prior to training session for that piece of equipment or system.
- D. Satisfactorily complete functional testing before beginning operator training.
- E. The OWNER may videotape the training for later use with the OWNER’s personnel.

1.8 MINIMUM SERVICE SCHEDULE

Minimum services as specified shall be provided in accordance with the following schedule:

Specification Section	Equipment	Minimum On-Site Time Requirements		
		1) Equipment Installation	2) Equipment Testing	3) Operator Training
40 21 52	Deep Well Vertical Turbine Pumps	2 CWD	3 CWD	1 CWD
40 05 23.72	Pressure Reducing Valves	0.5 CWD per valve	0.5 CWD per valve	0.25 CWD per valve
40 91 11	Water Quality Analyzers	1 CWD	0.5 CWD	0.5 CWD
40 91 03	Flow Detection	1 CWD	0.5 CWD	0.25 CWD
40 XX XX	Instrumentation & Control Devices	5 CWD	4 CWD	2 CWD

NOTE: CWD is defined as a consecutive working day consisting of 8 hours each from 8:00 a.m. to 5:00 p.m.

1.9 OPERATIONAL TESTING

- A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.
- B. Conduct operational test for continuous 7-day period.
- C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.
- D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.
- E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

- A. Maintain and submit to ENGINEER the following records generated during start-up and testing phase of project:
 - 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 - 2. Logs of time spent by manufacturer's representatives performing services on the job site.
 - 3. Equipment lubrication records.
 - 4. Electrical phase, voltage, and amperage measurements.
 - 5. Insulation resistance measurements.
 - 6. Pump torsional and lateral vibration analysis report.
 - 7. Data sheets of control loop testing including testing and calibration of instrumentation devices and set points.

END OF SECTION

SECTION 02 30 00 - SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.1 SUMMARY

- A. Subsurface investigations and reporting have been performed for the purpose of obtaining data for the planning and design of this project. Copies of such reporting are attached to the Contract Documents as Supplementary Information.

1.2 LIMITATIONS

- A. The subsurface investigations and reporting are being made available solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risk, duty to make examinations and investigations as required by Article 4 of the Instructions to Bidders, or any other responsibility under the Contract Documents.
- B. It is mutually agreed to by all parties:
 - 1. Written reports are reference documents and are not part of the Contract Documents.
 - 2. Subsurface investigations are for the purpose of obtaining data for planning and design of the project.
 - 3. Data concerning borings and test pits is intended to represent with reasonable accuracy conditions and material found in specific borings and test pits at the time the borings and test pits were made.
- C. It is expressly understood and agreed the Owner and Engineer assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigation thus made, the records thereof, or of the interpretations set forth therein, or made by the Owner in his use thereof; and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations, or records thereof, are representative of those existing throughout such areas, or any part, or that unforeseen developments may not occur.
- D. The Owner's subsurface investigations and reporting are made available to Bidder or Contractor only on the basis of the understandings and agreement herein stated.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of existing facilities.
2. Abandoning and removing utilities.

B. Related Sections:

1. Section 31 05 16 - Aggregates for Earthwork
2. Section 31 10 00 - Site Clearing
3. Section 31 22 13 - Rough Grading
4. Section 31 23 16 - Excavation
5. Section 33 11 50 - Existing Pipe Abandonment

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit to Engineer a copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.3 QUALITY ASSURANCE

A. Existing Conditions: Determine the extent of work required and limitations before proceeding with Work.

B. Conform to applicable local, state, and federal codes for environmental requirements in relation to disposal of debris.

1. Burning at the Site for the disposal of refuse, debris, and waste materials resulting from demolition and site clearing operations shall not be permitted.

C. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.

D. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the Work and requirements of the General Provisions.

E. If the existing material to be demolished and removed contains any hazardous materials which will require special handling upon removal, such as asbestos or lead, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state and local regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or Specifications.
- B. Crushed Rock: As specified in Section 31 05 16-2.1, Aggregates for Earthwork. Of the size shown in the Drawings or specified herein.
- C. Sand: As specified in Section 31 05 16-2.2, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The Owner assumes no responsibility for the actual condition of the facilities to be demolished. The Contractor shall visit the site, inspect all facilities and be familiar with all existing conditions and utilities.
- B. Demolition drawings identify major equipment and structures to be demolished only. Auxiliary utilities such as water, air, chemicals, drainage, lubrication oil, hydraulic power fluid, electrical wiring, controls, and instrumentation are not necessarily shown shall be considered incidental to all demolition work.
- C. Identify waste and salvage areas for placing removed materials.

3.2 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-332-2344, not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
 - 3. Keep all active utilities intact and in continuous operations.

3.3 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.

- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.
- C. Preservation and Trimming of Trees, Shrubs and Other Vegetation: As specified in Section 31 10 00-3.4.C, Site Clearing.
- D. Landscaped Areas: Protect existing landscaped areas as specified in Section 31 10 00-3.4.D, Site Clearing.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, guy wires, utility poles, and curbs.
- F. Repair and Replacement:
 - 1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of Work of this contract.
 - 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.4 DEMOLITION

- A. Areas which are to be excavated for the purpose of demolition shall be cleared and stripped in accordance with Section 31 10 00-3.6, Site Clearing.
- B. Carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, consult with Engineer prior to the placement of such equipment or material.
- C. Demolition of Existing Structures:
 - 1. Excavate around existing structures as required to perform demolition operations and to plug associated existing pipelines where shown in the Drawing.
 - 2. Provide shoring, bracing, and supports, as required, to ensure adjacent structures are not damaged and structural elements of existing structure are not overloaded during demolition activities.
 - a. Increase structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.
 - b. Remove all temporary protection when the Work is complete or when so authorized by the Engineer.

3. Any floors that are to remain in place shall be completely cracked through to allow for drainage. Cracking shall be accomplished by dropping a demolition ball or by other methods approved by the Engineer.
 4. Remove and dispose of all exposed and/or protruding metalwork, piping, plumbing, and conduits resulting from demolition activities, and all woodwork, roofing, and electrical and mechanical equipment removed from demolished structures.
 - a. Reinforcing bars shall be cut flush with final wall elevations as shown in the Drawings.
 - b. No detached metalwork, excluding concrete reinforcing bars, shall be buried with the concrete and masonry rubble.
- D. Backfill at Demolished Structures:
1. For structures designated to be abandoned and/or demolished in place, concrete and/or masonry rubble and excavated soils resulting from demolition activities shall be used for backfill or placed in the bottoms of said structures only as directed by the Engineer.
 2. Concrete and masonry rubble used for backfilling shall be broken into pieces no larger than 12 inches on any one side.
 3. Materials resulting from abandonment/demolition activities approved for backfill shall be combined with imported filler sand to create a dense, compacted backfill.
 4. Backfilling or placement of the excavated material in the structures shall meet the following requirements.
 - a. Furnish, place and compact filler sand along with the concrete and masonry rubble so that all voids are filled and a dense, compacted backfill is obtained.
 - b. Filler sand shall be placed in horizontal layers completely filling all voids between pieces of rubble and not exceeding 12 inches in thickness.
 - c. Each layer of filler sand shall be compacted to obtain at least 90 percent of maximum density as determined by ASTM Method D-698-78 (AASHTO T-99).
 - d. Water shall be furnished by the Contractor and added to each layer as required to maintain optimum moisture content.
 - e. The amount of filler sand used shall only be the amount needed to fill all voids created by placement of the concrete and asphalt rubble, as directed by the Engineer.
 - f. At locations where concrete and masonry rubble are used for backfill, they shall be placed such that a minimum of 3 feet of compacted non-rubble backfill material (crushed rock) exists between any rubble and finished grade.

Protruding reinforcing bars shall be cut to lengths that allow granular backfill to be placed and compacted to required levels in and above the rubble.

5. Disposal of all materials not used for backfill shall be performed off-site and in compliance with applicable local, state, and federal codes and requirements.
 6. In areas where new construction will take place, no trace of these structures shall remain prior to placing of backfill.
- E. Backfilling within the footprint of new structures with rubble material resulting from demolition activities will not be allowed.
- F. All existing improvements designated in the Drawings or specified to be removed, including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the demolition work.
- G. Unless otherwise specified, any resulting voids shall be backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

3.5 EXISTING WATER UTILITY PIPING ABANDONMENT

- A. As specified in Section 33 11 50, Existing Pipe Abandonment.

3.6 ELECTRICAL AND CONTROL SYSTEM DEMOLITION

- A. All electrical and control system demolition work shall at all times be conducted in a safe and proper manner to avoid injury from electrical shock to all personnel.
1. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable.
 2. At no time shall live electrical wiring or connections or those which can become energized be accessible to any persons without suitable protection or warning signs.

3.7 PERMANENT ABANDONMENT OF WELLS

- A. The Contractor shall be responsible for securing and paying any local, state, or federal fees for abandonment of the well.
- B. Abandonment of the well shall be performed by a licensed well constructor in the state in which the work is accomplished.
- C. All work shall be performed according to federal, state, and local standards for permanent well abandonment.

3.8 ASPHALTIC CONCRETE DEMOLITION

- A. Asphalt pavement shall be removed to the limits shown in the Drawings.
- B. The limits of the removal shall be saw cut.
- C. Asphalt pavement may not be used as rubble fill.

3.9 REMOVAL

- A. Remove debris, rock, excavated materials, rubble, abandoned piping, and extracted plant life resulting from abandonment and/or demolition activities from site.
- B. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- C. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the project site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

3.10 GRADING

- A. All grading work shall be completed in accordance with Section 31 22 13, Rough Grading.

3.11 CLEANUP:

- A. During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, debris, and dust and shall leave all areas affected by the work in a clean, condition, as may be subject to Engineer approval.
- B. Adjacent structures shall be cleaned of dust, dirt, and debris resulting from demolition.
- C. Adjacent areas shall be returned to their existing condition prior to the start of work.

3.12 SCHEDULES

- A. The following equipment is to be demolished and removed for the project site:
 - 1. ASR 2 – VFD and Line reactor.
 - 2. Reservoir 4 – Existing PLC Base.
- B. Protect the following equipment.
 - 1. All electrical, mechanical, and instrumentation equipment found in ASR2 and Reservoir 4 well house not explicitly called out for removal/ demolition.

END OF SECTION

SECTION 03 21 00 - REINFORCING STEEL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes all the work necessary to furnish all labor, materials, equipment, and services necessary to furnish reinforcing steel, accessories, welding, equipment and services, and place concrete reinforcement.
- B. Section includes:
 - 1. Reinforcing steel.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete Work.
- B. Section 04 22 00 Concrete Masonry Units.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Submit shop drawings of detailed placing and bending lists for the ENGINEER's approval before the reinforcement is fabricated.
- C. Mill Certificates: Mill test certificates shall be submitted to the ENGINEER to certify that the reinforcing steel meets the specified requirements. Mill test certificates shall be furnished and paid for by the CONTRACTOR.
- D. In addition, the ENGINEER may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the OWNER's expense.

1.4 QUALITY CONTROL

- A. The ENGINEER may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the OWNER's expense.

PART 2 PRODUCTS

2.1 DEFORMED REINFORCING BARS

- A. Unless otherwise specified, reinforcing steel shall be Grade 60 billet steel conforming to ASTM Specification A615 or ASTM 706.
 - 1. All such reinforcing shall be deformed steel bars with *deformations* conforming to the requirements set forth in ASTM Specification A615 or ASTM 706
 - 2. Stirrups and Ties shall be Grade 60 but Grade 40 may be used for #3 and smaller.
- B. Spiral reinforcement and steel wire shall be cold-drawn steel wire conforming to the requirements of ASTM Specification A82 unless shown otherwise on the Drawings.
- C. Welded Wire Fabric (WWF) shall conform to ASTM Specification A185.
- D. Bar and rod mats for concrete reinforcement conforming to ASTM A184
- E. Tie wire, 16 gauge or heavier black annealed wire.
- F. Varying grades shall not be used interchangeably in structures.
- G. Steel bending processes shall conform to the requirements of ACI 318.
- H. Bending or straightening shall be accomplished so that the steel will not be damaged.
- I. Kinked bars shall not be used.

2.2 PLAIN REINFORCING BARS

Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82 unless shown otherwise on the Drawings.

Plain smooth dowels and ¼-inch diameter smooth bars conforming to ASTM A615 Grade 60.

2.3 SUPPORTS

- A. Bar supports shall conform to ACI 315 and CRSI Manual of Standard Practice, Chapter 3, Bar Supports
- B. Bar supports shall consist of approved high density "adobes", stainless steel chairs, plastic spacers or plastic shim plates.
 - 1. Brick, broken concrete masonry units, spalls, rocks or similar materials **shall not** be used for support of reinforcing steel.

2. Steel chairs shall be furnished with plastic tips when incorporated into concrete exposed to view, such as in the roof slab.
 3. Plastic spacers shall be PRECO BARSPAN WHEELS, as manufactured by the PRECO CORPORATION or equal.
 4. Plastic shim plates may be used to support the plastic spacers and shall be used to support the vertical reinforcing in the corewall, unless shown otherwise on the Drawings.
- C. Hot-dipped Galvanized Reinforcing Bars
- When reinforcing bars are indicated on the Drawings to be hot-dipped galvanized, they shall be galvanized in accordance with ASTM A767 and ASTM A143. The grade of reinforcing bars shall be as specified under Section 2.1. The bars shall be galvanized in conformance with a Class 1 coating and shall be galvanized after fabrication and shearing.
- D. Steel Tie Wire: Annealed steel tie wire shall be used to fasten the reinforcing steel in place.

PART 3 EXECUTION

3.1 REINFORCING BARS

Comply with the specified codes and standards and Concrete Reinforcing Steel Institutes recommended practice for "placing reinforcing bars," for details and methods of reinforcement placement and supports, and as herein specified.

A. General

1. Mild steel reinforcing bars shall be furnished, cut, bent and placed as indicated on the Drawings.
2. At the time of placing concrete, all reinforcement shall be free from loose mill scale, rust, grease, oil, or other coating which might destroy or reduce its bond with concrete.
 - a. Reinforcing bars with rust, mill scale or a combination of both will not be acceptable without cleaning or brushing provided that upon wire brushing a sample, the dimensions including height of deformations and weights shall not be less than the applicable ASTM requirements. Steel reinforcement which is to be placed in the work shall be stored under cover to prevent rusting and shall be placed on blocking such that no steel touches any ground surface.

3. All reinforcing steel placed in the work shall be tied together and supported in such a manner that displacement during placing of concrete and shotcrete will not occur.
4. When there is a delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.

B. Cutting and Bending

1. Steel reinforcement shall be cut and bent in accordance with ACI 318 and with approved practices and machine methods, either at the shop or in the field.
2. Reinforcement shall be accurately formed to the dimensions indicated on the Drawings and on the bending schedule.
3. Bends for hooks on bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar.
4. All bars shall be bent cold.

C. Minimum Bar Spacing

The clear distance between parallel bars shall not be less than one and one-half times the diameter of the bars and, unless specifically authorized, shall in no case be less than 1-inch, nor less than the maximum size of coarse aggregate specified.

D. Concrete Cover (Minimum)

1. On all formed surfaces which will be exposed to water, ground or the elements, there shall be a nominal cover over the steel of 2.0-inches for bars number 6 through number 18 and 1-1/2 inches for bars number 5 and smaller, with an installation tolerance of + 1/4 inch. When crossing bars of different diameter are encountered in one face, one shall consider the bar size and location that will provide the largest cover over the nearest steel to the outside surface.
2. Unless otherwise specified in these specifications or shown on the Drawings, all reinforcing steel facing subgrades for concrete construction of the foundation or below-grade elements shall be given a nominal protective cover of 3.0-inch minimum. The largest cover shall be used when different size bars are encountered in one face.
3. The minimum cover over reinforcing steel for concrete construction of other facilities shall be as shown on the Drawings.
4. No "bury" or "carrier" bars will be allowed unless specifically approved by the ENGINEER.

E. Splicing

1. Except as shown or specified on the Drawings, reinforcing steel shall not be spliced at any location without specific approval by the ENGINEER. Splices in adjacent bars shall be staggered.
2. Where permitted or required, splices in reinforcing steel shall have sufficient lap to transfer full strength of the bar by bond and shear. Unless specified or shown otherwise on the Drawings, the bars at a lap splice shall be in contact with each other. In no event shall the lap be less than 40 diameters of the spliced bars.
3. Unless specified or shown otherwise on the Drawings, bars shall be lap spliced in accordance with ACI 318 and shall be fastened together with steel tie wire.
4. Unless shown otherwise on the Drawings, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

F. Supports

1. All reinforcement shall be retained in place, true to indicated lines and grades, by the use of approved bar supports. The CONTRACTOR shall submit for ENGINEER's approval, samples of all bar supports he proposes to use along with a written description of where each bar support will be used.
2. The supports shall be of sufficient quantity, strength and stability to maintain the reinforcement in place throughout the concreting operations. Bar supports shall be placed no further than 4 feet apart in each direction. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete. The CONTRACTOR shall be held responsible for providing the appropriate quantity and type of bar supports.
3. Do not place reinforcing bars more than two inches beyond the last leg on continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

G. Bar Tying

1. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (this shall not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity).

2. Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	Slab Bars (in)	Wall Bars (in)
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 through No. 11	120	96

- H. Reinforcement Around Openings -- Where reinforcing steel has to be cut to permit passage of pipe or to create openings, and should no detail be shown for extra reinforcing in such areas, the area of steel removed by the creation of the opening must be replaced by placing at least double the area of steel removed by the opening equally around the openings. The steel shall be placed such that it extends 5 feet beyond the opening on each side to provide for sufficient bond.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE WORK

PART 1 GENERAL

1.1 SUMMARY

- A. The extent of concrete work is shown on the Drawings.
- B. Work includes providing formwork and shoring for cast-in-place concrete and installation of related items including reinforcing steel bar (rebar), anchor bolts, setting plates, bearing plates, anchorages, inserts, reveals, frames, nosings, sleeves and other items to be embedded in concrete.
- C. Definitions
 - 1. Batch: Used in this specification to define an overall class of concrete as delivered from a concrete batching plant or on-site batching operation. Batching operations can continue for hours or days and as long as the class of concrete is similar, the batch would be considered the same. Multiple mixer truck loads could be used to deliver a "batch" of concrete over the course of multiple hours or days.
 - 2. Batched/Batching: The loading of concrete, as combined and mixed at a batching/ready-mix plant, into a concrete mixer truck for delivery to the job site.
 - 3. Truckload: A standard concrete mixer truck size is assumed to have a concrete capacity of 8 cubic yards. A truckload is used to help define the frequency of testing which of occurs per concrete mixer truck.
 - 4. Ready-Mix Concrete: Concrete that is manufactured in a batch plant, according to a set engineered mix design. This specification assumes ready-mix concrete will be delivered by mixer truck to the job site.
 - 5. Mass Concrete: Concrete placements with a least dimension that is greater than 4-feet thick.

1.2 RELATED SECTIONS:

- A. Section 03 21 00 - Reinforcing Steel.

1.3 QUALITY ASSURANCE

- A. Codes and Standards

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified here:

ACI 301 "Specifications for Structural Concrete for Buildings"

- ACI 311 "Recommended Practice for Concrete Inspection"
- ACI 318 "Building Code Requirements for Reinforced Concrete"
- ACI 347 "Recommended Practice for Concrete Formwork"
- ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
- ACI 308 "Guide to External Curing of Concrete"

Concrete Reinforcing Steel Institute, "Manual of Standard Practice"

Comply with building code requirements which are more stringent than the above and all OSHA requirements.

B. American Society for Testing and Materials (ASTM)

1. C31, Making and Curing Concrete Test Specimens in the Field.
2. C33, Specification for Concrete Aggregate.
3. C39, Compressive Strength of Cylindrical Concrete Specimens.
4. C40, Organic Impurities in Fine Aggregate for Concrete.
5. C85, Cement Content of Hardened Portland Cement Concrete.
6. C88, Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
7. C94, Standard Specifications for Ready-Mixed Concrete.
8. C131, Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
9. C136, Method for Sieve Analysis to Fine and Coarse Aggregate.
10. C143, Slump of Portland Cement Concrete.
11. C150, Standard Specification for Portland Cement.
12. C156, Water Retention by Concrete Curing Materials.
13. C173, Air Content of Freshly Mixed Concrete by the Volumetric Method.
14. C231, Air Content of Freshly Mixed Concrete by the Pressure Method.
15. C233, Standard Method of Testing Air-Entraining Admixtures for Concrete.
16. C260, Standard Specifications for Air-Entraining Admixtures for Concrete.

17. C289, Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
18. C441, Standard Test Method for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reaction.
19. C457, Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete.
20. C494, Standard Specifications for Chemical Admixtures for Concrete.
21. C670, Preparing Precision Statements for Test Methods for Construction Materials.
22. C803, Penetration Resistance of Hardened Concrete.

C. Workmanship

The CONTRACTOR is responsible for correction of concrete work that does not conform to the specified requirements, including strength, tolerances, and finishes. Correct deficient concrete as directed by the OWNER or ENGINEER. The CONTRACTOR shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

D. Concrete Testing Service

The OWNER or a representative of the OWNER will engage a special inspector/testing laboratory to perform material evaluation tests and to design concrete mixes. See detailed requirements in Part 3.14 "Quality Control Testing during Construction". Per the OWNER or ENGINEER's requirements the CONTRACTOR shall notify the designated representative to schedule the special inspections and materials testing required by the project documents.

E. Testing Requirements

Materials and installed work may require testing and retesting, as directed by the OWNER or ENGINEER, at anytime during the progress of the work. Allow free access to material stockpiles and facilities at all times.

The costs for preparation of mix designs (if required by the OWNER to be performed by an independent testing laboratory) and testing of concrete and materials shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

F. Tests for Concrete Materials

1. Test aggregates by the methods of sampling and testing of ASTM C33.

2. For Portland cement, sample the cement and determine the properties by the methods of test of ASTM C150.
3. Submit written reports to the OWNER and ENGINEER, for each material sampled and tested prior to the start of work. Provide the project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.
4. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing. The materials producer and the CONTRACTOR must sign certificates of compliance.

G. Allowable Tolerances:

1. Construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347, and as follows:
 - a. Variation from plumb in lines and surfaces of columns, piers, walls and rises; 1/4-inch per 10 feet, but not more than 1-inch. For exposed corner columns, control joint grooves, and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum; 1/2-inch maximum in 40 feet or more.
 - b. Variation from level or grade in slab soffits, ceilings, beam soffits, and rises 1/4-inch in 10 feet, 3/8-inch in any bay or 20 feet maximum, and 3/4-inch in 40 feet or more. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum and 1/2-inch in 40 feet or more.
 - c. Variation from position of the linear lines and related columns, walls, and partitions, 1/2-inch in any bay or 20 feet maximum, and 1-inch in 40 feet or more.
 - d. Variation in sizes and locations of sleeves, floor openings, and wall openings, 1/4-inch.
 - e. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls, minus 1/4-inch and plus 1/2-inch.
 - f. Variations in footing plan dimensions, minus 1/2-inch and plus two (2) inches; misplacement or eccentricity, two (2) percent of the footing width in direction of misplacement but not more than two (2) inches; thickness reduction, minus five (5) percent.

- F. Material Certificates may be provided in lieu of materials laboratory test reports. The material manufacturer and the CONTRACTOR, certifying that each material item complies with, or exceeds, the specified requirements shall sign material certificates.

1.5 CONCRETE MIX DESIGNS

- A. All concrete materials shall be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.
- B. If the concrete mix designs specified herein have not been used previously by the ready-mix supplier or if directed by the ENGINEER, mix proportions and concrete strength curves for regular cylinder tests, based on the relationship of 7, 14 and 28 day strengths versus slump values of two (2), four (4), and six (6) inches, all conforming to these Specifications, shall be established by an approved ready-mix supplier or an independent testing laboratory. A laboratory, independent of the ready-mix supplier, shall be required to prepare and test all concrete cylinders.

The costs for preparation of mix designs (if required by the OWNER to be performed by an independent testing laboratory) shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

Testing of concrete and materials shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

- C. The exact proportions by weight of all materials entering into the concrete delivered to the jobsite shall conform to the approved mix design unless specifically so directed by the ENGINEER or Laboratory for improved specified strength or desired density, uniformity and workability.
- D. The proportions of such mix design shall be based on a full cubic yard of hardened concrete.
- E. Ready-mix companies or jobsite batch plants shall furnish delivery tickets, signed by a Certified Weighmaster, on which each shall state the weight of aggregates, sand, cement, admixtures and water and the number of cubic yards of concrete furnished, which will be compared against the approved mix design.
- F. There shall be no variation in the weights and proportions of materials from the approved mix design.
- G. There shall be no variation in the quality and source of materials once they have been approved for the specific mix design.

1.6 READY-MIXED CONCRETE

Ready-mixed concrete shall conform to the requirements of ACI 301 and ASTM C 94. In case of conflict, ACI 301 shall govern.

1.7 SAMPLE

Upon request by the OWNER or ENGINEER the CONTRACTOR shall pour and finish one 2-foot square exposed aggregate concrete sample for ENGINEER's approval prior to construction if exposed aggregate is included on job.

1.8 JOB CONDITIONS

Maintain continuous traffic control and access for vehicular and pedestrian traffic as required for other construction activities as well as to adjoining facilities for regular operation. Utilize flagmen, barricades, warning signs and warning lights as required, to maintain a safe entrance and passage on all roads or drives abutting the project.

PART 2 PRODUCTS

2.1 WALL FORMS

- A. Full Height Pours: The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.
- B. Wall Form Ties
 1. Form ties which remain in the wall of a subgrade water-retaining structure shall have waterstops and a 1.5 inch minimum breakback or cone depth.
 2. Snap ties, if used, shall not be broken until the concrete has reached the design concrete strength. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. The use of tie wires as form ties will not be permitted. Fully threaded stub bolts may be used in lieu of smooth ties with waterstops.
 3. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Provide A-58 SURE PLUG as manufactured by DAYTON SUPERIOR or approved equal.

4. Ties shall positively secure the wall to the required dimension and hold the wall to that dimension prior to and during concrete placement.
- C. Wall Form Stiffeners
1. Horizontal walers shall consist of structural steel channels, angles or tubing of adequate size to retain the concrete without deflecting.
 2. As required the walers shall be rolled or welded to the proper radii or offset brackets shall be used for shaping the wall to the dimensions shown on the Drawings and shall be used both for inside and outside wall forms in direct contact with the wall panels and at vertical spacings of no more than 96 inches on center.
 3. There shall be at least one such waler within 24 inches of the top and bottom of the wall.
 4. The largest dimension of the steel waler shall be in the radial direction.
 5. Vertical structural steel or wood members shall be spaced so as to have sufficient rigidity and strength to insure the proper vertical alignments with the aid of braces under all predictable stress conditions.
 6. In lieu of the above, a different system and spacings may be used if it is satisfactorily demonstrated to the ENGINEER that it will be equally effective.

2.2 FORMS FOR EXPOSED FINISH CONCRETE

Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Finish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection. Use overlaid plywood complying with U.S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form", Class I. Use flexible spring steel forms or laminated boards free of distortion and defects to form radius bends as required.

2.3 FORMS FOR UNEXPOSED FINISH CONCRETE

- A. Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.

2.4 FORM MATERIALS

- A. Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments

of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound. Petroleum based coatings shall not be used for structures in creeks and waterways. Biodegradable coatings shall be used which will not contaminate the creeks/waterways or an alternate method for stripping the form shall be proposed.

B. Chamfers, Reveals, Drips

Provide preformed PVC or shaped wood or metal of size and profile as shown on drawings.

C. Cylindrical Columns and Supports

Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide units having "seamless" interior to minimize spiral gaps or seams.

D. Pan Forms

Provide forms for concrete pan-type construction complete with covers and end enclosures to form a true, clean, smooth concrete surface. Design units for easy removal without damaging placed concrete. Block adjoining pan units if required to avoid lateral deflection of formwork during concrete placement and compaction. Provide standard or tapered end forms, as shown.

If required, factory-fabricate pan form units to required sizes and shapes of the following:

1. Steel - 16 gauge minimum, free of dents, irregularities, sag and rust, or
2. Glass-Fiber Reinforced Plastic - Molded under pressure with matched dies, 0.11 inches minimum wall thickness.

E. Inserts & Embeds

Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work. Provide "Parabolt" by the Molly Company, "Phillips Red-Head", "Burke" or approved equal products. The CONTRACTOR is responsible for insuring that all required anchorage not specified in the project documents is installed per current building code and applicable ICC report requirements.

2.5 REINFORCING MATERIALS

- A. See Section 03 21 00 – Reinforcing Steel for additional information

- B. Reinforcing Bar (rebar): ASTM A615 or ASTM 706 and as follows below
 - Stirrups and Ties Grade 60 (Grade 40 may be used for #3 and smaller)
 - All other Uses Grade 60
- C. Steel Wire: ASTM A82, plain, cold-drawn, steel.
- D. Welded Wire Fabric (WWF): ASTM A185, welded steel wire fabric.
- E. Supports for Reinforcement

Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise specified. Wood, brick, concrete blocks and other devices **will not** be acceptable. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are hot-dip galvanized, after fabrication, or plastic protected or stainless steel protected.

- F. Fiber Reinforcement – Collated polypropylene fiber, ¾”-inch, manufactured from 100% virgin homopolymer polypropylene, hydrophobic, in compliance with ASTM C116.

2.6 CONCRETE MATERIALS

- A. Portland Cement

ASTM C150, Type II unless otherwise acceptable to ENGINEER. Use only one (1) brand of cement throughout the project, unless otherwise acceptable to the ENGINEER. The use of ground granulated blast furnace slag is not allowed.

1. Type IL cement shall only be allowed with an accompanying testing report indicating the surrounding **[soils/water]** sulfate levels are below the following limits:
 - a. $SO_4 < 0.10$ water-soluble sulfate (SO_4) in soil percent by mass.
 - b. $SO_4 < 150$ dissolved sulfate (SO_4) in water, ppm.

- B. Aggregates

ASTM C33 and as herein specified. Provide aggregates from a single source for all exposed concrete.

Local aggregates not complying with ASTM C33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the ENGINEER.

1. Fine Aggregate - Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank-run sand and manufactured sand are not acceptable.
 2. Coarse Aggregate - Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:
 - a. Crushed stone processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.
 - c. Maximum Aggregate Size - Not larger than one-fifth ($1/5$) of the narrowest dimensions between sides of forms, one-third ($1/3$) of the depth of slabs, nor three-fourths ($3/4$) of the minimum clear space between individual reinforcing bars or bundles of bars.
 3. These limitations may be waived if, in the judgment of the ENGINEER, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.
 4. In general it is desired that normal commercial mixes using 1-1/2-inch or 3/4-inch maximum aggregate size be used.
 5. Aggregate for exposed aggregate concrete shall consist of selected aggregate of washed clean river gravel in color range of medium to dark in browns and grays; material uniformly sized 5/8-inch to 3/4-inch.
- C. Water: Clean, fresh, potable.
- D. Air Entraining Admixture: ASTM C260.
- E. Water-Reducing Admixture: ASTM C494, Type A or F
- F. Set-Control Admixtures: ASTM C494, as follows:
1. Type B, Retarding.
 2. Type C, Accelerating.
 3. Type D, Water-reducing and Retarding.
 4. Type E, Water-reducing and Accelerating.

Calcium chloride will not be permitted in concrete, unless otherwise authorized in writing by the ENGINEER.

G. Accelerators: No accelerators shall be used for mass concrete

2.7 RELATED MATERIALS

A. Waterstops

Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as shown. Size to suit joints or as shown. Provide PVC waterstops complying with Corps of Engineer's CRD-C 572. Waterstops provided to be Greenstreak 701 or approved equal. Split face waterstops will not be acceptable under any circumstances.

B. Bituminous and Fiber Joint Filler

Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D1751, FS HH-F-341, Type 1 and AASHTO M 213. Provide one of the following products:

1. Elastite; Philip Carey/Celotex
2. Flexcell; Celotex Corp.
3. Crane Fiber 1390; W.R. Grace & Co.
4. Fibre; W.R. Meadows, Inc.
5. Tex-Lite; J & P Petroleum Prod. Inc.
6. Sonoflex; Sonneborn/Contech, Inc.

C. Joint Sealing Compound: See Section 07 92 00, Joint Sealants.

D. Moisture Barrier

Provide moisture barrier cover over all prepared base material. Use only materials that are resistant to decay when tested in accordance with ASTM E154. The moisture barrier consists of heavy Kraft papers laminated together with glass fiber reinforcement and overcoated with black polyethylene on each side. Provide Moistop, St. Regis, or equal.

E. Form Ties (for forms other than wall forms)

Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise shown, provide ties so portion remaining within concrete after removal is at least 1.5 inches inside concrete. Unless otherwise shown, provide form ties, which will not leave holes larger than 1-inch in diameter in concrete surface.

F. Concrete Curing Materials

Concrete curing materials shall be in accordance with ACI 301 Section 5 and ACI 308.1 Section 2.

1. Water-based resin curing compound. W.R. Meadows, Inc. 1100, Euclid Kurez DR VOX, or approved equal.
2. Acrylic curing and sealing compound. W.R. Meadows, Inc. CS-309-30, or approved equal.
3. Water emulsion acrylic curing and sealing compound formulated of acrylic polymers of water-based carrier. W.R. Meadows, Inc. VOCOMP-20, Euclid Luster Seal WB, or approved equal.

G. Epoxy Adhesive

For application to wire-brushed and prepared existing concrete to be mated to new concrete.

1. W.R. Meadows, Inc. INTRALOK, Sika Sikadur-32 Hi-Mod, Sika Armatec-100 EpoCem, or approved equal.
2. Apply per manufacturer's recommendations.

H. Chemical-Hardener Finish: Provide Hornolith from Tamms Industries, or approved equal.

I. Non-slip Aggregate Finish

Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof and non-glazing, and is unaffected by freezing, moisture and cleaning materials.

J. Non-shrink Grout: See Section 03 60 00, Grouting.

2.8 PROPORTIONING NORMAL CONCRETE

- A. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1. All measurements shall be by weight. All concrete admixtures will either be by the same supplier to insure compatibility. If different suppliers are used a memorandum from EACH admixture supplier will be provided stating the compatibility of their product with the other supplier's products.
- B. The slump shall be between two inches and four inches when tested in accordance with ASTM Specifications C 143. Variations in the slump range may be allowed by the ENGINEER if admixtures, such as water reducers or superplasticizers, are utilized in the concrete mix. Regardless of the measured slump, the maximum allowable water-cement ratios as specified here-in, shall be strictly adhered to.

C. Compressive Strength, Water and Cement Content

Notwithstanding what has been stated here-before, and unless shown otherwise on the Drawings, the concrete shall meet the following requirements. All concrete except as noted otherwise on the drawings shall have 4,500 psi 28-day compressive strength and a maximum water/cement ratio of 0.45. Up to a maximum of 15% of cementitious material may be fly ash in accordance with ASTM C618. The use ground granulated blast furnace slag is not allowed for any surfaces in contact with potable water.

D. Retarding Densifiers

1. All concrete (as defined in 2.9 below) used for wall construction shall also contain DARATARD-17, as manufactured by Grace Const. Products, Cambridge, MA or MBL-82, as manufactured by Master Builders, Cleveland, OH in the amounts recommended by the additive manufacturer whenever the air temperature during the pour exceeds 85° F.
2. To be considered as equal, any alternate product offered for consideration shall contain no calcium chloride, and shall be compatible with air-entrained cements and air-entraining admixtures conforming to the applicable ASTM, AASHTO, ANSI and Federal specifications.
3. CONTRACTOR shall certify that admixtures do not contain calcium chlorides or other corrosive materials.

E. Air-Entraining Agents

1. All concrete that that is specified to be air entrained or that may be exposed to freeze/thaw action either during construction or the service life of the structure must be air entrained.
2. Air-entraining agents shall meet ASTM C 260, ASTM C 233 and ASTM C 457.
3. The total volumetric air content of the concrete before placement shall be six (6) percent +/- 1.5 percent as determined by ASTM C 173 or ASTM 231 for mixes using a 3/4" nominal aggregate size.
4. Subject to these Specifications, consideration will be given to the following products: PROTEX "AES," GRACE "DAREX AEA," MASTER BUILDERS "MB-AE10," or SIKA CHEMICAL "AER."

F. Water Reducing Admixtures

1. In addition to air-entrainment, approved water reducing additives, which do not affect the ultimate performance of any steel in any way, may be added to maintain the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C 494, Type A or D.

2. The use of water reducing additives shall not permit a reduction in the minimum specified cement content or in the specified amount of air-entrainment.
 3. Admixtures shall contain no calcium chloride, tri-ethanolamine or fly ash. All admixtures shall be from the same manufacturer.
 4. Superplasticizers, if allowed by the ENGINEER, shall conform to ASTM C 494, Type F or G, batch plant added using second or third generation only.
 5. Set control admixtures if allowed by the ENGINEER, shall conform to ASTM C 494, Type B (retarding) or Type C (accelerating).
- G. Fiber reinforcement admixture shall be included in the ready-mix concrete design used for filling and channeling the wet well chambers. Fibers shall be used in strict accordance with the manufacturer's directions.

2.9 CONCRETE MIXING

A. Ready-Mix Concrete

1. Comply with the requirements of ASTM C94, and as herein specified. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is between 85°F and 90°F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.
2. Minimum Mix Time: Once all materials are in the drum, the minimum mixing time shall be for 10 minutes before concrete is placed.

PART 3 EXECUTION

3.1 FORMS

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formworks so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design formworks to be readily removable without impact shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts

and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

- D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- E. Erect falsework and support; brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures.

Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances.

- F. Forms for Exposed Concrete

Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes. Do not use metal cover plates for patching holes or defects in forms. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material, which will produce bow. Assemble forms so they may be readily removed without damage to exposed concrete surfaces. Form molding shapes, recesses and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

Corner Treatment - Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise indicated.

- G. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings of forms at inconspicuous locations.
- H. Chamfer exposed corners and edges, reveals and drips as shown using wood, metal, PVC or rubber strips fabricated to produce uniform smooth lines and tight edge joints. A ½ inch chamfer at exposed edges is typical unless noted otherwise.

- I. Provisions for Other Trades - Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such ties. Accurately place and securely support items built into forms.
- J. Cleaning and Tightening - Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate mortar leaks.

3.2 PLACING REINFORCEMENT

Detail and place according to ACI Manual SP-66. Unless otherwise noted, minimum cover shall be 1-1/2 inches for No. 5 and smaller bars, 2.0-inches for No. 6 and larger bars or for any bars exposed to exterior or wet environments, and 3.0-inches when poured against earth. Unless otherwise noted, bend all horizontals reinforcing a minimum of two (2) feet at corners and wall intersections.

- A. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
- B. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
- C. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Do not place reinforcing bars more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- D. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus two (2) inches, and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

- A. Construction Joints - Locate and install construction joints not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the ENGINEER. Install and locate other construction joints as specified.
- B. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints. Unless otherwise specified, reinforcement shall be lapped in accordance with ACI Standards.
- C. Waterstops - Provide waterstops in construction joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to

support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joint.

- D. Isolation Joints in Slabs-on-Ground - Construct isolation joints in slabs-on-ground at all points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.
- E. Control Joints in Slabs-on-Ground - Construct control joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4-inch wide by one-fifth (1/5) to one-fourth (1/4) of the slab depth, unless otherwise shown.
 - 1. Form control joints by the following methods
 - a. Inserting a premolded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. After the concrete has cured, remove inserts and clean groove of loose debris.
 - b. Saw cutting a control joint in the required location. Plan for saw cutting so work does not damage reinforcing or violate edge distance minimums.
 - 2. Joint sealant material shall be as specified above.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General - Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs - Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screed strips by the use of strike-off templates or accepted compacting type screeds.
- C. Cast in Place Reglets - Place in straight and continuous lines as detailed to enable flashing to be applied continuously without deviation at reglet joints more than 1/8-inch. Miter corners for continuous reglet joint where outside corners occur. At inside corners extend one section 1-inch past corner. Adequately anchor or secure reglets per manufacturer's instructions prior to pouring and during construction to insure dimensional tolerances and alignment. Vibrate concrete to insure concrete cover adjacent to and around reglet. Visually inspect after pour and patch as required.

3.5 PREPARATION OF FORM SURFACES

Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Thin formcoating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Use dissipating-

type form oil at surfaces to receive cement plaster finish. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.6 CONCRETE PLACEMENT

A. Pre-Placement Inspection

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work as required. Notify ENGINEER in time for inspection prior to pouring.
2. Remove all garbage and debris from the base of formwork. Items such as aluminum cans, food containers, plywood, and their like are to be cleaned-up and disposed.
3. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.
4. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
5. Concrete Curbs and Paving - Do not place concrete until subbase is completed and approved by the ENGINEER as required to provide uniform dampened condition at the time concrete is placed. Moisten subbase as required to provide uniform dampened condition at the time concrete is placed.

B. Place concrete in compliance with the practices and recommendations of ACI 304 and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.
2. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
3. Do not use concrete which becomes non-plastic and unworkable or does not meet the required quality control limits or which has been contaminated by foreign

materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location. Do not use concrete whose allowable mixing time has been exceeded.

C. Concrete Conveying

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods, which will prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.
3. The CONTRACTOR shall provide traffic control on the narrow access roads to the work sites.
4. The CONTRACTOR shall not wash concrete trucks/chutes/equipment off at the project site unless plastic tarps and hay bales are employed to contain the concrete. The CONTRACTOR will be required to haul off-site all concrete contaminated soil.

D. Placing Concrete into Forms

1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
2. Do not interrupt successive placement; do not permit cold joints to occur.
3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted.
5. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete at least six (6) inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete

embedment of reinforcement and other embedded items without causing segregation of the mix.

6. Do not place concrete in supporting elements until the concrete previously placed in columns and walls is no longer plastic.

E. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment so the concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in the remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other acceptable methods. Limit the time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.
4. Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
5. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

F. Bonding

1. Roughen surfaces of set concrete at all joints except where bonding is obtained by use of concrete bonding agent, and clean surfaces of laitance, coatings, loose particles and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and not to leave laitance, loose particles of aggregate or damaged concrete at the surface.
2. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:
 - a. At joints between footings and walls or columns, and between walls or columns and beams or slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.
 - b. At joints in exposed work; at vertical joints in walls; at joints in girders, beams, supported slabs and other structural members; and at joints designed to

contain liquids; dampen, but do not saturate the roughened and cleaned surface of set concrete and apply a liberal coating of neat cement grout.

- c. Use neat cement grout consisting of equal parts Portland cement and fine aggregate by weight and not more than six (6) gallons of water per sack of cement. Apply with a stiff broom or brush to a minimum thickness of 1/16-inch. Deposit fresh concrete before cement grout has attained its initial set.
 - d. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instructions of the bonding material manufacturer.
3. Prepare for bonding of fresh concrete to fully cured hardened concrete or existing concrete by using an epoxy-resin-bonding agent as follows:
 - a. Handle and store epoxy-resin adhesive binder in compliance with the manufacturer's printed instructions, including safety precautions.
 - b. Mix the epoxy-resin adhesive binder in the proportions recommended by the manufacturer, carefully following directions for safety of personnel.
 - c. Before depositing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy-resin grout not less than 1/16-inch thick. Place fresh concrete while the epoxy-resin material is still tacky, without removing the in-place grout coat, and as directed by the epoxy-resin manufacturer.

G. Cold Weather

1. Protect all concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
2. When the air temperature has fallen to or is expected to fall below 40°F, provide adequate means to maintain the temperature in the area where concrete is being placed at either 70°F for three (3) days or 50°F for five (5) days after placing. Provide temporary housing or coverings including tarpaulins or plastic film. Keep protections in place and intact at least 24 hours after artificial heat is discontinued. Keep concrete moist. Avoid rapid dry-out of concrete due to over-heating and avoid thermal shock due to sudden cooling or heating.
3. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50°F, and not more than 80°F, at point of placement.

4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.
5. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot Weather Placing

1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
3. Cover reinforcing steel with water soaked burlap if it becomes too hot so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
4. Wet forms thoroughly before placing concrete.
5. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 FINISH OF FORMED SURFACES

A. Rough Form Finish

For formed concrete surfaces not exposed to view in the finish work or covered by other construction, unless otherwise shown or specified. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.

B. Smooth Form Finish

Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view. Or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.

Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of

seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

C. Curb Finishes

Curbs shall be screeded off accurately to true lines and planes or warped surfaces as indicated or directed. Finish smooth. Arises shall be true and straight or properly eased where curved and neatly rounded with approved tool. Smooth trowel finish with corners rounded to 3/4-inch radius.

D. Grout Cleaned Finish (Sacked)

Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment, and to all exposed to view interior and exterior building surfaces, typical.

Combine one part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.

Thoroughly wet concrete surfaces and apply grout immediately to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

E. Related Unformed Surfaces

At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.8 MONOLITHIC SLAB FINISHES

A. Float Finish

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing or sand bed terrazzo, and as otherwise shown on drawings or in schedules.
2. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float, or both. Consolidate the surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not

exceeding 1/4-inch in 10 feet when tested with a 10-foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill at low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

B. Trowel Finish

1. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint, or other thin-film finish coating system.
2. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
3. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Exposed Aggregate Finish

1. Screed to true plane, bullfloat surfaces, provide uniform double troweled finish. After troweling, let set until hard enough to wash without disturbing coarse aggregates. Simultaneously brush and spray with water to expose large aggregate and produce texture to match approved sample. Water cure or keep wet for 25 hours.
2. Scrub surface after 24 hours with a one (1) part muriatic acid to 10 part water solution. Rinse thoroughly.

D. Broom Finish (Non-Slip)

1. Apply non-slip, broom finish to exterior concrete platforms, steps and ramps and elsewhere as shown on the drawings or in schedules.
2. Immediately after trowel finish, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route or in the direction of water flow. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the ENGINEER before application.

E. Chemical-Hardener Finish

1. Apply chemical curing-hardening compound or chemical-hardener to all interior concrete floors which will not receive applied finish materials. Mask adjacent work

and surfaces to avoid over spray. Apply liquid chemical-hardener after complete curing and drying of the concrete surface.

2. Dilute the liquid hardener with water and apply in accordance with the manufacturer's printed directions. Evenly apply each coat and allow for drying between coats in accordance with manufacturer's printed directions.
3. After the final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

F. Non-slip Aggregate Finish

Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as shown on the drawings or in schedules.

After completion of float finishing and before starting trowel finish, uniformly spread 25 pounds of dampened non-slip aggregate per 100 square feet of surface. Tamp aggregate flush with surface using steel trowel, but do not force the non-slip aggregate particles below surface. After broadcasting and tamping, apply trowel finish as herein specified. After curing, lightly work the surface with a steel wire brush, or an abrasive stone, and water to expose the non-slip aggregate.

3.9 SCHEDULE OF CONCRETE SURFACE FINISHES

Also see Section 09 90 00, Painting and Coating for protective coating requirements.

<u>Surface Description</u>	<u>Type</u>	<u>Finish Requirement</u>
A. Interior Horizontal Slabs	Slab	Trowel Finish
B. Exterior Horizontal Slabs	Slab	Broom Finish (Non-Slip)
D. Interior Vertical Surfaces (including Wet Well)	Formed	Smooth Form
E. Exterior Vertical Surfaces Exposed to View	Formed	Smooth Form

3.10 CONCRETE CURING AND PROTECTION

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least seven (7) days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods

Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing or by combinations thereof, as herein specified. Provide the curing methods indicated as follows:

1. For concrete floor slabs provide moisture curing, moisture cover curing or liquid membrane/chemical curing-hardening curing. If liquid membrane curing is used, it must be compatible with concrete hardening compounds to be applied later.
2. For other concrete work, provide moisture curing or moisture cover curing. Do not use liquid membrane or chemical curing-hardening curing on any concrete work to receive any applied finishes.
3. For curing, use only water that is free of impurities, which could etch or discolor exposed, natural concrete surfaces.
4. Provide moisture curing by any of the following methods:
 - a. Keeping the surface of the concrete continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering the concrete surface with the specified absorptive cover thoroughly saturated with water and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges with a 4-inch lap over adjacent absorptive covers.
5. Provide moisture-cover curing as follows - Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete placed in the widest practicable width with sides and ends lapped at least three (3) inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

6. Provide liquid membrane curing as follows:
 - a. Apply the specified membrane-forming curing compound to damp concrete surfaces as soon as the water film has disappeared. Apply uniformly in a coat continuous operation by power spray equipment in accordance with the manufacturer's directions. Recoat areas, which are subjected to heavy rainfall within three (3) hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period.
 - b. Do not use membrane-curing compounds on surfaces, which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete. Such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the ENGINEER.
7. Curing formed Surfaces - Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
8. Curing Unformed Surfaces
 - a. Initially cure unformed surfaces, such as slabs, floor topping and other flat surfaces by moist curing, whenever possible.
 - b. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.
 - c. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise acceptable to the ENGINEER.
9. Provide liquid curing-hardening compound as follows:
 - a. Apply to horizontal surfaces when concrete is dry to touch by means of power spray, hand spray or hair broom in accordance with manufacturer's directions.

C. Temperature of Concrete during Curing

1. When the atmospheric temperature is 40°F and below, maintain the concrete temperature between 50°F and 70°F continuously throughout the curing period. When necessary, make arrangements before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protections complying with the requirements of ACI 306.

2. When the atmospheric temperature is 80°F, and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation wind breaks or shading, and for fog spraying, wet sprinkling or moisture-retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protections complying with the requirements of ACI 305.
 3. Maintain concrete temperature as uniformly as possible and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete, which exceed 5°F in any one-hour and 50°F in any 24-hour period.
- D. Protection from Mechanical Injury - During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In - Fill-in holes and openings in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.
- B. Curbs - Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations - Provide machine and equipment bases and foundations as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

3.12 REMOVAL OF SHORES AND FORMS

- A. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support the work without excessive stress or deflection.

Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until the concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

- B. Formwork not supporting weight of concrete, such as sides of beams, walls, columns and similar parts of the work, may be removed after cumulative curing at not less than

50°F for 24 hours after placing concrete. Providing the concrete is sufficiently hard to not be damaged by form removal operations and provided curing and protection operations are maintained.

- C. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in place concrete by testing field-cured specimens representative of concrete location or members.
- D. Form facing material may be removed four (4) days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
- E. Re-Use of Forms

Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use “patched” forms for exposed concrete surfaces, except as acceptable to the Architect.

No forming material will be allowed to be built permanently into exposed visible surfaces.

3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas
 - 1. Repair and patch defective areas with cement mortar immediately after removal of forms but only when directed by the ENGINEER.
 - 2. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter and holes left by tie rods and bolts down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the ENGINEER.
 - 3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify

mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.
- B. Repair of Formed Surfaces
1. Repair exposed-to-view formed concrete surfaces that contain defects, which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the ENGINEER. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolt; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.
 2. Repair concealed formed concrete surfaces that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects, as such, include cracks in excess of 0.01-inch wide, cracks or any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.
- C. Repair of Unformed Surfaces
1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
 3. Repair finished unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets and other objectionable conditions.
 4. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so those repairs can be made without damage to adjacent areas.
 5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh

concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the ENGINEER.

6. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with a neat cement grout coating, or use concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same material to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over 1 inch in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean off dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.
8. For repair of existing unformed surfaces, mechanically remove all loose concrete as required to expose sound aggregate. Clean concrete surfaces to achieve a contaminate free, open textured surface. Square cut or under cut perimeter to minimum depth as specified by the repair mortar manufacturer. Remove all loose concrete around the exposed steel and hand tool or blast clean all portions of rebar with visible rust to near white metal finish. If half of the diameter of the reinforcing steel is exposed, chip out behind the reinforcing to a 1/2-inch minimum depth. Splice new reinforcing steel to existing where corrosion has depleted the cross-section area by 25%. Apply a corrosion inhibitor/primer/bonding agent to all exposed rebar and other steel components and to concrete surfaces to be repaired per manufacturer's requirements, such as Sika Armatec 110 . Apply a polymer-modified, cement-based, repair mortar, trowel applied as specified by the manufacturer, such as Sika MonoTop 615.
9. Repair methods not specified above may be used subject to the acceptance of the ENGINEER.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. The OWNER or a representative of the OWNER will engage a special inspector/testing laboratory to perform all tests and to submit test reports to the OWNER, ENGINEER, and the CONTRACTOR.
- B. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:
 - 1. Sampling Fresh Concrete - ASTM C172, except modified for slump to comply with ASTM C94.
 - 2. Slump Test - ASTM 143; one (1) test for each set of compressive strength test specimens. Samples shall be taken at point of discharge.
 - 3. Air Content - ASTM C231, pressure method; one (1) for each set of compressive strength test specimens.
 - 4. Compression Test Specimen - ASTM C31; One (1) Set which consist of a minimum of four (4) standard cylinders to allow for compressive strength testing, unless otherwise directed. If early loading of members or sections is desired by the CONTRACTOR, additional tests cylinders shall be collected for testing. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - 5. Concrete Temperature - Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens is made.
 - 6. Compressive Strength Tests - ASTM C39; One (1) Set for each 100 cubic yards or fraction thereof, of each concrete class placed in any one (1) day, OR for each 5,000 square feet of surface area placed, OR as per minimums outlined below.
 - a. When the frequency of testing will provide less than five (5) Sets of cylinders by which to perform strength tests for a given class of concrete, conduct testing, as follows.
 - 1) For a class of concrete with a total batch size of greater than 500 cubic yards or 25,000 square feet of surface area, collect test Sets as outlined above.
 - 2) For a class of concrete with a total batch size of less than 500 cubic yards or 25,000 square feet of surface area, but greater than 300 cubic yards or 15,000 square feet of surface area, collect four (4) Sets for testing. Two (2) Sets near the beginning of pouring, one (1) Set mid-way through pouring and one (1) Set towards the end of pouring.

- 3) For a class of concrete with a total batch size of less than 300 cubic yards or 15,000 square feet of surface area, but greater than 50 cubic yards or 2,500 square feet of surface area, collect four (3) sets of testing. One (1) Set near the beginning of pouring, one (1) Set mid-way through pouring and one (1) Set towards the end of pouring.
 - 4) When the total quantity of a given class of concrete is less than 50 cubic yards, and NO anchors are embedded in the concrete, the ENGINEER may waive the strength tests if, in their judgment, adequate evidence of satisfactory strength is provided. Otherwise testing shall occur as outlined in 3.14.B.6.a
- b. Testing Procedure: A Set of specimens with yield four (4) cylinders. Therefore, five (5) Sets will yield 20 cylinders, four (4) Sets will yield 16 cylinders, three (3) Sets will yield 12 cylinders, From each set test one (1) cylinder at seven (7) days, test two (2) cylinders at 28 days, and one (1) cylinder shall be retained in reserve for later testing if required. Additional cylinders can be obtained, at the CONTRACTOR's or OWNER's discretion, for testing at alternate times.
 - c. If required by the building official, perform strength tests of cylinders cured under field conditions. Field cured cylinders shall be taken and molded at the same time and from the same samples as the laboratory cured test cylinders. When the strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
- C. Report test results in writing to the ENGINEER and the CONTRACTOR on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of CONTRACTOR, name of concrete supplier and concrete mixing truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength and type of break for both 7-day tests and 28-day tests.
 - D. Additional tests - The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure, as directed by the ENGINEER. The testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. CONTRACTOR shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 03 60 00 - GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes all work necessary to form, mix, place, cure, repair, finish, and perform all other work as required to produce finished grout, in accordance with the requirements of the Contract Documents.
- B. Work covered in this Section includes:
 - 1. Patching, grouting, and sealing.
 - 2. Grouting of door frames in CMU wall
 - 3. Grouting for support of plumbing, fire sprinklers, and HVAC equipment
 - 4. Grout for support of mechanical, electrical, and communications equipment
 - 5. Removal of loose and spalling grout and concrete.
 - 6. Anchoring cement for metal fabrications

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete Work.
- B. Section 05 50 00 – Miscellaneous Metals
- C. Additional Sections

1.3 SUBMITTALS

- A. Manufacturer Technical Data and Strength Test Results: For sack-mix grouts used on minor-structure/systems provide datasheet information verifying the compressive strength, shrinkage, and expansion requirements specified herein for grout used.
- B. Manufacturer's Literature: Containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout used in the work.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as specified in Section 03 30 00, Cast-in-Place Concrete Work and as referred to herein.

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified.

B. Codes and Standards

1. American Society for Testing and Materials (ASTM)

- a. C1084, "Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete"
- b. C109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)"
- c. C191, "Standard Test Method for Setting Time of Hydraulic Cement"
- d. C131, "Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"
- e. C136, "Standard Test Method for Sieve Analysis to Fine and Coarse Aggregate"
- f. C143, "Standard Test Method for Slump of Hydraulic Cement Concrete"
- g. C150, "Standard Specification for Portland Cement"
- h. C488, "Standard Test Method for Pull-Out Strength"
- i. C531, "Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes"
- j. C579, "Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes"
- k. C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"
- l. C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"
- m. C882, "Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear"
- n. C939, "Standard Test Method for Flow of Grout for Preplaced – Aggregate Concrete (Flow Cone Method)"
- o. C942, Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory ""
- p. C1090, "Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic Cement Grout"

- q. C1107, "Standard Test Method for Packaged Dry, Hydraulic Cement Grout (Non-Shrink)"
 - r. C1437, "Standard Test Method for Flow of Hydraulic Cement Mortar"
 - s. E488, "Standard Test Method for Strength of Anchors in Concrete and Masonry Elements"
2. American Concrete Institute (ACI)
- a. "Guide to Hot Weather Concreting", ACI 305R.
 - b. "Guide to Cold Weather Concreting", ACI 305R.
 - c. "Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces", ACI 305R, as supplemented and modified herein.
3. CRD-C 621, Corps of Engineers Specification for Non-Shrink Grout

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2-year experience installing similar products.

1.6 DELIVERY HANDLING AND STORAGE

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Handle products in accordance with manufacturer's printed recommendations. Do not place grout when temperature or humidity will affect the performance or appearance of the grout.
- C. Store products in a dry area. Protect from direct sunlight.
- D. Do not place grout on dirty, wet, or frozen substrates.

PART 2 PRODUCTS

2.1 PREPACKAGED GROUTS

- A. High Strength Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents unless another type is specifically referenced.
 - 1. High Strength Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water.

Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each type of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

Early Height Change, ASTM C827	0.0 to +0.3%		
Hardened Height Change, ASTM C1090	+0.2 to +0.4%		
Effective Bearing Area	95%		
Compressive Strength, ASTM C942	Plastic	Flowable	Fluid
1 Day (min.)	1,000 psi	1,000 psi	1,000 psi
28 Days (min.)	5,000psi	5,000psi	5,000psi
Bond Strength, ASTM C882			
28 Days	2000psi		
Application Temperature	40°F to 90°F		
Material Temperature	40°F to 90°F		

B. Application

1. High Strength Non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under the exterior rim of the steel tank and all equipment base plates, and at all locations where grout is specified in the contract documents.

2.2 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where “dry pack” is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed four (4) inches.

2.3 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers approved by the ENGINEER. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 GROUTING PROCEDURES

Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

3.3 Installation

A. Examination

1. Examine substrates and conditions under which materials will be installed. Do not proceed with Installation until unsatisfactory conditions are corrected.
2. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas landscaping from contact due to mixing and handling of materials.

B. Surface Preparation

Comply with manufacturer's printed instructions and the following:

1. Mechanically remove all unsound concrete to the limits indicated on the drawings. Remove cement paste and laitance to expose sound aggregate.
2. Clean surface to receive grout of all materials including dust, oil, dirt, and grease or Efflorescence.
3. Dampen with clean water before patching and remove standing water.

C. Specialized Installation Requirements

1. Grout in Steel Bollards:
 - a. Fill steel bollards with non-metallic non shrink grout.
 - b. Smooth trowel grout to 1-inch-high convex curve at top of bollards.

2. Grout in Steel Door Frames: Install non-metallic non shrink grout between masonry rough opening and door frames in masonry walls, fully filling frames with grout.
- D. Formwork:
1. Comply with manufacturer's printed instructions and the following:
 - a. Forms must be watertight, strong, properly braced, and properly coated.
 - b. Allow a minimum clearance of 2 inches between forms and baseplate for grout entry.
 - c. Allow a minimum grout head of 6 inches.
 - d. Slope form on placing side to assist in grout movement and to prevent trapping air.
 - e. Allow 1-inch horizontal clearance and 1-inch vertical clearance for height above bottom of baseplate.
 - f. Provide venting of forms to avoid entrapment of air.
- E. Mixing Requirements:
1. Comply with manufacturer's printed instructions and the following:
 - a. Do not re-temper with additional water.
- F. Placement of Grout Materials:
1. Comply with manufacturer's printed instructions and the following:
 - a. The area to be grouted should be thoroughly flushed and soaked with clean water prior to grouting. Leave no standing water.
 - b. Place the grout quickly and continuously use light rodding or strapping to eliminate air bubbles.
 - c. Place grout mixture into prepared areas from one side or the other, rapidly and continuously, to reduce air entrapment. Avoid placing grout from opposite sides.
 - d. Grout temperature should be maintained from 50°F to 90°F to achieve specified results. Use cold water in hot weather or hot water in cold weather to achieve desired grout temperature. Do not use if temperature is expected to go below 32°F within a 12-hour period.

G. Curing Requirements:

1. Utilize a damp cure of at least 3 days is necessary to control the Non-Shrink characteristics and maintain strength levels.
2. Cover fresh grout and anchoring cement with plywood where exposed to construction traffic for 24 hours minimum.

H. Cleaning After Grout Placement

1. Remove excess material before material cures. If material has cured, remove using mechanical methods that will not damage substrate.

3.4 Completion

- A. Adjusting Defective Work: Replace or patch grout and anchoring cement as directed by OWNER/ENGINEER/ARCHITECT

END OF SECTION

SECTION 04 05 17 - MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SCOPE

- A. This Section includes all labor, materials and equipment required to complete masonry mortar and grout work required by the Contract Documents including, but not limited to, these major items:
 - 1. Installation
 - 2. Grouting.
 - 3. Placement of vertical and horizontal reinforcing.
 - 4. Cleaning of masonry.

- B. Section Includes:
 - 1. Masonry Grout.
 - 2. Mortar.
 - 3. Admixtures.
 - 4. Masonry cleaners.

- C. Related Sections:
 - 1. Section 03 30 00 – Cast-in-Place Concrete Work
 - 2. Section 03 21 00 – Reinforcing Steel
 - 3. Section 04 22 00 – Concrete Masonry Units

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 2. ASTM C204 - Standard Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus.
 - 3. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 4. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 5. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 6. ASTM C476 - Standard Specification for Grout for Masonry.

1.3 SUBMITTALS

- A. Masonry Grout design: Indicating type and proportions of the ingredients according to the proportion requirements herein and ASTM C 476.
 - 1. In lieu of Masonry Grout design, submit the mix designs and grout strength test performed in accordance with ASTM C 476.
- B. Mortar design: Indicating type and proportions of ingredients in compliance with the proportion specification herein and ASTM C 270.
 - 1. In lieu of mortar design, submit the mix design and mortar tests performed in accordance with the property specification of ASTM C 270.
- C. Color samples for OWNER selection of mortar color.
- D. Material certificates certifying each material is in compliance for all Mortar and Grout materials and admixtures.
- E. Construction procedures for Cold Weather Construction and/or Hot Weather Construction.
 - 1. Adhere to the procedures and general practices provided for cast-in-place concrete in Section 03 30 00 Cast-in-Place Concrete Work
- F. Masonry Cleaner: Product information

1.4 QUALITY ASSURANCE

- A. Testing Service -- The OWNER will engage an independent testing laboratory to perform material evaluation tests and to perform required Special Inspections.
- B. Materials and installed work may require testing and retesting, as directed by the OWNER or ENGINEER, at any time during the progress of the Work. Allow free access to material stockpiles and facilities at all times. All initial testing required by the Contract Documents shall be done at the OWNER's expense. Testing expenses for the retesting of rejected materials and installed work will be charged back to the CONTRACTOR.
- C. Minimum Testing Frequency:
 - 1. An independent testing agency or laboratory shall make test specimens of masonry grout and mortar on job site.
 - 2. One mortar test and one grout test shall be taken for each 5,000 square feet of wall area but at least one set of tests shall be taken.

3. The use of testing and inspection does not relieve the CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

D. Inspection Criteria:

1. Masonry construction shall be inspected and evaluated in accordance with the requirements of Chapter 17 of the Oregon Structural Specialty Code, per TMS 402/ACI 530/ASCE 5 Table 1.19.3 – Level C Quality Assurance and TMS 602/ACI 530.1/ASCE 6, Table 5 – Level C Quality Assurance requirements (ACI 530 Table 1.19.1, Table 1.19.2, & Table 1.19.3), unless otherwise indicated.
2. The Contract Documents shall dictate the required level of inspection per above reference or provide a project specific special inspection program.
3. If the Contract Drawings do not specify the level of required inspection, provide Level C Quality Assurance, or obtain written direction from the ENGINEER to the required level of inspection.

E. Environmental:

1. The cold weather construction provisions of ACI 530.1/ASCE6/TMS 602, Article 1.8 C shall be implemented when the ambient temperature falls below 40 degrees F or the temperature of the masonry units is below 40 degrees F.
2. The hot weather construction provisions of ACI 530.1/ASCE 6/TMS 602, Article 1.8 D shall be implemented when the ambient temperature exceeds 100 degrees F or when the temperature exceeds 90 degrees F and the wind velocity is greater than 8 mph.
3. No salt, anti-freeze chemicals or related materials permitted. Store masonry units and bagged materials off ground and protect from rain.
4. Do not build on work having film of water or frost on surfaces.
5. Protect work by covering in rainy weather; protect green masonry from freezing.
6. Before stopping work for day, cover tops of walls at new work with non-staining waterproof covering extended 2 feet minimum down both sides of wall and secured.

- F. Delivery, Storage and Handling – Deliver and store packaged materials in original, unopened containers and store in dry weathertight enclosures. Stockpile and handle aggregates to prevent segregation and contamination. Maintain sand for volume proportioning of mortar and grout in a damp loose condition.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C150.
- B. Fine and coarse aggregate: ASTM C404 for grout.
- C. Sand:
 - 1. Clean, sharp, well graded, and free from salt, loam, clay, and other foreign matter.
 - 2. Sand shall conform to ASTM C144 for mortar.
 - 3. Sand shall be graded as follows:

Sieve Size	Percent Passing
4	100
8	95 – 100
16	70 -100
30	40 – 75
50	15 – 35
100	2 – 15
200	0

- D. Lime: Hydrated type conforming to ASTM C207, Type S.
- E. Water: Clean, fit for drinking (potable), and free from strong acids, alkalis, oils, or organic material.
- F. Waterproofing admixture: Powder.
 - 1. Type: Grace Hydratite Plus, CemMaster Hydrolox 400, BASF Rheomix, BASF Rheopel or approved equal.
- G. Accelerator or retardant
 - 1. May be added when required by weather conditions.
 - 2. Type: Anti-Hydro, Grace Dehydratine 80 or Dehydratine 80M, BASF Pozzoloth, Sika Plastiment, Sonneborn Sonotard, Trimex, or approved equal.
- H. Intrusion (water-reducing) admixture for masonry grout.
 - 1. Type: BASF Pozzoloth, IntrusionAid or approved equal.

- I. Water-reducing admixture for mortar.
 - 1. Type: BASF Rheomix or approved equal.
- J. Mortar Color.
 - 1. Pure natural finely milled inert water insoluble non-bleeding and free of deleterious fillers or extenders.
 - 2. Color shall be as shown on the Drawings.
 - 3. Color shall be selected by OWNER from manufacturer's standard range of colors.

2.2 PROPORTION OF MIXES

- A. Mortar
 - 1. Conform to ASTM C270 and be of the type and color specified.
 - 2. Type S with minimum 28-day compressive strength of 2,000 psi minimum.
 - 3. Mixed by volume in ratio of 1-part Portland cement (6 sacks per cubic yard minimum), 1/4 to 1/2-part lime, 2-1/4 to three (3) parts (to cement-lime combined volume) sand.
 - 4. Pointing mortar shall be one part cement, 1/4 lime, three (3) parts sand by volume. Add one (1) pound of water-reducing admix for mortar per bag of cement and one pound per cubic foot of lime.
 - 5. Add waterproofing in amounts recommended by manufacturer, 0.2 pounds of waterproofing per 100 pounds of cement minimum.
 - 6. Do not use admixtures containing more than 0.2 percent chloride ions.
 - 7. Limit the maximum percentage of mineral oxide or carbon black job site pigments by weight of cement as follows: For pigmented Portland cement-lime mortar; 10 percent maximum mineral oxide pigment or 2 percent maximum carbon black pigment.
- B. Masonry grout
 - 1. Conform to ASTM C476.
 - 2. Minimum 28 days compressive strength greater than or equal to 2,500 psi, seven (7) sacks of cement minimum per cubic yard.

3. Waterproofing admix and intrusion admix in amounts recommended by manufacturer, 0.2 lb. of waterproofing per 100 pounds of cement minimum.
- C. Masonry grout for pouring:
1. Fluid consistency, seven (7) to eight (8) inches slump.
 2. Accurately mix by volume 1-part Portland cement: two (2) parts minimum to three (3) parts maximum of damp loose sand: two (2) parts maximum of 3/8-inch minus aggregate.
 3. For masonry grout spaces less than three (3) inches in any dimension, omit 3/8-inch minus aggregate.
- D. Masonry grout for pumping:
1. Without segregation of the constituent parts.
 2. Mixed to a consistency that has a slump between eight (8) to eleven (11) inches.
- E. Empty bags for waterproofing and intrusion admixes shall be retained for verification prior to their disposal. Use accelerator or retardant in strict accordance with manufacturer's printed instructions.

2.3 MASONRY CLEANER

- A. Sure Kleen #101 Lime Solvent or approved equal.

PART 3 EXECUTION

3.1 MIXING

- A. Masonry grout shall be plant batched.
- B. Mortar:
1. All tools and equipment used in mixing of mortar shall be clean and free of contaminants.
 2. Measure materials by volume or equivalent weight, not by shovel.
 3. Supply only as much water as necessary to obtain desired workability; required compressive strength must be met.
 4. Mix by placing 1/2 of the water and sand in the operating mixer. Then add the cement, lime and the remainder of the sand and water.

5. After all ingredients are in the batch mixer, they shall be mechanically mixed for not less than three (3) minutes.
6. Hand mixing shall not be employed.
7. Heat aggregates when air temperature is below 32 degrees F to maintain mortar at 70 to 120 degrees F until used.
8. Maintain workability of mortar by retempering.
 - a. Retemper by adding only as much water as required to maintain high plasticity.
 - b. Retempering shall only be done by adding water within a basin formed from mortar on a mortar board and working mortar into water.
 - c. Discard all mortar which has begun to stiffen, or which is unused after 2-1/2 hours from the initial mixing.

3.2 INSTALLATION

- A. See Section 04 22 00, Concrete Masonry Units.
- B. All masonry shall be laid true straight level, plumb and neatly in accordance with the drawings; lay out in advance so that no concrete unit less than eight (8) inches in length occur except where necessary as in reveals, etc.
- C. All units shall be saw cut accurately to fit all openings, and for electrical and plumbing work.
 1. No plumbing or electrical boxes or conduit shall be placed in any cell or course that contains reinforcing.
 2. All cutting shall be done with masonry saw and produce neat and true surface.
- D. All units shall be sound, dry, clean, and free from cracks and chips.
- E. No construction supports shall be attached to the wall except where specifically permitted by the ENGINEER.
- F. Units shall be "air" dry at time of laying.

3.3 REINFORCEMENT

- A. Refer to Section 03 21 00, Reinforcing Steel.

- B. The following minimum requirements shall be met unless shown otherwise:
1. Provide #5 verticals at two (2) feet maximum on center.
 2. Locate two #5 at each jamb of door, window, louver, and other openings and end of walls; run full height of wall. Reinforcement adjacent to openings need not be provided for openings smaller than 16-inches in either the horizontal or vertical direction, unless the spacing of distributed reinforcing is interrupted by such openings.
 3. Position one #5 vertical at each wall corner and each wall intersection; run full height of wall.
 4. Dowel verticals to foundation with one #5 dowel four (4) feet long minimum per vertical; embed dowel two (2) feet in foundation unless otherwise shown on drawings.
 5. Horizontal reinforcement, unless shown otherwise, shall be two #4 rebars in the bond beams which are located at two (2) feet maximum on center and at all floor and roof levels. Bend rebar at corners and intersections, or supply two (2) feet by two (2) feet rebar of same size and number as horizontal reinforcement. Horizontal reinforcement shall be anchored around vertical reinforcing bars with a standard hook at all wall ends, corners, and intersections that are not continuous around the corner or through the intersection. For openings, minimum lintel size and reinforcement shall be two (2) #4 rebars in bottom of 8-inch lintel for less than four (4) feet span, and two (2) #5 rebars in bottom of 16 inches lintel for four (4) feet to 10 feet span. Lintel reinforcement to extend two (2) feet beyond each side of jamb.
 6. Before placing reinforcement remove mud, oil, mills scale, loose rust, ice, and any other coatings from it. Position reinforcement accurately; center in cells unless noted otherwise. Secure against displacement, holding vertical reinforcement firmly in place by means of frames, rebar spacers, or other suitable devices, and place horizontal reinforcement as laying progresses. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 192 diameters of the reinforcement.
 7. Minimum clear distance between longitudinal bars shall be nominal diameter of bar or 1-inch, whichever is larger. Minimum thickness of mortar or grout between masonry and reinforcement shall be 1/4-inch for fine grout and 1/2-inch for coarse grout. Unless noted otherwise, reinforcing bars and dowels shall be lapped 40 bar diameters or 2-foot six (6) inches minimum, where spliced end shall be separated by 1 bar diameter or wired together.
 8. Splice reinforcement only at points shown on Drawings or reviewed shop drawings; any other locations must be specifically reviewed by ENGINEER.

- a. Splices in adjacent bars shall be staggered; in horizontal reinforcement of walls separate at least 10 feet longitudinally for bars of same tier.
 - b. Splices in reinforcement shall be made only at such points and in such a manner that the structural strength of the member will not be reduced.
 - c. Lapped splices shall provide sufficient lap to transfer the working stress of the reinforcement by bond and shear.
 - d. Minimum lap shall be 48 bar diameters, where spliced end shall be separated by 1 bar diameter or wired together.
 - e. Welded or mechanical connections shall develop the full yield strength of the reinforcement.
 - f. Bond beams shall be continuous around corners.
9. When a foundation dowel does not line up with a vertical core, it shall not be sloped more than one horizontal in six vertical. Dowel shall be grouted into a core in vertical alignment, even though it may be in cell adjacent to cell holding vertical wall reinforcing.
 10. Bond beam reinforcement shall be laid continuously on webs of bond beam units. Intersecting masonry walls shall be tied to one another by horizontal reinforcement, unless noted otherwise; where masonry walls intersect with concrete walls, connect with 1/2-inch diameter by 15-inch mechanical bolts in flush shells at bond beams.
 11. To allow bonding masonry, clean laitance from top of concrete foundation before proceeding. The stating joint on foundations or slabs shall be laid with full mortar coverage except at the area where grout occurs, which shall be kept free of mortar so that grout is in contact with the foundation slabs.
 12. Lay units in regular running bond except where soldier or other coursing is shown on drawings; maintain even module. Corners shall have same masonry bond by overlapping units. Joints shall be uniform throughout all work having same type of masonry units.
 13. At running bond, thread vertical reinforcing through alternately overlapping cells. Lay units according to "face and shell" method; provide full mortar coverage on all face shells, and on faces and webs surrounding vertical and horizontal cells to be filled with grout.
 14. Do not furrow bed joints. Shove tightly each new unit against existing unit so that mortar bonds well to both.

15. Rock closures into place. Do not pound corners and jambs to fit stretcher units after they are set in position. Remove all excess grout and mortar spilled on masonry units during construction.
16. Dry brush all masonry surfaces at end of each day's work. Stop off horizontal run of masonry by racking back one-half length of unit in each course at end of day's work. Tooling is not permitted. Where fresh masonry joins partially set masonry, remove loose units and mortar clean and then lightly wet exposed surface of set masonry before starting new work.
17. Joints of walls to be covered or furred may be left flush, without tooling. Joints of all walls which are to be exposed shall be tooled when "thumb right" (hard mortar is partially set but still sufficiently plastic to bond) with round jointer or bar to produce a dense, slightly concave surface, well bonded at edges. All tooling shall be done with a tool which compacts the excess mortar out of joint rather than dragging it out. Joints which are not tight at the time of tooling shall be raked out, pointed, then tooled. If it is necessary to move to a unit after it has been once set in place, the unit shall be removed from wall, cleaned, and set in fresh mortar. Remove any mortar fins from joint junctions.
18. Unless shown otherwise on drawings, provide 8-inch lintel for concrete masonry openings four (4) feet wide or less and 16-inch lintel for openings greater than four (4) feet wide. Forms and shores for lintels shall be substantial. Brace or tie forms to maintain position and shape. Forms shall be tight with no leakage of mortar or grout. Do not remove forms and shores until masonry has hardened sufficiently to carry its own weight and other temporary loads that may be placed on it during construction, 10 days minimum.

3.4 MASONRY GROUTING

- A. Masonry grouting shall be by low lift method.
 1. The repetitive construction procedure of erecting a masonry wall to a height not greater than four (5) feet, grouting the wall as required and then repeating this cycle until the top of the wall is reached shall be classified as low-lift grouting. Grout shall be placed while mortar joints are still soft and plastic or the grout spaces shall be cleaned of mortar droppings and protruding mortar joints shall be removed.
- B. Cells containing reinforcement or embedded items shall be solidly filled with grout. Before grouting starts, reinforcing steel shall be secured in a place and observed by ENGINEER and inspected by Building Inspector from governmental unit having authority.
- C. Vertical cells to be filled shall have vertical alignment to maintain continuous unobstructed cell area. To confine grout to horizontal masonry beams, the tops of

unfilled cell cavities or cores in masonry units under beams shall be covered with metal lath, or special bond beam or lintel units shall be used, or another method may be employed if approved by ENGINEER, building paper shall not be permitted.

- D. All bolts, anchors, etc., inserted in walls shall be fully and solidly grouted in place. Embedment shall not be less than 3/4 of the wall thickness, unless otherwise noted.
- E. Masonry shall cure at least 24 hours before grouting. Keep clean of mortar and drippings those cavities and cores which are to be grouted. Mortar projections and droppings shall be washed out of spaces and off reinforcing with a jet stream of water.
- F. Masonry grout shall be poured in lifts not exceeding five (5) feet. All masonry shall be laid using the Low-Lift grouting method with maximum grout pour heights not to exceed five (5) feet unless otherwise allowed in writing by the ENGINEER. In addition, grout pour heights shall not exceed the maximum grout pour height limits of Table 7 of TMS 602/ACI 530.1/ASCE 6, based upon the minimum grout space dimensions for grouting of cells of hollow units. Lay masonry until location of a bond beam or horizontal lintel beam is reached, but not to exceed the limits of Table 7 of TMS 602/ACI 530.1/ASCE 6, and then grout full the vertical cells required to be grouted and fill the beam or lintel without pause.
- G. To ensure complete filling of grout space, consolidate grout at time of pouring by puddling and then reconsolidate by later puddling before the plasticity is lost. Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
- H. Solid grout hollow metal door and window frames; for all wall openings over two (2) feet wide, solid grout from lintel to floor or roof above in one continuous operation.
- I. Place grout within 1 1/2 hour from introducing water in the mixture and prior to initial set.

3.5 MASONRY CLEANING

- A. All mortar and grout must be thoroughly set and cured before cleaning. Remove excess mortar or mortar stains or efflorescence; scraping devices shall be nonferrous. Protect all adjacent surfaces, including sash and other corrodible metalwork, from damage by cleaning solvent.
- B. Saturate all exposed masonry with water immediately before cleaning, apply solution of cleaner as per manufacturer's instructions and rinse thoroughly with fresh, clean water immediately after cleaning. Do small sections at a time, working from top to bottom. Repeat as necessary.

- C. Tuckpoint any loose or defective mortar joints. At conclusion of masonry work, remove scaffolding and equipment used in work and remove debris, refuse and surplus masonry material.

END OF SECTION

SECTION 04 22 00

CONCRETE MASONRY UNIT

PART 1 GENERAL

1.1 SCOPE

- A. Work included under this section shall include all materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to complete the work, including, but not limited to, these major items:
 - 1. Concrete masonry units.
 - 2. Vertical and horizontal reinforcing and dowels projecting into subsequently placed concrete.
 - 3. Setting of flashing and other work to be embedded in masonry.
- B. Related Sections:
 - 1. Section 03 21 00, Reinforcing Steel.
 - 2. Section 04 05 17, Masonry Mortar and Grout.

1.2 SUBMITTALS

- A. Samples -- Before any concrete unit masonry materials are delivered to the job site, submit one sample of each proposed concrete masonry unit.
- B. Submit color samples for OWNER selection of concrete masonry unit colors.
- C. Material Certificates -- Prior to delivery of concrete masonry materials, anchors, ties, fasteners, and metal accessories to the job site, deliver a letter from the manufacturer of the proposed masonry units, anchors, ties, fasteners, and metal accessories certifying that all such units to be delivered to the job site are in strict conformance with the provisions of this Section.
- D. Construction procedures for Cold Weather Construction and/or Hot Weather Construction for review and approval by OWNER in compliance with the requirements herein prior to use on the project.
- E. A letter of certification from the Supplier of the materials prior to delivery of the materials to the site to verify *f'm* according to the Chapter 17 of the International Building Code (IBC).

1.3 QUALITY ASSURANCE

A. Qualifications of Workers

1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
2. Provide one skilled journeyman mason who shall be present at all times during execution of this portion of the work and who shall personally direct all work performed under this Section.

B. Standards, Specifications and Codes

Comply with the applicable provision of the following codes, specifications and standards to the extent indicated by reference thereto:

1. American Concrete Institute (ACI)
2. American Society of Testing and Materials (ASTM)
3. National Concrete Masonry Association (NCMA)
4. Structural Clay Products Institute (SCPI)
5. American Society of Civil Engineers (ASCE)
6. The Masonry Society (TMS)
7. The International Building Code (IBC)

Comply with building code requirements which are more stringent than the above and all O.S.H.A. requirements.

C. Testing Service -- The OWNER will engage an independent testing laboratory to perform material evaluation tests and to perform required Special Inspections.

D. Materials and installed work may require testing and retesting, as directed by the OWNER or ENGINEER, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. All testing required by the contract documents shall be done at the OWNER's expense. Testing expenses for the retesting of rejected materials and installed work will be charged back to the CONTRACTOR.

E. Inspection Criteria:

1. Masonry construction shall be inspected and evaluated in accordance with the requirements of Chapter 17 of the Oregon Structural Specialty Code, per TMS 402/ACI 530/ASCE 5 Table 1.19.3 – Level C Quality Assurance and TMS 602/ACI 530.1/ASCE 6, Table 5 – Level C Quality Assurance requirements (ACI 530 Table 1.19.1, Table 1.19.2, & Table 1.19.3), unless otherwise indicated.

2. The Contract Documents shall dictate the required level of inspection per above reference or provide a project specific special inspection program.
 3. If the Contract Drawings do not specify the level of required inspection the CONTRACTOR shall provide C inspection or obtain written direction from the ENGINEER to the required level of inspection.
- F. Minimum Testing Frequency:
1. An independent testing agency or laboratory shall verify the compressive strength ($f'm$) of the proposed construction prior to construction and at regular intervals during construction as indicated in the Contract Documents, but at least one test for every 5,000 square feet during construction.
 2. The compressive strength ($f'm$) shall be determined for each wythe of multiwythe walls.
 3. Unless specifically directed within the Contract Documents, use the unit strength method specified by TMS 602/ACI 530.1/ASCE 6.
 4. The use of testing and inspection does not relieve the CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the

1.4 PRODUCT HANDLING

- A. Store materials under cover in a dry place and in a manner to prevent damage or intrusion of foreign matter. During freezing weather protect all masonry units with tarpaulins or other suitable material. Store masonry units under covers that will permit circulation of air and prevent excessive moisture absorption. Protect concrete masonry units from wetting.
- B. Handle unit on pallets or flatbed barrows.
- C. Replacements -- In the event of damage, immediately make all repairs and replacements necessary to the approval of the OWNER and at no additional cost to the OWNER.
- D. Reinforcing, metal ties, and anchors shall be protected from contact with soil and water and before being placed shall be free of loose rust and other coatings that will reduce or destroy bond.
- E. Environmental Conditions - Implement the following special construction procedures based on the environmental conditions encountered during masonry construction. Failure to maintain the conditions specified below during the construction of masonry work will be just and sufficient cause for such work to be rejected.

1. Cold Weather - The cold weather construction provisions of TMS 602/ACI 530.1/ASCE 6, Article 1.8 C shall be implemented when the ambient temperature falls below 40 degrees F or the temperature of the masonry units is below 40 degrees F. All masonry units and all work on which new masonry is constructed shall be free of frost, ice, snow, and surface moisture and their temperature shall not be lower than 40 degrees F. Protect green masonry from freezing. No salt, anti-freeze chemicals or related materials are permitted.
2. Hot Weather - The hot weather construction provisions of TMS 602/ACI 530.1/ASCE 6, Article 1.8 D shall be implemented when the ambient temperature exceeds 100 degrees F or when the temperature exceeds 90 degrees F and the wind velocity is greater than 8 mph.
3. Wet Weather - Store masonry units and bagged materials off ground and protected from rain. Do not build on work having a film of water on any surfaces. Protect work by covering in rainy weather. Before stopping work for the day, cover the tops of walls at new work with non-staining, waterproof covering extended 2 feet minimum down both sides of wall and secured in place.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Smooth face concrete block.
- B. Unit shall be in modular sizes. Exposed-to-view units in anyone building shall be of the same appearance. The texture of units shall match the approved samples for the types of construction and locations designated on the plans. Units shall not contain iron spots or other substances that will stain plaster or paint.
- C. Hollow load-bearing units shall conform to ASTM C90 type 1, Grade N.
- D. The composition shall be 50 percent lightweight (pumice) and 50 percent sand. The lightweight aggregate shall conform to ASTM C331 and the sand shall conform to ASTM C33.
- E. Minimum compressive strength of all blocks shall be 2,000 psi based on the net area.
- F. Maximum water absorption permitted for units at the time of delivery to the job site shall be 15 pounds per cubic foot (15 pcf) of concrete as an average of five units for normal weight aggregate per ASTM C140.
- G. Maximum moisture content permitted for standard weight aggregate units at time of delivery shall be 30 percent of total absorption. The tests for moisture content shall be determined from an average of five units per ASTM C140.

- H. Maximum linear shrinkage shall not exceed 0.035-inch/unit. Concrete masonry units shall include lintel, and bond beam units, and special shapes and sizes required to complete the work indicated.
- I. Certification required above shall show results of tests made not more than 12 months prior to delivery of concrete masonry units to the job site, shall show compliance with the specified values, and shall certify that the mix design, yield per batch, and curing procedures for the units delivered to the job site will be equal to those submitted for the test.
- J. Unit Colors. Pure natural finely milled inert water insoluble non-bleeding and free of deleterious fillers or extenders. Colors shall be as shown on the plans. Colors shall be selected by OWNER from manufacturer's standard range of colors.

2.2 MORTAR AND GROUT

Provide mortar and grout as indicated on the drawings in conformance with the requirements of Section 04 05 17, Masonry Mortar and Grout, of these specifications.

2.3 REINFORCEMENT STEEL

Provide reinforcement steel as indicated on the drawings and in conformance with the requirements of Division 3 of these specifications and of Section 04 05 17, Masonry Mortar and Grout.

2.4 OTHER MATERIALS

All other materials, not specifically described but required of a complete and proper installation of the work of this Section, shall be as selected by the CONTRACTOR subject to the approval of the OWNER.

PART 3 EXECUTION

3.1 INSPECTION

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 INSTALLATION

- A. Masonry shall be plumb, true to line, with level courses accurately spaced, and built to thickness and bond pattern indicated. Where no pattern is indicated, masonry shall be laid in running bond pattern. Concrete masonry units shall be dry when laid. Each unit shall be adjusted to final position in the wall while mortar is still soft and plastic. Any unit disturbed after mortar has stiffened shall be removed and re-laid with fresh mortar. Chases shall be built in and not cut in. Chases shall be plumb and shall be minimum one unit length from jambs of openings. Chases and raked-out joints shall be kept from mortar or debris. Spaces around metal door frames and other built-in items shall be solidly filled with mortar as each course is laid. Anchors, wall plugs, accessories, flashings, and other items to be built in shall be installed as the masonry work progresses. All cutting and fitting of masonry, including that required to accommodate the work of other sections shall be done by masonry saws.
- B. Where fresh masonry joins masonry that is partially set or totally set, clean the exposed surface of the set masonry, and remove all loose mortar. If it is necessary to “stop off” a horizontal run of masonry, this shall be done by raking back one-half brick or block length in each course. Tothing will not be permitted.
- C. Before closing up any pipe, duct or similar inaccessible spaces or shafts with masonry, remove all rubbish and sweep out the area to be enclosed.
- D. Provide level and solid bearing in masonry walls under all bearing structural floor and roof elements. Solid bearing shall be bond beams unless otherwise indicated.
- E. All masonry walls shall extend to underside of floor beams or roof metal decking unless otherwise indicated.
- F. If blowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt at no additional cost to the OWNER.
- G. Mortar Beds and Joints
 - 1. Hollow units shall be laid with full mortar coverage on horizontal and vertical face shells, except that webs shall be also be bedded in all courses of the starting course on footings and solid foundation walls, and where adjacent to cells or cavities to be reinforced and/or filled with grout or concrete.
 - 2. Horizontal and vertical face joints shall be 3/8-inch thick unless otherwise indicated. Vertical joints shall be shoved tight. Mortar joints in exposed or painted surfaces shall be tooled when thumbprint hard to a flush joint. Joints in unparged masonry below grade shall be pointed tight with a trowel. Mortar joints in surfaces to be plastered, stuccoed, or covered with other masonry shall be cut flush. Mortar

protrusions extending into cells or cavities to be reinforced and filled shall be removed.

H. Placing Reinforcement

1. Place reinforcing as covered in Section 04 05 17 – 3.3, Masonry Mortar and Grout, of these specifications.
 - a. Vertical reinforcement shall be rigidly secured at the top and bottom of CMU wall and at intervals necessary to hold the reinforcing in proper position.
 - b. Reinforcement shall be placed at the wall centerline unless indicated otherwise.

I. Low-Lift Grouting

1. Place reinforcing as covered in Section 04 05 17 – 3.4, Masonry Mortar and Grout, of these specifications.
 - a. Set steel lintels in beds of mortar. Fill spaces around jambs and head of metal door buck and frames solidly with mortar.

J. Pointing and Cleaning

1. At the completion of the work, all holes in joints of masonry surfaces to be exposed or pointed except weep holes shall be filled with mortar and suitably tooled, masonry walls shall be dry brushed at the end of each day's work and also final pointing, and shall be left clean and free from mortar spots and droppings. Any cracks in masonry shall be repaired. Defective joints shall be cut out and repointed.
2. Remove efflorescence, mortar spots and other areas that appear unclean with cleaning agent to a sample wall area as directed by the OWNER. The OWNER retains the right to change proposed cleaning methods and shall be notified before any additional cleaning agent is used. The cleaning methods agent shall be applied to a small section of the wall at a time and work shall proceed from the top to the bottom. Protect all metal sashes, lintel, louvers, and other corrodible parts when masonry is cleaned.

END OF SECTION

SECTION 042613 - MASONRY VENEER

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brick.
 - 2. Mortar materials.
 - 3. Ties and anchors.
 - 4. Embedded flashing.
 - 5. Accessories.
 - 6. Mortar mixes.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
- C. Samples for Verification: For each type and color of the following:
 - 1. Clay face brick, in the form of straps of five or more bricks.
 - 2. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

- B. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.
 - b. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
 - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
 - 3. Mortar admixtures.
 - 4. Anchors, ties, and metal accessories.
- C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

1.6

- A. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- B. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain exposed masonry units from single manufacturer.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

- B. Clay Face Brick: Facing brick complying with ASTM C216, Class H40V, Grade MW or SW, Type FBX or FBS.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Mutual Materials.
 - b. Willamette Greystone.
 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
 3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 4. Size (Actual Dimensions): 3-1/2 inches high by 11-1/2 inches long.
 5. Application: Use where brick is exposed unless otherwise indicated.
 6. Color and Texture: Basis of Design is Mutual Materials – Mountain Blend Smooth.

2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Masonry Cement: ASTM C91.
- C. Mortar Cement: ASTM C1329
- D. Aggregate for Mortar: ASTM C144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

F. Water: Potable.

2.5 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
 2. Stainless Steel Wire: ASTM A580/A580M, Type 304.
- C. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
 2. Fabricate wire ties from 0.187-inch diameter, hot-dip galvanized steel or stainless steel wire unless otherwise indicated.
 3. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
 4. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie.
 5. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie. Provide with seismic tie, clip, and continuous wire in veneer.
 6. Masonry-Veneer Anchors; Seismic-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting leg with slotted hole for vertical leg of seismic pintle tie. Tie is rib-stiffened, sheet metal bent plate with down-turned leg to fit in anchor slot and with integral tabs to hold continuous wire in veneer.

2.6 EMBEDDED FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees.
 4. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
 5. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
 6. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
- B. Drainage Plane Flashing: Fabricate from stainless steel and drainage membrane to shapes indicated. Provide flashing materials as follows:
1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- D. Termination Bars for Flexible Flashing: Stainless steel steel bars 0.075 inch by 1 inch.

2.7 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene PVC.
- B. Weep/Vent Products: Use one of the following unless otherwise indicated:
1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.
 2. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches long.

3. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
 4. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
 5. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches or dimpled surface that prevent clogging with mortar droppings.

2.8 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.
1. For masonry below grade or in contact with earth, use Type M.
- D. Pigmented Mortar: Use colored cement product.
1. Pigments do not exceed 10 percent of portland cement by weight.
 2. Mix to match Architect's sample.
 3. Application: Use pigmented mortar for exposed mortar joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
 - 1. Rake out mortar joints for pointing with sealant.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached and seismic anchors to CMU backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Embed tie sections in masonry joints.
 - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
 - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 EXPANSION JOINTS

- A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints as follows:
 - 1. Build in compressible joint fillers where indicated.
 - 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.8 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated
- B. Install flashing as follows unless otherwise indicated:
 - 1. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches.
 - 2. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/cavity vent products to form weep holes.
 - 2. Space weep holes 24 inches o.c. unless otherwise indicated.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

- B. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- C. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar compressive strength.

3.10 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.11 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. The extent of metal fabrications work is shown on the Drawings and includes items fabricated from iron, steel, stainless steel and aluminum shapes, plates, bars, sheets, strips, tubes, pipes, and castings which are not a part of structural steel or other metal systems in other sections of these specifications.
- B. Section Includes:
 - 1. Shop-fabricated metal items.
 - 2. Ladders.
 - 3. Window Security Grilles
 - 4. Anchor bolts.
 - 5. Stairs.
 - 6. Handrails and railings.
 - 7. Rough Hardware
 - 8. Miscellaneous fabrications, framing, and supports.

1.2 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete Work.
- B. Section 09 90 00, Painting and Coating.

1.3 REFERENCE STANDARDS

- A. Aluminum Association:
 - 1. AA DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American National Standards Institute:
1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements.
- D. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
 3. AWS D1.6 - Structural Welding Code - Stainless Steel.
- E. ASTM International:
1. ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 2. ASTM A36 - Standard Specification for Carbon Structural Steel.
 3. ASTM A47, grade as selected - Malleable Iron Castings.
 4. ASTM A48, Class 30 - Gray Iron Castings.
 5. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 6. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 9. ASTM A193 - Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications.
 10. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

11. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
12. ASTM A283, Grade C - Steel Plates to be Bent or Cold Formed.
13. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
14. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
15. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless-Steel Pipes.
16. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
17. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
18. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
19. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
20. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
21. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
22. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
23. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
24. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
25. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
26. ASTM A992 - Standard Specification for Structural Steel Shapes.
27. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings.
28. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings.

29. ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
 30. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 31. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
 32. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
 33. ASTM B 308, Alloy 6061-T6, Anodic Coating Class I, AA-C22-A41, anodized after fabrication - Structural Aluminum Shapes and Plates.
 34. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 35. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 36. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 37. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
 38. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
 39. ASTM F436 - Standard Specification for Hardened Steel Washers.
 40. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
 41. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
- F. Builders Hardware Manufacturers Association (BHMA):
1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps.
- G. National Ornamental & Miscellaneous Metals Association:
1. NOMMA Guideline 1 - Joint Finishes.

- H. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
 - 3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
 - 4. SSPC SP 1 - Solvent Cleaning.
 - 5. SSPC SP-7 Brush-off Blast Cleaning.
 - 6. SSPC SP 10 - Near-White Blast Cleaning.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Data: For information only, submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in miscellaneous metal work, including paint products.
- C. Shop Drawings:
 - 1. General: Submit copies of shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the manufacturer's data sheets.
 - a. Include plans, elevations and details of sections and connections and fabricators proposed shop coat paint or galvanizing specifications.
 - b. Show anchorage and accessory items.
 - c. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.
 - d. Indicate welded connections using standard AWS A2.4 welding symbols.
 - e. Indicate net weld lengths.
 - 2. Stairs, Handrails and Railings:
 - a. Indicate profiles, sizes, and accessories.
 - b. Clearly identify connection on Shop Drawings with complete details to the extent that all connections can be made without further reference to the Contract Documents.

- c. Include information indicating weld type, joint preparation information such as degree of bevel, weld length, etc. Indicated root openings, back-ups, filler, runout tabs, etc.
 - d. Indicate changes from the Contract Documents on the Shop Drawings. Structural calculations for any proposed changes or alterations to the configuration shown in the drawings. Calculations shall be Stamped by a Structural Engineer licensed in the State of Oregon.
 - 3. Gratings:
 - a. Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances.
- D. Samples:
 - 1. Submit two sets of representative samples of materials, illustrating factory finishes as may be requested by the Engineer.
 - 2. Engineer's review will be for color, texture, style and finish only.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transporting, handling, storing, and protecting products shall be in accordance with manufacturer's requirements.
- B. Inspection: Accept metal fabrications on-site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to preparation of Shop Drawings and fabrication. Indicate field measurements on Shop Drawings.
 - 1. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication.

PART 2 PRODUCTS

2.1 GENERAL

- A. For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness and defects which impair strength, durability, and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes including zinc coatings.

2.2 LOOSE STEEL LINTELS

- A. Description:
 - 1. Steel sections.
 - 2. Size and Configuration:
 - a. As indicated on Drawings.
 - b. Length to allow 8-inch minimum bearing on both sides of opening.
 - 3. Exterior Location Shop Finish: Galvanized or Prime paint, one coat.
 - 4. Interior Location Shop Finish: Prime paint, one coat.

2.3 WINDOW SECURITY GRILLES

- A. Description:
 - 1. Construction: Welded steel; conform to shape of window.
 - 2. Verticals: 1/2-inch diameter solid bar; 4 inches o.c.
 - 3. Top and Bottom Rail: 1/4-by-1-1/2-inch flat bar; 6 inches from top and bottom.
 - 4. Hinges: Two for each grille; mounted for side swing.
 - 5. Padlock Hasp: Side opposite hinges for securing gates in closed position.
 - 6. Anchors:
 - a. Fabricate as required for attachment to existing window jambs within window opening.
 - b. Attachment to exterior building façade; overlapping window opening is not permitted.

7. Shop Finish: Galvanized.

2.4 FABRICATED ARCHITECTURAL TRIM

- A. Description: Steel sections, size and configuration as indicated on Drawings.
- B. Shop Finish for Exterior Locations: Galvanized.

2.5 ANCHOR BOLTS

- A. All anchors shall be epoxy anchors or expansion anchors as shown in the Drawings.
- B. Materials:
 - 1. As shown in the Drawings.
 - 2. For direct bury:
 - a. Malleable iron complying with ASTM A47.
 - b. Cast steel complying with ASTM A27.
 - c. Iron and steel galvanized in compliance with ASTM A153.
 - 3. For wetted atmospheric conditions
 - a. Type 316 stainless steel.
 - 4. Threaded rod, nuts, bolts, and washers:
 - a. Material matching anchor insert type.
- C. Types:
 - 1. Threaded-type Concrete Inserts:
 - a. Internally threaded to receive machine bolts.
 - b. Malleable iron, ASTM A47.
 - c. Cast steel, ASTM A27.
 - d. Stainless steel, type 304, ASTM A320.
 - 2. Wedge-type Concrete Inserts:
 - a. Box-type ferrous castings designed to accept bolts having special wedge-shaped heads.
 - 3. Slotted-type Concrete Inserts:
 - a. Box-type welded construction with slot designed to receive square head bolt and with knockout cover.

D. Manufacturers:

1. Hilti, Inc.
2. Simpson Strong-Tie Co., Inc.
3. DeWalt, Inc.
4. Proprietary products as named in the Drawings.

2.6 HANDRAILS AND GUARDRAILS

A. Railing assembly and attachments to resist lateral force of 200 lb. at any point without damage or permanent set. Test according to ASTM E935.

B. Construction:

1. Include guardrails, handrails, midrails and toe plates in accordance with OSHA/WAC requirements.
 - a. Guard Height: 3 foot 6-inch high.
 - b. Handrail Height: Min. 2 foot 6-inch to Max 3 foot 2-inch.
2. Outside diameter:
 - a. 2-inch for components (based on 1-1/2-inch Schedule 40 pipe).
3. Top corners of handrail are to be bent to the smallest radius possible without causing grain separation or otherwise impairing the work.
4. Radius Sections -- Roll to radii shown on Drawings.
5. Vertical segments of handrail are to be set plumb and mount as shown on Drawings or as otherwise specified.
6. Spacing between vertical segments will be according to Drawings.

C. Welded Connections:

1. Cope intersections of rails and posts, weld joints of tailings or use welding connectors, at fabricator's option.
 - a. Other methods of welding may be used when acceptable to the Engineer.
2. Weld corners and seams continuously and in accordance with the recommendations of AWS.
3. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.
4. Discoloration of finished surfaces and sharp edges will not be acceptable.

D. Materials: As shown on the Drawings.

2.7 GRATINGS

A. Meet all applicable codes and Occupational Safety and Health Administration (OSHA) requirements.

B. Grating used inside the reservoir must meet NSF-61 certification for use of products in potable water systems.

C. Minimum Design Live (Pedestrian) Load: Fabricate stair assembly to support uniform live load of 250 lb./sq. ft. and moving concentrated load of 500 pounds with deflection of stringer or landing framing not to exceed 1/360 of span.

D. Layout:

1. Provide removable grating sections with end-banding bars for each panel.
2. Exposed connections shall fit accurately together to form tight hairline joints.
3. Install all gratings with bearing bars spanning the shortest dimension unless shown otherwise on the plans.
4. Provide welded positioning tabs in support angles at each grating section to prevent lateral movement of grating sections.
5. Layout units to allow grating removal without disturbing items penetrating grating.

E. Penetrations:

1. Provide for notched gratings and banding for penetrations as indicated.
2. Provide banding for openings in grating of same material and size as bearing bars unless otherwise indicated.
3. Wherever bar gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar of same material and size as bearing bars to the cut ends of the bars.
4. Divide panels into sections only to the extent required for installation wherever bar grating platforms, runways, etc., are to be placed around previously installed pipes, ducts, and structural members.

F. Materials: As shown on the Drawings.

1. For exterior stairs McNichols as manufactured by McNichols Co., Inc., or approved equal are acceptable materials.

2. For interior stairs: Duragrate, as manufactured by Strongwell Corporation, or approved equal, are acceptable materials. Molded Fiberglass Grating shall meet NSF-61 certifications.

2.8 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting systems. Acceptable manufacturers are Simpson or approved equal.
- B. Manufacture or fabricate items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish galvanized steel washers.

2.9 MISCELLANEOUS FABRICATIONS, FRAMING AND SUPPORTS

- A. Provide miscellaneous steel framing and supports required to complete the Work.
- B. Fabricate miscellaneous units to the sizes, shapes and profiles shown in the Drawings or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing.
- C. Except as otherwise shown, fabricate from structural steel shapes and plate and steel bars, all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection.
- D. Cut, drill, and tap units to receive hardware and similar items to be anchored to the work.
- E. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed.
- F. Galvanize all miscellaneous fabrications unless otherwise noted.

2.10 NON-SHRINK GROUT

- A. Where required for anchoring, patching, or sealing, grouting, and sealing compounds shall conform to the requirements of Section 03 60 00, Grouting.

2.11 MATERIALS

- A. Materials listed below shall be provided unless otherwise noted in the Drawings or other sections of these specification.

B. Steel:

1. Structural W Shapes: ASTM A992.
2. Structural Shapes: ASTM A36.
3. Channels and Angles: ASTM A36.
4. Steel Plate: ASTM A36.
 - a. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C.
5. Hollow Structural Sections: ASTM A500, Grade B.
6. Structural Pipe: ASTM A53, Grade B, Schedule 40 unless shown otherwise in Drawings.
7. Bar: ASTM A36 .
 - a. Cold-Finished Steel Bar: ASTM A108, grade as selected by fabricator.
8. Sheet Steel: ASTM A653, Grade 33 Structural Quality.
9. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
10. Standard Bolts: ASTM A307; Grade A.
 - a. Washers: ASTM F844.
11. High Strength Bolts: ASTM F3125, Grade A325.
 - a. Washers: ASTM F436; Type 1.
12. Nuts: ASTM A563; heavy-hex type.
13. Welding Materials: AWS D1.1; type required for materials being welded.

C. Stainless Steel:

1. Bars and Shapes: ASTM A276; Type 316.
2. Tubing: ASTM A269; Type 316.
3. Pipe: ASTM A312, seamless; Type 316.
4. Plate, Sheet, and Strip: ASTM A666; Type 316.
5. Bolts, Nuts, and Washers: ASTM A354; Type 316.
6. Welding Materials: AWS D1.6; type required for materials being welded.

D. Aluminum:

1. Structural Aluminum Shapes and Plates: ASTM B308, Alloy 6061, Temper T66, Anodic Coating Class I, anodized after fabrication.
2. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6.
3. Aluminum-Alloy Bars: ASTM B211 Alloy 6063, Temper T6.
4. Bolts, Nuts, and Washers: Stainless steel or Steel, galvanized.
5. Welding Materials: AWS D1.1; type required for materials being welded.

E. Bolts, Nuts, and Washers for Equipment and Piping:

1. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items.
2. Carbon Steel:
 - a. General: Zinc-coated, ASTM A153.
 - b. Structural Connections: ASTM A307, Grade 2 (60 ksi), hot dip galvanized.
 - c. Anchor Bolts: ASTM A307, Grade 2 (60 ksi), hot dip galvanized.
 - d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7.
 - e. High Strength Bolts: ASTM F3125, Heavy Hex Head.
3. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts.
 - a. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts.

2.12 FABRICATION

A. Workmanship:

1. Use materials of the size and thicknesses shown in the Drawings or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the Engineer.
2. Work to the dimensions shown in the Drawings or accepted on Shop Drawings, using proven details of fabrication and support.
3. Use the type of materials shown in the Drawings or specified for the various components of work.

4. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 5. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise shown in the Drawings.
 6. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.
- B. Fit and shop-assemble items in largest practical sections for delivery to Site.
- C. Fabricate items with joints tightly fitted and secured.
- D. Continuously seal join members by means of continuous welds in accordance with the recommendations of AWS, unless otherwise noted or approved.
- E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- H. Loose Bearing and Leveling Plates:
1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.
 2. Drill plates to receive anchor bolts and for grouting as required.
 3. Galvanize after fabrication.
- I. Miscellaneous Steel Trim:
1. Provide shapes and sizes for profiles shown in the Drawings.
 2. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.
 3. Use concealed field splices wherever possible.

4. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.
- J. Fabrication Tolerances:
1. Squareness: 1/8-inch maximum difference in diagonal measurements.
 2. Maximum Offset between Faces: 1/16-inch.
 3. Maximum Misalignment of Adjacent Members: 1/16-inch.
 4. Maximum Bow: 1/8-inch in 48 inches.
 5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

2.13 FINISHES

- A. Steel:
1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
 2. Do not prime surfaces in direct contact with concrete or where field welding is required.
 3. Prime-paint items with one coat, except where galvanizing is specified.
 4. Coatings as specified per Section 09 90 00, Painting and Coating.
 - a. Primer paint selected must be compatible with the required finish coats of paint.
 - b. At locations in contact with potable water, use only primer approved for potable water use.
 5. Galvanizing for Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; hot dip galvanize after fabrication.
 6. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153.
 - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
 7. Chrome Plating: ASTM B177, nickel-chromium alloy, satin finish.
 8. Sheet Steel: Galvanized.
 9. Bolts: Hot dip galvanized.
 10. Nuts: Hot dip galvanized.
 11. Washers: Hot dip galvanized.

12. Touchup Primer for Galvanized Surfaces: ASTM A780 (A780M), A1. Repair Using Zinc-Based Alloys (Heat and Stick Method).

B. Stainless Steel:

1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.
2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

C. Aluminum:

1. Protection of All Aluminum:

- a. Aluminum surfaces in contact with cementitious, masonry or dissimilar materials, apply the following coating system:
 - 1) One (1) coat of epoxy primer, 1 to 2 mils dry film (D.F.).
 - 2) Followed by two (2) coats of Bitumastic, 6 to 8 mils D.F.
 - 3) Followed by two (2) coats of tarset material, 6 to 8 mils D.F.

D. Shop Painting

1. Shop painting of metal fabrications shall be allowed only at the sole discretion of the Engineer.
2. Shop paint miscellaneous metal work in accordance with Section 09 90 00, Painting and Coating, with the following exceptions:
 - a. Those members or portions of members to be embedded in concrete or masonry.
 - b. Surfaces and edges to be field welded.
 - c. Galvanized surfaces.
3. Remove scale, rust, and other deleterious materials before the shop coat of paint is applied.
 - a. Clean off heavy rust and loose mill scale in accordance with SSPC SP-7, Brush-off Blast Cleaning.
 - b. Remove oil, grease and similar contaminates in accordance with SSPC SP-1, Solvent Cleaning.

4. Immediately following surface preparation, brush, or spray on metal primer paint, applied in accordance with the manufacturer's instructions or as specified below.
 5. Apply one (1) shop coat of metal primer paint to fabricated metal items, except apply two (2) coats of paint to surfaces which will be inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.
- E. Touch-up Painting, Pre-painted Items:
1. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting.
 2. Apply touch-up coatings by brush or spray to provide a minimum dry film thickness of the original coating thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where Site welding is required.
- B. Furnish setting drawings, diagrams, templates, instructions, and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections. Coordinate delivery of such items to the project Site.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
- D. Fit exposed connections accurately together to form tight hairline joints.

- E. Grind joints smooth and touch-up shop paint coat.
- F. Do not weld, cut, or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication and are intended for bolted or screwed field connections.
- G. Field-weld components indicated on Drawings and Shop Drawings.
- H. Perform field welding according to AWS D1.1 with regards to procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.
- I. Obtain approval of Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

- A. Maximum Variation from Plumb: 1/4-inch per story or for every 12 feet in height, whichever is greater, non-cumulative.
- B. Maximum Variation from Level: 1/16-inch in 3 feet and 1/4-inch in 10 feet.
- C. Maximum Offset from Alignment: 1/4-inch.
- D. Maximum Out-of-Position: 1/4-inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds according to AWS D1.1.
- B. Replace damaged or improperly functioning hardware.
- C. After erection, touch up welds, abrasions, and damaged finishes with prime paint to match shop finishes.
 - 1. For galvanizing repair, repair any damaged areas by heat and stick method as may be required.
- D. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

- A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

SECTION 06 05 23 - WOOD, PLASTIC, AND COMPOSITE FASTENINGS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for fasteners and adhesives used in the construction of the wood, plastic, and composite elements of the project.
- B. Section includes:
 - 1. Rough carpentry hardware.
 - 2. Nails.
 - 3. Bolts and screws.
 - 4. Framing anchors.
 - 5. Joist, rafter, and beam hangers.
 - 6. Adhesives.

1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.
- B. Section 06 17 53 - Shop-Fabricated Wood Trusses.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's data on all materials.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's handling, delivery, storage, and installation requirements.

PART 2 PRODUCTS

2.1 ROUGH CARPENTRY HARDWARE

Rough carpentry hardware used in CMU buildings shall conform to the latest provisions of the Oregon State Structural Specialty Code, the International Building Code (IBC), and to any local codes and ordinances.

2.2 NAILS

- A. Steel Common Nails: For framing, appropriately sized for the materials being joined.
- B. Hot-Dipped Galvanized Nails: Wherever exposed.

- C. Stainless Steel Nails: At locations where stainless-steel hardware is specified. Do not mix dissimilar materials without approval of the ENGINEER.
- D. Treated Wood: Hot-dipped galvanized or stainless-steel nails are required at all locations where they are in contact with treated wood.
- E. The number and size of nails connecting wood members shall be per the Contract Documents but shall not be less than that set forth in Table 2304.9.1 of the IBC for any members.

2.3 BOLTS AND SCREWS

- A. Conforming to ASTM A307, Grade A, appropriately sized for the materials being joined.
- B. Use galvanized bolts and screws where exposed or in contact with treated wood or embedded into concrete.

2.4 FRAMING ANCHORS & JOIST, RAFTER AND BEAM HANGERS

- A. Use galvanized, minimum 18-gauge steel of the size and type required for the materials connected.
- B. Post hot-dip galvanize all connection hardware in contact with pressure treated wood, or use stainless steel connectors.
- C. Manufacturers:
 - 1. Simpson "Strong-Tie".
 - 2. Teco "MiTek".
 - 3. Approved equal.

2.5 ADHESIVES

Use gun grade adhesive suitable for bonding various metals and non-metallic materials such as wood, plastic, and glass without primer.

PART 3 EXECUTION

3.1 GENERAL

- A. Use only skilled workers and the highest standards of the craft.
- B. Lay out, cut, fit, and install all rough carpentry items.
- C. Anchor sufficiently to ensure rigidity and permanence as noted on the Drawings.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish materials, labor, equipment, and services necessary to provide rough framing as shown on the Drawings and as specified herein.
- B. Section includes:
 - 1. Lumber.
 - 2. Plywood.
 - 3. Building Paper

1.2 RELATED SECTIONS

- A. Section 06 05 23 - Wood, Plastic, and Composite Fastenings.
- B. Section 06 17 53 - Shop-Fabricated Wood Trusses.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Submit a complete list of products, product information, type, and grade for prior to beginning building construction.

1.4 QUALITY ASSURANCE

- A. All work specified herein shall conform to the latest provisions of the International Building Code (IBC), IBC-508, and the local Codes and Ordinances of all Governmental agencies having jurisdiction over the Project.
- B. Where special inspection of wood structural elements is required in the Contract Documents, an independent testing agency or laboratory shall perform special inspection of the elements indicated in the Contract Documents. The OWNER or an agent of the OWNER will engage a testing laboratory acceptable to the ENGINEER to perform the required Special Inspections and/or Material Tests.
- C. Materials and installed work may require testing and retesting, as directed by the ENGINEER, at any time during the progress of the work.
 - 1. Allow free access to material stockpiles and facilities at all times.
 - 2. All testing required by the contract documents shall be done at the OWNER'S expense.

3. Testing expenses for the retesting of rejected materials and installed work will be charged back to the CONTRACTOR.

1.5 DELIVERY, HANDLING AND STORAGE

- A. Immediately upon delivery to Site, place materials in an area protected from weather.
- B. Store materials a minimum of six (6) inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.
- C. Do not store seasoned materials in wet or damp portions of building.
- D. Protect sheet materials from breaking corners and damaging surfaces while unloading.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Lumber grading rules and wood species shall be in conformance with the latest edition of U.S. Department of Commerce, National Institute of Standards and Technology, Product Standard DOC PS 20 and the National Forest Products Association.
- B. Wood members shall conform to the requirements above and provide design values equal to those published in the "Design Values for Wood Construction," a supplement to the 2015 edition of the National Design Specification for Wood Construction, published by the National Forests Products Association.
- C. Plywood grading rules shall be in conformance with the latest edition of U.S. Product Standards PS 1 and PS 2, and be Engineered Wood Association (APA) rated Exposure 1.
- D. Lap siding, soffit panels and trim shall be as specified in Section 07 46 46, Fiber Cement Siding of these Specifications.

2.2 GRADE MARKS

- A. Each piece of lumber shall be stamped or branded with the grade as determined by an approved grading association indicating conformance with the latest edition of U.S. Product Standard DOC PS 20.
- B. Each panel of plywood shall be identified with the appropriate grade trademark of the American Plywood Association.
- C. Moisture content shall not exceed 19 percent, unless otherwise specified.

2.3 LUMBER

- A. Dimensions given are nominal. Surface four sides (S4S), unless specified otherwise.
- B. Unless otherwise noted, lumber shall be as follows:

Use	Minimum Grade
General framing, studs, plates, blocking, furring, braces and nailers	Douglas Fir-Larch No. 2
Structural light framing, two (2) inches to four (4) inches thick, two (2) inches to six (6) inches wide	Douglas Fir-Larch No. 2
Structural joists, rafters, and planks, two (2) inches to four (4) inches thick, five (5) inches and wider and headers	Douglas Fir-Larch No. 2
Beams, stringers, posts, timber	Douglas Fir-Larch No. 1
Fascia Board	Fiber cement board manufactured by James Hardie or approved equal
Sills and Plates	Douglas Fir-Larch No. 2, Treated in accordance with IBC 2303.1.9

2.4 PLYWOOD

- A. Roof Sheathing:
 - 1. Conform to APA-rated sheathing and shall be identified with the appropriate trademark.
 - 2. Minimum sheathing shall be Exposure 1, 15/32-inch or greater, grade CDX. Span rated 32/16 per APA.
- B. MDO -- APA rated Medium Density Overlay exterior glue.

2.5 BUILDING PAPER

- A. Asphalt-saturated felt conforming to ASTM D 226 or D 250, Type I, plain non-perforated.

PART 3 EXECUTION

3.1 GENERAL

- A. Use only skilled workers and the highest standards of the craft.
- B. Plan work in advance and perform in proper sequence to facilitate prompt and continuous progress of the work.

- C. Lay out, cut, fit, and install all rough carpentry items.
- D. Anchor sufficiently to ensure rigidity and permanence and as noted on Drawings.
- E. Provide for installation and support of other work.

3.2 CONDITIONS OF SURFACES

- A. Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

3.3 INSTALLATION

A. Plates

1. Set level and flush with outside face of concrete or masonry unit walls or as shown on the Drawings.
2. Anchor into concrete or masonry unit walls with specified anchors.
3. Location and spacing of plate anchorages shall be as shown or if not shown in conformance with current local building codes.

B. Stud Framing

1. Plates and Stud Members

- a. Unless shown otherwise in the Drawings, provide pressure treated double top plates, 1-1/2 inches thick by 7-1/4 inches wide (2 x 8). Provide double top plates for the tops of the wood framed interior partition wall, 1-1/2 inches thick by 5-1/2 inches wide (2 x 6). Splice top plates at corners and intersections with an appropriate framing anchor as specified in Section 06 05 23. Stagger top plate laps by a minimum of 4 feet.
- b. Provide studs in continuous lengths without splice.
- c. End nail studs to bottom plate and end nail to lower top plate where required.
- d. Facenail upper top plate to lower top plate.
- e. Anchor plates to concrete or CMU walls as shown on Drawings.

2. Blocking

- a. Install continuous, staggered horizontal row where shown on Drawings or required by code.

- b. Locate blocking to facilitate installation of finishing materials, fixtures, specialty items, hardware, and trim.
- C. Engineered Trusses: See Drawings for requirements and Section 06 17 53, Shop-Fabricated Wood Trusses.
- D. Roof Sheathing
 - 1. Install plywood with face grain perpendicular to supports, using panel with continuous end joints over two or more spans staggered between panels and locate over supports.
 - 2. Allow minimum space 1/16-inch (1.6 mm) between end joints and 1/8-inch at edge joints for expansion and contraction of panels.
 - 3. Support edge joints by use of ply clips or lumber blocking, unless noted otherwise on Drawings.
- E. Ceiling Plywood
 - 1. Install ceiling plywood where shown on Drawings with joints transverse to the members they attach to.
 - 2. Attach plywood sheets to wood framing using finish nails.
 - 3. Countersink nails.
 - 4. Spackle and sand joints, knot holes, and nail holes as required to provide a smooth uniform surface prior to application of paint coating system as specified in Section 09 90 00, Painting and Coating.
- F. Lap Siding: Install horizontal lap siding as required by manufacturer recommendations.
- G. Fastener Requirements:
 - 1. Connections for wood members shall be in accordance with the Contract Drawings and Section 06 05 23, Wood, Plastic, and Composite Fastenings.
 - 2. The number and size of nails connecting wood members shall not be less than that set forth in Table 2304.10.1 of the IBC.

END OF SECTION

SECTION 06 10 63 - EXTERIOR ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood blocking
 - 2. Soffit and Fascia framing
 - 3. Wood Eave Braces

1.3 DEFINITIONS

- A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater in width.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.
- B. Evaluation Reports: For preservative-treated wood products, from ICC-ES.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 LUMBER, GENERAL

- A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
 - 1. Factory mark each item with grade stamp of grading agency.
- B. Maximum Moisture Content:
 - 1. Boards: 15 percent.
 - 2. Dimension Lumber: 15 percent 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness.

2.2 LUMBER

- A. Dimension Lumber: No. 1 grade and any of the following species:
 - 1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
 - 2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
 - 3. Western Red Cedar; Structural Select #1

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Use fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 unless otherwise indicated.
 - 2. For pressure-preservative-treated wood, use stainless steel fasteners.
- B. Nails: ASTM F1667.
- C. Power-Driven Fasteners: ICC-ES AC70.
- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

- E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Post-installed Anchors: Stainless steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488, conducted by a qualified independent testing and inspecting agency.
 - 1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.
- C. Install metal framing anchors to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1) **ICC-ES AC70 for power-driven fasteners.**
- H. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

END OF SECTION

SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for design, manufacture, and supply of wood trusses as shown on the Drawings and as specified.
- B. Section includes:
 - 1. Design and performance criteria.
 - 2. Lumber.
 - 3. Metal connecting hardware.
 - 4. Manufacturing requirements.

1.2 RELATED SECTIONS

- A. Section 06 05 23 - Wood, Plastic, and Composite Fasteners.
- B. Section 06 10 00 - Rough Carpentry.

1.3 DEFINITIONS

- A. BCSI: Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses jointly produced by the Structural Building Components Association and the Truss Plate Institute.
- B. Contractor: The person who contracts with the OWNER, who constructs the Building in accordance with the Construction Documents and the Truss Submittal Package. The term "CONTRACTOR" shall include those subcontractors who have a direct contract with the CONTRACTOR to construct all or a portion of the construction.
- C. Cover/Truss Index Sheet: Sheet that is signed and sealed by an Oregon licensed Professional Engineer, by the Truss Design Engineer, and shall contain the following information: (1) identification of the Building, including Building name and address, lot, block, subdivision, and city or county; (2) identification of Construction Documents by drawing number(s) with revision date; (3) specified Building Code; (4) computer program used; (5) roof dead and live loads; (6) floor dead and live loads; (7) wind load criteria from a specifically defined code (e.g., ASCE 7) and any other design loads (such as ponding, mechanical loads, etc.); ; (8) a listing of the individual identification numbers and dates of each Truss Design Drawing referenced by the Cover/Truss Index Sheet; and (9) name, address, date of drawing and license number of Truss Design Engineer.

- D. Framing Structural System: Completed combination of Structural Elements, Trusses, connections, and other systems, which serve to support the Building's self-weight and the specified loads.
- E. Truss: Individual metal-plate-connected wood component manufactured for the construction of a Building.
- F. Truss Design Drawing: Written, graphic and pictorial depiction of an individual Truss that includes the information required in the Standard.
- G. Truss Design Engineer: Person who is licensed to practice engineering as defined by the Legal Requirements of the Jurisdiction in which the Building is to be constructed and who supervises the preparation of the Truss Design Drawings.
- H. Truss Designer: Person responsible for the preparation of the Truss Design Drawings.
- I. Truss Manufacturer: Person engaged in the fabrication of Trusses.
- J. Truss Placement Diagram: Illustration identifying the assumed location of each Truss.
- K. Truss Submittal Package: Package consisting of each individual Truss Design Drawing, and, as applicable, the Truss Placement Diagram, the Cover/Truss Index Sheet, Lateral Restraint and Diagonal Bracing details designed in accordance with generally accepted engineering practice, applicable BCSI defined lateral restraint and diagonal bracing details, and any other structural details germane to the Trusses.

1.4 DESIGN

- A. Trusses shall be designed in accordance with the Standard and, where any applicable design feature is not specifically covered herein, design shall be in accordance with the applicable provisions of the latest edition of the American Forest & Paper Association's (AF&PA's) National Design Specification® (NDS®) for Wood Construction and all applicable Legal Requirements.
- B. Truss Manufacturer shall furnish Truss Design Drawings and Calculations prepared in accordance with all applicable Legal Requirements and signed and stamped by an Oregon licensed Professional Engineer.
- C. The Truss Manufacturer shall furnish a Truss Placement Diagram, which shall provide, at a minimum, the location assumed for each Truss based on the Truss Manufacturer's interpretation of the Construction Documents.
- D. The Truss Manufacturer shall submit the Truss Submittal Package to the OWNER and ENGINEER for review and approval prior to the manufacturing of the Trusses.

- E. The Truss Design Drawings shall include, at a minimum, the information specified below (per the Standard):
1. Building Code used for Design, unless specified on Cover/Truss Index Sheet.
 2. Slope or depth, span and spacing.
 3. Location of all joints and support locations.
 4. Number of plies if greater than one.
 5. Required bearing widths.
 6. Design loads as applicable, including:
 - a. Top Chord live load (for roof Trusses, this shall be the controlling case of live load or snow load);
 - b. Top chord dead load;
 - c. Bottom chord live load;
 - d. Bottom chord dead load;
 - e. Additional loads and locations;
 - f. Environmental Load Design Criteria (wind speed, snow, seismic, and all applicable factors as required to calculate the Truss loads); and
 - g. Other lateral loads, including drag strut loads.
 7. Adjustments to Wood Member and Metal Connector Plate design values for conditions of use.
 8. Maximum reaction force and direction, including maximum uplift reaction forces where applicable.
 9. Metal Connector Plate type, manufacturer, size, and thickness or gauge, and the dimensioned location of each Metal Connector Plate except where symmetrically located relative to the joint interface.
 10. Size, species, and grade for each Wood Member.
 11. Truss-to-Truss connection and Truss field assembly requirements.
 12. Calculated span to deflection ratio and/or maximum vertical and horizontal deflection for live and total load and KCR (creep factor) as applicable.

13. Maximum axial tension and compression forces in the Truss members.
14. Fabrication tolerance per the Standard.
15. Required Permanent Individual Truss Member Restraint location and the method of Restraint/Bracing to be used per the Standard.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber:

1. identified by grade mark of a lumber inspection bureau or agency approved by the American Lumber Standards Committee.
2. Of the size, species, and grade as shown on the Truss Design Drawings, or equivalent as approved by the Truss Design Engineer/ Truss Designer.
3. In accordance with Article 2.3, Lumber of Section 06 10 00, Rough Carpentry.
4. Adjustment of value for duration of load or conditions of use shall be in accordance with the latest edition of the National Design Specification for Wood Construction (NDS).
5. Fire retardant treated lumber, if applicable, shall meet the specifications of the fire retardant chemical manufacturer, the Truss design and the Standard and shall be re-dried after treatment in accordance with the American Wood-Preservers' Association (AWPA) Standard C20 Structural Lumber – Fire Retardant Treatment by Pressure Processes. Allowable values must be adjusted in accordance with NDS. Lumber treater shall supply certificate of compliance.

B. Metal Connector Plates:

1. Manufactured by a Truss Plate Institute (TPI) member plate manufacturer.
2. Shall not be less than 0.036 in. thick (20 gauge).
3. Meet or exceed ASTM A653/A653M grade 33.
4. Galvanized coating, meeting, or exceeding ASTM A924/924M, coating designation G60. Working stresses in steel are to be applied to effectiveness ratios for plates as determined by test and in accordance with the Standard.
5. In highly corrosive environments, special applied coatings or stainless steel may be required as noted on the Contract Documents.

6. At the request of the ENGINEER, a TPI member plate manufacturer shall furnish a certified record that materials comply with steel specifications.

2.2 MANUFACTURING

Trusses shall be manufactured to meet the quality requirements of the Standard and in accordance with the information provided in the final approved Truss Design Drawings.

PART 3 EXECUTION

3.1 HANDLING, INSTALLING, RESTRAINING AND BRACING

- A. Trusses shall be handled during manufacturing, delivery and by the CONTRACTOR at the job site so as not to be subjected to excessive bending.
- B. Trusses shall be unloaded in a manner so as to minimize lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Trusses shall be handled in such a way so as to prevent toppling when banding is removed.
- C. CONTRACTOR shall be responsible for the handling, installation, and temporary restraint/ bracing of the Trusses in a good workmanlike manner and in accordance with the recommendations set forth in the latest edition of BCSI.
- D. Apparent damage to Trusses, if any, shall be reported to Truss Manufacturer prior to erection.
- E. Trusses shall be set and secured level and plumb, and in correct location. Each Truss shall be held in correct alignment until specified permanent restraint and bracing is installed.
- F. Cutting and altering of Trusses is not permitted. If any Truss should become broken, damaged, or altered, written concurrence and approval by a Registered Design Professional is required.
- G. Concentrated loads shall not be placed on top of Trusses until all specified restraint and bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of plywood or other concentrated loads on top of Trusses.
- H. Truss Submittals and any supplementary information provided by the Truss Manufacturer shall be provided by the CONTRACTOR to the individual or organization responsible for the installation of the Trusses.
- I. Trusses shall be permanently restrained and braced in a manner consistent with good building practices as outlined in BCSI and in accordance with the requirements of the

Construction Documents. Trusses shall furthermore be anchored or restrained to prevent out-of-plane movement so as to keep all Truss members from simultaneously buckling together in the same direction. Such permanent lateral restraint shall be accomplished by: (a) anchorage to solid end walls; (b) permanent diagonal bracing in the plane of the web members; or (c) other suitable means.

- J. Materials used in temporary and permanent restraint and bracing shall be furnished by CONTRACTOR.

END OF SECTION

SECTION 06 61 00 - FIBERGLASS REINFORCED PLASTICS (FRP) FABRICATIONS, MOLDED GRATING

PART 1 GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall furnish, modify (where necessary), and install all fiberglass reinforced plastic (FRP) items, along with all support structures, appurtenances, accessories, and incidentals necessary to produce a complete, fully supported, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 05 50 00 - Miscellaneous Metals

1.3 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. The CONTRACTOR shall furnish shop drawings of all fabricated gratings and accessories in accordance with the provisions of this Section. Shop drawings shall include information on the FRP grating support structure as well as details for intermediate support structure necessary for supporting FRP grates at cuts and penetrations.
- C. The CONTRACTOR shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.
 - 1. The FRP grating sections shall be designed so as to be removeable. Individual FRP panels sections shall not weight more than 100-lbs.
- D. The CONTRACTOR shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.
- E. The CONTRACTOR may be requested to submit sample pieces of each item specified herein for acceptance by the ENGINEER as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.

1.4 REFERENCES

- A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

1. ASTM D635 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
2. ASTM D 732 Shear Strength of Plastics by Punch Tool
3. ASTM E84 Surface Burning Characteristics of Building Materials
4. NSF/ANSI STANDARD 61

1.5 QUALITY ASSURANCE

- A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years' experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.
- B. Manufacturer shall offer a 3-year limited warranty on all FRP products against defects in materials and workmanship.
- C. Manufacturer shall be certified to the ISO 9001:2015 standard.
- D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (DNV, ABS, USCG, AARR).
- E. Manufacturer shall provide proof, via independent testing less than six months old, that materials proposed as a solution do not contain heavy metals in amounts greater than that allowed by current EPA requirements.

1.6 DELIVERY, HANDLING AND STORAGE

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.
- B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage.

Adhesives, resins, and their catalysts are to be stored in dry indoor storage facilities between 70- and 85-degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Pultruded gratings shall be Safe-T-Span® (or ENGINEER approved equal) as manufactured by

Fibergrate Composite Structures Inc.

5151 Belt Line Road, Suite 1212

Dallas, Texas 75254-7028 USA

(800) 527 4043 Phone (972) 250 1530 Fax

Website: www.fibergrate.com

E-mail: info@fibergrate.com

2.2 GENERAL

- A. All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements, and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.
- C. Resin shall be Vinyl Ester or Isophthalic Polyester with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- D. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids and without dry spots, cracks, crazes, or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
- E. All pultruded structural shapes shall be further protected from ultraviolet (UV) light with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to help produce a resin rich surface.
- F. All fire-retardant molded grating products shall have a tested flame spread rating of 25 or less per ASTM E84 Tunnel Test. Gratings shall not burn past the 1 inch (25 mm) reference mark and will be classified HB per ASTM D635.

- G. All mechanical grating clips shall be manufactured of Type 316SS (stainless steel).

2.3 MOLDED FRP GRATING

- A. Manufacture: Grating components shall be high strength and high stiffness pultruded elements having a maximum of 70% and a minimum of 60% glass content (by weight) of continuous roving and continuous strand mat fiberglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and resistance to ultraviolet degradation. Bearing bars shall be interlocked and epoxied in place with a two-piece cross rod system to provide a mechanical and chemical lock. Cross rods should be below the walking surface of the grating. Gratings with cross rods that are flush with the walking surface are excluded.
- B. Non-slip surfacing: Grating shall be provided with a quartz grit bonded and baked to the top surface of the finished grating product.
- C. Grating bar intersections are to be filleted to a minimum radius of 1/16" to eliminate local stress concentrations and the possibility of resin cracking at these locations.
- D. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84. Manufacturer may be required to provide certification of ASTM E84 test on grating panels from an independent testing laboratory. Test data shall be from full scale testing of actual production grating, of the same type and material supplied on the project. Test data performed only on the base resin shall not be acceptable.
- E. Resin system: The resin system used in the manufacture of the grating shall be VEFR or ISOFR. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating corrosion resistance and shall not be accepted.
- F. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.
- G. Color: Gray, Yellow, or as allowed by OWNER
- H. Depth: 2" deep load bars with a tolerance of plus or minus 1/32".
- I. Mesh Configuration: 2" load bar spacing, 6" tie bar spacing on centers. Grating shall be SAFE-T-SPAN® [T3320 or T5020] as manufactured by **Fibergrate Composite Structures Incorporated**.

- J. Load/Deflection: Grating design loads shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Grating shall be designed for a uniform load of 125 psf or concentrated load of 300 lb. Live load deflection is not to exceed 0.25" or $L/D = 360$, whichever is less.
- K. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.
- L. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the ENGINEER for approval.

2.4 GRATING FABRICATION

- A. Measurements: Grating supplied shall meet the minimum dimensional requirements as shown or specified. The CONTRACTOR shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. Determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.
- B. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating supports shall be provided at openings in the grating by CONTRACTOR where necessary to meet load/deflection requirements specified herein. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- C. Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the CONTRACTOR in accordance with the manufacturer's instructions.
- D. Hardware: Type 316 stainless steel hold down clips shall be provided and spaced at maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

- A. Shop inspection is authorized as required by the OWNER and shall be at OWNER's expense. The fabricator shall give ample notice to CONTRACTOR prior to the beginning of any fabrication work so that inspection may be provided. The grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination,

blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.2 INSTALLATION

- A. CONTRACTOR shall install gratings in accordance with manufacturer's assembly drawings. Fasten grating panels securely in place with hold down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Ensure all cuts are adequately supported. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board insulation for walls and roof.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Extruded polystyrene foam-plastic board insulation.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
 - 1. Sign, date, and post the certification in a conspicuous location on Project site.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation: ASTM C578, Type X 15-psi (104-kPa) minimum compressive strength on walls, Type VI 40-psi minimum under slab and on roof; unfaced.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. MBCI.
 - d. Owens Corning.
 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.
 - 1. Fit courses of insulation between wall ties, vertical 'Z' framing and other obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.
 - 3. Supplement adhesive attachment of insulation by securing boards with screws or adhesive through the Z's.

- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Vapor-retarding, fluid-applied air barriers.
 - 2. Vapor-permeable, fluid-applied air barriers.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

- B. Low-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils (1.5 to 0.38 mm) over smooth, void-free substrates.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. PROSOCO, Inc., R-Guard CAT 5 Rain Screen
 - b. Dow Corning Corporation; Dow Corning® DefendAir200.
 - c. Hohmann & Barnard, Inc; Enviro-Barrier VP.
 - d. Polyguard Products, Inc.; Airloc Flex WG.
 - e. W.R. Meadows, Inc; Air-Shield TMP.
 - f. Approved "Or-equal."
 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
 - b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method, Procedure A.
 - c. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
 - d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541.
 - e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - f. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.3 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by air-barrier material manufacturer.

- C. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Pecora Corporation.
 - c. The Dow Chemical Company.
 - d. Tremco Incorporated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 - 3. Verify that substrates are visibly dry and free of moisture.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. If substrate preparation is the responsibility of another installer, notify Owner's Representative of unsatisfactory preparation before proceeding. Do not begin installation until substrates have been properly prepared.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 SURFACE PREPARATION

- A. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

- B. Do not begin installation until substrates have been properly prepared. If substrate preparation is the responsibility of another installer, notify Owner's Representative of unsatisfactory preparation before proceeding.
- C. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- D. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- E. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- F. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in CMU with substrate-patching material.
- G. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- H. Bridge expansion joints and discontinuous wall-to-wall joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
 - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, storefront systems, exterior louvers, exterior door

framing, and other construction used in exterior wall openings, using accessory materials.

- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip or preformed silicone extrusion so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
 - 1. Transition Strip: Roll firmly to enhance adhesion.
 - 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Low-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
1. Vapor-Permeable, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 15 mils, applied in two equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material, or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface, according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Air-barrier dry film thickness.
 3. Continuous structural support of air-barrier system has been provided.
 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 5. Site conditions for application temperature and dryness of substrates have been maintained.

6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 7. Surfaces have been primed, if applicable.
 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 9. Termination mastic has been applied on cut edges.
 10. Strips and transition strips have been firmly adhered to substrate.
 11. Compatible materials have been used.
 12. Transitions at changes in direction and structural support at gaps have been provided.
 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 14. All penetrations have been sealed.
- C. Tests: As determined by testing agency from among the following tests:
1. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 at two locations of installed air barrier.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Repair damage before proceeding with subsequent construction.
- C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- D. Remove masking materials after installation.

END OF SECTION

SECTION 07 41 13.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes standing-seam metal roof panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Sample of special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 10 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips inside laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
1. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AEP Span; A BlueScope Steel Company.
 - b. Architectural Building Components.
 - c. CENTRIA Architectural Systems.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.0284 inch (22 Gauge).
 - b. Exterior Finish: Three-coat fluoropolymer.
 - c. Color: match AEP Span Cool Leaf Green
 3. Clips: Two-piece floating to accommodate thermal insulation and thermal movement.
 - a. Material: 0.064-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - b. Joint Type: Double folded.
 4. Panel Coverage: 16 inches.
 5. Panel Height: 2.0 inches.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Grace Construction Products; W.R. Grace & Co. -- Conn, Ice & Water Shield.
 - b. Henry Company- Blueskin Roof Ice & Water Barrier RF200.
- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Sub-framing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or cross-linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance.

Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

- D. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb sub-framing of 0.060-inch-nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and sub-framing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
- E. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 2605 Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 EXECUTION

3.1 PREPARATION

- #### A. Miscellaneous Supports:
- Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.2 UNDERLAYMENT INSTALLATION

- #### A. Self-Adhering Sheet Underlayment:
- Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
1. Apply over the entire roof surface.
- #### B. Slip Sheet:
- Apply slip sheet over underlayment before installing metal roof panels.
- #### C. Flashings:
- Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

- #### A. Standing-Seam Metal Roof Panel Installation:
- Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with fasteners recommended by manufacturer for substrate.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seam tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION

SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes fiber-cement siding and soffit.
- B. Related Requirements:
 - 1. Section 06 10 63 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 07 27 26 "Fluid-Applied Membrane Air Barrier" for weather resistive barriers.

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For fiber-cement siding and soffit including related accessories.
- C. Samples for Verification: For each type, color, texture, and pattern required.
 - 1. 12-inch- (300-mm-) long-by-actual-width Sample of siding.
 - 2. 12-inch- (300-mm-) long-by-actual-width Sample of soffit.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement siding and soffit.

- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full lengths of fiber-cement siding and soffit including related accessories, in a quantity equal to 2 percent of amount installed.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
- B. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie “Hardi-Plank Lap Siding”. Provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. GAF.
 - 3. James Hardie Building Products, Inc.
 - 4. Nichiha Architectural Panels.
- C. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- D. Nominal Thickness: Not less than 5/16 inch (8 mm).
- E. Horizontal Pattern: Boards with 8” and 4” (184 to 190 mm) wide exposure.
 - 1. Texture: Smooth.
- F. Factory Priming: Manufacturer's standard acrylic primer.

2.3 FIBER-CEMENT SOFFIT

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
 - 1. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie “HardieSoffit”. Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. James Hardie Building Products, Inc.
 - c. Nichiha Architectural Panels.
- B. Nominal Thickness: Not less than 1/4 inch (8 mm).
- C. Pattern: (400-mm-)24-inch wide sheets with smooth texture.
- D. Ventilation: Provide perforated soffit.
- E. Factory Priming: Manufacturer's standard acrylic primer.

2.4 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
 - 2. Siding Vents: Cor-A-Vent SS-112 Sturdi Strips
 - a. Dimensions: 3/8 inches depth by 1-1/2 inches wide by 48 inches long.
 - b. Color: Black.
- B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:
 - 1. Door casings as indicated on drawings.
 - 2. Top of wall trim.
- C. Flashing: Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
- D. Fasteners:
 - 1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
 - 2. For fastening fiber cement, use hot-dip galvanized fasteners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and soffit and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Do not install damaged components.
 - 2. Install fasteners no more than 16 inches (600 mm) o.c.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Formed roof-drainage sheet metal fabrications.
 - 2. Trim at doors and windows.
 - 3. Gutters and downspouts

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following
 - 1. Underlayment materials.
 - 2. Elastomeric sealant.
 - 3. Butyl sealant.
 - 4. Epoxy seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details of termination points and assemblies.

5. Include details of roof-penetration flashing.
6. Include details of edge conditions, including eaves, ridges, rakes, crickets and flashings.
7. Include details of trim at door and windows.
8. Include details of connections to adjoining work.
9. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches (1:5).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.6 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient (100 deg C).

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Surface: Smooth, flat and with manufacturer's standard clear acrylic coating on both sides.
 - 2. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
 - 3. Color: As selected by Architect from manufacturer's full range.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
 - 1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

G. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- (2400-mm-) long sections.
3. Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Gutter Profile: see drawings.
6. Fabricate from the following materials: (0.61 mm)24 ga. Pre-finished Steel.
7. Color: Paint Green to match roof.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

1. Fabricated Hanger Style: Fig. 1-35G in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:
 - a. (0.61 mm)Pre-finished Steel.
 - b. Color: Match roof color

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, or sealant.
 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
 6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 7. Do not field cut sheet metal flashing and trim by torch.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
 - 1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
 - 2. Do not use torches for soldering.
 - 3. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
 - 1. Join sections with riveted and soldered joints.
 - 2. Provide for thermal expansion.
 - 3. Attach gutters at eave or fascia to firmly anchor them in position.
 - 4. Provide end closures and seal watertight with sealant.
 - 5. Slope to downspouts.
 - 6. Fasten gutter spacers to front and back of gutter.
 - 7. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
 - 8. Install gutter with expansion joints not exceeding, 50 feet (15.2 m) apart. Install expansion-joint caps.
 - 9. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.
- C. Downspouts:
 - 1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
 - 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
 - 3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
 - 4. Provide elbows at base of downspout to direct water away from building.
 - 5. Connect downspouts to underground drainage system.

3.4 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
 - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.6 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.8 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Immersible joint sealants.
 - 4. Mildew-resistant joint sealants.
 - 5. Latex joint sealants.
 - 6. Preformed joint sealants.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - 1. Joint-sealant location and designation.
 - 2. Manufacturer and product name.
 - 3. Type of substrate material.
 - 4. Proposed test.
 - 5. Number of samples required.
- D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion-Test Reports: For each sealant application tested.
- G. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Type 1 - Silicone base, nonsag, non-immersible, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25. Capable of withstanding movement up to 50 percent of joint width.
 - 1. Dow Corning Corp.; No. 790
 - 2. General Electric; Silpruf
 - 3. BASF; Sonneborn, Omniseal-50.

2.3 URETHANE JOINT SEALANTS

- A. Type 2 – Multipart Polyurethane, Nonsag, Non-immersible, Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
 - 1. BASF; Sonneborn NP-2
 - 2. Pecora Corp.; Dynatrol II
 - 3. Tremco; Dymeric 240
 - 4. Sika Chemical Corp.; Sikaflex 2c NS
- B. Type 3 - One-Part Polyurethane, Non-immersible, Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
 - 1. Pecora Corp.; Dynatrol 1 XL
 - 2. Tremco; Dymonic
 - 3. BASF; Sonneborn, NP-I
- C. Type 4 - Tape Sealant, Compressible polyurethane foam impregnated with polybutylene or polymer-modified asphalt, Color: Black, Size: 3/4 inch wide by length required by expanded thickness recommended by manufacturer for particular application.
 - 1. Emseal Joint Systems, Ltd.; AST—High Acrylic
 - 2. Dayton Superior; Polytite Standard
 - 3. PARR Technologies; PARR Sealant EP-7212-T

2.4 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C1247, Class 1; tested in deionized water unless otherwise indicated
- B. Type 5 – Multipart Polyurethane, Self-leveling, Immersible, multicomponent, chemical curing; ASTM C920 Type M, Grade P, Class 25, capable of being continuously immersed in water.
 - 1. BASF; Sonneborn, SL-2

2. Pecora Corp.; Urexspan NR 200
 3. Tremco; THC-900/901
 4. Sika Chemical Corp.; Sikaflex 2c SL
- C. Type 6 - Multipart Polyurethane, Nonsag, Immersible, Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25, Capable of being continuously immersed in water.
1. Pecora; DynaTrol II
 2. Tremco; Dymeric 240
 3. BASF; Sonneborn NP-2
 4. Sika Chemical Corp.; Sikaflex 2c NS
- D. Type 7 – One-part Polyurethane, immersible, Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25, Capable of being continuously immersed in water.
1. Nonsag: Sika Chemical Corp.; Sikaflex-1a
 2. Nonsag: Tremco; Vulkem 116
 3. Self-leveling: BASF; Sonneborn, SL-1
 4. Self-leveling: Tremco; Vulkem 45
 5. Self-leveling: Sika Chemical Corp.; Sikaflex 1c SL

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Type 8 – Sanitary sealant, silicone base, similar to type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color.
1. Dow Corning Corp.; 786
 2. General Electric; Sanitary Sealant SCS1700

2.6 PREFORMED COMPRESSIBLE JOINT SEALS

- A. Exterior Conditions, widths up to 5 inches, color selected by Owner's Representative.
1. BASF; Wabo Weatherseal II
 2. Emseal Joint Systems Limited; Colorseal
- B. Interior Conditions, widths up to 3 inches, color black.
1. BASF, Inverseal

2.7 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. BASF Corporation; Construction Systems
 2. Pecora Corporation
 3. Sherwin-Williams Company (The)
 4. Tremco Incorporated

2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Alcot Plastics Ltd.
 2. BASF Corporation; Construction Systems
 3. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean, porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.

- d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.
 - 4. Provide flush joint profile according to Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth according to Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field tests per owner requests.
- B. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed, and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.

- b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- C. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

Joint Locations	Sealant Type(s)
Expansion/Contraction and Control Joints at:	
Concrete Floor Slabs (except for water-holding Structures)	5, 7
Slabs Subject to Vehicle and Pedestrian Traffic	5, 7
Masonry Walls	1, 2, 3, 6, 7
Material Joints at:	
Metal Door, Window, and Louver Frames (Exterior)	1, 3, 7
Wall Penetrations (Exterior)	1, 3, 7
Wall Penetrations (Interior)	1, 3, 7
Floor Penetrations	3, 7
Ceiling Penetrations	1, 2, 3, 6, 7
Roof Penetrations	7
Sheet Metal Flashings	7
Sheet Metal Roofing and Siding	4, 7
Other Joints:	
Threshold Sealant Bed	7

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Standard and custom hollow metal doors and frames.
- 2. Transom frames.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
- 2. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
- 3. Division 08 Section "Door Hardware".
- 4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

- 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
- 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
- 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.

6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
13. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
14. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.

5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves,

concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).
 - 3. Pioneer Industries (PI).
 - 4. Security Metal Products (SMP).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 38 percent.
- D. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

- B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.
1. Design: Flush panel.
 2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
 - a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
 - b. Thermal properties to rate at a fully operable minimum U-Factor 0.29 and R-Value 3.4, including insulated door, thermal-break frame and threshold.
 - c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.36 and R-Value 2.7, including insulated door, kerf type frame, and threshold.
 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.
 4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.

2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 3. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Manufacturers Basis of Design:
1. Curries Company (CU) - Polystyrene Core - 707 Series.
 2. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 3. Manufacturers Basis of Design:
 - a. Curries Company (CU) – M CM Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 3. Manufacturers Basis of Design:
 - a. Curries Company (CU) - M Series.

- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- C. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
 - 3. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
 7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and

replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes access doors and frames for ceilings.

1.3 ALLOWANCES

- A. Access doors and frames are part of an access door and frame allowance.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - a. Acudor Products, Inc.;
 - b. Babcock-Davis; [JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Larsens Manufacturing Company.
 - d. Nystrom; .
- 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
- 3. Locations: Ceiling.

4. Door Size: As indicated on drawings or as needed for access.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Latch and Lock Hardware:
 1. Quantity: Furnish number of latches required to hold doors tightly closed.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Paint to match adjacent surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 62 00 - UNIT SKYLIGHTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-flashing unit skylights with integral curbs.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of unit skylight.
- B. Shop Drawings: For unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.
- C. Samples: For each type of exposed finish required and each type of glazing.
- D. Product Schedule: For unit skylights.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification data.
- B. Product test reports.
- C. Field quality-control reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Crystalite Skylights
 - 2. Wasco Skylights
 - 3. Major Industries, Inc
 - 4. Kawneer.

2.2 PERFORMANCE REQUIREMENTS

- A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Performance Class and Grade: Class CW-PG 30 minimum.
 - 2. Certification: AAMA-, WDMA-, or CSA-certified unit skylights with label attached to each.
- B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.35 Btu/sq. ft. x h x deg F.
- C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for enhanced protection.
 - 1. Large-Missile Test: For glazing located within 30 feet of grade.
 - 2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.

2.3 METAL FRAMED SKYLIGHT

- A. Metal-Framed Skylights: Glazed skylight assemblies supported by aluminum framing.
- B. Unit Shape and Size: As indicated.
- C. Aluminum Framing Systems: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
- D. Insulating Glass: Frosted, sealed units that comply with Section 08 80 00 "Glazing," in manufacturer's standard overall thickness.
 - 1. Laminated glass: Two plies of 3-mm clear fully tempered glass with 0.030-inch clear polyvinyl butyl interlayer.

2. Low-Emissivity Coating: Manufacturer's standard.
 3. Safety Grating: Provide internal aluminum fall-protection grating, to prevent falls per weight requirements of OSHA and local authorities having jurisdiction.
- E. Glazing Gaskets: Manufacturer's standard.
 - F. Site built curb by contractor.
 - G. Condensation Control: Fabricate unit skylights with integral internal gutters and non-clogging weeps to collect and drain condensation to the exterior.
 - H. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.
 - I. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened. Provide non-removable fastener heads.

2.4 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Color and Gloss: Black.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.
- B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.
- C. Perform test for total area of each unit skylight.
- D. Work will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.3 CLEANING

- A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

END OF SECTION

SECTION 08 71 00 – DOOR HARDWARE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
- C. Related Sections:
 - 1. Division 08 Section “Hollow Metal Doors and Frames”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies.
 - 3. CAN/ULC-S104 – Standard Method for Fire Tests of Door Assemblies.
 - 4. ULC-S319 - Electronic Access Control Systems.
 - 5. UL 305 – Panic Hardware.
 - 6. ULC-S132, Emergency Exit and Emergency Fire Exit Hardware.
 - 7. ULC-S533 – Egress Door Securing and Releasing Devices.

8. ANSI/UL 437- Key Locks.
9. ULC-S328, - Burglary Resistant Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door

hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

- 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Five years for exit hardware.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.

- b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
- a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
- a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
- a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
5. Manufacturers:
- a. Hager Companies (HA).
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.

4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Match Facility Standard.
- D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 2. Manufacturers:
 - a. Corbin Russwin (RU) – Access 3 AP.
 - b. Sargent (SA) – Degree DG1.
- F. Keying System: Each type of lock and cylinders to be factory keyed.
1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. New System: Key locks to a new key system as directed by the Owner.
- G. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
- H. Construction Keying: Provide construction master keyed cylinders.
- I. Key Registration List (Bitting List):
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2. Provide transcript list in writing or electronic file as directed by the Owner.

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) – ML2000 Series.
 - b. Sargent Manufacturing (SA) – 8200 Series.

2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 4. Dustproof Strikes: BHMA A156.16.

2.6 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper

fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished

in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
- b. Sargent Manufacturing (SA) - 80 Series.

2.7 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

- a. Corbin Russwin Hardware (RU) – DC8000 Series.

- b. Norton Door Controls (NO) – 7500 Series.
- c. Sargent Manufacturing (SA) – 1431 Series
- d. Sargent Manufacturing (SA) – 351 Series.

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

- 1. Manufacturers:

- a. Hiawatha, Inc. (HI).
- b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
- c. Trimco (TC).

2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

- 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

- 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

- E. Manufacturers:

- 1. National Guard Products (NG).
- 2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- D. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures" and "Cash Allowances". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

- B. Manufacturer's Abbreviations:

		1. MK - McKinney		
		2. RO - Rockwood		
		3. SA - SARGENT		
		4. RF - Rixson		
		5. NO - Norton		
		6. PE - Pemko		
		7. YA - Yale		
		8. SU - Securitron		

Hardware Sets				
Set: 1.0				
Doors: 101, 102				
Description: pair ext. HM x HM, storeroom lock, panic				
6	Hinge, Hvy Wt	T4A3386 (NRP)	US32D	MK

1	Concealed Vert Rod Exit, Exit Only	19 43 MD8610 EO	US32D	SA	
1	Concealed Vert Rod Exit	DG163 19 43 MD8606 ETND	US32D	SA	
2	Surface Closer	CPS7500T	689	NO	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
1	Threshold	per sill detail		PE	
1	Rain Guard	346C		PE	
1	Gasketing	S773BL		PE	
2	Sweep	315CN		PE	
1	Astragal	18041CNB		PE	
<u>Set: 2.0</u>					
Doors: 103					
Description: single int. HM x HM, storeroom lock, panic					
3	Hinge, Hvy Wt	T4A3386 (NRP)	US32D	MK	
1	Office/Entry Lock	DG163 8205 LNND	US32D	SA	
1	Surface Closer	7500	689	NO	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	
1	Wall Stop	409 / 441CU	US32D	RO	
1	Gasketing	S773BL		PE	

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Insulating glass.
2. Glazing sealants.
3. Miscellaneous glazing materials.

- B. Related Requirements:

1. Section 08 11 13 "Hollow Metal Doors and Frames" for hollow metal door leaves and frames scheduled to receive glazing.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. OSSC: Oregon Structural Specialty Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 3. Test one sample of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AGC Glass Company North America, Inc.
 - 2. Guardian Glass; SunGuard.
 - 3. Pilkington North America.
 - 4. Vitro Architectural Glass
- B. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the OSSC and ASTM E1300:
 - 1. Design Wind Pressures: as per code.
 - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 2. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on LBL's WINDOW 7 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 3. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on LBL's WINDOW 7 computer program.
 - 4. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA Publications: "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements". Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements". Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.

2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
1. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
1. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
1. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient (100 deg C).
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes

glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent

sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Clear Reflective Exterior Appearance Insulating Glass Type GL-1:
 - 1. Basis-of-Design Product: Vitro Architectural Glass Solarban R100 (2) + Clear.
 - 2. Overall Unit Thickness: 1 inch (25 mm) (16 mm).
 - 3. Minimum Thickness of Each Glass Lite: 6 mm.
 - 4. Outdoor Lite: Fully tempered float glass.
 - 5. Interspace Content: Argon.
 - 6. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.
 - a. Thickness of Each Glass Ply: 6.0 mm.
 - b. Interlayer Thickness: 0.060 inch.

7. Low-E Coating: Pyrolytic on second surface.
 8. U-Factor: As indicated on drawings.
 9. Back paint interior surface.
- B. Glass Type GL-2: Clear annealed float glass.
1. Minimum Thickness: 6 mm.
- C. Glass Type GL-3: Low-e-coated, clear insulating laminated glass. (Skylight)
1. Overall Unit Thickness: 1-3/16 inch.
 2. Thickness of Outdoor Lite: 6.0 mm.
 3. Outdoor Lite: Fully tempered float glass.
 4. Interspace Content: Argon.
 5. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.
 - a. Thickness of Each Glass Ply: 6.0 mm.
 - b. Interlayer Thickness: 0.060 inch.
 6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
 7. Provide safety glazing labeling.

END OF SECTION

SECTION 08 91 19 - LOUVERS

PART 1 GENERAL

1.1 DESCRIPTION

A. SCOPE - This section specifies intake air louvers and accessories.

B. EQUIPMENT LIST:

Description	Equipment No.
Pump Room Louver	A
Electrical Room Louver	B

C. PERFORMANCE AND DESIGN REQUIREMENTS - Louver shall be suitable for air supply or discharge service and shall be sized as specified.

Equipment No.	Type	Louver dimension, inches		Minimum free area, sq ft	Airflow, cfm	Maximum pressure drop, in. WC
		Width	Height			
A	Standard	40	32	4.5		0.05
B	Standard	48	48	8		0.05

1.2 QUALITY ASSURANCE

A. REFERENCE:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AA 45	Designation System for Aluminum Finishes
AMCA Standard 500	Test Methods for Louvers, Dampers, and Shutters
ASTM B221	Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM C1071	Standard Specification for Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Material)

3. CERTIFICATION: Louvers shall bear the AMCA certified ratings seal for both air performance and water penetration.

1.3 SUBMITTALS

A. The following submittals shall be provided:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Owner's Representative shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Manufacturer's catalog and/or other data confirming conformance to specified design, material and equipment requirements.
3. Certified results of pressure drop test data and water penetration data

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of the Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that a named manufacturer's standard equipment or products will comply with the requirement of this Section.

Candidate manufacturers include Airlite, Construction Specialties, Greenheck, and Ruskin, or equal.

2.2 MATERIALS

Component	Material
Blades	ASTM B221, 6063-T52 extruded aluminum alloy
Frame	ASTM B221, 6063-T52 extruded aluminum alloy
Fasteners	Stainless steel or aluminum
Bird screen	Aluminum

2.3 STANDARD LOUVERS

- A. BLADES - Blades shall be of the fixed, drainable type with interlocking blade braces to provide an uninterrupted horizontal line. Blades for all louvers shall be minimum 0.081 inch thick. Slideable interlocked mullions shall have provisions for expansion and contraction.
- B. FRAME - The frame shall be minimum 0.081 inch thick by 4 inches deep. The louver frame shall be assembled by welding. The head, sill, and jamb shall be one-piece structural members and shall have an integral calking slot and retaining bead. Provide frame with security bars.
- C. SCREEN - The louver shall be furnished with a removable bird screen constructed of 1/2-inch mesh, 16-gage wire and secured within a 10-gage extruded aluminum frame. The screen shall be mounted on the interior louver face but independent of the louver.
- D. FINISH - Unless otherwise specified, all louvers shall receive a 215-R1, Aluminum Association Code AA-C22A41, clear anodized finish after assembly. Minimum coating thickness shall be 0.7 mil.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The louver shall be aligned, connected, and installed as specified and in accordance with the manufacturer's recommendations. A bituminous coat shall be applied to all aluminum surfaces in contact with concrete or masonry. Provide neoprene gasket between louver frame and dissimilar metals.

3.2 TESTING

- A. After completion of installation, all louvers with operating dampers, both manually and automatically operated, shall be completely field tested to ensure compliance with these specifications.

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. PABCO Gypsum.
 - d. USG Corporation.
 - 2. Thickness: 5/8 inch (15.9 mm).
 - 3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.

- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Ceilings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.
- B. This specification is applicable to coated pipe, steel, concrete, and other surfaces listed in the coating schedule at the end of this section. Architectural painting, pipe corrosion protection systems, galvanizing, and anodizing are specified elsewhere within the contract documents.
- C. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.
- D. Related Work Specified in Other Sections -- Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes, or corrosion resistant finishes may be scheduled or directed to be painted by the ENGINEER to unify a wall finish or color scheme, at the ENGINEER's discretion.
- E. Exclusions -- Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze, and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; Fencing; Multiple coated factory finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits, and items specified elsewhere for special linings and coatings.
- F. Damaged Factory Finish -- If directed by the ENGINEER, refinish the entire exposed surfaces of equipment chipped, scratched, or otherwise damaged in shipment or installation.
- G. All coating coming in contact with potable water shall be NSF approved.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.
1. "Architectural Specification Manual" by the Painting and Decorating Contractors of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.
 2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).
 3. NSF International (NSF) Standard No. 61.
- B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.
- C. Pipe Coating Commercial Standards
- | | |
|----------------|---|
| ANSI/AWWA C105 | Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. |
| ANSI/AWWA C203 | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied. |
| ANSI/AWWA C205 | Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied |
| ANSI/AWWA C209 | Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Pipelines. |
| ANSI/AWWA C210 | Liquid Epoxy Coating for Exterior and Interior of Steel Pipe. |
| ANSI/AWWA C213 | Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. |
| ANSI/AWWA C214 | Tape Coating systems for the Exterior of Steel Water Pipelines. |
- D. Federal Specifications
- | | |
|------------------|--|
| DOD-P-23236A(SH) | Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast. |
|------------------|--|

1.3 CONTRACTOR SUBMITTALS

- A. Coating Materials List -- The CONTRACTOR shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating systems

herein. The amount of copies to submit shall be as specified within Section 01 33 00, Submittal Procedures.

- B. Coating Manufacturer's and Applicator Information -- For each coating system to be used the CONTRACTOR shall submit, the following listed data.
1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
 2. Manufacturer's instructions and recommendations on surface preparation and application.
 3. Colors available for each product and each coat.
 4. Compatibility of shop and field applied coatings (where applicable).
 5. Material safety data sheet (MSDS) for each product used.
 6. The manufacturer's recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.
 7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.
 8. Certificate -- Submit manufacturer's certificate of compliance with the specifications and standards signed by a representative in the manufacturer's employ.
 9. Samples -- Provide painted surface areas at the job for approval of main color selections, or submit sample on 12-inch sample of substrate using required finish system at ENGINEER's discretion.

1.4 QUALITY ASSURANCE

- A. Painter Qualifications -- The Painting/Coating CONTRACTOR must be capable of performing the various items of work as specified. The Painting/Coating CONTRACTOR shall furnish a statement covering experience on similar work, a list of machinery, plant and other equipment available for the proposed work, and a financial statement, including a complete statement of the Painter/Coating CONTRACTOR's financial ability and experience in performing similar painting and coating work. The Painting/Coating CONTRACTOR shall have a minimum of 5 years practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the Painting/Coating CONTRACTOR shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.

- B. The CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.
- C. All such work shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such work in its absence.
- D. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- E. Surface Preparation -- Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.
- F. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be provided by the CONTRACTOR to cover all areas to be inspected.
- G. Paint Products -- No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the CONTRACTOR and ENGINEER may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the ENGINEER.
- H. Manufacturer's Representative -- Require coating manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.
- I. Labels -- Deliver to the job site in the original sealed containers with manufacturer's name, product name, type of product, manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.
- J. Colors -- Colors will be selected from manufacturer's standard colors as reviewed by ENGINEER and approved by the OWNER. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of manufacturer's standard colors, provided that the manufacturer's product line represents a color range comparable to similar products of other manufacturers.
- K. Flame Spread -- Provide paint materials which will result in a Class II finish for all coated surfaces in exit corridors, and a Class III finish for all other interior rooms or areas.
- L. Film Thickness Testing -- On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model

111/1EZ, or approved equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using wet film gage readings and destructive film thickness tests.

- M. Inspection Device -- The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the ENGINEER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- N. Holiday Testing -- The CONTRACTOR shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
 - 1. Coatings With Thickness Exceeding 20 Mils -- For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Coatings With Thickness of 20 Mils or Less -- For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or approved equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.
- B. Provide adequate heat and forced mechanical ventilation for health, safety, and drying requirements. Use explosion proof equipment. Provide face masks.
- C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the project daily.
- D. Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Do not apply coating in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet

surfaces, unless otherwise permitted by the coating manufacturer's printed instructions. Coating application may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.6 PROTECTION

- A. Follow all safety recommendations of manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.
- B. Protect surface adjacent to work being coated from overspray, drips or other damage.

1.7 EXTRA STOCK

Provide one gallon of each type and color, fully labeled, at completion of job.

PART 2 PRODUCTS

2.1 GENERAL

- A. Definitions -- The terms "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- B. General -- Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.
- C. The CONTRACTOR shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.
- D. Compatibility -- In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the ENGINEER, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- E. Colors -- All colors and shades of colors of all coatings shall be as selected or specified by the ENGINEER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the

manufacturer's standard color samples by the ENGINEER. Color pigments shall be lead free.

- F. Protective Coating Materials -- Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.
- G. Substitute or "Or-Equal" Submittals -- Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The CONTRACTOR shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.
- H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the ENGINEER shall be paid by the CONTRACTOR. If the proposed substitution requires changes in the contract work, the CONTRACTOR shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications and as directed by the ENGINEER. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100

- a. Location -- Exposed, unprimed, non-galvanized, nonsubmerged metal surfaces, both interior and exterior including piping, and structural steel.
- b. Surface Preparation -- As specified herein.

- c. Coating System -- Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.
- 2. Coating System 101
 - a. Location -- Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tneme-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series 66 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 175 Endura Shield, or approved equal. Color as selected by Owner.
- 3. Coating System 102
 - a. Location -- Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel, and all other metal items not otherwise specified.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 20 Pota-Pox, or approved equal. Color as selected by Owner.
- 4. Coating System 103
 - a. Location -- Vertical concrete walls, exterior, below finish grade, not exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Paint System -- Apply two coats 9.0-10.0 mils each, Carboline Bitumastic 50, or approved equal.
- 5. Coating System 104
 - a. Location -- Non-submerged, exposed to view, PVC piping.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply one coat, 4.0-6.0 mils Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " 'Or-Equal' Clause" in Section 01 10 00, Summary of Work.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 200 -- Cement Mortar Coating
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than 1-part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches. At the ENGINEER's discretion, the hot applied coal tar epoxy coating may be used as the curing membrane for the mortar coating.
2. Coating System 201 -- Hot Applied Coal Tar Epoxy Coating
 - a. Location -- Exterior surface of concrete pipe and cement-mortar coated pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- The hot applied coal tar epoxy shall be a solvent free 100 percent solids coal tar epoxy chemically compatible with hydrating cement and suitable for application on moist surfaces of freshly placed cement mortar or concrete and properly prepared cured surfaces. The coal tar epoxy coating material shall be Amercoat 1972B or approved equal. The finish coal tar epoxy coating shall have a minimum DFT of 26 mils.

3. Coating System 202 -- Coal-Tar Epoxy Coating System
 - a. Location -- Exterior surface of buried steel pipe, fittings, and other ferrous surfaces.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- High build, two-component amine or polyamide cured coal-tar epoxy shall have a solids content of at least 68 percent by volume, suitable as a long term coating of buried surfaces, and conforming to AWWA C210. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field. The coal-tar epoxy coating system shall include:
 - 1) Prime coat (DFT = 1-1/2 mils), Amercoat 83HS, Tnemec P66, or equal.
 - 2) Finish coats (Two or more, DFT = 18 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.
 - 3) Total system DFT = 19-1/2 mils.
4. Coating System 203 -- Fusion Bonded Epoxy
 - a. Location -- Ferrous surfaces of sleeve couplings, steel pipe, and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.
 - 1) Liquid Epoxy -- For field repairs, the use of a liquid epoxy will be permitted, applied in not less than three coats to provide a DFT 16 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.
 - 2) Coating (DFT = 16 mils), Scotchkote 203, or equal.
 - 3) Total system DFT = 16 mils.
5. Coating System 204 -- Hot, Coal-Tar Enamel
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation - As specified herein

- c. Coating System -- Coal-Tar Enamel materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a primer layer, coal-tar enamel layer, coal-tar saturated non-asbestos felt outerwrap, and a finish coat. Total system DFT = 188 mils.
- 6. Coating System 205 -- Hot Applied Tape
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a cold-applied liquid primer and heated coal-tar base tape. Total system DFT = 50 mils.
- 7. Coating System 206 -- Cold Applied Tape
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consists of a primer layer, inner layer tape of 35 mils, and an outer layer tape of 35 mils. Total system DFT = 70 mils.
- 8. Coating System 207 -- PVC Tape
 - a. Location -- Small galvanized steel pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prior to wrapping pipe with PVC tape, the pipe and fittings shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half lapped for a total thickness of 40 mils.
- 9. Coating System 208 -- Mastic
 - a. Location -- Pipe and fitting joints, and general buried surface coating repair and touch up.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Mastic shall be a one-part solvent drying heavy bodied thixotropic synthetic elastomeric coating with chemically inert resins and fillers and an average viscosity of 650,000 CPS at 77 degrees Fahrenheit (F), thereby

requiring generous applications by hand or trowel. Total coat thickness shall be 30 mils, minimum. Mastic shall be Protecto Wrap 160 H or approved equal and be fully compatible with pipeline coating systems.

10. Coating System 209 -- Polyethylene Encasement

- a. Location -- Ductile iron, steel and concrete cylinder pipe and fittings
- b. Surface Preparation -- None required.
- c. Coating System -- Except as otherwise specified, application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

2.4 ARCHITECTURAL COATING SYSTEMS

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Acrylics require 60 degrees F and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the paint manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300

- a. Location -- Vertical, exterior concrete masonry unit walls exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply prime, intermediate and topcoat, 75 square foot per gallon (ft²/gal), 100 ft²/gal and 100 ft²/gal respectively for each coat of Tnemec Series 156 Envirocrete or approved equal. Color as selected by Owner.

2. Paint System 301
 - a. Location -- Vertical concrete exterior walls and flat concrete exterior roofs and slabs exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply two coats 6.0-9.0 mils (100 ft²/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.
3. Paint System 302
 - a. Location -- Interior concrete masonry unit walls and interior and exterior wood walls, ceilings, and other wood surfaces not otherwise specified, exposed to view.
 - b. In accordance with Interior Painting Schedule, Section 09 91 23, Interior Painting.
4. Paint System 303
 - a. Location -- Wood surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply an alkyd primer as recommended by the manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Total DFT = 8 mils. Color as selected by Owner.
5. Paint System 304
 - a. Location -- Interior drywall surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Apply two coats 2.0 - 3.0 mils each coat of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Color as selected by Owner.
6. Paint System 305
 - a. Location -- Exterior brick surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- Surfaces shall be cleaned with a manufacturers approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint, and other contaminants before the coating

system is applied. Coating system shall be applied according to the manufacturers published recommendations. A manufacturer's representative shall be present during application of the coating system, if required by the manufacturer's warranty.

- c. Coating System -- Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a 5-year manufacturer's warranty.

PART 3 EXECUTION

3.1 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations -- Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing -- Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.
 - 1. Solvent Cleaning (SSPC-SP1) -- Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. Hand Tool Cleaning (SSPC-SP2) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. Power Tool Cleaning (SSPC-SP3) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. White Metal Blast Cleaning (SSPC-SP5) -- Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products, and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. Brush-Off Blast Cleaning (SSPC-SP7) -- Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. Near-White Blast Cleaning (SSPC-SP10) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. High- and Ultra High- Pressure Water Jetting (SSPC-SP12): Water jetting at high- or ultra-high-pressure to prepare a surface for recoating using pressure above 10,000 pounds per square inch (psi).
9. Surface Preparation of Concrete (SSPC-SP-13) - Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
10. Industrial Blast Cleaning (SSPC-SP14): Blast cleaning to remove all visible oil, grease, dust and dirt, when viewed without magnification

3.3 CORRECTIONS AND CLEANUP

At completion any damaged, de-laminated or defaced coated surfaces shall be touched up, restored, and left in first class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required patching, repair, and cleaning to the satisfaction of the ENGINEER. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the ENGINEER prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by coating manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas.

Surface preparation minimums shall be as follows:

1. Exposed metal items, non-submerged, unprimed, non-galvanized both interior and exterior, including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".
2. Exposed metal items, shop primed, both interior and exterior including: piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease, loose, or peeling or chipped paint.
3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel, and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".
4. Stainless Steel – Non-submerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".
5. Polyvinyl Chloride (PVC) – Non-submerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.
6. Non-submerged Concrete - Clean all concrete surfaces of dust, form oil, curing compounds, or other incompatible matter. Etch and prime if required by manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.
7. Concrete Masonry Units -- Repair all breaks, cracks and holes with concrete grout. The surface must be free of dirt, dust, loose sand and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.
8. Wood -- Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes, and other defects properly filled, smoothed, and sandpapered to fine finish. Wipe clean of dust.
9. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral spirits or Rodda's

Gresof before coating, or as recommended by manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.5 PRIME COATING

- A. Exposed Steel -- Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.
- B. Galvanized Metal -- After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with manufacturer before application the compatibility with coatings specified to follow.
- C. Shop Primed Metal -- Where indicated on the plans or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the CONTRACTOR shall apply intermediate and topcoats of the specified paint system to shop primed metal. The CONTRACTOR shall verify with the manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.
- D. Non-Shop Primed Metal and Piping -- Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.
- E. Cast-In-Place Reinforced Concrete -- After surface preparation specified above, prime coat concrete as specified in the coating schedule found elsewhere in the specifications.
- F. Concrete Masonry Units -- After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the specifications.
- G. Wood Surfaces -- Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 FIELD PRIME

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and re-priming, at the ENGINEER's discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 APPLICATION

- A. Thickness -- Apply coatings in strict conformance with the manufacturer's application instructions. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.
- B. Porous Surfaces -- Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Ventilation -- Adequately ventilate enclosed rooms and spaces during painting and drying periods.
- H. Drying Time -- Do not apply next coat of coat until each coat is dry. Test non-metallic surfaces with moisture meter. The manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 COATING SCHEDULE

Coating & Painting Schedule

Coating/Paint System	Location	Comments
100	Applies to entire project.	Including entry gate if not primed.
101	Applies to entire project.	Including entry gate if primed.
102	Applies to entire project.	
103	Applies to entire project.	Including exterior surfaces of vaults at all sites
104	Applies to entire project.	Including chemical containment tank vent piping
200 through 202	Do not apply	
203	Applies to entire project.	Applies to miscellaneous buried steel pipe, fittings, and other ferrous surfaces.
204 through 207	Do not apply	
208 and 209	Applies to ductile iron pipe only.	
300	Applies to entire project.	
301	Applies to entire project.	
302	Applies to entire project.	Shall be per 09 91 23 Interior Painting
303	Applies to entire project.	
304	Applies to entire project.	
305	Applies to entire project.	

END OF SECTION

SECTION 09 91 13 EXTERIOR PAINTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel and iron.
 - 2. Galvanized metal.
- B. Related Requirements:
 - 1. Section 055000 "Miscellaneous Metalwork" for shop priming metal fabrications.
 - 2. Section 076200 "Sheet Metal Flashing and Trim".

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
 2. Label each coat of each Sample.
 3. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 25 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Dulux Canada; a licensed product of PPG Architectural Coatings.
 - 3. Kelly-Moore Paint Company Inc.
 - 4. Rodda Paint Co.
 - 5. Sherwin-Williams Company (The).
 - 6. Miller Paints.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Wood: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

- D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. Alkyd System MPI EXT 5.1Q:

- a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
- b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
- c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

B. Galvanized-Metal Substrates:

1. Alkyd System MPI EXT 5.3B:

- a. Prime Coat: Primer, galvanized, cementitious, MPI #26.
- b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
- c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5)[, MPI #94].

END OF SECTION

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMUs).
 - 2. Steel and iron.
 - 3. Galvanized metal.
 - 4. Gypsum board.
- B. Related Requirements:
 - 1. Section 055000 "Miscellaneous Metalwork" for shop priming metal fabrications.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 25 sq. ft. .
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F .
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F .
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Dulux Canada; a licensed product of PPG Architectural Coatings.
 2. Rodda Paint Co.
 3. Sherwin-Williams Company (The).
 4. Miller Paint Co.
 5. Devoe HP Coatings.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: Off-white as selected by owners representative.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Masonry (Clay and CMUs): 12 percent.
 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and loose shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 3.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat,

but provide sufficient difference in shade of undercoats to distinguish each separate coat.

- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in Sampling Room:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Metal conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Latex System MPI INT 4.2A:

- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

B. Steel Substrates:

1. Alkyd System MPI INT 5.1EE:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

C. Gypsum Board Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

END OF SECTION

SECTION 09 93 00 – WOOD STAINS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood stains on eave braces.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of finish system and in each color and gloss of finish required.
- C. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MOCKUPS

- A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals and to set quality standards for materials and execution.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Rodda Paint Company.
 - 3. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 WOOD STAINS

- A. Stain, Exterior, Solvent Based, Semitransparent: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new wood surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Maximum Moisture Content of Exterior Wood Substrates: 12 percent, when measured with an electronic moisture meter.

3.2 PREPARATION

- A. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Architectural Woodwork:

1. Semitransparent Stain System :

- a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
- b. Topcoat: Stain, exterior, solvent based, semitransparent.

END OF SECTION

SECTION 10 14 10 - IDENTIFYING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the work necessary to furnish and install, complete, identifying devices for the Project.
- B. Section includes:
 - 1. Process pipe color coding and labeling
 - 2. Process equipment nameplates
 - 3. Door and warning signs

1.2 RELATED SECTIONS:

- A. Section 40 05 13 - Common Work Results for Process Piping

1.3 STANDARDS, SPECIFICATIONS, AND CODES

- A. All safety related signs, markers, labeling, and symbols shall conform to the applicable provisions or codes of the Occupational Safety and Health Administration (OSHA), unless specifically modified hereinafter.
- B. All signage providing emergency information or general circulation directions, or identifies rooms for the physically handicapped, shall comply with the requirements of the latest edition of American National Standards Institute (ANSI A117.1).

1.4 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Manufacturer's Data - Specifications and installation instructions for each type of sign required.
- C. Samples - Submit three full size samples of each color and finish of pipe labeling, process equipment nameplates, and warning signs with sample letters.
 - 1. ENGINEER's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the CONTRACTOR.
 - 2. Submit samples of any other special identifying or signing provided for elsewhere in this specification.

PART 2 PRODUCTS

2.1 PIPE LABELING AND COLORS

- A. Unless noted otherwise on the Drawings or specified differently hereinafter, pipe labeling and colors shall conform to the following schedule:

<u>Service</u>	<u>Symbol (label)</u>	<u>Symbol Color (label)</u>	<u>Pipe Color</u>
Plant Water/Potable Water/Well Water	PW	White	Blue
Domestic Water (Cold/Hot)	--	White	Blue
Chlorine Solution	CS	Black	Yellow
Drains	D	White	Gray
Vents	V	Black	Green
Misc. Piping	As directed by the ENGINEER	As directed by the ENGINEER	As directed by the ENGINEER

- B. Pipe identification labels and flow direction arrows shall consist of lettering and symbols applied over the pipe base color.
- C. Coating systems and surface preparation requirements used in color coding piping and lettering and flow arrows shall be as specified in Section 09 90 00, Painting and Coating.

2.2 PROCESS EQUIPMENT NAMEPLATES

- A. Nameplates shall be used to identify all process equipment including but not limited to pumps, chlorinators, control panels, and any other equipment requiring identification as directed by the Engineer.
- B. Fabricated from 1/16-inch thick satin-surfaced Setonply, all edges beveled neatly.
- C. Furnish with drilled holes for mounting to the appropriate equipment or nearest adjacent surface. As an alternative, acceptable adhesive attachment methods may be used if approved by the Engineer.
- D. Nameplate background color, lettering color, and wording shall be as directed by the Engineer and approved by the Owner.
- E. Minimum Size: 4-inch x 1-1/2-inch.
- F. Manufacturer: Seton Nameplate Company, New Haven, CT, Style 2060-40 or approved equal.

2.3 CONFINED SPACE WARNING SIGNS

- A. Painted aluminum with a yellow background and black lettering.

- B. Each sign shall contain the following wording:

“DANGER
 PERMIT-REQUIRED CONFINED SPACE
 DO NOT ENTER”

2.4 EXTERIOR STATION SIGNS

- A. A bronze metal plaque shall be fabricated and mounted on the pump station exterior wall as shown with approximate dimensions of 16 inches high by 20 inches wide with back sides for epoxy mounting.
- B. Bronze plaque shall be free of pits, scale, sand holes, and other defects.
- C. Bronze used shall be 85-5-5-5 alloy.
- D. Hand tool and buff to provide clean, sharp figures with a bright finish.
- E. Provide border, background, texture, and finish as selected by the ENGINEER from manufacturer’s standards.
- F. Protect the exposed surfaces with two coats clear non-yellowing lacquer.
- G. Provide hardware for concealed mounting on brick or CMU and mount at location as directed.
- H. Plaques shall be lettered as directed below. Obtain ENGINEER’s written approval of proof before fabricating.
- I. Plaque face shall have a 4-inch diameter rendition of City of Tigard logo and the following lettering:

CITY OF TIGARD	
ASR 3 PUMP STATION	
ENGINEER:	MURRAYSMITH, INC.
CONTRACTOR:	<to follow>
CONSTRUCTED:	<to follow>

PART 3 EXECUTION

3.1 PIPE LABELS AND FLOW DIRECTION ARROWS

- A. Location: At all connections to equipment, valves, branching fittings, at wall boundaries, and at intervals along the piping not greater than 5 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe. Exposed

piping not normally in view, such as behind ceilings and in closets and cabinets, shall also be labeled.

- B. Labels shall not be applied to the pipe until all pipe painting is complete or as approved by the ENGINEER.
- C. Application: By stencil over pipe base color. Base coat shall be cured, clean, and dry, prior to application of lettering.
- D. Lettering sizes for pipe labels shall be in accordance with ANSI A13.1, Table 3, and based upon the outside diameter of the pipe to which they are applied.
- E. Stripes on solution pipe shall be applied at intervals along the piping not greater than 5 feet on center with at least one stripe applied to each exposed horizontal and vertical run of pipe.

3.2 PROCESS EQUIPMENT NAMEPLATES

- A. Location: As directed by the ENGINEER.
- B. Mounting of process equipment nameplates shall be in accordance with the manufacturer's instructions, and as directed by the ENGINEER.

3.3 PAINTED SIGNS

- A. Prepare and mask base material as required to provide clean surface for application of letters by stencil.
- B. Unless otherwise noted, color of letters shall be black.
- C. Paint Type: Semi-gloss alkyd enamel.

3.4 CONFINED SPACE WARNING SIGNS

- A. Securely fasten signs to the underside of all hatches entering vaults such that the sign can be read when the hatch is opened.

3.5 EXTERIOR STATION SIGNS

- A. Mount signs in the locations as directed by the ENGINEER.
- B. Secure signs to fences using stainless steel fasteners.

END OF SECTION

SECTION 10 44 20 - FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers, cabinets and mounting brackets for fire extinguishers.
 - 1. Multipurpose Dry-Chemical Type in Steel Container.
 - 2. Carbon Dioxide Type in steel Container.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that may fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket location indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Guardian Fire Equipment, Inc.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division.
 - d. Larsens Manufacturing Company.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Hanging Bracket: Manufacturer's standard for CMU mounting.
 - 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container (FE-1) in Pump Room: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- C. Carbon Dioxide Type (FE-2) in Electrical Room: UL-rated 10-B:C, 10-lb nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION

SECTION 11 05 00 - COMMON WORK RESULTS FOR EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing and operation of equipment and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents.
- B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise specified or shown.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, products and their installation shall be in accordance with the following standards, as applicable and as specified in each section of these specifications:
 - 1. ASTM International (ASTM)
 - 2. American Public Health Association (APHA)
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Mechanical Engineers (ASME)
 - 5. American Water Works Association (AWWA)
 - 6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - 7. American Welding Society (AWS)
 - 8. National Fire Protection Association (NFPA)
 - 9. Federal Specifications (FS)
 - 10. National Electrical Manufacturers Association (NEMA)
 - 11. Manufacturer's published recommendations and specifications
 - 12. Oregon Occupational Safety and Health Division (OR-OSHA)
- B. The following standards have been referred to in this Section of the specifications.
 - 1. ASTM International:
 - a. ASTM A48 - Specification for Gray Iron Castings.

- b. ASTM A108 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
- 2. American National Standards Institute (ANSI):
 - a. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
 - b. ANSI B16.5 - Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys.
 - c. ANSI B46.1 - Surface Texture.
 - d. ANSI S12.6 - Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors.
- 3. American Society Mechanical Engineers (ASME):
 - a. ANSI/ASME B1.20.1 - General Purpose Pipe Threads (Inch).
 - b. ANSI/ASME B31.1 - Power Piping.
- 4. American Water Works Association (AWWA):
 - a. AWWA C206 - Field Welding of Steel Water Pipe.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Furnish complete shop drawings for all equipment specified in the various sections, together with all piping, valves, and controls for review by the ENGINEER.
 - 2. Include calculations showing equipment anchorage forces and the capacities of the anchorage elements where required.
- C. Special Tools:
 - 1. Supply one complete set of special tools where necessary for the assembly, adjustment, and dismantling of the equipment.
 - 2. Tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal.
- D. Spare Parts:
 - 1. Obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment.

2. Furnish the name, address and telephone number of the nearest distributor for each piece of equipment.
 3. Spare parts shall be supplied when indicated in the appropriate equipment specification sections.
- E. Torsional and Lateral Vibration Analysis:
1. Where required by the individual equipment sections, provide a torsional and lateral vibration analysis of the equipment, in accordance with Section 01 13 00, Submittals.
 2. Equipment shall be designed and constructed such that the natural frequency of the drive train is avoided by a minimum of 25 percent throughout the entire operating range.
 3. Analysis shall be performed by a specialist experienced in this type of work and approved by the Engineer.
 - a. The specialist, or their assigned representative who shall similarly be experienced in this type of work and who shall be approved by the Engineer, shall visit the Site during startup and testing of the equipment to analyze and measure the amount of equipment vibration, certify that the operating frequency avoids the natural frequency by 25 percent, and make a written recommendation for keeping the vibration at a safe limit.

1.4 QUALITY ASSURANCE

- A. Demonstrate all equipment meets the specified performance requirements. Provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment, who shall visit the Site to perform the following tasks:
1. Assist the Contractor in the installation of the equipment.
 2. Inspect, check, adjust if necessary, and approve the equipment installation.
 3. Start-up and field-test the equipment for proper operation, efficiency, and capacity.
 4. Perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the ENGINEER.
 5. Instruct the OWNER's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

- B. The costs of all inspection, startup, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the Contractor. When available, the Owner's operating personnel will provide assistance in the field testing.
- C. Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts.
- D. The type of finish shall be the most suitable for the application and shall be in accordance with ANSI B46.1.
- E. Unless otherwise noted, all equipment furnished shall have a record from the same manufacturer of at least 3 years successful, trouble-free operation in similar applications.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage.
- B. Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.
- C. All equipment shall be protected from exposure to corrosion and shall be kept thoroughly dry at all times.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Hearing Protection:
 - 1. At each high noise level location, where equipment produces noise exceeding 85 dBA at 3 feet or exceeding OSHA noise level requirements for operator safety, supply two pairs of high attenuation hearing protectors.
 - 2. Ear protectors shall meet the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz.
 - 3. Hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband.
 - 4. Protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the CONTRACTOR and mounted in an approved location near the noise producing equipment.

- B. Welding:
 - 1. Unless otherwise specified or shown, all welding shall be by the metal arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS.
 - 2. Qualification of welders shall be in accordance with the AWS Standards governing same.
- C. Protective Coatings:
 - 1. All equipment shall be painted or coated in accordance with Section 09 90 00, Painting and Coating, unless otherwise indicated.
 - 2. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil.
 - 3. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- D. All equipment subject to vibration shall be provided with restrained spring type vibration isolators or pads per manufacturer's written recommendations.
- E. Shop fabrication shall be performed in accordance with the Specifications and the Engineer-approved shop drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Design Loads:
 - 1. All equipment supports, anchors, and restraint shall be adequately designed for static, dynamic, wind, and seismic loads.
 - 2. The design horizontal seismic force shall be the greater of that noted in the general structural notes or as required by the governing building code (10 percent of gravity minimum).
- B. Equipment foundations shall be as per manufacturer's written recommendations.
- C. All equipment shall be mounted as shown on the manufacturer's standard details, unless otherwise shown or specified.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

- A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

2.4 FLANGES AND PIPE THREADS

- A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125 or B16.5, Class 150, unless otherwise shown.
- B. All pipe threads shall be in accordance with ANSI/ASME B1.20.1 and with requirements of Section 40 05 13, Common Work Results for Process Piping.

2.5 COUPLINGS

- A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts, three-piece spacer couplings or universal type couplings for extended shafts shall be installed.
- B. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. Taper-lock bushings may be used to provide for easy installation and removal on shafts of various diameters.
- D. Where universal type couplings are shown, they shall be equipped with grease fittings.

2.6 BEARINGS

- A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association (AFBMA).
- B. All field-lubricated type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- C. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.
- D. Except where otherwise specified or shown, all bearings shall have a minimum B-10 life expectancy of 5 years or 20,000 hours, whichever occurs first.
- E. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the manufacturer. Split type housings may be used to facilitate installation, inspection, and disassembly.
- F. Sleeve type bearings shall have a Babbitt or bronze liner.

2.7 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA and RMA standards.
- B. Unless otherwise specified, sheaves shall be machined from the finest quality gray cast iron.
- C. All sheaves shall be statically balanced. In applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 feet per minute (fpm) may be required to be of special materials and construction.
- D. To facilitate installation and disassembly, sheaves shall be furnished complete with taper-lock or QD bushings as required.
- E. Finish bored sheaves shall be furnished complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.8 DRIVE GUARDS

- A. All power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910) requirements.
- B. Guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened.
- C. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.9 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment.

2.10 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with the requirements of Section 40 05 13, Common Work Results for Process Piping.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron type "V" packing shall be Garlock No. 432, John Crane "Everseal" or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER.

2.11 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location.
- B. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

PART 3 EXECUTION

3.1 WELDING

- A. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions.
- B. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed.
- C. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions.
- D. All sharp corners of material to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.2 COUPLINGS

- A. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- B. Installation shall be per equipment manufacturer's printed recommendations.

3.3 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with his subcontractors.
- B. If the packaged system has any additional features other than specified, the Contractor shall coordinate such features and furnish all material and labor necessary for a complete installation, as required by the manufacturer, at no additional cost to the Owner.

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING AND VALVES

PART 1 GENERAL

1.1 SCOPE

This section covers the work necessary to furnish materials, labor equipment and services necessary to provide all domestic water piping, valves and equipment as shown on the drawings and specified herein.

1.2 QUALITY ASSURANCE

Install plumbing to meet requirements of local and states codes and provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.3 SUBMITTALS

Submittals shall include manufacturer's certificate of conformance; certified copies of test reports; documentation on piping; layout drawings showing type, spacing, maximum loads and materials for hangers and supports and manufacturer's warranty statements.

PART 2 PRODUCTS

2.1 PIPING

- A. Domestic water piping above ground, unless specified elsewhere, shall be Type "L", hard drawn, conforming to ASTM B88.
- B. Domestic water piping underground, under floor slabs, or cast in concrete shall be Type "K".
- C. Connections of copper tubing to steel or other metallic piping shall be made using insulating couplings or fittings that provide complete electrical isolation.
- D. Flexible Water Heater Connectors: Corrugated seamless copper tubing with dielectric insulator; sweat or threaded connection
- E. Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Water Pipe and Fittings: PVC and CPVC pipe 4 inches and smaller shall be solvent welded, unless otherwise indicated on the Drawings. Pipe shall be schedule 40, Type 1 Grade I normal impact PVC pipe conforming to ASTM D1785 and D2467, unless schedule 80 pipe is indicated on the Drawings.
 1. For material transitions in hot water systems, only transition fittings with the CPVC portion molded directly to the metal body shall be used to transition from CPVC to another material.

2. For material transitions in cold water systems, all-PVC or all-CPVC male threaded fittings may be used to transition from PVC/CPVC to another material. All-PVC or all-CPVC female threaded fittings shall not be used: instead, transition fittings with the PVC/CPVC portion molded directly to the metal body shall be used.
- F. Flexible Plastic Tubing -- Flexible plastic pipe shall be standard weight polyethylene thermoplastic tubing conforming to ASTM D-1248 Type 1, Class A, Category 4, Grade E5.
- G. No galvanized steel pipe or fittings shall be used in this facility.

2.2 PLUMBING VALVES

- A. Ball Valves 2 inches and under: Ball valves 2 inches and under shall be 400 lb. WOG with bronze body and trim, TFE seat ring, and fluorocarbon O-ring seals. The valve shall be of three-piece construction so that maintenance can be performed without disturbing the valve body after installation. Valves shall be Nibco T-590-Y or equal.
- B. Globe Valves, Two (2) inches and Smaller: Type 2, Class 150 bronze globe valves with nonmetallic disc and union-ring bonnet. Manufacturers:
 1. Crane Company; Crane Valve Group; Crane Valves
 2. Crane Company; Crane Valve Group; Jenkins Valves
 3. Crane Company; Crane Valve Group; Stockham Valves
 4. Grinnell Corporation
 5. Hammond Valve
 6. Milwaukee Valve Company
 7. NIBCO Inc.
 8. Red-White Valve Corp.
- C. Swing check valves 2 inches and under: Swing check valves 2 inches and under shall be Y-pattern check style and have a body constructed of 85-5-5-5 bronze conforming to ASTM B62. Check valves shall be capable of functioning in the vertical position. Swing check valve connections shall be standard threaded or threaded for fire hose connection where shown on plans. Check valves 4 inches and under shall be red-white Toyo, or approved equal.
- D. Double check valve assemblies shall meet the requirements of the latest edition of AWWA Standard C-510, Double Check Valve Backflow Prevention Assembly, as modified herein. Unless otherwise noted on the drawings, the assembly shall be equipped with NRS resilient seated flanged shutoff valves.
- E. Reduced-Pressure Backflow Preventers: Reduced-pressure assemblies ¾-inch through 2-inch shall consist of a differential pressure relief valve located between two independently acting "Y" pattern check valves, two full ported ball valve shut-offs and

four test cocks. Mainline valve body and caps, including relief valve body and cover, shall be bronze. Check valves shall be center stem guided. All seat discs shall be reversible. The relief valve shall have a removable seat ring. Assemblies shall be certified in compliance with ASSE 1013, AWWA C511-89, and CAN/CSA B64.4, and should be approved by the Oregon Health Administration. The reduced-pressure assembly shall be Febco Model 825Y, or approved equal

- F. Pressure-Reducing and Relief Valves, 2 inches and under: Pressure-reducing and relief valves 2-inches and under shall be of the spring-loaded diaphragm type with a minimum pressure rating of 250 psi, bronze body, nickel alloy or stainless steel seat and threaded ends. These valves are limited to use in interior plumbing systems. Manufacturers:

1. A.W. Cash Valve Mfg. Corp
2. Fisher Controls Company
3. Mueller Company
4. Masoneilan
5. Watts Regulator Company
6. Wilkins Regulator
7. or approved equal

- G. Water Hammer Arresters

1. In-Line, factory-sealed shock arresters with direct action bellows and screwed connections: Provide an isolation valve upstream of each water hammer arrester.
2. J. R. Smith Hydrotrol, or equivalent of Wade, Josam or Zurn: Sizes selected to suit the number of fixture units and the piping length, in accordance with PDI certification with allowance for the piping lengths.

PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION OF PLUMBING PIPING AND SPECIALTIES

- A. Connection of copper tubing to steel or other metallic piping shall be made using insulating couplings or fittings such as to provide complete electrical isolation.
- B. Care shall be taken that copper tubing or fittings are not permitted to come in contact with steel or other metallic piping, reinforcing steel, or other steel at any location.
- C. Electrical checks shall be made between copper tubing and metallic elements to assure that isolation is maintained. Wherever electrical contact is demonstrated by such tests, the CONTRACTOR shall locate the point or points of contact and correct this condition.

- D. The CONTRACTOR shall coordinate the work of roughing-in, wall and floor sleeves, pipe inserts, cutting of roof and floor construction to receive piping. Pipes below ceilings shall be held as high as possible without interfering with other trades.

END OF SECTION

SECTION 22 11 19 - DOMESTIC WATER SPECIALTIES

PART 1 GENERAL

1.1 SCOPE

- A. This section covers the work necessary to furnish materials, labor, equipment and services necessary to provide domestic water specialties as shown on the drawings and specified herein.

1.2 QUALITY ASSURANCE

Install plumbing to meet requirements of local and state codes and provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.3 SUBMITTALS

Submittals shall include manufacturers certificate of conformance; certified copies of test reports; documentation on plumbing fixtures; fabrication drawings for roof flashing and counterflashing; layout showing type, spacing, maximum loads and materials for hangers and supports and manufacturer's warranty statements.

PART 2 PRODUCTS

2.1 PLUMBING SPECIALTIES

A. Strainers (Metal Body)

1. Equipment Requirements: Strainers shall be of the Y-pattern or basket type with flush connections, bronze bodies and screwed ends for sizes 3-inch and smaller; and cast iron with flanged ends for sizes greater than 3-inch. They shall be designed for not less than 250 psi working pressure in sizes 3-inch and smaller, and 125 psi working pressure in sizes over 3-inch. Strainers shall be of the same size as the entering pipe and the screens shall have a free area of not less than three times the cross-sectional area of the pipe.
2. Screens: Unless otherwise indicated or required by the service fluid, the screen shall be of Type 316 stainless steel or monel construction, easily-removable, with the following mesh or perforations:

<u>Strainer Size</u>	<u>Size of Perforations</u>
1/4- through 2-inch	20 mesh
2 1/2- through 5-inch	20 mesh
6- through 8-inch	1/8-inch diameter
over 8-inch	3/16-inch diameter

3. Strainers shall be Spriax-Sarco, Type BT and IF-125, or equal:

B. Pressure Gauges

Pressure gauges shall be 3-1/2-inch diameter with stainless steel case, polycarbonate glass window, stainless steel movement, blowout disc and 1/4-inch NPT stainless steel lower connection. Gauges shall be Ashcroft Type 1009, glycerine-filled, or approved equal. Supply gauges complete with 1/4-inch Type 1095 stainless steel gauge cock and Type 11125 pressure snubber of porosity designation E.

The CONTRACTOR shall select the range of the pressure gauge such that under normal operating conditions the gauge will read from 40 to 70 percent of full scale.

C. Displacement-Type Water Meters, 2-inches and Smaller

AWWA C700 rotating-disc totalization meter with bronze case, threaded end connections, and 150-psig minimum working pressure rating. Registration in gallons or cubic feet, as required by OWNER. Manufacturers: Sensus SR11

2.2 ELECTRIC TANKLESS WATER HEATERS

A. Staged, twin heating module: Flow switch activates heater only on demand. Unit shall have an adjustable precision temperature setting and turn on in stages: minimum flow 0.7 gpm and maximum flow 3 gpm. Wall mounted with 3/4" compression fittings at inlet and outlet, with replaceable filter at inlet fitting. Fittings located on bottom of unit. NEMA 4 enclosure. Heating elements shall be replaceable cartridge inserts. Elements shall be iron free, nickel chrome material.

B. Unit shall be Eemax "Series-Two™ TC" series or approved equal.

2.3 INSULATION

A. All hot-water piping valves and fittings, and all and cold-water piping valves and fittings located outside of a conditioned space, shall be provided with one-inch thick insulation.

B. All components of the insulation, including covering, mastics and adhesives shall have a flame spread rating of not over 25, and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. Insulation shall be applied in strict accordance with the manufacturer's instructions.

C. Pipe insulation shall be molded-type pipe covering made of fibrous glass with a minimum K-factor of 0.23 at 75°F mean temperature.

D. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of Kraft paper and aluminum foil laminated together and reinforced with fiberglass yarn.

Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with an acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports. Where insulation protection shields are provided, the top half section of pipe insulation at support locations shall be of the same specified density; and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb./cu. ft. All insulation shall be covered with smooth aluminum weatherproof metal or plastic performed jacketing with a factory-attached moisture barrier. The jacket for the fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum or PVC and all joints shall be sealed with silicon mastic or solvent welding to provide a continuous, air and weathertight joint. Strapping shall be 1/2-inch wide Type 3003 aluminum or stainless steel.

- E. Manufacturers, or Equal
 - 1. Armstrong Contracting and Supply Corporation
 - 2. Certain-Teed Corporation
 - 3. Manville
 - 4. Owens-Corning Fiberglass Corporation
 - 5. PPG Industries, Inc.

PART 3 EXECUTION

3.1 FIXTURE INSTALLATION

- A. The CONTRACTOR shall provide chrome-plated rigid or flexible supplies to fixtures with angle stops, reducers and escutcheons.
- B. All fixtures shall be installed and secured in place with wall supports, wall carriers, floor carriers and bolts.
- C. Fixtures shall be sealed to wall and floor surfaces with sealant as indicated in Section 07 92 00, Joint Sealants. Color shall match fixture.

3.2 PLUMBING SPECIALTIES INSTALLATION AND APPLICATION

- A. The CONTRACTOR shall coordinate the work of roughing-in, wall and floor sleeves, pipe inserts, cutting of roof and floor construction to receive pipes to required invert elevations. Pipes below ceilings shall be held as high as possible without interfering with other trades.

- B. The CONTRACTOR shall install all plumbing specialties in accordance with manufacturer's printed instructions to permit intended performance.

3.3 PIPING INSULATION INSTALLATION

Piping insulation shall be installed in strict conformance with the manufacturer's recommendations.

3.4 WATER HEATER INSTALLATION

- A. The CONTRACTOR shall install water heaters in accordance with manufacturer's printed instructions.
- B. All openings shall be sealed until pipe connections are made.
- C. Water heater shall be securely fastened to the wall using an approved anchor system.
- D. Installation shall be coordinated with plumbing, piping and related electrical work to achieve a fully functional system.
- E. Unit shall be flushed after installation.

END OF SECTION

SECTION 22 13 16 - SANITARY DRAIN AND VENT PIPING

PART 1 GENERAL

1.1 SCOPE

This section covers the work necessary to furnish materials, labor equipment and services necessary to provide all drain and vent piping, equipment and specialties for the plumbing system as shown on the drawings and specified herein.

1.2 QUALITY ASSURANCE

Install plumbing to meet requirements of local and states codes and provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.3 SUBMITTALS

Submittals shall include manufacturers certificate of conformance; certified copies of test reports; documentation on plumbing fixtures; fabrication drawings for roof flashing and counterflashing; layout showing type, spacing, maximum loads and materials for hangers and supports and manufacturer's warranty statements.

PART 2 PRODUCTS

2.1 PIPING

- A. For aboveground waste and vent piping 1-1/4-inch to 4-inch, use hubless, cast-iron soil piping.
 - 1. Heavy duty Type 304 stainless steel couplings: 3-inch-wide stainless steel shield with (4) stainless steel bands and ASTM C564 rubber sleeve.
 - 2. For flexible transition couplings for underground nonpressure piping, use ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
- B. PVC pipe for non-pressurized sanitary drain systems shall be manufactured from rigid polyvinyl chloride compounds conforming to ASTM D-1784, Class 12454-B. PVC pipe and fittings 4 inches to 15 inches in diameter shall meet the requirements of ASTM D-3034, SDR 35. PVC pipe 18 inches and larger in diameter shall conform to ASTM F-679, PS-46. Pipe shall have a minimum stiffness of 46 psi. Non pressurized PVC pipe joints shall be integral bell push-on type meeting the requirements of ASTM D-3212. Gaskets shall be rubber ring type meeting the requirements of ASTM F477. Rubber gaskets shall be factory installed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Each floor drain shall be connected to a trap primer.
- B. All sanitary drain and vent piping shall be installed in accordance with the applicable plumbing code.

3.2 PLUMBING SPECIALTIES INSTALLATION AND APPLICATION

- A. The CONTRACTOR shall coordinate the work of roughing-in, wall and floor sleeves, pipe inserts, cutting of roof and floor construction to receive drains and vents to required invert elevations. Pipes below ceilings shall be held as high as possible without interfering with other trades.
- B. The CONTRACTOR shall install all plumbing specialties in accordance with manufacturer's printed instructions to permit intended performance.
- C. Cleanouts shall be extended to finished floor or wall surface. Threaded cleanout plug shall be lubricated with mixture of graphite and linseed oil. The CONTRACTOR shall ensure sufficient clearance at cleanouts for rodding of drainage system.
- D. Exterior cleanouts shall be encased in concrete flush with pavement or they shall be extended to above finished grade in unpaved locations.

END OF SECTION

SECTION 22 13 19 - WASTE PIPE SPECIALTIES

PART 1 GENERAL

1.1 SCOPE

- A. This section covers the work necessary to furnish materials, labor, equipment and services necessary to provide waste pipe specialties as shown on the drawings and specified herein.

1.2 QUALITY ASSURANCE

Install plumbing to meet requirements of local and state codes and provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.3 SUBMITTALS

Submittals shall include manufacturers certificate of conformance; certified copies of test reports; documentation on plumbing fixtures; fabrication drawings for roof flashing and counterflashing; layout showing type, spacing, maximum loads and materials for hangers and supports and manufacturer's warranty statements.

PART 2 PRODUCTS

2.1 FLOOR DRAINS (STANDARD)

- A. Floor drains shall be of cast iron with sediment buckets. Floor drains shall be sized to match the outlet piping as shown on the plans.
- B. All floor drains will have a connection for a 3/8-inch copper line from the trap primer.
- C. Floor drains shall be JR Smith model 2490, Zurn Z511 or approved equal.

2.2 FLOOR DRAIN WITH INTEGRAL DUCK-BILL CHECK VALVE INSERT

- A. Floor drain shall have a heavy-duty cast-iron body and 9-inch strainer. The integral duck-bill check valve shall consist of an elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at the bottom.
- B. The duck-bill check valve shall open and adequately discharge floor drain wastewater through its interior and then closes and returns to original molded shape after wastewater discharge is complete. In the closed position, the insert shall prevent emission of sewer gas into the space without the need of a trap primer or p-trap. Insert shall be serviceable after installation.

- C. Floor drain shall be model Trap Guard by ProSet Systems or approved equal.

2.3 TRAP PRIMER VALVES

- A. Trap primers shall protect floor drains and hub drains connected to the sanitary sewer. Unless otherwise stated on the Drawings, 3/8-inch copper tubes shall be run from the primer valve or distribution unit to the traps of the floor drains and hub drains.
- B. Trap primer valves shall be of the automatic, self-drip, pressure-drop type. Trap primer valves shall operate within the pressure range of 20 psi to 80 psi. Valves shall automatically operate at pressure drops values as low as 3 psi. on pressure drop and incorporate vacuum breakers and 0-pressure safety seals. The manifold will have a valved distribution manifold to allow flow equalization to each trap.
- C. Distribution units that can prime up to four traps per unit shall be provided as necessary. Distribution units shall be by the same manufacturer as the primer valve.
- D. Primer valves shall be Jay R. Smith’s “Trap Defender” Figure 2694, ProFlow’s PFTP2500/PFTP3500, approved equal.

2.4 CLEANOUTS

- A. All cleanouts shall be heavy plugs with tapered shoulders against caulked lead or heavy brass plugs. Where underground or concealed, cleanouts shall be brought to floor level and to accessible locations with access covers and frames.
- B. Manufacturer’s, or Equal: The following cleanouts, or equal, shall be furnished:

	<u>Josam</u>	<u>J.R.Smith</u>	<u>Zurn</u>
Exposed locations	58500-20	4405	Z-1440-A
Underground	53010-30	4143	ZN-1400-2
Walls, concealed	58790-20	4535	ZN-1445-1-A
Traffic areas	56070	4240	Z-1420-27

2.5 TRENCH DRAINS

- A. Trench drain channels shall be made of precast polymer concrete with a minimum top width of 6 inches and radiused bottoms. Channels shall have a built-in 0.6 percent bottom slope.
- B. All channels shall interlock with tongue and groove connections with adjoining channels. Channels shall have knockouts for four (4) or 6-inch discharge lines.
- C. Each channel shall have four (4) horizontal anchoring ribs to mechanically lock the channel into the concrete floor slab.

- D. Channel grates shall be made of vinylester FRP, and shall be Extra Heavy Duty, H-20 rated, load class D, designed for severe point loads with a minimum proof load pressure of 490 psi. Grates shall include frames and shall be securely locked down with built in channel lock blocks. Locking mechanism shall be designed to provide an obstruction free trench for maintenance and cleaning.
- E. Trench channels shall be PolyDrain trench drain systems as manufactured by ABT, Inc, or approved equal. Channel grates and frames shall be PolyDrain model 2822, as manufactured by ABT, Inc, or approved equal.

PART 3 EXECUTION

3.1 FIXTURE INSTALLATION

- A. Each fixture shall be installed with trap, easily removable for servicing and cleaning, and vented in accordance with the applicable plumbing code.
- B. The CONTRACTOR shall provide chrome-plated rigid or flexible supplies to fixtures with angle stops, reducers and escutcheons.
- C. All fixtures shall be installed and secured in place with wall supports, wall carriers, floor carriers and bolts.
- D. Fixtures shall be sealed to wall and floor surfaces with sealant as indicated in Section 07 92 00, Joint Sealants. Color shall match fixture.

3.2 PLUMBING SPECIALTIES INSTALLATION AND APPLICATION

- A. The CONTRACTOR shall coordinate the work of roughing-in, wall and floor sleeves, pipe inserts, cutting of roof and floor construction to receive drains to required invert elevations. Pipes below ceilings shall be held as high as possible without interfering with other trades.
- B. The CONTRACTOR shall install all plumbing specialties in accordance with manufacturer's printed instructions to permit intended performance.
- C. Cleanouts shall be extended to finished floor or wall surface. Threaded cleanout plug shall be lubricated with mixture of graphite and linseed oil. The CONTRACTOR shall ensure sufficient clearance at cleanouts for rodding of drainage system.
- D. Exterior cleanouts shall be encased in concrete flush with pavement or they shall be extended to above finished grade in unpaved locations.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SCOPE

This section covers the work necessary to furnish materials, labor equipment and services necessary to provide all plumbing fixtures and specialties as shown on the drawings and specified herein.

1.2 QUALITY ASSURANCE

Install plumbing fixtures to meet requirements of local and states codes and provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.3 SUBMITTALS

Submittals shall include manufacturer's certificate of conformance; certified copies of test reports; documentation on plumbing fixtures; layout showing type, spacing, maximum loads and materials for anchors, hangers and supports and manufacturer's warranty statements.

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES

A. Sinks

1. Single Basin Hand Wash:

- a. Sinks shall be made from #20-gauge type 304 stainless steel.
- b. Full-length 7-inch high backsplash
- c. Exposed surfaces shall have a brushed finish
- d. Hand wash up sink, model CHS1716C complete with LK940GN04L2H chrome plated gooseneck spout faucet with aerator, LK8 drain fitting, and lk500 P-trap, as manufactured by Elkay, or approved equal.

B. Combination Emergency Shower and Eye/Face Wash

1. Materials:

- a. Frame: 1.25-inch IPS Schedule 40 hot-dipped galvanized steel pipe and fittings with powder-coated cast-iron floor flange.
- b. Valves: Stainless steel
- c. Strainer and filters: chrome-plated brass
- d. Eye/Fash wash: Chrome-plated brass swing-out valve body
- e. Showerhead: ABS plastic
- f. All components of the combination unit shall be supplied by a single manufacturer.

2. Eye/Face wash unit shall have a minimum of 3 gpm capacity. The shower unit shall have a minimum 22 gpm capacity. The maximum combined eye/face plus shower capacity shall be 26 gpm.

3. Eye/Face Wash: Axion MSR eye/face wash head providing an inverted directional laminar flow with integral flow control and an 11-inch diameter stainless steel round bowl.

4. Shower: ABS plastic showerhead with flow control, chrome-plated brass stay-open ball valve and chrome-plated brass in-line 50x50 mesh water strainer.

5. A thermostatic mixing valve, from the same manufacturer as the combination emergency shower and eye/face wash unit, shall automatically mix hot and cold water to maintain tepid water flow.

6. Manufacturers: Combination emergency shower and eye/face wash shall be model 8300-8309 as manufactured by Haws, or approved equal. Thermostatic mixing valves shall be model 9201E by Haws, or approved equal.

C. Plumbing Valves

1. Stop valves shall be installed for each water connection to all fixtures, except where the fitting has an integral stop valve. Stops shall be loose key, chrome plated.

PART 3 EXECUTION

3.1 FIXTURE INSTALLATION

- A. All fixtures shall be mounted to the following heights above finished floor:

Sinks	31 inches to top of basin rim
-------	-------------------------------
- B. Each fixture shall be installed with trap, easily removable for servicing and cleaning, and vented in accordance with the applicable plumbing code.
- C. The CONTRACTOR shall provide chrome-plated rigid or flexible supplies to fixtures with angle stops, reducers and escutcheons.
- D. All fixtures shall be installed and secured in place with wall supports, wall carriers, floor carriers and bolts.
- E. Fixtures shall be sealed to wall and floor surfaces with sealant as indicated in Division 7. Color shall match fixture.

3.2 PLUMBING SPECIALTIES INSTALLATION AND APPLICATION

- A. The CONTRACTOR shall coordinate the work of roughing-in, wall and floor sleeves, pipe inserts, cutting of roof and floor construction to receive drains to required invert elevations. Pipes below ceilings shall be held as high as possible without interfering with other trades.
- B. The CONTRACTOR shall install all plumbing fixtures in accordance with manufacturer's printed instructions to permit intended performance.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters
 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook
 3. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems
 4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure)
 5. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel
 - b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
 - c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
 - e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip
 - g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
 - h. A653/A653M, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

- i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment
 - j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process
 - k. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - l. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - m. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - o. C916, Standard Specification for Adhesives for Duct Thermal Insulation
 - p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
 - q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications
 - r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials
 - s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials
6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems
7. National Fire Protection Association (NFPA):
- a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
 - b. 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
 - c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

- d. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
 - e. 259, Standard Test Method for Potential Heat of Building Materials
 - f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- a. Duct Construction Standards
 - b. Guidelines for Seismic Restraints of Mechanical Systems
 - c. Fibrous Glass Duct Construction Standards
 - d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems
 - e. HVAC Air Duct Leakage Test Manual
9. Underwriters Laboratories Inc.(UL):
- a. 181, Standard for Safety Factory-Made Air Ducts and Connectors
 - b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films
 - c. 555, Standard for Safety Fire Dampers
 - d. 555S, Standard for Safety Smoke Dampers

1.2 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
- 1. CFM: cubic feet per minute
 - 2. FPM: feet per minute
 - 3. PCF: pounds per cubic foot
 - 4. WC: water column
- B. Sealing Requirements: For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:
- 1. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.
 - 2. Joints, duct surface connections including:
 - a. Girth joints
 - b. Branch and subbranch intersections
 - c. Duct collar tap-ins
 - d. Fitting subsections
 - e. Louver and air terminal connections to ducts
 - f. Access door and access panel frames and jambs

- g. Duct, plenum, and casing abutments to building structures

1.3 SUBMITTALS

A. Action Submittals:

1. Ductwork Product Data: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, hangers and supports, seam and construction details, and finishes.

- a. Ductwork Accessories: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes.

- #### B. Informational Submittals: Seismic anchorage and bracing drawings, cut sheets, and calculations as required by Section 13 05 41, Seismic Restraint Requirements for Non-Structural Components and Systems.

PART 2 PRODUCTS

2.1 GENERAL

- #### A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.
- #### B. Ductwork material shall be aluminum or galvanized steel, minimum thickness 24-gauge.
- #### C. Duct Sealants: Adhesives, cements, and sealants shall be as recommended by duct manufacturer for industrial applications.
- #### D. Ductwork Interior Surfaces:
1. Smooth
 2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.
 3. Seams and joints shall be external.

2.2 SHEET METAL MATERIALS

- A. Construct supply and exhaust duct systems from aluminum or galvanized steel construct odor control duct systems from stainless steel as specified herein.
- B. Galvanized Steel Ductwork:
 - 1. Comply with ASTM A653/A653M and ASTM A924/924M.
 - 2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel)
 - 3. Sheet Designation: CS Type B
 - 4. Applicable Specification: ASTMA653/A653M
 - 5. (Zinc) Coating Designation: G90
 - 6. Coating designation in accordance with Test Method A, ASTM A90/A90M and ASTM A924/A924M.
 - 7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.
 - 8. Provide sheet metal packaged and marked as specified in ASTM A700.
- C. Aluminum Ductwork:
 - 1. Comply with ASTM B209.
 - 2. Aluminum Sheet: Alloy 3003-H14, unless indicated otherwise.
 - 3. Aluminum Connectors and Bar Stock: Alloy 6061-T6, or equivalent.
- D. Stainless Steel Ductwork:
 - 1. Comply with ASTM A167, ASTM A176, ASTM A240/A240M, and ASTM A480/A480M.
 - 2. Stainless Steel Sheet: Type 316/316L, unless indicated otherwise.
 - 3. Gauge shall comply with SMACNA HVAC Industrial Duct Construction Standards manual, unless specified otherwise.
 - 4. Finish: No. 2 B (cold-rolled, bright) finish. Welds shall be grinded smooth and passivated.
 - 5. Longitudinal fusion welded butt seam, flanged fittings, and joints with all seams welded.

6. Elbows: Provide centerline equal to radius 1-1/2 times elbow diameter.
7. Fittings: Continuously welded along seams.
- E. Exposed Ductwork: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.
- F. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.3 DUCT SEALING MATERIALS

- A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.
- C. Solvent-Based Sealants:
 1. Ultraviolet light resistant
 2. Mildew resistant
 3. Flashpoint: Greater than 70 degrees Fahrenheit (F), SETACC.
 4. Manufacturers and Products:
 - a. Hardcast, Inc.; Versagrip 102
 - b. Rectorseal; AT-33
 - c. Childers CP-140
- D. Water-Based Sealants:
 1. Listed by manufacturer as nonflammable in wet and dry state.
 2. Manufacturers and Products:
 - a. Foster; Series 32
 - b. Childers; CP-145A, 146
 - c. Rectorseal; Airlok 181
- E. Do not use silicone sealants at odor control ducting. Instead, utilize expanded Teflon (Gortex), or a Hypalon product.

2.4 DUCTWORK FASTENERS

A. General:

1. Rivets, bolts, or sheet metal screws.
2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.

B. Self-Drilling Screws:

1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.
2. Aluminum Ductwork System:
 - a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated Type 410 stainless steel, complete with bonded metal and fiber washer for dielectric separation.
 - b. Manufacturers:
 - 1) DB Building Fasteners Inc., Santa Fe Springs, CA
 - 2) Clark Craft Fasteners, Tonawanda, NY
3. Stainless Steel Ductwork System:
 - a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated, Type 410 stainless steel.
 - b. Manufacturers:
 - 1) DB Building Fasteners Inc., Santa Fe Springs, CA
 - 2) Clark Craft Fasteners, Tonawanda, NY

2.5 DUCTWORK PRESSURE CLASS

A. Construct duct systems to pressure classifications indicated as follows:

1. Supply Ducts: 3-inch WC
2. Return Ducts: 2-inch WC, negative pressure
3. Exhaust Ducts: 2-inch WC, negative pressure

B. Where no specific duct pressure designations are indicated in Specifications or on Drawings, 2-inch WC pressure class shall be basis of Contract.

2.6 RECTANGULAR DUCTWORK

- A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.7 RECTANGULAR DUCTWORK FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- B. Elbows:
 - 1. Fit square-turn elbows with vane siderails.
 - 2. Shop fabricate double blade turning vanes of same material as ductwork.
 - 3. Fabricate with equal inlet and outlet.
 - 4. Rectangular radius elbows with inside radius of $\frac{3}{4}$ of duct width in direction of turn.
 - 5. Manufacturers and Products:
 - a. Elgen; All-Tight
 - b. Duro-Dyne; Type TR

2.8 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

- A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.9 RIGID ROUND DUCTWORK

- A. Construct rigid round ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.
- B. Basic Round Diameter: As used in this Article, is inside diameter of size of round duct.
- C. Where space limitations prevent use of round duct or where shown on Drawings, provide ductwork of flat oval construction hydraulically equivalent to round ductwork.

- D. Fabricate round ducts with spiral seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams.
- E. Ductwork seams of Snaplock type shall not be used.

2.10 RIGID ROUND DUCTWORK FITTINGS

- A. Construct rigid round ductwork fittings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless otherwise specified.
- B. 90-Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA manual with metal thicknesses specified for longitudinal seam straight duct.
- C. Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- D. Elbows:
 - 1. Fabricate in stamped (die-formed), pleated, or segmented (gored) construction 1-1/2 times elbow diameter. Two-piece segment elbows are not allowed, except with turning vanes.
 - 2. Segmented Elbows: Fabricate with welded construction.
 - 3. Round Elbows 8 Inches and Smaller:
 - a. Stamped elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 3-1/2 inches and 4-1/2 inches) elbows with segmented construction.
 - 4. Round Elbows 9 Inches Through 14 Inches:
 - a. Segmented or pleated elbows for 30, 45, 60, and 90 degrees.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 9-1/2 inches and 10-1/2 inches) elbows with segmented construction.

2.11 DUCTWORK FLEXIBLE CONNECTIONS

- A. General:
 - 1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.

2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.
 3. Comply with NFPA 90A and NFPA 90B requirements.
 4. Airtight and waterproof.
- B. Materials:
1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.
 3. Fabric:
 - a. Comply with NFPA 701 or UL 214 (except Teflon coated)
 - b. Woven polyester or nylon
- C. Construction:
1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.
 2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.
 3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.
 4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheet metal.
- D. Manufacturers:
1. Ductmate; PROflex, Commercial
 2. Ventfabrics
 3. Duro-Dyne

2.12 DUCTWORK HANGERS AND SUPPORTS

- A. General:
1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.
 2. Duct hanging system shall be composed of three elements: upper attachment to building, hanger itself, and lower attachment to duct.

3. Wire hangers are not acceptable.
4. Hanger Spacing:
 - a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
 - b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.
- B. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:
 1. Of same material as ductwork.
- C. Building Attachments:
 1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.
 2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
 3. Upper Attachment (Concrete):
 - a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.
 - b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.
 - c. Concrete attachments shall be made of steel.
- D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article Ductwork Fasteners.
- E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

2.13 DOUBLE WALL DUCTWORK

- A. Provide double wall ductwork at odor control ductwork passing through the liquid phase odor control room where indicated on Drawings.
- B. Materials of Construction: Type 316 stainless steel for inner duct and type 304 stainless steel for outer duct.

- C. Joining Method: Inner duct shall be joined using flanges and Vee Band with appropriate joint sealant suitable to withstand 10-percent sulfuric acid. Outer duct shall be joined using channel band with joint sealant. Both inner duct and outer duct joints shall be airtight.
- D. Annular space to be air insulated.
- E. Duct gauge thickness as specified herein.
- F. Provide manufacturer's standard gasketed flexible connection.
- G. Manufacturers and Products:
 - 1. Selkirk Model 12PS316/304
 - 2. Or equal

2.14 MANUAL DAMPERS

- A. Butterfly Manual Dampers:
 - 1. Frame: 1-1/2-inch by 10-gauge.
 - 2. Blade: 1/4-inch thick.
 - 3. Elastomer type full circumference seal. Seal fastened to blade with bolted retainer ring.
 - 4. Bearings: Grease lubricated ball bearings mounted outboard of frame with adjustable packing gland shaft seals.
 - 5. Materials of construction: Type 316 stainless steel
 - 6. Hand quadrant operator.
 - 7. Maximum System Pressure: 20 inches WC.
 - 8. Leakage: 1.1 cfm for 12-inch damper based on a pressure differential of 10 inches WC.
 - 9. Damper Manufacturer and Model:
 - a. Ruskin CDR192
 - b. Greenheck HCDR-351
 - c. Or equal.

B. Aluminum, Counterbalanced, Standard Duty:

1. Fabrication:

- a. Frame: 3 inches by minimum 0.09-inch, 6063-T5 extruded aluminum channel with front flange and rear flange and mitered corners.
- b. Blades:
 - 1) Style: Single piece, overlap frame
 - 2) Action: Parallel
 - 3) Material: Minimum 0.025-inch (0.6-millimeter) 6063-T5 formed aluminum.
 - 4) Width: Maximum 6 inches (152 millimeters).
- c. Bearings: Corrosion-resistant, long-life, synthetic, formed as single piece with axles.
- d. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
- e. Linkage: Concealed in frame.
- f. Axles: Corrosion-resistant, long-life, synthetic, locked to blade and formed as single piece with bearings.
- g. Finish: Mill aluminum.

2. Performance Data:

- a. Temperature Rating: Withstand minus 40 degrees to 200 degrees F (minus 40 degrees to 93 degrees Celsius (C)).
- b. Maximum Back Pressure: 1-1/2-inch WC or 55 miles per hour (MPH) external wind.
- c. Maximum Spot Air Velocity: 1,000 fpm (5 meters per second (mps)).
- d. Operation of Blades:
 - 1) Start to Open: 0.03-inch WC
 - 2) Fully Open: 0.1-inch WC
- e. Pressure Drop: Maximum 0.04-inch WC (0.01 kilopascal (kPa)) at 1,000 fpm (305 meters per minute (mpm)) through 24-inch by 24-inch (610-millimeter by 610-millimeter) damper.

3. Accessories:
 - a. Duct Transition Connection: Rectangular.
 - b. Factory Sleeve: Minimum 20-gauge (1.0-millimeter) thickness, minimum 12-inch (305-millimeter) length.
 - c. Screen:
 - 1) Type: Bird
 - 2) Location: Rear with sleeve
 - 3) Material: Aluminum
4. Manufacturers and Products:
 - a. Ruskin; Model BD2A1
 - b. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.
 2. Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.
 3. Joints and seams shall be sealed watertight.
 4. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
 5. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.
- B. Ductwork Location:
 1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.
 2. Avoid diagonal runs wherever possible.

3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.
 4. In general, install as close to bottom of structure as possible.
 5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.
 6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.
- C. Penetrations:
1. Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls, and ceilings.
 2. Clearances:
 - a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.
 - b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.
 3. Closure Collars:
 - a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.
 - b. Fit collars snugly around ducts and insulation.
 - c. Same gauge and material as duct.
 - d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.
 - e. Use fasteners with maximum 6-inch centers on collars.
 4. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.

D. Coordination with Other Trades:

1. Coordinate duct installation with installation of louvers, dampers, and ductwork accessories.
2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on Drawings.
3. Coordinate ductwork layout to avoid interference with lighting, bridge crane, suspended ceiling, tanks, generator, electrical panels, and all process equipment.

3.2 RECTANGULAR DUCTWORK

A. General:

1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.
2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.

B. Low Pressure Taps:

1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct-tap with a gasket or sealed with sealant as specified for medium pressure ductwork.
2. Determine location of spin-in after outlet location is determined.
3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.

C. Fittings:

1. Use bell-mouth or conical tee fittings for round duct takeoffs from rectangular mains.
2. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.
3. Make offsets with maximum angle of 45 degrees.
4. Use fabricated fittings for changes in directions, changes in size and shape, and connections.

D. Rectangular Ductwork Transverse Joints:

1. Install each run with a minimum of joints.

2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
3. Mechanical Joint Option:
 - a. Construct transverse joints with Ductmate 25/35 duct connector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.
 - b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.
 - c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.
 - d. For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.
 - e. Conform to SMACNA Class A sealing requirements.

3.3 RIGID ROUND OR OVAL DUCTWORK

A. General:

1. Round ductwork may be substituted in place of rectangular ductwork at locations approved by the Owner. Obtain written approval from the Owner prior to substituting round for rectangular ductwork.
2. Round ductwork shall be installed in lengths as long as possible to minimize joints.

B. Rigid Round or Oval Ductwork Joints:

1. Rigid round ductwork joints shall be in accordance with SMACNA, unless otherwise specified.
2. Single and Double Wall Supply and Return System Joints:
 - a. Less than 36 Inches: Slip coupling.
 - b. 36 Inches and Larger: Flanged connector, Van Stone, or welded companion flange type.

3. Single and Double Wall Exhaust and Return System Joints:
 - a. Spiral Seam Duct: Welded flanged connector.
 - b. Longitudinal Seam Duct: Van Stone flange connector.

3.4 FLEXIBLE CONNECTIONS

- A. Flexible Collars and Connections:
 1. Use between fans and ducts.
 2. For round ducts, securely fasten flexible connections by zinc-coated steel clinch-type drawbands.
 3. For rectangular ducts, lock flexible connections to metal collars.

3.5 DUCTWORK HANGERS AND SUPPORTS

- A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.
- B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.
- C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- E. Support vertical ducts at maximum interval of 16 feet and at each floor.
- F. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load but are not limited to specific methods indicated.
- G. In new construction, install concrete insert prior to placing concrete.

3.6 DUCT SEALING

- A. Seal duct seams and joints as follows:
 1. In accordance with SMACNA requirements.
- B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.
- C. Provide additional duct sealing as required to comply with Article Ductwork Leakage Testing.

D. Seal all audible leaks.

3.7 DUCTWORK LEAKAGE TESTING

A. General:

1. Tests shall be conducted on completed ductwork systems.
2. Testing of partial installations or limited sections of ductwork will not be acceptable.
3. All ductwork leakage test procedures and results shall be submitted to ENGINEER for review.
4. ENGINEER shall retain the right to witness some or all ductwork leakage testing procedures.
5. Subcontractor shall notify ENGINEER in writing at least 5 working days prior to ductwork testing.

B. Leakage Criteria:

1. Assemble and install ductwork with maximum leakage limited as follows:
2. Odor Control Systems:
 - a. Odor Control Ductwork:
 - 1) Operating Pressure: 0- to 2-inch WC.
 - a) Allowable Leakage: 2 percent of design airflow.
 - 2) Operating Pressure: 3-inch and over WC.
 - a) Allowable Leakage: 1 percent of design airflow.

C. Leakage Testing Method:

1. Subcontractor shall be responsible for providing all necessary test fans and calibrated measuring devices to accomplish ductwork leakage test and to demonstrate that ductwork systems leakage rate is less than maximum rate specified.
2. Pressure testing shall be accomplished using a pressure blower with a calibrated orifice and manometer.
3. Blower shall maintain SMACNA construction pressure classification during test.

4. Perform testing in accordance with procedures given in SMACNA HVAC Air Duct Leakage Test Manual.

3.8 BALANCING OF AIR SYSTEMS

- A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.9 CLEANING

- A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.
- B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.
- C. If duct systems are found to contain construction debris at time of construction completion Subcontractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

END OF SECTION

SECTION 23 34 00 - HVAC FANS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Acoustical Society of America (ASA)
2. Air Movement and Control Association International (AMCA)
3. American Bearing Manufacturers Association (ABMA)
4. ASTM International (ASTM)
5. National Electrical Manufacturers Association (NEMA)
6. Occupational Safety and Health Act (OSHA)
7. Underwriters Laboratories Inc. (UL)

1.2 SUBMITTALS

A. Action Submittals: Provide for all products specified, as follows:

1. Unit tag number or equipment identification as referenced in Contract Documents.
2. Manufacturer's name and model number.
3. Descriptive specifications, literature, and drawings.
4. Dimensions and weights.
5. Fan sound power level data (reference 10 to power minus 12 Watts) at design operating point.
6. Fan Curves:
 - a. Performance Curves Indicating:
 - 1) Relationship of flow rate to static pressure for various fan speeds.
 - 2) Brake horsepower curves.
 - 3) Acceptable selection range (surge curves, maximum revolutions per minute, etc.).
 - 4) Static pressure, capacity, horsepower demand, and overall efficiency required at the duty point, including drive losses.
7. Capacities and ratings.

8. Construction materials.
 9. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
 10. Wheel type, diameter, revolutions per minute, and tip speed.
 11. Motor and Power Data: Refer to Section 26 29 00, Motors and Controls.
 12. Manufacturer's standard vibration isolation accessories.
 13. Factory finish system.
- B. Informational Submittals:
1. Recommended procedures for protection and handling of products prior to installation.
 2. Manufacturer's installation instructions, including seismic anchorage and bracing requirements.
 3. Factory test reports.
 4. Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 FAN DRIVES

- A. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.
- B. Shaft Guard:
1. Provide shaft guard for each fan and drive not housed in its own fan enclosure.
 2. Shaft guards shall be easily removable and enclose entire drive assembly, meeting federal and OSHA requirements.
 3. Guard faces shall be constructed of expanded metal having minimum 60 percent free area for ventilation.

2.2 FINISHES

- A. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
1. Parts cleaned and chemically pretreated with a phosphatizing process.
 2. Alkyd enamel primer.

3. Air-dry enamel topcoat.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.

2.3 DIRECT DRIVE BACKWARD INCLINED CENTRIFUGAL FANS

A. General Description:

1. Fans shall be direct driven backward inclined centrifugal fans.
2. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius).
3. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.
4. Fans shall be listed by Underwriters Laboratories (UL 705) and bear the AMCA Certified Ratings Seal for Sounds and Air Performance.
5. All steel fan components shall be coated with an electrostatically applied baked polyester powder coating. Each component shall be subject to a five-stage environmentally friendly wash system, followed by a minimum 2-mil thick baked powder finish.

B. Wheel:

1. Propeller shall be aluminum blade riveted to steel hub.
2. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft.
3. Statically and dynamically balanced in accordance with AMCA Standard 204-05.
4. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

C. Motors:

1. Motor shall be a DC electronic commutation type motor.
2. Motor shall be a NEMA design B with class B insulation rated for continuous duty.
3. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
4. Motor shall be speed controllable down to 20% full speed. Speed shall be controlled be either a potentiometer dial mounted at the motor or a 0-10 VDC signal.

5. Motor shall be a minimum of 85% efficient at all speeds.
 6. Motors are permanently lubricated seal bearings, matched to the fan load, with voltage and phase as shown on the Drawings.
 7. Motor shall be accessible for maintenance.
- D. Drive Frame:
1. Drive frame assemblies and fan panels shall be galvanized steel.
 2. Drive frame shall have welded wire or formed channels and fan panels shall have pre-punched mounting holes, formed flanges and a deep formed one-piece inlet venture.
- E. Disconnect Switches:
1. NEMA rated: 4X
 2. Positive electrical shut-off
 3. Wired from fan motor to junction box
 4. Dampers:
 - a. Type: Gravity
 - b. Prevents outside air from entering back into the building when fan is off
 - c. Balanced for minimal resistance to flow
 - d. Galvanized frames with pre-punched mounting holes
 5. Dampers Guards:
 - a. Guard material: Galvanized
 - b. Shall completely enclose the damper or wall opening on the discharge side of the fan.
- F. Controls
1. Provide manual speed control
- G. Hazardous Duty
1. Environment will be NFPA Class 1, Division 2.
 2. Fan shall be Spark B resistant construction per AMCA 99-0401.
- H. Manufacturers and Products:
1. Greenheck; SQ-VG.

2. Or approved equal

2.4 BELT-DRIVEN INLINE CENTRIFUGAL FANS

A. General Description:

1. Fans shall be duct mounted, belt driven centrifugal square inline. Provide belt guards for all fans.
2. Sidewall mounted applications
3. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius).
4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.
5. Fans shall be listed by Underwriters Laboratories (UL 705) and bear the AMCA Certified Ratings Seal for Sounds and Air Performance.
6. All steel fan components shall be coated with an electrostatically applied baked polyester powder coating. Each component shall be subject to a five-stage environmentally friendly wash system, followed by a minimum 2-mil thick baked powder finish.

B. Wheel:

1. Propeller shall be aluminum blade riveted to steel hub.
2. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft.
3. Statically and dynamically balanced in accordance with AMCA Standard 204-05.
4. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

C. Motors:

1. Motor shall be NEMA design B with class B insulation rated for continuous duty. enclosures: Totally enclosed fan cooled
2. Motors are permanently lubricated seal bearings, matched to the fan load,, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at 120 voltage and single phase with voltage and phase as shown on the Drawings.
3. Accessible for maintenance.

D. Drive Frame:

1. Drive frame assemblies and fan panels shall be galvanized steel.
2. Drive frame shall have welded wire or formed channels and fan panels shall have pre-punched mounting holes, formed flanges and a deep formed one-piece inlet venturiventure.

E. Disconnect Switches:

1. NEMA rated: 4X
2. Positive electrical shut-off
3. Wired from fan motor to junction box
4. Dampers:
 - a. Type: Gravity
 - b. Prevents outside air from entering back into the building when fan is off
 - c. Balanced for minimal resistance to flow
 - d. Galvanized frames with pre-punched mounting holes
5. Dampers Guards:
 - a. Guard material: Galvanized
 - b. Shall completely enclose the damper or wall opening on the discharge side of the fan.

F. Manufacturers and Products:

1. Greenheck; BSQ.
2. Or approved equal

2.5 MOTORS GENERAL

A. General:

1. Provide integral self-resetting overload protection on single-phase motors.
2. Motors shall not operate into service factor in any case.

B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:

1. Electrically commutated, permanent magnet type
2. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily
3. Solid state electronics

4. Shaft Type: Solid, carbon steel
5. Mounting: As required for fan arrangement

2.6 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch high engraved or die-stamped block type equipment identification number and letters indicated in this Specification and as shown on Drawings. All units shall include factory installed permanently attached nameplate displaying unit model and serial number.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.
- C. Provide wall-mounted thermostat(s) in accordance with the HVAC schedules in the Drawings for control of fans and motorized louvers. Thermostats shall use 120VAC single phase voltage or control voltage (24VDC), whichever is more appropriate and compatible with the fans supplied. Locate all thermostats 5 feet above finished floor in the approximate location shown on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fans level and plumb.
- B. Labeling: Label fans in accordance with Article Accessories.
- C. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
- D. Connections:
 1. Refer to Section 23 31 13, Metal Ducts and Accessories.
 2. Isolate duct connections to fans.
 3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Functional Tests:
 1. Verify blocking and bracing used during shipping are removed.
 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.

3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 4. Verify that cleaning and adjusting are complete.
 5. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 6. Verify lubrication for bearings and other moving parts.
 7. Verify manual and automatic volume control and dampers in connected ductwork are in fully open position.
- B. Performance Tests:
1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.3 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

END OF SECTION

SECTION 23 82 39 - CONVECTIVE UNIT HEATERS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provisions of Division 23 Heating, Ventilation and Air Conditioning apply to this section.

1.2 DESCRIPTION

- A. Work in this section includes self-contained heating units such as unit heaters, convectors, finned pipe units, cabinet heaters, and radiant heaters.

1.3 REGULATORY AGENCIES

- A. All work shall be in conformance with the requirements of the applicable codes.

1.4 REFERENCE STANDARDS

- A. The publications of the organizations listed below form a part of this specification to the extent referenced.
 - 1. National Electrical Manufacturers Association (NEMA)
 - 2. Underwriters Laboratories (UL)

1.5 SUBMITTALS

- A. Product Data
 - 1. Electric Unit Heaters

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers:
 - 1. Qmark, MUH Pro Series
 - 2. Chromalox, LUH
 - 3. Approved Equal
- B. Unit heaters shall be electric coil, horizontal blow type with propeller fan, size and capacity as scheduled
- C. Heaters shall be completely factory wired and assembled, with all required electrical power devices and accessories, including automatic re-setting overheat control, wall

bracket, contactors, fuses, transformer, and terminal blocks. Unit shall be UL approved.

- D. Heater shall be a convective type, providing its own airflow as necessary for the heating capacity. Heating capacity shall be as shown on the Drawings.
- E. Heater shall be protected from air flow failure so heater is inoperative unless fan is running.
- F. Heater shall be wall mounted using the supplier's wall mounting bracket.
- G. Controls: Heater shall have a 24V transformer and shall be controlled by a low voltage, external, digital thermostat.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment and accessories shall be installed with required clearances from combustible surfaces. Provide a minimum of 36" clearance in front of the electrical access panel.
- B. Install heaters suspended by four, 3/8" steel threaded rod supports from roof structure or secure anchor heaters to wall.
- C. When using an non-integral thermostat, install thermostat outside the heater's direct fan exhaust path to avoid on/off cycling.

END OF SECTION

SECTION 25 32 11

SEISMIC PROTECTION SYSTEMS

PART 1 GENERAL

1.1 SCOPE

- A. This Section includes furnishing and installing the seismic protection system for reservoir isolation valves, including the seismic control panel and seismic controller as specified herein and shown on the Drawings.
- B. Section Includes:
 - 1. Control panel.
 - 2. Seismic sensor/switch.

1.2 RELATED SECTIONS

- A. Section 25 32 13 - Integrated Operation Actuators and Operators.
- B. Division 26 - Electrical.
- C. Section 40 05 23.18 - Butterfly Valves.

1.3 MANUFACTURER'S REPRESENTATIVE

- A. Manufacturers of seismic protection system shall have a minimum of 10 years manufacturing experience and installed units.
- B. The seismic protection system Supplier shall furnish the service of a qualified manufacturer's representative to supervise the installation, start-up and field testing of the equipment. A qualified manufacturer's representative shall be one who is trained and certified by the manufacturer and who has at least two years' experience in the installation of the types of equipment specified for this Project.
- C. Seismic protection system manufacturer shall coordinate with butterfly valve manufacturer to verify the seismic actuator supplied will close the butterfly valve under line break conditions of 25 feet per second (fps).
- D. A representative of the manufacturer of the seismic monitor shall provide start-up services and training in the operation and maintenance of the equipment.

1.4 SUBMITTALS

- A. In accordance with Section 13 30 00, Submittal Procedures.
- B. Component and attachment testing seismic certificate of compliance.

- C. An installation and operation certification and a statement from the manufacturer as outlined above.
- D. Explanation to tripping point of seismic sensor.
- E. Sample test certification for seismic sensor.
- F. Complete operations and maintenance information for all equipment and accessories, include manufacturer's warranties.
- G. Shop drawings including:
 - 1. Complete specifications, descriptive drawings, wiring schematics for each unit along with wiring diagram for complete seismic system layout, and literature of the equipment and appurtenances.
 - 2. Third-Party Testing Certification for seismic sensor and motorized actuator's torque.
 - 3. Operations and Maintenance Information, including parts lists for each piece of equipment, shall be submitted for all materials and equipment furnished under this and related Sections.
- H. At the completion of the installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1. Certification letter signed by the manufacturer's representative stating the following as a minimum:
 - a. All required installation manuals were provided to the equipment installer with the equipment.
 - b. The installation is as specified and is acceptable to the manufacturer.
 - c. The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.
 - 2. Certification letter signed by the equipment installer stating the following as a minimum:
 - a. The installation and operations manuals were received with the equipment and appurtenances.
 - b. The installer has read the manufacturer's recommended installation procedures.

- c. The equipment and appurtenances were installed in strict conformance with the Specification requirements and the manufacturer's recommended installation procedures. Any variances shall be noted.

1.5 ELECTRICAL AND CONTROLS COORDINATION

- A. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring or conduit for the equipment must be increased from that shown on the Electrical Drawings, the Contractor shall furnish and install the larger items. The increased wiring and conduct shall be provided at no additional cost to the Owner.
- B. All electrical, instrumentation, and control equipment and panels furnished under this Section shall conform to appropriate Sections of these Specifications. Equipment and panels shall be NEMA 4X unless otherwise specified or designated on the Drawings.
- C. Manufacturer of seismic protection systems to coordinate with actuator manufacturer as to the motor control interface.

1.6 WARRANTY

- A. All seismic protection system equipment shall be warranted for a period of five (5) full years from the date of installation inspection by the manufacturer's representative.
- B. The manufacturer shall test the calibration of the seismic sensing device within sixty (60) days prior to the warranty expiration date.

PART 2 PRODUCTS

2.1 SEISMIC MONITOR RESERVE POWER & VALVE CONTROL PANEL

- A. The Seismic Monitor Valve Control panel shall be housed in a single enclosure as a stand-alone system.
- B. A control switch shall be provided for each valve to enable manual manipulation of each valve actuator connected. Indicating lights shall be provided to indicate open/close status for each valve. A fault indicator contact shall be provided to report on the following system status: Loss of AC power, AC fuse blown, actuator circuit breaker trip, and Short fault protection.
- C. Following a seismic activation ("Seismic Trip"), control circuitry shall hold valve system in closed position until reset by operator.
- D. Terminal connectors shall be provided for connection to the RTU. The panel shall provide N/O dry contacts for the valve for indication of Valve Opened and Valve Closed

statuses as well as N/O dry contacts for Seismic System Armed, and Seismic Trip as minimum indications. Contacts shall be rated 5 amps at 24 VDC.

- E. Power Requirements: 120 VAC, 60 Hz. Consumption; 40 VA. Control outputs 24 VDC, Dry Contact, user selectable N/O or N/C contacts. Control relays remain latched following seismic activation until reset by operator.
- F. Physical Enclosure: NEMA 4X fiberglass with security locks and supports as recommended by the manufacturer. Operating temperature, minus 4F to plus 158F. Control relays at 10-amp capacity. The indicating and control devices shall be mounted behind the enclosure door to prevent unwanted operation. No indicating devices or controls shall be accessible with the enclosure door closed. The enclosure door shall be provided with a recessed padlock hasp to secure the door.
- G. Seismic Sensor/Switch:
 - 1. The sensor shall sense tri-axial movement reacting to ground motion in the X, Y, and Z-axis.
 - 2. Band pass filter equipped to preclude response to industrial vibrations (earthquake specific response) shall be provided.
 - 3. Sensor setpoints shall be factory set to CCR Part 12, Title 24 compliance unless otherwise specified.
 - 4. Each sensor shall have a manual trip button and manual arm (Reset) button to test sensor.
 - 5. Each sensor shall have the ability to be remotely tripped and/or reset to test sensor.
 - 6. The sensor shall be factory tested and certified at the manufacturing plant prior to shipment.
 - 7. Each sensor shall receive three (3) printouts showing that sensor trips at the appropriate set point in all three axes while not affected by vibrations of 10Hz. Each certification shall be signed and dated by inspecting party.
 - 8. Sensor design shall have been tested and certified by Third Party National Testing Facility not affiliated with manufacturer. Certification shall accompany submittals.
- H. Manufacturer/Model:
 - 1. Seismic monitor and valve controller panel shall be model "FL201-1SA" as manufactured by FLO-LOC Seismic Protection Systems.

- I. Seismic Protection System shall be tested or analyzed in compliance with section 1708.4 of the IBC.
- J. Seismic Protection System shall be certified in accordance with section 1705, Mechanical and Electrical Components of the IBC.

PART 3 EXECUTION

3.1 GENERAL

- A. All mechanical portions of the installation shall comply with Drawing details, the requirements outlined below, the manufacturer's latest recommendations and the best practices of the industry.

3.2 INSTALLATION

- A. Carefully handle and protect the equipment and appurtenances.
- B. Prior to installation, review all installation manuals provided with the equipment.

3.3 INSPECTION START-UP AND FIELD TESTING

- A. The Contractor shall furnish a representative of the seismic monitor manufacturer and the actuated control valve manufacturer to perform inspection, start-up and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- B. The manufacturer's representatives shall check the installation and supervise initial startup of the equipment. They shall certify that the installation is correct, and that the equipment has operated satisfactory.
- C. After the installation, the operation of the equipment has been certified, the manufacturer's representatives shall train the Owner's personnel for one 8-hour day in the proper operation and maintenance of the equipment.

3.4 FUNCTIONAL TESTING OF SEISMIC OUTPUT

- A. Following installation of entire system, a manual test shall be performed to verify control relay closure.

END OF SECTION

SECTION 25 32 13 - INTEGRATED OPERATION ACTUATORS AND OPERATORS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section includes materials, installation, and testing of electric motor actuators and operators for those butterfly valves as shown in the Drawings.

1.2 RELATED SECTIONS

- A. Section 25 32 11 - Seismic Protection Systems.
- B. Division 26 - Electrical.
- C. Section 40 05 23 - Common Work Results for Process Valves.
- D. Section 40 05 23.18 - Butterfly Valves.

1.3 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) through 72 In. (1,800 mm).
 - 2. C542, Electric Motor Actuators for Valves and Slide Gates.

1.4 SUBMITTALS

- A. Supplier's Catalog Data:
 - 1. Motor actuator and gear operator parts and materials of construction, referenced by AISI, NEMA, ASTM, SAE, or CDA specification and grade.
 - 2. Motor actuator and gear operator dimensions and weights.
 - 3. Coatings.
- B. Motor Data:
 - 1. Nameplate data, insulation type, output torque, voltage, phases, frequency, current at running torque and locked rotor, duty rating, and OPEN/CLOSE travel time.
- C. OPEN/CLOSE travel and cycle times.
 - 1. Travel time is defined as CLOSE to OPEN or OPEN to CLOSE time. A cycle is defined as CLOSE to OPEN and back to CLOSE.

- D. Electrical schematic drawings and physical wiring diagrams showing all components and actual terminal numbering.
- E. Certified factory performance test records: Including written cycle test results as specified in Article Factory Testing of Motor Actuator.
- F. Drawings of the electrical components enclosure: Physical layout in three dimensions or multiple views.
- G. Information showing the relationship between the operator output torque and torque limit switch settings.
- H. Calculations to substantiate the selection of the proposed electric actuator operator model.
- I. Provide torque calculations that meet torque requirements for all actuators as specified herein.
- J. Detailed specification of replacement motors, including part numbers and vendors.
- K. Warranty certification, from actuator supplier, that actuator meets or exceeds specified requirements.
- L. Operation and Maintenance Manual: One electronic copy and three hard-copy notebooks. Manual shall, at a minimum, provide:
 - 1. Complete installation instructions.
 - 2. Operating and maintenance instructions.
 - 3. Complete parts list.
 - 4. Part change out instructions.
 - 5. Theory of operation of the actuator and intermediate gearing.
 - 6. Expanded parts drawings, showing all mechanical and electrical parts.
 - 7. Electrical schematic drawings and physical wiring diagrams showing all components including interconnection wiring point to point diagrams, power and control diagrams for each actuator.
 - 8. Drawings of the electrical components enclosure (physical layout in three dimensions or views).
 - 9. List of recommended spare parts.

10. List of special tools for installation, maintenance, and adjustments.
 11. Lubrication guide with list of recommended lubricants.
 12. Programming settings of each actuator by valve name.
 13. Complete updated actuator schedule and valve actuator data/test sheet provided with all the information identified in Supplement Valve/Actuator Data/Test Sheet for each actuator/valve.
- M. Copies of factory training certification, from the actuator supplier, for any maintenance or installation technicians. Training certifications shall be specific to the models that will be installed under this Contract. Certificates must be approved by the Owner before technicians are authorized to perform any work on the valve actuators.
- N. Provide third party testing and FM approval certification for all actuators operating continuously for a minimum of 30 minutes or for a full duty cycle, whichever is greater. A full duty cycle is defined as stroking the valve from a full closed position to full open position, and back to the full closed position without interruption.
- O. Provide actuator programmed settings for each actuator that meet the manufacturer operating requirements for the specific valve the actuator will be provided with.
- P. For each electric motor actuator installed, provide certificate of proper installation from actuator manufacturer's representative.
- Q. Seismic anchorage & bracing drawings and cut sheets as required or recommended by the manufacturer.

1.5 ELECTRIC MOTOR ACTUATOR WARRANTY

- A. The electric motor actuator supplier shall warrant its product to be free from defects in materials, workmanship, and performance for actuators incorporated in the work for a period of 5 years from the date of recording of the Notice of Completion. Upon notice by the Owner, any damage or defect found during the warranty period shall be promptly repaired or replaced by the actuator supplier at no cost to the Owner.
- B. In emergency situations, if warranty service is not immediately available from the Vendor/Supplier, the Owner will perform repairs to re-establish proper operation of the actuator and valve. All defective parts returned by the Owner shall be replaced with new parts. If the Owner replaces the entire actuator for cause, the Vendor/Supplier shall repair or replace the entire actuator.
- C. Maintenance or repair work performed by the Owner during the warranty period shall not be cause for voiding the warranty.

PART 2 PRODUCTS

2.1 SUPPLIERS

- A. Actuator suppliers shall have a minimum of 10 years' experience manufacturing and installing the specified intelligent electric motor actuators.
- B. Actuator models submitted for approval must have a minimum maintenance history of 50 units, of the same model and option package as the submitted actuator, that have each functioned in a field installation for a period of 1 year without defect or malfunction.
- C. Valve actuator supplier shall provide complete documentation to meet this requirement, including contact names and telephone numbers that can verify the field installations. Acceptance of the validity of submitted maintenance history is solely at the discretion of the Owner.

2.2 ACTUATOR IDENTIFICATION

- A. Plate permanently attached to operating showing:
 - 1. Model number.
 - 2. Serial number.

2.3 ELECTRIC ACTUATORS

- A. General:
 - 1. Each standard electric actuator shall be furnished complete with a motor, gearing, handwheel, limit switches, torque switches, lubricants, heating elements, wiring, and terminals as further detailed herein.
 - 2. Each actuator shall be constructed as a self-contained unit and shall be integrally assembled on the applicable valve by the valve manufacturer.
 - 3. All electric actuators shall be NEMA 4, 4X, and 6 rated for submersible service.
 - 4. Actuators shall be used for open-close service.
 - 5. Actuators are to be rated as 10-minute duty cycle or 20-minute full duty cycle, within a 5 percent plus or 10 percent minus tolerance.
 - a. A full duty cycle is defined as stroking the valve from a full closed position to full open position, and back to the full closed position without interruption.

- b. The motor duty shall be the total time the motor is running during the full duty cycle, not to include any time the motor is not running to reach the desired total operating time.

B. Environmental:

1. Actuators shall be suitable for indoor and outdoor use.
2. Capable of functioning in an ambient temperature ranging from 22°F to 140°F, up to 100% relative humidity.
3. The line fluid temperature range shall be 40 °F to 100 °F.
4. Noise generated by the actuator shall be less than 72 dBA at all times within a 3-foot radius.

C. Actuator Sizing:

1. In accordance with AWWA C504 and C542.

D. Torque Requirements

1. Provide actuator with rated output torque at least 1.5 times the maximum torque required to operate the valve at any position, including seating and unseating conditions and neglecting hammer-blow effect.
2. Maximum torque requirement is defined as the torque required at the most severe operating conditions, including maximum differential pressure across the valve, and maximum mechanical friction or other restrictive conditions inherent in the valve assembly.
3. The differential pressure across the valve is defined as the pressure rating of the valve.
4. Actuator maximum torque shall be calculated with the applied voltage 10 percent below the nominal motor voltage rating.
5. Coordinate with the valve supplier to assure motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.
6. For torque calculations, the maximum line velocity with an open valve shall be based on the maximum design flow rate for the individual valves as provided in Supplement 1 of this Section.

E. Enclosure:

1. O-ring sealed, watertight to NEMA 4, 4X, and 6.

2. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site for cabling,
3. Terminal compartment shall have the same ingress protection rating as the actuator with the terminal cover removed.
4. Enclosure must allow for temporary site storage without the need for electrical supply connection.
5. All external fasteners shall be plated stainless steel. The use of un-plated stainless steel or steel fasteners is not permitted.

F. Motor:

1. The motor shall be designed specifically for valve actuator applications, rated for heavy duty operation.
2. Low inertia high torque design.
3. 3-phase, 120/208V AC power supply.
4. Capable of operating the valve continuously under full differential pressure for one full duty cycle of travel without overheating when voltage to the motor is within +/- 10 percent of the specified voltage.
5. Class F insulation.
6. Overload Protection: Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control.
7. Motor bearings shall be permanently lubricated. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case.
8. Motor Protection: At a minimum, provide the protections listed below.
 - a. Stall: Motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
 - b. Over Temperature: Thermostat will cause tripping of the motor. Auto-reset on cooling of motor.
 - c. Single Phasing: Lost phase protection.
 - d. Direction: Phase rotation correction.

G. Power Gearing:

1. Gear Case:

- a. Gearing shall be fully enclosed in a grease- or oil-filled gear case.
- b. Provide with seals on shafts to prevent entry of dirt and water into the actuator.
- c. Design shall permit the opening of the gear case for inspection or disassembly without releasing the stem thrust or taking the valve out of service.

2. All drive gearing and components shall be of metal construction, designed for a minimum of 100 percent overload.

3. Reduction shall be accomplished by mean of worm gear complying with material requirements of AWWA C542.

- a. Proportioned to permit operation of the valve under a differential pressure of 150 psig with a maximum input of 150 feet-pounds on the operating nut.

4. Self-locking to prevent the valve back-driving the actuator.

5. Output shaft:

- a. Hollow to accept a rising stem.
- b. Incorporate thrust bearings of the ball or roller type at the base of the actuator.

H. Hand Operation:

1. A handwheel shall be provided for manual operation, engaged when the motor is declutched by a lever or similar means.

2. Handwheel shall not rotate during motor operation.

3. Operation of the handwheel shall not cause the motor to rotate.

4. If power is returned to the motor while the handwheel is in use, the design of the actuator shall prevent transmission of the motor torque to the handwheel.

5. Movement from motor operation to handwheel operation shall be accomplished by a positive, padlockable hand/auto clutch lever, which mechanically disengages the motor and related gearing.

6. Handwheel shall rotate counterclockwise to open the valve.

7. A position indicator, digital display or indicator dial, shall be provided to indicate real time valve position.

8. Maximum input force under full differential pressure to operate valve:
 - a. 80 lb. for seating or unseating.
 - b. 60 lb. at any point through the travel for running load.
- I. Limit Switches / Sensors:
 1. Actuators shall be designed to be readily field adaptable for a minimum of two limit switch assemblies.
 2. Each switch assembly shall consist of at least three separate limit switches and shall be operated by the driving mechanism whether the unit is operated electrically or manually.
 3. Each switch assembly shall be independently adjustable to trip at any point at and between the fully open and fully closed valve positions.
- J. Torque Switches / Sensors:
 1. Torque and thrust loads in both closing and opening directions, or when an obstruction has been encountered in either direction of travel, shall be limited by a torque sensing device.
 2. Motor shall be automatically de-energized if an over-torque condition is sensed.
 3. Each torque sensing device shall be provided with an adjustment setting indicator. Adjustment shall permit a variation of 40 to 100 percent in torque setting, preferably in 1 percent increments.
 4. Measurement of torque shall be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux, etc. are not acceptable.
 5. A means for automatic "torque switch bypass" to inhibit nuisance tripping during valve unseating shall be provided.
- K. Heating Element:
 1. Not required.
- L. Drive Coupling:
 1. Couple the actuator to the valve stem and provide a means of disassembling the actuator from the operator or valve as detailed in the Drawings.

M. Electrical Controls Enclosure:

1. Terminal facilities for connection to motor leads, space heater, limit switches and torque switches shall be housed in compartment(s) integral to the actuator.
2. Rated NEMA 6.
3. Each terminal compartment shall have at least two openings for external electrical conduits, sized at 1 ¼-inch diameter minimum.

N. Electrical Controls:

1. Control Module

- a. Microprocessor-based design.
- b. Actuator shall have a local interface/display screen capable of displaying alphanumeric characters and a 0 to 100 percent display for valve position readout. Local programming interface shall be protected by user selected password protection for all programmable features.
- c. All text messages or displays shall be in English.
- d. All calibration and setup features shall be available via a Bluetooth connection or from the local interface/display screen accessible without requiring the removal of any covers or the use of special tools.
- e. Be of a modular design, with replaceable circuit boards for troubleshooting. The control module shall be entirely housed within the actuator, and shall be easily accessible for maintenance.
- f. The control circuit boards or modules shall be connected with plug-in card connectors or wiring plugs.
- g. Include a solid-state motor reversing circuit. Mechanical reversing contactors are not acceptable. Failure of the solid-state motor reversing module shall not result in unintended motor operation.
- h. Include any necessary internal protection fuses. No external or accessory fuses shall be required for full protection of the motor or control electronics package.
- i. Be capable of 300 starts per hour for modulating service.
- j. All control transformers shall include vacuum impregnated coils, and have dual primary fuses.

- k. Include an automatic directional reversal delay, to prevent current surges from rapid motor reversal.
 - l. Incorporate an automatic phase-correction circuit to correct motor rotation errors due to incorrect site wiring.
 - m. Include an automatic phase-failure detection circuit that shall disable motor rotation if a phase loss is detected.
 - n. Be designed to prevent undesired valve operation in the event of an internal fault or erratic command signal. Fault detection by the control module, or failure of the control module, shall not energize the motor.
 - o. Accumulate and store diagnostic information about the performance of the actuator. This information shall include motor, position encoder, and contactor performance, cycle time, handwheel operations, actuator identification, output turns, and a torque profile of the valve baseline stroke and the last valve stroke for comparison. All diagnostic information shall be displayed on the local operator interface panel, and shall be available over the Modbus communication link.
 - p. Provided with a two-speed pulsing feature that can be enabled to extend the operating time for both close and open directions. Pulsing may be applied from 1 to 99 percent of full travel or limited to a small portion of the travel span. The ON pulsing cycle shall be configurable to 0.5 to 20 seconds in 0.5 second increments and the off-pulsing cycle shall be configurable from 1 to 200 seconds in 1 second increments.
2. Remote Control and Indication:
- a. Actuator shall allow programming of all programmable features via a laptop computer connected directly to the actuator.
 - b. Actuator shall allow for dynamic control mode selection including digital control, DDC control, or Analog control.
 - c. Actuator shall support dual channel DDC Modbus protocol communication to the Owner's SCADA system. Modbus communication shall be accomplished through a card or module internal to the actuator.
 - d. All actuator status signals, command signals, configuration, and calibration functions shall be accessible via the DDC Modbus interface.
 - e. Actuator will include Open, Close, Stop, and Emergency Shutdown (ESD) discrete status and alarm signals for Modbus.

- f. Actuator will include position feedback via 24V DC, 4 to 20 mA analog signal.
 - 1) The unit shall contain zero and span adjustments for calibration of the transmitter with a maximum error of plus or minus 1 percent.
 - 2) The span shall be adjustable such that a 4-milliamp signal can be obtained to indicate the valve is closed, and a 20-milliamp signal can be obtained to indicate the valve is fully open.
 - 3) The 1 percent maximum error shall include repeatability, linearity, and positional accuracy throughout the entire range of motion.
 - g. Actuator will accept Open, Stop, and Close discrete input commands.
 - h. Actuator will accept position command input via 24V DC, 4 to 20 mA analog signal.
 - i. Actuator controller shall include a two-speed timer function. This function shall be configurable for remote step-mode control, using 24V dc command lines.
 - j. Actuator shall supply 24V dc power for remote control status, and control signals. Internal actuator power supplies shall be automatically protected against overcurrent or short circuit conditions.
3. Local Interface:
- a. Actuator shall have a local HAND/OFF/AUTOMATIC (HOA) mode selector switch, as well as a local OPEN/OFF/CLOSE position command switch. The HOA switch shall be lockable in any position by using a standard padlock.
 - b. The local control switches shall not penetrate the actuator enclosure, and shall electrically isolate the operator from any internal voltages.
 - c. The OPEN/OFF/CLOSE switch shall be user-configurable for maintained or inching control.
 - d. One single pole, double throw (SPDT) contact shall be provided to indicate an OPEN position. One single pole, double throw contact shall be provided to indicate a CLOSED position. The contacts shall be programmable to activate at any position between FULL OPEN and FULL CLOSED, or shall be programmable to indicate any of the following: mid-travel, local mode, over torque, motor over temperature, manual operation, remote mode, valve moving, close torque switch, open torque switch, hardware failure, or valve jammed. These contacts shall be rated 250V ac/30V dc, 5 amps.

- e. Supply actuator with OPEN and CLOSE status lights and non-latching OPEN and CLOSE push buttons or non-latching switches.

- 1) It is preferable for status lights to be red color for CLOSED and green color for OPEN positions.

4. Power/Control Wiring:

- a. All connections shall be in a compartment that is separate from the control circuits and other internal spaces. Accessing the wiring compartment shall not require opening any other actuator compartments.
- b. The wiring connections compartment shall contain a suitable number of screw-type terminals to allow connection of DDC Modbus control wiring as well as hardwired status and control wiring.
- c. The control wiring shall be physically separated from the power wiring.

5. Power Interruption Switch

- a. A disconnect switch (load break switch) shall be provided to isolate the actuator from the three-phase supply.
- b. The switch shall be suitable for breaking motor locked rotor amperage.
- c. The disconnect switch shall be enclosed in its own NEMA 4, 4X, and 6 housing separate from all other actuator components.
- d. The disconnect switch housing can be coupled to an actuator conduit entry, and the power wires may be connected from the disconnect switch to the actuator terminal block.
- e. Site wiring shall be direct to the disconnect switch which shall be accommodated by a 1.25-inch NPT conduit entry in the disconnect housing. All connection terminals shall be shrouded and the switch shall be padlockable in either position.

O. Painting and Coatings

1. Shop coated.

2. Interior surfaces:

- a. Ferrous internal surfaces, except for finished working parts, such as shafts and gears, surfaces subject to constant coating by lubricants or working fluids, and corrosion-resistant metals, shall be shop cleaned and coated to resist corrosion.

b. A light color shall be used to enhance inspection and maintenance.

3. Exterior surfaces:

a. Machined surfaces shall be coated with suitable rust preventative applied in accordance with the actuator manufacturer's recommendations.

b. All other external surfaces shall be thoroughly cleaned and shop coated with a suitable paint system to a minimum dry film thickness of 3 mil.

P. Manufacturers / Models:

1. Rotork, iQ3.
2. Approved equal.

2.4 QUALITY ASSURANCE

A. Factory test each actuator prior to shipment in accordance with AWWA C542.

B. Submit certified test reports of performance as detailed in Article 1.04, Submittals.

1. The application torque used during the testing shall be the maximum torque required to open or close the valve at any position, including seating and unseating conditions.

PART 3 EXECUTION

3.1 ATTACHING ELECTRIC ACTUATORS

A. The valve manufacturer shall mount the electric motor actuator and accessories on each new valve and stroke the valve prior to shipment. Adjust limit switch positions, valve position transmitter, and torque switches.

B. The valve manufacturer shall provide, install (including mounting brackets), and calibrate each new valve actuator on the specified valve(s). The valve supplier shall only employ skilled workers that are factory certified by the actuator supplier to install and calibrate each valve actuator. Actuator mounting arrangements shall facilitate operation and maintenance and shall be determined by the valve manufacturer, unless indicated otherwise on the Drawings or directed by the Owner. Provide certification that the valve actuators have been installed and adjusted by the valve supplier. The actuator access cover shall be oriented to prevent the cover from falling into the workspace, causing injury to personnel.

C. The actuator supplier shall coordinate with the valve manufacturer regarding actuator mounting brackets requirements and shall provide design drawings to facilitate

fabrication of mounting brackets that will be required to facilitate installation of the actuator on the valves. The valve manufacturer will be responsible for providing mounting brackets for the actuators.

3.2 FIELD TESTING OF ELECTRIC MOTOR ACTUATORS

- A. The electric motor actuator supplier shall be available at the site to check the installation, supervise the startup, and conduct field testing and adjustment of the equipment.
- B. Only maintenance technicians certified by the actuator supplier shall be employed to perform any field testing, adjustment, or setup of the valve actuator.
- C. Test motor actuators as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions.
 - 1. Measured current shall not exceed the current measurement recorded during the factory performance test by more than 5 percent.
 - 2. If the measured current drawn exceeds the above value, provide a larger motor of the same type or a gear drive or adjust the actuator so that the measured amperage does not exceed the value.
- D. Assure limit switches are placed at their correct settings.
- E. Open and close valve twice and assure limit switches function.
- F. Verify position transmitters and any other information being developed in the actuator complies with requirements contained within the Contract Documents.
- G. During the field testing for each valve actuator, the valve/actuator data/test sheet provided in Supplemental Valve/Actuator Data/Test Sheet will be completed in its entirety. During field testing, all items identified in Functional Test, of Supplemental Valve/Actuator Data/Test Sheet, shall be observed by the Actuator Manufacturer Representative; tested parameters shall be within manufacturer's requirements for acceptance.

3.3 MANUFACTURER SERVICES

- A. Site Training: The actuator manufacturer shall provide the Owner with classroom instruction at the Owner's facility.
- B. Minimum Qualifications of Instructor:
 - 1. The manufacturer representative shall have at least 10 years' experience in training personnel for equipment of similar size and complexity.

- C. Submit proposed training material and a detailed outline of each lesson to the Owner for review.
- D. Provide classroom instruction for a minimum of 2 consecutive working days, which shall include the following as a minimum:
 - 1. Instruction of actuator/gear operator programming and operation.
 - 2. Instruction of assembly and disassembly procedures.
 - 3. Instruction of maintenance procedures for actuator and gear operators.
 - 4. Instruction of troubleshooting procedures.
- E. Installation and Startup Assistance:
 - 1. The manufacturer's authorized factory representative shall be onsite to witness each valve actuator installation and startup activities required below for each valve actuator.
 - 2. The actuator manufacturer shall be present onsite at each installation for the minimum number of consecutive working days associated with each installation and startup activity specified below:
 - a. 2 consecutive working days per actuator/gear operator for installation assistance and final inspection of completed installed of each actuator. Installation assistance shall consist of but not be limited to the following:
 - 1) Confirmation that torque and limit switches are set correctly and operate correctly.
 - 2) Confirmation that actuator cycles the valve fully open and fully closed.
 - 3) Confirmation that wiring is correct internal to actuators.
 - 4) Confirmation that valve assembly is correctly installed.
 - b. 2 working days per actuator to assist with startup and field testing, which includes programming of the actuators as required to meet the valve manufacturer operating requirements for the valves.
 - c. 1 working day per actuator to recommend final field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

3.4 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are part of this Specification.

1. Supplement 1 - Actuator Schedule for Butterfly Valves.

END OF SECTION

Actuator Schedule for Butterfly Valves

Valve Tag No.	Location	Valve Dia. (inches)	Max Delta Operational Pressure (PSI)	Max Operational Flow (gpm)	Functionality
FV1620	Reservoir 16 -Seismic Valve Vault, Outlet Line	24	30	5,000	Open / Closed

VALVE/ACTUATOR DATA/TEST SHEET

Date:	
Valve Tag:	
Valve Size:	
Valve Type:	
Location:	

Actuator Information:

Part No.:		Type:	
ID No.:		SF:	
Voltage:		Phase:	
Amps:		HP:	
LRA:		Temp Rating:	
Duty Cycle:		Class:	
Code:		Frame:	

1. Visual Examination

1.1 Nameplate:		1.3 Inlet Tag:	
1.2 Coatings:		1.4 Workmanship:	

2. Functional Test

Parameter	Observed	MFR/Specification Requirements
2.1 Hand wheel rotation to close (CW/CCW)		
2.2 Number of turns of hand wheel open – close		
2.3 Actual time to Open with actuator		
2.4 Opening Housing temperature		
2.5 Opening electrical amperage		
2.6 Actual time to Close with actuator		
2.7 Closing Housing temperature		
2.8 Closing electrical amperage		
2.9 Actual temperature at one full cycle, CLOSE to OPEN and back to CLOSE		
2.10 Seating electrical amperage		

Attendance:

	Contractor	Actuator MFR Rep	Valve MFR Rep	PWB Rep

SECTION 26 05 00 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Furnish all labor, equipment, appliances, materials, transportation, facilities, services, tools and other equipment, and skilled supervision necessary for the construction, erection, installation, connection, testing, and adjustment of all circuits and electrical equipment specified herein, shown, or noted on the drawings; specified or required in other portions of this specification; and its delivery to the job site complete in all respects and ready for use.
- C. The Contractor shall be responsible for the provision of equipment including all enclosures, disconnects, generators, transfer switches, MCC's, package systems, panelboards, lights, receptacles, and the like, unless otherwise specified. In addition, the Contractor shall be responsible for the following:
 - 1. Visit the site of proposed construction. Verify and inspect the existing site to determine all conditions that affect this work.
 - 2. Investigate and be apprised of the applicable codes, rules, and regulations as enforced by Authorities Having Jurisdiction (AHJs).
 - 3. Use this Specification as a guide for workmanship and materials of construction.
- D. Costs/charges for installation of all permanent and temporary facilities shall be included in the lump sum bid for the appropriate facility. This includes any up-front money required by the utility to provide permanent service.
- E. Electrical Contractor installs and terminates wiring for I&C system, unless otherwise indicated.

1.2 INTENT OF DRAWINGS AND SPECIFICATIONS

- A. Drawings and specifications are complimentary; what is called for by one shall be as binding as if called for by both. The Drawings govern in matters of quantity, the Specification in matters of quality. In event of conflict on Drawings or in the Specifications, the greater quantity and the higher quality apply.

- B. Electrical drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the approval of the Engineer.
- C. Riser and other diagrams are schematic only and shall not be used for obtaining quantities.
- D. The electrical drawings do not show complete details of the site conditions. The Contractor shall verify actual conditions at the project site, prior to ordering items.

1.3 COORDINATION OF WORK

- A. The Contractor shall plan his work in coordination with the power utility authorities and site operations as applicable.
- B. The Contractor shall field verify all dimensions of equipment to be installed or provided by others or by this contract so that correct clearances and connections may be made between the work installed by the Contractor and equipment installed or provided by others.
- C. The Contractor shall arrange all conduit runs so that they do not interfere with duct work, structural members, etc.
- D. All working measurements shall be taken from the sites, checked with those shown on the drawings, and if they conflict, reported to the Engineer at once, and before proceeding with the work. Should the Contractor fail to comply with this procedure, he shall alter his work at his own expense as directed by the Engineer.
- E. No extra payments will be allowed where obstructions in the work of other trades, or work under this contract requires offsets to conduit runs.
- F. The Contractor is responsible for all alterations in the work to accommodate equipment differing in dimensions or other characteristics (such as control wiring, in the case of VFDs or similar equipment) from that shown or specified.

1.4 DEPARTURES FROM CONTRACT DOCUMENTS

- A. Submit to the Engineer, in writing, details of any proposed departures from these Contract Documents, and the reasons the departures are necessary. Submit such requests as soon as practicable and within 30 days after award of the Contract. Make no such departures without written approval of the Engineer.
- B. Should the Electrical Documents indicate a condition conflicting with the governing codes and regulations, refrain from installing that portion of the work until clarified by Engineer.

1.5 SUPERVISION

- A. The Contractor shall maintain adequate supervision of the work and shall have a responsible person in charge at the site during all times that work under this contract is in progress, or when necessary for coordination with other work.

1.6 CODES AND STANDARDS

- A. All work and materials shall conform to the applicable current standards (standard rules, regulations, and specifications) of the National Electrical Code (NEC), National Electrical Safety Code (NEC), Institute of Electrical and Electronic Engineers (IEEE), National Electrical Manufacturers' Association (NEMA), American National Standards Institute (ANSI), Insulated Cable Engineers Association (ICEA), Occupational Safety and Health Administration Standards (OSHA), State and local electrical codes, and other specifically cited standards, as applicable. All materials, unless otherwise approved by local government authorities, shall bear the label of, or be listed by, a Nationally Recognized Testing Laboratory (NRTL); the Underwriters' Laboratory, Inc. (UL) is one such NRTL. Where conflicts exist between any of the above standards, the standard which is most stringent shall take precedence. Where the contract documents exceed minimum requirements, the contract documents take precedence.
- B. Observe where applicable the prevailing rules and requirements of the National Fire Protection Association (NFPA), the State and local fire marshals' regulations, and standards pertaining to adequate protection and/or guarding of any moving parts or otherwise hazardous conditions.
- C. Resolve at the Contractor's expense all conflicts with applicable standards and provide a complete installation of Electrical Work, approved in all respects. Certain methods and materials for the project may require special approval and it is the Contractor's responsibility to prepare and submit to all approving authorities additional clarifying details, test data, methods and materials as needed to secure the required approval and resolve conflicts.

1.7 WORKMANSHIP

- A. All work shall be performed by personnel skilled in the particular trade. Workmanship shall conform to the standards of the NEC and the installation standards of the National Electrical Contractors' Association (NECA).
- B. The Engineer shall be the sole judge as to whether or not the finished work is satisfactory; and if in his judgment any material or equipment has not been properly installed or finished, the Contractor shall replace the material or equipment whenever required and reinstall it in a manner entirely satisfactory to the Engineer without any increase in cost to the Owner.

1.8 PERMITS, FEES, AND SERVICE CHARGES

- A. The Contractor shall obtain all electrical permits and pay all related fees. See Section 01 10 00, Summary of Work regarding permit responsibilities for this project.

1.9 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. In accordance with provisions elsewhere in these Contract Documents, manufacturers' names and catalog numbers stated herein are intended to indicate the type and quality of equipment or materials desired.
- B. Make requests for approval of alternates in writing to the Engineer during the submittal process (no requests for pre-bid approvals will be accepted). Provide sufficient material or data to allow evaluation of the proposed alternatives and determination of compliance with these Contract Documents. List any proposed deviations from these Contract Documents.

1.10 SUBMITTALS AFTER AWARD OF CONTRACT

- A. General: All electronic (PDF) submittals (including O&M Manual submittals) shall use standard 8.5" x 11" page sizes for all non-drawing pages. Drawings and/or schematics may use 8.5" x 11", 11" x 17", or 22" x 34" sized pages, as applicable. All drawings/schematic must be legible on whatever page size is used. Any manufacturer supplied information that comes on sizes other than these shall be re-sized to meet these requirements. Contractor may use any means necessary to have the information re-sized, but all re-sized materials must be legible. Submittals which do not meet these requirements are subject to wholesale rejection.
- B. The Contractor shall provide complete manufacturer's descriptive information and shop drawings for all equipment, material, and devices furnished under this Division, including certified outline drawings, arrangement drawings, elementary (schematic) diagrams, interconnection diagrams, and connection diagrams, in accordance with provisions in Section 01 33 00 of these Contract Documents. Provide the number of copies specified therein for the Engineer, Contractor, and Operation and Maintenance Manuals.
- C. Manufacturer's standardized elementary diagrams shall not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.
- D. Contractor shall check submittals for proper number of copies, adequate identification, correctness and compliance with Drawings and Specifications, and initial all copies indicating this has been done. Revise, change, and/or resubmit all submittal

information until acceptable to the Engineer. Obtain Engineer's acceptance before commencing fabrication or installation of any materials or equipment.

1. When a resubmittal is requested, resubmit only the indicated deficient portions of the submittal in question or where changes have been made to previously acceptable items. Resubmitting previously acceptable items slows the review process as all resubmitted material is (re)reviewed.
- E. Review of submittal information by the Engineer shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications unless he has requested and received written approval from the Engineer for specific deviations at time of submission. Review of submittal information shall not relieve the Contractor from responsibility for errors and omissions in shop drawings or literature.
- F. Submittals shall be made in accordance with the schedule listed hereinafter. Provide certified shop drawings, literature, and requested samples showing items proposed for use, size, dimensions, capacity, special features required, schematic (elementary) control diagrams, equipment schedules, rough in, etc., as required by the Engineer for complete review and for installation. Use NEMA device designations and symbols for all electric circuit diagrams submitted. Make content of schematic (elementary) connection of interconnection diagrams in accordance with the latest edition of NEMA ICS.
- G. Submittals shall be made on, but not necessarily limited to, the following items, as applicable:
1. Switchgear, Switchboards, and/or Motor Control Centers
 2. Circuit breakers and enclosures
 3. Transformers
 4. Panelboards and circuit breakers
 5. Motor Controls
 6. Special control panels - outline and schematic drawings, descriptive information, component schedules
 7. Wiring Devices, including Receptacles (120v duplex outlets; generator receptacles), switches, boxes, etc.
 8. Special pull boxes and junction boxes
 9. All conduit types used in project

10. All conductor/wire types used in project
- H. Submit a listing of all nameplate data from actual motors provided after delivery to site.
 - I. Provide one copy of each final, fully accepted submittal furnished complete in the appropriate sections of the Operation & Maintenance (O&M) Manuals. The final submittals included in the O&M Manuals shall be compiled, as may be required, from all submittals and resubmittals, with any and all corrections included. Do not include all iterations of the submittals in the O&M Manuals; provide only the final, complete, fully corrected, and fully accepted submittal.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT, COMMON REQUIREMENTS

- A. Unless otherwise indicated, provide all first-quality, new materials, and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment listed by UL (or other acceptable NRTL), bearing their label wherever standards have been established by that agency.
- B. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- C. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.
- D. Indicated brand names and catalog numbers are used to establish standards of performance and quality. The description of materials listed herein governs in the event that catalog numbers do not correspond to materials described herein.

2.2 EQUIPMENT FINISHES

- A. Provide materials and equipment with manufacturers' standard finish system. Provide manufacturers' standard finish color, except where specific color is indicated.

2.3 PORTABLE OR DETACHABLE PARTS

- A. The Contractor shall retain in his possession and shall be responsible for all portable and detachable parts or portions of installations such as fuses, key locks, adapters, blocking chips, and inserts until completion of his work.

- B. These parts shall be delivered to the Engineer and an itemized receipt obtained. This receipt, together with 2 copies of the final inspection certificate, shall be attached to the Contractor's request for final payment.
- C. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the manufacturer's recommendations.

2.4 RUBBER MATTING

- A. Install rubber floor matting in electrical room in front of all power distribution equipment, motor controllers and control panel.
- B. Corrugated non-slip rubber mat of high dielectric strength and long aging qualities. Mat size, minimum of 36 inches wide extending the entire length of each power panel and control panel. Comply with ASTM Specification D178.24. 10,000 Volt minimum dielectric strength, 3/16" thick.

2.5 EQUIPMENT BASES

- A. Provide equipment bases for all floor-mounted electrical equipment.
- B. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted.
- C. On all equipment bases in interior locations, unless otherwise noted, provide two or more parallel, cast-in-place continuous-slot channel erection system concrete inserts for equipment mounting. Bolt equipment to channels. Provide additional surface-mounted channels where required to match and line up with existing equipment.
- D. Provide concrete pads and mounting provisions for all exterior equipment. Equipment shall be anchored to equipment pad so that it is secure and meets the equipment manufacturer's installation recommendations for outdoor installations. Adhere to specific directions indicated on the drawings or specified in other portions of the specifications.
- E. Provide engineered calculations for anchorage of any self-supporting enclosure pad, stamped, and signed by a registered professional structural engineer licensed in the state of Oregon.

2.6 ACCESSORIES

- A. Include special features, finishes, accessories, and other requirements as described in the Contract Documents regardless of the item's listed catalog number.

- B. Provide incidentals not specifically mentioned herein or noted on Drawings, but needed to complete the system or systems, in a safe and satisfactory working condition.

PART 3 EXECUTION

3.1 DEMOLITION

- A. Contractor shall be responsible for loss or damage to the existing facilities caused by him or his workmen and shall be responsible for repairing or replacing such loss or damage.
- B. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all electrical services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- C. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- D. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner and the Engineer. The Contractor shall notify the Owner and the Engineer at least 2 weeks in advance in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount:
 - 1. Contractor shall arrange for all required temporary power as may be required during service outages.
 - 2. Where temporary generators are used for extended periods, contractor shall provide temporary circuits for battery charger and block heater, as required.
- E. The Contractor shall modify, remove, or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities. All removals or dismantling shall be conducted in a manner as to produce maximum salvage.
- F. The Contractor shall survey the project with the Owner before demolition begins and determine all materials which the Owner specifically chooses to have salvaged. Pre-establish with the Owner locations where salvaged materials are to be stored. Salvage materials shall remain the property of the Owner and shall be delivered to such destination as directed by the Owner.

- G. When items scheduled for salvaged are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged during construction operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost.
- H. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed entirely, or as acceptable to the Engineer.
- I. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Engineer.

3.2 INSTALLATION, COMMON REQUIREMENTS

- A. Install materials and equipment in a workmanlike manner, utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.
- B. Coordinate electrical work with work of other trades to avoid conflicts, errors, delays, and unnecessary interference with plant operations during construction.
- C. Install electrical equipment complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of the electrical equipment; examine the instructions thoroughly. When requirements of the installation instructions conflict with the Contract Documents, request clarification from Engineer prior to proceeding with the installation.
- D. Do not install electrical equipment in obvious passages, doorways, scuttles, or crawl spaces which would impede or block the area passage's intended usage.
- E. Provide any necessary backing required to properly support all fixtures and equipment installed under this contract.

3.3 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Protect everything from the effects of weather.
- B. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, and conductors. Energize all space heaters furnished with equipment.
- C. Following installation protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Cap conduit runs during

construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

3.4 CUTTING, PATCHING, AND FRAMING

- A. The Contractor shall determine in advance the locations and sizes of all sleeves, chases, and openings necessary for the proper installation of his work.
- B. Whenever practical, inserts or sleeves shall be installed prior to covering work. Cutting and patching shall be held to a minimum. All required holes in concrete construction shall be made with a core drill and patched with non-shrink grout.
- C. Cutting, fitting, repairing, and finishing of carpentry work, metal work, or concrete work, and the like, which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required, it shall be done in such a manner as not to weaken walls, partitions, or floors; and holes required to be cut in floors must be drilled without breaking out around the holes.

3.5 CLEANING AND TOUCHUP PAINTING

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the color, consistency, and type of surface of the original finish.

3.6 FIELD QUALITY CONTROL

- A. Load Balance: The Drawings and Specifications indicate connection of electrical loads and distribution equipment; however, after installation, if necessary, certain electrical loads may require re-connection to achieve a more equal current balance. Make re-connections as may be required.
- B. Motor Rotation: After final service connections are made, check, and correct, if necessary, the rotation of all motors. Coordinate rotation with the Contractor responsible for the driven equipment. Submit a written report to the Engineer for each motor, verifying that rotation has been checked and corrected.
- C. Inspection: All materials, equipment, and workmanship shall be subject to inspection at any time by the Engineer, or his representatives. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.

D. Tests:

1. Carry out tests specified hereinafter and as indicated under individual items of materials and equipment specified in other sections.
2. During site evaluations by Engineer, provide an electrician with tools to remove and replace trims, covers, devices, and the like, so that a proper evaluation of the installation can be performed.
3. The Contractor shall furnish all labor, material, instruments, and tools to make all connections for testing of the electrical and instrumentation installation. All equipment shall be demonstrated as operating properly prior to the acceptance of the work. All protective devices shall be operative during testing of equipment.
4. General:
 - a. Perform the tests as described below. Upon completion of all tests, submit written test results in duplicate for approval by the Engineer prior to acceptance.
 - b. After visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the entire wiring system shall be thoroughly tested for shorts and grounds. A log of results for each circuit shall be kept by the Contractor and presented to the Engineer.
 - c. Equipment shall be tested by operating all electric motors, relays, controls, switches, heaters, etc. sufficiently to demonstrate proper installation and electrical connections. Control and emergency conditions shall be artificially simulated where necessary for complete system or subsystem tests.
 - d. Insulation resistance measurements of each circuit shall be made with loads connected and contactors, if any, blocked closed to give complete circuits. Insulation resistance of complete circuit shall be measured from the circuit breaker load terminals with the breaker open. A log of complete results shall be prepared by the Contractor and presented to the Engineer. Values of resistance shall be 10 megohms or greater.
5. Operations:
 - a. After the electrical system installation is completed and at such time as the Engineer may indicate, conduct an operating test for approval. Demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings.
 - b. Perform the test in the presence of the Engineer or his authorized representative. Furnish all instruments and personnel required for the tests.

The Owner will furnish the necessary electric power. System performance shall conform to the following criteria. Deviations, if any, shall be noted on the test reports with indication of corrective action taken or proposed.

- 1) Plus, or minus 2 percent maximum variation between nominal system voltage and average system voltage.
- 2) Plus, or minus 5 percent maximum variation from nominal system voltage for all load conditions.
- 3) Actual motor current on each ungrounded conductor at prevailing conditions shall be equal to or less than nameplate rated full load motor current at a service factor of 1.0.
- 4) One percent maximum voltage unbalance at full load defined as 100 times the maximum deviation from average voltage divided by the average voltage. (Balance system loads and cooperate with the serving utility company to achieve a balanced condition which is within the indicated limits.)
- 5) Plus, or minus 10 percent maximum variation between average phase current and individual phase current. Balance system loads to achieve a balanced condition which is within the indicated limits.
- 6) Insulation resistance shall be tested under normal climatic conditions and shall conform to the following:
 - a) Circuits of 600 volts or less shall have conductor insulation resistance as installed of not less than 10,000,000 ohms to ground.

6. Document tests and include in Closeout Documents.

3.7 TEST REPORTS

- A. Submit dated "Electrical System Test Reports" indicating all tests performed and demonstrating conformance with the required system performance criteria. This test report shall include all voltage, current, and resistance test data of the electrical service, main feeders, panelboards, power transformers, and ground systems, as applicable.

3.8 FINAL CORRECTION

- A. Promptly correct any failures or defects revealed by these tests as determined by the engineer. Re-conduct tests on these corrected items as directed by the engineer.

3.9 CLEANING

- A. Remove dirt and debris caused by the execution of the electrical work.
- B. Leave the entire electrical system installed under this Contract in clean, dust-free, and proper working order.
- C. Vacuum clean interiors of electrical equipment enclosures.

3.10 RECORD DRAWINGS

- A. The Contractor shall maintain a neatly marked set of record drawings. Contract Drawings shall be marked with red indelible pencil to show all departures from original Drawings, underground cable, conduit, or duct runs dimensioned from established building lines, and all electrical work revisions. In addition, the locations of panels, field mounted instruments and panels, terminal boxes, junction boxes and any other materials included in this contract shall be shown. As built drawings shall be kept current with the work as it progresses and shall be subject to inspection by the Engineer at any time.

3.11 GUARANTEE

- A. Materials, equipment, and workmanship shall be guaranteed in accordance with provisions in these Contract Documents.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. This section covers the work necessary to furnish and install complete conductor systems as specified herein, including but not necessarily limited to building wire and cable, instrumentation cables, communication cables, and wiring connectors and connections.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) - Standard of Installation.
- B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Stranded copper conductor for services, feeders, and branch circuits.
 - 2. Stranded copper conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power circuits.
 - 4. Conductor not smaller than 18 AWG for control circuits.
 - 5. Conductor not smaller than 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
 - 6. Conductors not smaller than 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

7. Instrumentation and control signal and communication cabling as specified in 2.3 and 2.4 of this section.

1.5 SUBMITTALS

- A. Sections 01 33 00 and 26 05 00
- B. Product Data: Submit for building wire, instrumentation cables, and communication cables.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.8 COORDINATION

- A. Section 01 10 00
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.
- B. Unless otherwise shown or indicated, all conductors shall be stranded copper, with 90°C insulation.

2.2 BUILDING WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper, stranded conductor for all feeders and branch circuits.
- C. Minimum Size: 12 AWG.

- D. Insulation: NFPA 70; Type THHN-2/THWN-2 insulation for feeders and branch circuits smaller than 2 AWG; Type XHHW-2 for all feeders and branch circuits 2 AWG and larger. Type XHHW-2 may also be used for all feeders and branch circuits smaller than 2 AWG (Contractor's option).

2.3 CONTROL WIRE

- A. Product Description: single or multi-conductor insulated wire.
- B. Conductor: Copper, stranded conductor.
- C. Minimum Size: 18 AWG.
- D. Insulation: NFPA 70; Type THHN-2/THWN-2, type TFFN, or type XHHW-2.

2.4 INSTRUMENTATION CABLE

- A. 600-volt, NEC Type CL2, general purpose communications cable:
 - 1. Individual Conductors: Stranded, tinned copper, PVC insulation, 18 AWG minimum, unless otherwise indicated.
 - 2. Assembly: Twisted pair conductors wrapped with aluminum polyester shield. Drain wire shall be stranded, tinned copper, 18 AWG minimum, unless otherwise indicated. Shield coverage shall be 100%. Covered with PVC jacket.

2.5 COMMUNICATIONS CABLE

- A. Network Cable: Shielded category 5e cable or category 6 cable.

2.6 PANEL WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper, stranded
- C. Minimum Size: 14 AWG
- D. Insulation: NFPA 70; Type SIS

2.7 VFD CABLE

- A. Product Description: Cable assembly shall be UL 1227 600V and UL 2277 1000V listed for 90°C wet/dry locations.
- B. Cable: Provide cable comprised of 3 copper phase conductors with 3 copper ground conductors for symmetrical grounding with dual copper shielding.
- C. Minimum Size: As noted on the drawing circuit schedule. Symmetrical ground conductor combined circular-mil area shall equal or be greater than the NEC required equipment ground conductor equivalent.

- D. Insulation: The cable shall have XLPE rated insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Install wire and cable in accordance with NECA "Standard of Installation."
- C. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- D. Ground the shield drain wire at only the supply end.
- E. Identify wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- F. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- G. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise:
 - a. All splices in underground boxes or direct buried shall be insulated and waterproofed, using scotchcast epoxy splicing compounds suited for the purpose.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.

4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 COLOR CODE

- A. All service, feeder, and branch circuits conductors shall be color coded, as follows:
 1. 120/240V or 120/208V, single or three-phase:
 - a. Phase A: Black
 - b. Phase B: Red. For 120/240V, 3-phase "high leg" systems, add orange colored tape at both ends and at all accessible locations (terminals, j-boxes, vaults, hand holes, etc.).
 - c. Phase C: Blue
 - d. Neutral: White.
 2. 480/277V, single or three-phase:
 - a. Phase A: Brown
 - b. Phase B: Orange
 - c. Phase C: Yellow
 - d. Neutral: Light/Natural Gray or White.
- B. Equipment Grounding Conductors: Equipment grounding conductors shall be green.
- C. Conductor sizes 6 AWG and smaller shall have solid color compound or solid color coating.
- D. Conductor sizes 4 AWG and larger shall follow the same color code above, using either:
 1. Solid color compound or solid color coating.
 2. Stripes, bands, or hashmarks of colors specified above
 3. Colored pressure-sensitive plastic or rubber tape. Tape shall be applied in half overlapping turns for a minimum of 3 inches at all terminal points, and at all accessible locations such as junction boxes, pull boxes, troughs, manholes, handholes, etc. Tape shall be at least 3/4 inch wide with colors as specified above.

The last two laps of tape shall be applied with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

- E. Multiple Neutral Conductors: When two or more neutrals are located in one raceway, wireway, or tray, individually identify each with proper circuit number and panel of origin.

3.5 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. This section covers the work necessary to furnish and install and complete the electrical grounding system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100) - Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
- B. NECA (National Electrical Contractors Association) - Standard of Installation.
- C. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. NFPA 70 (National Fire Protection Association) - National Electrical Code.

1.4 SUBMITTALS

- A. Sections 01 33 00 and 26 05 00
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL (or other NRTL) labeled.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.8 SYSTEM DESCRIPTION

- A. Provide grounding and bonding of electrical service, circuits, equipment, signal, and control systems.
- B. Performance Requirements: Supplement the grounded neutral of the secondary distribution system with an equipment grounding system to properly safeguard the equipment and personnel. Install equipment grounding such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment, and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide a low impedance path for possible ground fault currents.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of the NEC, latest adopted version with amendments by local AHJ's.
- B. Furnish products listed by UL or other NRTL acceptable to AHJ.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Grounding Connectors: Hydraulic compression tool applied connectors, exothermic welding process connectors, or powder actuated compression tool applied connectors.

Mechanical type of connectors are not acceptable. Manufacturers: Burndy Hyground Compression System, Erico/Cadweld, Amp Ampact Grounding System, or approved.

- B. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe. Burndy GAR Series, O Z Gedney, Thomas & Betts, or approved.

2.2 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Copper conductor bare.
- C. Bonding Conductor: Copper conductor bare.
- D. Equipment Grounding Conductor: Copper with green insulation.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide all grounding systems and make connections mechanically secure and electrically continuous. Ground all line voltage electrical systems completely and effectively as required by code and as specified herein.
- B. Ground all raceway systems and equipment enclosures. Where not otherwise indicated, grounding conductor size shall conform to the most stringent of the governing codes, except that no grounding conductor shall be smaller than 12 AWG:
 - 1. Ground the service and transformers in an approved manner.
 - 2. Provide grounding where indicated on the drawings. All ground mat conductors shall be bare soft drawn copper, sized as noted. Bury all conductors approximately 12-inches below grade.
 - 3. Grounding conductor connections shall be bolted except at inaccessible ground rods, buried ground conductors, and reinforcing steel grounding conductor connections, where connections shall be brazed, or an irreversible compression system used. Exothermic welded connections may be substituted for brazed connections subject to the Engineer's approval and demonstration on the project with actual test connections that the connections will be successfully made.
 - 4. Equipment grounding conductors, unless otherwise noted, shall be the same insulation type as the circuit conductors and shall be run in conduit.
 - 5. Continuity of equipment ground shall be maintained throughout the entire raceway, cabinet, and equipment enclosure system. Ground bushings and jumpers shall be used wherever normal conduit termination does not ensure continuity.

Where nonmetallic conduit is used for distribution or where direct burial cables are employed, install a green insulated equipment ground conductor with each circuit.

6. Metal parts of lighting fixtures shall be bonded to conduit system with green ground wire. Receptacles shall be grounded to outlet boxes with green ground wire and machine screw.
7. Motors and equipment shall be bonded to the equipment grounding system by a continuous green insulated equipment ground conductor run with each circuit through approved flexible conduit connections as permitted by code. Where flexible conduit size exceeds the code approved limits, provide a separate green grounding conductor inside each flexible conduit, bonded to the inside of the connection box and to the nearest accessible supply end conduit junction box.

3.2 PREPARATION

- A. Remove paint, rust, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142.
- B. Install grounding and bonding conductors concealed from view.
- C. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- D. Permanently ground entire power system in accordance with NEC, including distribution panelboards, switch and starter enclosures, receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- E. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards, switchboards, and motor control centers to grounding bus.

- F. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform continuity testing in accordance with IEEE 142.
- E. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 26 05 29 - ELECTRICAL HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.3 REFERENCES

- A. American Society of Testing Materials:
 - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
- B. FM (Factory Mutual Engineering Corporation) - Fire Hazard Classifications.
- C. NFPA 70 (National Fire Protection Association) - National Electrical Code.
- D. NECA (National Electrical Contractors Association) - Standard of Installation.
- E. Underwriters Laboratories, Inc. - Fire Resistance Directory:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Test for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
- F. WH (Warnock Hersey) - Directory of Listed Products.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

- A. Firestopping Materials: UL 1479 to achieve fire ratings for adjacent construction.
- B. Surface Burning: UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.7 SUBMITTALS

- A. Sections 01 33 00 and 26 05 00
- B. Anchoring and leveling criteria and recommendations from equipment manufacturers shall be included in the installation recommendation submittal required:
 - 1. Furnish complete dimensioned and scalable shop drawings of all supporting structures, trapezes, and wall supports.
 - 2. Furnish complete anchoring details for pole lights, transformers, control panels, supporting structures, trapezes, wall supports for equipment in excess of 200-pounds, and all freestanding supports:
 - a. Stamped by a Professional Engineer registered in the State of Oregon.
 - b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, shall be reviewed for general consistency with the requirements shown in the Contract Documents, but not for context, accuracy, or method of calculation.
 - 3. Include data on attachment hardware and construction methods that satisfy the design loading criteria.
- C. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

- D. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.
- E. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- F. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- G. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- I. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional ENGINEER suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.

2.2 CONDUIT SUPPORTS

- A. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- B. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- C. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- D. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- E. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

2.3 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting hole and screw closure.

2.5 SLEEVES

- A. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- B. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- C. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.6 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FIRESTOPPING

- A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Multiple component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.
 8. Concrete Grout
- B. Color: As selected from manufacturer's full range of colors.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish products tested by approved independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Obtain permission from Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Equipment Anchoring:

1. Install equipment in accordance with the printed recommendations of the equipment Manufacturer's literature, including anchoring methods and leveling criteria.

2. Design, detail, brace, and anchor freestanding equipment supports in place by methods that provide structural support conforming to seismic load, and wind load as indicated in the drawings and in accordance with Section 01 61 10 Seismic Requirements for Non-Structural Components:
 - a. Provide pedestals fabricated out of welded angle or tube sections.
 - b. Lateral deflection at top of supports not to exceed support height divided by 210, unless approved by the ENGINEER.
 3. Wall mounted panels that weigh more than 500 pounds or are installed above 18 inches off the floor shall be provided with fabricated steel support pedestals:
 - a. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions.
 4. Furnish all conduit racks and trapeze structures needed to support the conduits. Group conduits and position on racks to minimize crossovers, etc:
- B. Concrete housekeeping pads are required for all floor-standing electrical equipment and conduit penetrations through floor:
1. Pads shall be a minimum of 3.5 inches above the surrounding floor or grade unless otherwise noted.
 2. Pads shall extend a minimum of 2 inches beyond the extent of the equipment in all directions.
 3. Pads shall be sized for the actual equipment furnished and all future equipment identified on the Contract Drawings.
 4. All edges of the housekeeping pad shall be chamfered.
- C. Anchors and Fasteners:
1. Concrete Structural Elements: Provide precast inserts, expansion anchors and preset inserts.
 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.

5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 6. Sheet Metal: Provide sheet metal screws.
 7. Wood Elements: Provide wood screws.
- D. Inserts:
1. Install inserts for placement in concrete forms.
 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Locate and install anchors, fasteners, and supports in accordance with NECA Standard of Installation.
- F. Install conduit and raceway support and spacing in accordance with NEC.
- G. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- H. Install multiple conduit runs on common hangers.
- I. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 3. In wet and damp locations, install steel channel supports to stand cabinets and panelboards 1 inch off wall.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Remove dam material after firestopping material has cured.
- E. Fire Rated Surface:
 - 1. Seal opening at wall, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, and conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- F. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal pipe penetrations at telecommunication rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 3 inches beyond supported equipment. Refer to Division 3 and the Drawings .
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. This section covers the work necessary to furnish and install complete electrical raceway systems, including, but not necessarily limited to, conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. NECA (National Electrical Contractors Association) - "Standard of Installation"
- C. National Electrical Manufacturers Association:
 - 1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 2. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 3. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 4. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 5. NEMA TC 2- Electrical Polyvinyl Chloride (PVC) Conduit.
 - 6. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 7. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground: Provide PVC schedule 40 or schedule 80, Reinforced Thermosetting Resin (Fiberglass), or PVC coated rigid galvanized steel conduit.
- C. Transition through foundation wall or slab: Provide PVC coated rigid galvanized steel conduit. Sweeps and couplings to transitions shall be PVC coated rigid galvanized steel.
- D. Under Slab on Grade: Provide PVC schedule 40 or schedule 80, or Reinforced Thermosetting Resin (Fiberglass) conduit.
- E. Outdoor Locations, Above Grade (except where specified otherwise): Provide PVC coated rigid galvanized steel conduit in locations subject to physical damage; for other locations, provide Reinforced Thermosetting Resin (Fiberglass), or PVC coated rigid galvanized steel conduit. Provide cast metal outlet, pull, and junction boxes.
- F. In Slab on or Above Grade: Do not place conduits in slab on grade.
- G. Wet, Damp, or corrosive Locations (except where specified otherwise): Provide PVC coated rigid galvanized steel conduit in locations subject to physical damage; for other locations, provide Reinforced Thermosetting Resin (Fiberglass), or PVC coated rigid galvanized steel conduit. Provide cast metal outlet, junction, and pull boxes.
- H. Concealed Dry Locations (except where specified otherwise): Provide rigid galvanized steel or IMC conduit. Provide cast metal boxes. Provide hinged enclosure for large pull boxes.
- I. Exposed Dry Locations (except where specified otherwise): Provide rigid galvanized steel or IMC conduit. Provide cast metal boxes. Provide hinged enclosure for large pull boxes.
- J. Imbedded in Structural Concrete: Provide rigid galvanized steel conduit. Provide cast metal outlet, junction, and pull boxes.

1.5 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch if exposed or 1 inch if buried or below slab, unless otherwise specified.
- B. Coordinate conduit installation to avoid creating trip hazards and blocking equipment access for personnel and maintenance.

1.6 SUBMITTALS

- A. Sections 01 33 00 and 26 05 00
- B. Product Data: Submit for the following:
 - 1. All conduit types proposed for project.
 - 2. Raceway fittings.
 - 3. Conduit bodies.
 - 4. Wireway.
 - 5. Pull and junction boxes.
 - 6. Handholes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Record actual routing of conduits larger than 1.25 inch trade size.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.8 COORDINATION

- A. Section 01 10 00

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.

2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1. Galvanized.
- B. Intermediate Metallic Conduit (IMC): ANSI C80.6
- C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.3 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked zinc-coated steel core construction with PVC jacket. Liquid-tight flexible metallic conduit shall be suitable for conductors with 75 degree C

insulation. Provide conduit labeled sunlight resistant where exposed or otherwise required by local codes.

- B. Fittings: NEMA FB 1.

2.4 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2, specification WC1094A and UL 651; Schedule 40 or 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.5 REINFORCED THERMOSETTING RESIN (FIBERGLASS) CONDUIT

- A. Fiberglass conduit may be used in lieu of PVC conduit.
- B. Conduit shall be UL listed for both below ground and above ground installation. Internal conduit and elbow walls shall be smooth, and all fibers embedded in the epoxy. Carbon black shall be used as an ultraviolet inhibitor to protect conduit and fittings. Conduit shall be marked in accordance with NEMA TC 14.
- C. Fiberglass conduit fittings, elbows, and accessories shall be manufactured by the same manufacturer as the conduit.

2.6 PVC COATED RIGID STEEL CONDUIT

- A. Conduit used in the coating process shall be hot dip galvanized inside and out in accordance with Federal Specification WW-C-581-E, ANSI Standard C-80.1, and UL Standard 6. Finished conduit shall fully conform to the current NEMA RN-1 Standard and shall have a label affixed indicating compliance with UL Standard 6.
- B. The zinc surfaces of conduit and fittings shall remain intact and undisturbed on both the interior and exterior throughout the cleaning and coating processes as defined in section 4.3.1 of NEMA RN-1-1989.
- C. The PVC exterior coating on conduit, fittings, couplings, accessories, and hardware shall have a minimum thickness of 40 mils, except where part configuration or application dictate otherwise.
- D. A polyurethane coating having a nominal thickness of 2 mils shall be applied to the interior of conduit, couplings, elbows, nipples, and feed-through fittings, except where prohibited by design.
- E. All conduit threads shall be protected from corrosion by application of a polyurethane coating applied over the manufacturer's standard zinc coating.

- F. Use PVC Coated Rigid Steel (PVC-RGS) Conduit in corrosive or hazardous (Classified) areas, unless otherwise noted.

2.7 WIREWAY

- A. Product Description: Product Description: Minimum oil-tight and dust-tight type wireway (NEMA 12), or as indicated.
- B. Knockouts: None
- C. Fittings: Lay-in.
- D. Finish: Rust inhibiting primer coating with gray enamel finish.
- E. Barriers: Furnish barriers of the same type of material as the wireway to form separate compartments for wiring of different systems and/or voltages.

2.8 OUTLET BOXES

- A. Cast Boxes: NEMA FB 1, Type FD, cast ferroalloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

2.9 PULL AND JUNCTION BOXES

- A. Hinged Enclosures: As specified in Section 26 27 16.
- B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 GENERAL

- A. No raceway shall be installed until work which might cause damage to wires, conduit boxes, or fittings has been completed; conduit, boxes, fittings, and wires which become damaged in any way shall be removed from the job and replaced at expense of the Contractor.
- B. Conduit buried in earth: Install raceways to provide not less than 30 inches cover to finished grade. Pitch to drain away from buildings; avoid trapped runs. Grade trenches and place pipe bedding material to provide uniform trench bottom for raceway

support. Buried raceway shall not be smaller than 1 inch. All underground elbows shall be fiberglass or PVC-RGS. All interior stub-up conduit sections shall be PVC-RGS; make transition from non-metallic conduit to RGS under slab.

- C. Provide rigid steel conduit for raceways embedded in structural reinforced concrete, in hazardous areas, for exposed installations where subject to damage, for sizes 1.25-inch and larger, and at all locations not otherwise specified. IMC may be used in lieu of rigid steel conduit in all locations approved by the NEC.
- D. Provide flexible conduit connections at all motors and transformers plus other equipment connections subject to vibration. Utilize suitable fittings, keep route neat, at nominal right angles, and in conformance with equipment lines.
- E. Exposed conduit shall be run in straight lines parallel to column lines, walls, or beams. Where conduit is grouped, the bends and fittings shall be installed to present an orderly appearance. Unnecessary bending or crossing shall be avoided.
- F. Supports for exposed conduit runs shall be furnished and installed within 3 feet of each box. Supports shall be secured by means of expansion inserts in concrete.
- G. Conduit and fittings shall be properly protected during the construction period against mechanical injury from any cause. Conduit which extends out of floors, walls, or slabs shall be boxed or otherwise protected and ends shall be capped with metal pipe plugs.

3.2 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.3 INSTALLATION

- A. Install raceway and boxes in accordance with NECA "Standard of Installation".
- B. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- C. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- D. Identify raceway and boxes in accordance with Section 26 05 53.
- E. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 1-inch, unless otherwise indicated. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104°F.
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2-inch size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings or specified in section for outlet device.
- B. Surface mount boxes on block walls.
- C. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Support boxes independently of conduit.
- G. Install gang box where more than one device is mounted together. Do not use sectional box.

3.6 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Nameplates
 - 2. Labels
 - 3. Wire markers
 - 4. Conduit markers
 - 5. Stencils
 - 6. Underground Warning Tape
 - 7. Lockout Devices

1.3 SUBMITTALS

- A. Sections 01 33 00 and 26 05 00

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 33 00

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Install nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Letter Size:
 - 1. 1/8-inch-high letters for identifying individual equipment and loads.
 - 2. 1/4-inch-high letters for identifying grouped equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch.

2.3 LABELS

- A. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background.

2.4 WIRE MARKERS

- A. Description: Tubing type wire markers, applied to each end of every wire.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as specified below.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams or shop drawings and as specified below.

2.5 CONDUIT AND RACEWAY MARKERS

- A. Description: Stencils.
- B. Color:
 - 1. Medium Voltage: White lettering on a red background.
 - 2. 480 Volt System: Orange lettering on white background.
 - 3. 240 Volt/208 Volt Systems: Brown lettering on white background.
- C. Legend:
 - 1. Medium Voltage System: HIGH VOLTAGE

2. 480 Volt System: 480 VOLTS.
3. 240 Volt/208 Volt Systems: 240 Volts or 208 VOLTS, as applicable.
4. Instrumentation and Control System: INSTRUMENTATION AND CONTROL

D. Tagging:

1. Tag at both ends.
2. Follow Identify circuit type (power, control, lighting), origination equipment and circuit number.

2.6 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Raceway: ½-inch-high letters.
2. 2.5 to 6 inches Outside Diameter of Raceway: 1-inch-high letters.

2.7 UNDERGROUND WARNING TAPE

A. Description: 4 inch wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

2.8 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum or Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.

3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Motor Control Centers (MCCs)
 - d. Transformers.
 - e. Motor Controllers, including Drives.
 - f. Disconnect Switches
 - g. Instruments
- C. Label Installation:
1. Install label parallel to equipment lines.
 2. Install label for identification of individual control device stations, and input or output devices for the PLC.
 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 3. Install labels at data outlets identifying patch panel and port designation.
 4. Permanently post phase and system identification means at each branch circuit panelboard by using labels.
- E. Raceway Marker Installation:
1. Install raceway marker for each raceway longer than 6 feet.
 2. Raceway Marker Spacing: 20 feet on center.

3. Raceway Painting: Identify conduit using field painting.
 - a. Paint colored band on each conduit longer than 6 feet.
 - b. Paint bands 20 feet on center.
 - c. Color:
 - 1) Medium Voltage: Black
 - 2) 480 Volt System: Orange
 - 3) 240 Volt / 208 Volt Systems: Brown
- F. Underground Warning Tape Installation:
 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 26 05 73 - SHORT-CIRCUIT, COORDINATION, AND ARC FLASH STUDIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes computer-based fault-current studies to determine the minimum interrupting capacity of circuit protective devices, overcurrent protective device coordination studies to determine overcurrent protective device settings for selective tripping, and arc-flash studies to determine the arc-flash hazard distance and the incident energies to which personnel could be exposed during work on or near live electrical equipment.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form:
 - a. Short-circuit studies:
 - 1) Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - 2) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Owner's Representative for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
 - b. Coordination studies:
 - 1) Coordination study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - 2) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Owner's Representative for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

c. Arc flash studies:

- 1) Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates:

1. For short-circuit study software, certifying compliance with IEEE 399.
2. For overcurrent protective device coordination study software, certifying compliance with IEEE 399.
3. For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
 2. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 3. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
 4. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

- E. Power Systems Analyst Qualifications: Professional engineer in charge of performing the studies, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 PRODUCTS

1.6 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Comply with IEEE 242, IEEE 399, IEEE 551, IEEE 1584, and NFPA 70E.
- B. Analytical features of power systems analysis software program shall have capability to calculate "mandatory" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1.7 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Conduit type, if used.
 - 4. Transformer kilovolt ampere (kVA), impedance (%Z), primary and secondary configurations ("delta", "wye", etc.), and voltage ratings.
 - 5. Motor and generator designations and ratings.
 - 6. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 - 7. Derating factors and environmental conditions, if required.

- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstands ratings exceed available short-circuit current at equipment installation locations.
 - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
 - 1. One-line diagram of system being studied.
 - 2. Power sources available.
 - 3. Manufacturer, model, and interrupting rating of protective devices.
 - 4. Conductors.
 - 5. Conduit types, as applicable, for each circuit shown in system model.
 - 6. Transformer data.
- G. Short-Circuit Study Output Reports:
 - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
 - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.

- d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
- 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

1.8 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Any revisions to electrical equipment required by the study.

- D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available:
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
 - c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

- c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - d. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - e. Ground-fault protective devices, as required.
 - f. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Maintain selectivity for tripping currents caused by overloads.
 6. Provide adequate time margins between device characteristics such that selective operation is achieved.
 7. Comments and recommendations for system improvements.

1.9 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
 1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
 4. Motor and generator designations and ratings.
 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Arc-Flash Study Output Reports:
 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
 - a. Voltage.

- b. Calculated symmetrical fault-current magnitude and angle.
- c. Fault-point X/R ratio.
- d. No AC Decrement (NACD) ratio.
- e. Equivalent impedance.
- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

- 1. Arcing fault magnitude.
- 2. Protective device clearing time.
- 3. Duration of arc.
- 4. Arc-flash boundary.
- 5. Restricted approach boundary.
- 6. Limited approach boundary.
- 7. Working distance.
- 8. Incident energy.
- 9. Hazard risk category.
- 10. Recommendations for arc-flash energy reduction, if requested.

1.10 ARC-FLASH WARNING LABELS

- A. Produce 3.5-by-5-inch self-adhesive equipment labels for each work location included in the analysis.
- B. Danger labels shall have a red header with the wording, "DANGER, ARC-FLASH HAZARD," and shall be used where incident energy is in excess of 40 Cal/cm squared. Labels shall indicate that work on equipment while energized is prohibited, and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Protection boundaries:
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.

4. Available incident energy.
 5. Issue date.
- C. Warning labels shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
1. Location designation.
 2. Nominal voltage.
 3. Protection boundaries:
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 4. Available incident energy.
 5. Required minimum arc rating of PPE in Cal/cm squared.
 6. Working distance.
 7. Issue date.
- D. Labels shall be machine printed, with no field-applied markings.

PART 3 EXECUTION

1.11 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work:
1. Proceed with coordination studies only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted prior to coordination study may not be used in study.
 2. Proceed with arc-flash studies only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted prior to arc-flash study may not be used in study.

1.12 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the studies:
 - 1. Verify completeness of data supplied in one-line diagram and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article, below. Call any discrepancies to Architect's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the required input data to support the studies. Record data on a Record Document copy of one-line diagram.
- C. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the studies.

1.13 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Begin short-circuiting current analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is less than 10 kA.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- F. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram:

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Include in the report identification of any protective device applied outside its capacity.

1.14 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Perform analysis at the service, extending down to system overcurrent protective devices.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- F. Transformer Primary Overcurrent Protective Devices:
 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- G. Motor Protection:
 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time

equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- I. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.
- J. Include the ac fault-current decay from induction motors and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram:
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- L. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Include in the report identification of any protective device applied outside its capacity.

1.15 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

1.16 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.

- C. Calculate maximum and minimum contributions of fault-current size:
 - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
 - 2. Calculate arc-flash energy at both 100% and 85% of calculated short-circuit current at each location, according to IEEE 1584 recommendations. Arc-flash incident energies presented in study shall be based on larger of these results.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include low-voltage equipment locations. Where permitted by the Authority Having Jurisdiction, exclude equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited and restricted approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time.

1.17 LABELING

- A. Apply arc-flash label(s) on the front cover for each equipment included in the study. Base arc-flash label data on highest values calculated at each location:
 - 1. Where equipment has multiple, isolated sections (such as metal-clad switchgear) and/or an isolated main breaker compartment, multiple labels are permitted (one for each section) when the arc-flash energies differ between sections.

- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 - 1. Motor-control centers.
 - 2. Low-voltage switchboards.
 - 3. Switchgear.
 - 4. Panelboards and safety switches over 250 V.
 - 5. Applicable panelboards and safety switches under 250 V.
 - 6. Control panels.
 - 7. Other equipment as may be required by Authority Having Jurisdiction and/or Owner.

1.18 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels as directed by the Professional engineer in charge of performing the studies.

END OF SECTION

SECTION 26 05 88 - PREMIUM EFFICIENCY VERTICAL MOTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Work consists of vertical motors for vertical turbine pumps shown on the drawings and specified herein and in other divisions of the specifications. Motors shall be premium efficiency and furnished with the driven equipment.
- B. The requirements of all other sections of the specifications are equally applicable to the work to be performed under this section. Motors and controls are specified elsewhere in this and other divisions of the specifications. In the event of conflicts, the more restrictive specifications shall apply.
- C. Where two or more pump systems of the same type or size are required, all pumps shall all be produced by the same manufacturer.
- D. Provide all labor, equipment and materials and perform all operations in connection with the installation and testing of pumps.
- E. Coordinate and utilize all factory testing, installation, start-up and field testing services supplied in conjunction with the pumping equipment.
- F. Related Requirements:
 - 1. Section 43 21 52 – Deep Well Vertical Turbine Pumps

1.2 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Complete motor data shall be submitted and include the following data:
 - 1. Motor manufacturer.
 - 2. Motor type or model and dimension drawing to include motor weight.
 - 3. Nominal Horsepower.
 - 4. NEMA Design.
 - 5. Enclosure.
 - 6. Frame size.
 - 7. Winding insulation class and treatment.
 - 8. Rated ambient temperature.
 - 9. Service factor.
 - 10. Voltage, phase and frequency ratings.
 - 11. Full load current at rated horsepower for application voltage.

12. Starting code letter, or locked KVA, or current.
 13. Special winding configuration.
 14. Rated full load speed.
 15. Guaranteed minimum Power Factor at 100, 75 and 50 percent of full load.
 16. Guaranteed minimum efficiencies at 100, 75 and 50 percent of full load.
 17. Starting torque.
 18. Full load torque.
 19. Breakdown torque.
 20. Rated temperature rise at rated horsepower.
 21. Full load current at rated voltage.
 22. Current at no load on shaft at rated voltage.
 23. Connection diagram.
 24. Superimposed load speed torque curve over motor speed torque curve.
 25. Recommended spare parts list priced..
- C. Operation and Maintenance Manual: Containing the required information for each pump section.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

- A. All equipment shall be designed and built for industrial service and be capable of operating successfully under the following applicable conditions.
1. 40 degrees C maximum ambient temperature.
 2. Voltage variations to + 10% of nameplate rating.
 3. Frequency variations to + 5% of nameplate rating.
 4. Combined voltage and frequency variations to + 10% total, as long as frequency does not exceed + 5%.

2.2 ELECTRIC MOTORS

- A. General: Electric motor driven pumps shall be premium efficiency with hollow shaft electric motors, design B, high thrust, squirrel cage, induction type having NEMA weather protected type WP1 enclosures unless otherwise specified. Motors shall utilize adjustable spacer couplings. Motors shall be suitable electrically and mechanically to efficiently and effectively drive pumps. Motors shall operate in accordance with these specifications. Motors shall be sized such that the pump BHP shall not exceed the nameplate data at any location on the full-speed operating curve.
- B. Unless specified otherwise, all materials, workmanship and tests shall conform with the applicable specifications to NEMA, IEEE, ASA and AFBMA.

- C. Motor frame shall be steel or cast iron, aluminum shall not be permitted.
- D. Motors shall be rated for operation at 460 VAC, 3 phase, 60 hertz, Service factor of 1.15 or greater. Motors shall be provide the minimum horsepower at the maximum rpm stated in Section 11101.
- E. Motors shall be rated for premium efficiency. Rated efficiencies shall be based on NEMA standards MG1-12.536 or standards imposed by the local electric utility, which ever is more restrictive.
- F. Motors shall be capable of full load operation with voltage variations of +/- 10% and frequency variation of +/- 5%.
- G. Motor starting current shall not exceed 650% of motor full load current.
- H. Insulation system: All motors shall be provided with Class "F" or better insulation systems except that motor lead insulation may be class "B" or better. Completed windings, when tested in accordance with IEEE #57 shall show a thermal rating not less than 150 degrees for 30,000 hours of life.
- I. Windings shall be held firmly in stator slots to prevent coil shift. Stator windings shall be of high conductivity copper magnet wire. Completed stator windings shall be provided with a properly cured, uniform impregnation for mechanical rigidity, moisture resistance, and protection against winding failure from accumulation of foreign conductive matter. The completed insulation system shall be capable of withstanding phase to ground rms voltage of 600 volts continuous and 2,300 volts instantaneous.
- J. All motors used with variable frequency drives shall be inverter duty rated, have a minimum of 1600 volt insulation on the windings, have insulated motor bearings and shaft grounding rings and shall be compatible with the VFD specified elsewhere in Division 26.
- K. Rated temperature rise above 40 degrees C ambient temperature, at service factor load of 1.15 shall not exceed 90 degrees C.
- L. Motors rated 50 Hp and larger shall be rated NEMA locked rotor Code G or better.
- M. Motors shall be dynamically balanced to a maximum of .001 inches peak to peak amplitude.
- N. Motors shall be equipped with anti-friction type thrust and guide bearings. Angular contact thrust bearings shall be used. Bearings shall be of sufficient capacity to withstand all static and dynamic thrust loads, both momentary and continuous, imposed by the pump. Bearings shall provide minimum 3-year life based on

continuous design thrust loads. For variable frequency applications, bearings shall be insulated and shaft shall be grounded with a shaft-grounding/bearing protection ring.

- O. Motor thrust bearings shall be lubricated with the lubrication system recommended by the manufacturer to provide optimum lubrication of bearings for long life and trouble free operation. Motors lubricated with oil shall have visual level indicators and accessible fill and drain plugs for the oil reservoir.
- P. Motors shall be equipped with non-reverse mechanisms which shall limit maximum reversal to 10 degrees of rotation.
- Q. Motors shall be equipped with fabricated steel conduit boxes. The box shall be sized for two 350 MCM AWG conductors per phase and two #1 AWG ground conductors with stress cone terminations for main motor leads. Separate accessory terminal boxes shall be provided for space heater and temperature sensors.
- R. Motor Nameplates shall include Manufacturer name, serial number, rated horsepower, service factor, frequency, phase, load voltage, full load amps, full load speed, design designation, locked rotor current and or designation, insulation class, temperature rise, maximum ambient temperature, NEMA efficiency, and full load power factor, time rating, model #, bearing identification, frame size, thermal protection, nominal and guaranteed efficiency.
- S. Coating System: Manufacturers standard corrosion resistant coating.
- T. Motors shall be as manufactured by General Electric Company, or US Motors.

2.3 MOTOR ACCESSORIES

- A. Motor shall be equipped with a 120 volt, single phase space heater. The space heater shall maintain a motor temperature that is 15 degrees Fahrenheit above ambient temperature when the motor is not operating. Space heater leads shall be brought out to a separate auxiliary terminal box.
- B. Motor shall be equipped with winding thermostats. Thermostats shall be snap action, bi-metal, temperature and shall be factory mounted integral to motor. Thermostats shall be provided with one normally closed contact with switch point pre-calibrated by manufacturer.

PART 3 EXECUTION

3.1 GENERAL

- A. Install equipment and materials in a neat and workmanlike manner and align, level and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.

3.2 WIRING

- A. Arrange wiring in cabinets, panels and motor control centers neatly cut to proper length, and remove surplus wire. Apply stak-on or similar terminals to control wiring for connection to terminals, and bridle and secure in an approved manner. List all circuits emanating from power, distribution and lighting panelboards by function on the directory card. Identify all circuits entering motor control centers or other control cabinets by directory card listing terminal block number and function or by means of tags securely fastened to the conductors.

END OF SECTION

SECTION 26 27 00 - SERVICE AND DISTRIBUTION

PART 1 GENERAL

1.1 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Work consists of providing the complete service and distribution system shown on the drawings and specified herein. The requirements of all other sections of the specification are equally applicable to the work to be performed under this section.

1.2 GENERAL

- A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, and Section 26 05 00, ELECTRICAL - GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are necessary for this project.

1.3 SUBMITTALS AFTER AWARD OF CONTRACT

- A. Submittals after award of Contract shall be made in accordance with Division 1, GENERAL REQUIREMENTS, and Section 26 05 00, ELECTRICAL - GENERAL REQUIREMENTS.
- B. Provide complete coordination study of the electrical system. Include trip settings and trip curves for each overcurrent device provided in the project, including, but not necessarily limited to, the circuit breaker mounted in the generator, main circuit breaker/service disconnect, motor control center (MCC), motor starters, and panelboards. The coordination study shall conform to the requirements of the latest IEEE standard 242 – Protection and Coordination.
- C. The Contractor shall submit a coordination study report to the Engineer for review prior to project completion. The Engineer may direct the Contractor to make adjustments to trip settings based on the coordination study report findings. These adjustments shall be at no additional cost to the Owner.

1.4 ELECTRICAL SERVICE

- A. The utility company rendering electrical service to this project is Portland General Electric (PGE). Furnish all labor and install all material not furnished by the utility company, including meter bases, CT cans, and transformer pads or poles as shown, or as required by utility company to render service to the project from utility service point.

Verify service point metering requirements, pad construction details, service charges, etc., and include all costs in bid proposal.

- B. Provide ground services as required to satisfy utility company and code requirements.
- C. Provide trenching and backfill at locations shown on the plans and as required by the utility company for service cable to the project site.
- D. For utility service conduit, provide sweeps per utility company standards.
- E. Verify all pull boxes, transformer details, and cable details with the utility company and observe utility company standards throughout.
- F. The Contractor shall pay all Power Company fees.

1.5 SYSTEM VOLTAGE CHARACTERISTICS

- A. Provide electrical system nominal utilization voltage characteristics as follows:

Typical Voltage Description Herein	Nominal Utilization Voltage
480/277	460/265
120/208	115/200
120/240	115/230

PART 2 PRODUCTS

2.1 SAFETY SWITCHES AND DISCONNECTING MEANS

- A. Furnish safety switches and disconnecting means where required by the NEC, state and local codes or where required by the AHJ. All equipment shall conform to NEMA standards latest revision as applicable.
- B. Switches shall be heavy-duty class, quick-make, quick-break, safety-type, externally operable, with by-passable interlock to prevent opening of cover in "ON" position. Switch shall have positive indication of "OFF" and "ON" position. Devices shall have visible blades unless molded-case breaker mechanism is used. Switches shall be so constructed as to preclude single phasing of switch blades due to mechanical failure. Switches shall be padlockable in the open ("OFF") position. Where indicated, switches shall also be lockable in the closed ("ON") position.
- C. Switches shall be of the proper horsepower, ampere, and voltage rating with number of poles required to open all ungrounded conductors and with a solid neutral (S/N) bar where required. Provide auxiliary switch contacts in all disconnect switches to monitor the status of the disconnect switch.

- D. Unless otherwise indicated, individually mounted switches shall be in NEMA type 12 enclosures, except in wet locations, outdoors, or where indicated as weatherproof, in which case NEMA type 4 stainless steel enclosures shall be provided.

2.2 FUSES, 600-VOLT AND LESS

- A. Provide fuses as manufactured by Bussmann Manufacturing Company, Chase-Shawmut Company, or equal.
- B. Fuses protecting control circuits shall be Bussman "Fusetron", Chase-Shawmut "Trionic," or equal, dual-element type having an interrupting rating of at least 100,000 Amps RMS unless otherwise noted.
- C. The following general requirements shall apply to all fuses:
 - 1. Fuses shall be coordinated with each other and with circuit breakers in the circuit.
 - 2. Make adjustments in the specified fuse sizes and provide substitute fuses as required to achieve reliable trouble-free operation of all fused circuits.
 - 3. Provide a fuse in each fuse holder.
 - 4. Provide a label inside each cover or adjacent to each fuse holder indicating specific type of fuse required for replacement.
 - 5. Provide six spare fuses for each low-voltage current rating used on the project, except no spare fuses will be required for integral current-limiting fuse circuit breaker units.

2.3 PANELBOARDS

- A. General: Provide panelboards in conformance with the following specification for installation as shown on the drawings.
- B. Panelboards shall be dead-front, surface mounted with sub-breakers, main lugs, double lugs, or main breakers as shown on the drawings. Lugs shall be sized for feeders and shall conform to the specification for splicing and terminations. Buses shall be copper, full panel length. Buses shall be identified. Minimum bus rating shall not be smaller than the setting of the feeder protective device. Provide copper ground bus in all panelboards:
 - 1. Unless otherwise indicated, the interrupting rating for panelboards shall be:
 - a. 480V-Class: 42 kAIC at 480 VAC, minimum; provide higher ratings, if required.
 - b. 240V-Class: 10 kAIC at 240 VAC, minimum; provide higher ratings, if required.

2. Circuit breakers: Provide molded case bolt-on circuit breakers with thermal magnetic trip units, and a common trip bar for two or three-pole breakers, connected internally to each pole so that the tripping on one pole will automatically trip all poles of each breaker. Handle bales or clips will not be acceptable. Provide breakers of the trip-free and trip-indicating type, with quick-make, quick-break contacts. Provide single, two or three pole breaker interchangeability.
3. Special features: Provide split-bus, sub-feed lugs, sub-feed protective device and contactors as indicated on the drawings or specified in this or other sections of these specifications.
4. Tandem, duplex, or half-sized circuit breakers: Do not use this type of equipment.
5. Lighting and appliance panelboards (240 V class): Minimum breaker interrupting rating shall be 10,000 amps, symmetrical. Provide breakers and panel of higher interrupting rating where indicated on the drawings. Provide minimum box dimensions per NEC.
6. Covers: Covers shall be hinged front. Inside cover shall have panel schedule neatly typewritten in a plastic pouch.

2.4 DRY TYPE TRANSFORMERS

- A. General: Provide all power transformer equipment as shown on the drawings in conformance with the following specification. All transformers shall be built in accordance with the latest revised IEEE, ANSI, and NEMA standards. All transformers shall conform to or exceed DOE 2016 energy efficiency standards.
- B. Temperature rating: On all transformers, case temperature shall not exceed 30 degrees Centigrade rise above an ambient temperature of 40 degrees Centigrade. Terminal compartment shall be located to ensure termination of cable leads in temperature levels not to exceed 60 degrees Centigrade. Transformers shall be designed for full load operation at a maximum temperature rise of 115 degrees C.
- C. Enclosure: For general application, enclosures shall be drip-proof and rodent-proof. Ventilating openings shall be louvered; screening will not be acceptable. Design shall incorporate a built-in vibration dampening system. Finish shall be ANSI 60. Conform to the limited access requirements where applicable.
- D. Taps: Furnish four taps, two above and two below rated voltage, each 2 1/2 percent, for ratings above five (5) kVA.

- E. Tests: Provide routine tests as listed and described in ANSI specification No. C57.12.00, latest edition.
 - 1. Sound level tests shall be performed on the complete transformer assembly in accordance with the latest NEMA standards. Transformer 0-50 kVA shall conform to NEMA standards.

2.5 SURGE PROTECTION DEVICES

- A. Where shown, provide and install a surge protection device (SPD).
- B. The SPD shall be Listed and Component Recognized in accordance with UL 1449 (latest edition).
- C. SPD shall be installed integral to the switchgear at the equipment manufacturer's factory.
- D. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G and shall be suitable for service on high resistance-grounded power distribution systems when the power system is maintained in an overdamped state.
- E. SPD shall be modular in design. Each mode including N-G shall be fused with a 200 kAIR UL recognized surge rated fuse and incorporate a thermal cutout device.
- F. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided. SPD shall be provided with one set of NO/NC dry contacts.
- G. SPD shall meet or exceed the following criteria: Minimum surge current capability (single pulse rated) per phase shall be 160kA per phase.
- H. UL 1449 Suppression Voltage Ratings at 480Y/277Volt shall be 600V L-G, L-N, and N-G.

PART 3 EXECUTION

3.1 EQUIPMENT BASES

- A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally 3.5-inches high, and be one inch larger on all exposed edges than the equipment to be mounted. Provide additional surface-mounted channels where required to match and lineup with existing equipment. Provide concrete pads and mounting provisions for all exterior equipment as indicated or specified in other portions of the specifications.

3.2 SUPPORTS

- A. Provide hangers or other devices such as pads, channels, struts, joists, anchors, etc., necessary for the support of electrical equipment. Provide the design, fabrication, and erection of supplementary structural framing electrical equipment. Show on shop drawing supplementary framing including design loads, member size and location. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3.3 DAMP AND WET LOCATION

- A. Provide 1/4-inch air space behind all electrical equipment mounted in damp and wet locations and on concrete walls below grade. Use corrosion-resistant washers, bolts, and anchors.

3.4 MECHANICAL EQUIPMENT

- A. Provide convenience receptacle and disconnect for each mechanical device as required by the NEC.

3.5 START-UP AND TESTING

- A. The Contractor shall provide third party testing and certification of any ground fault circuit breakers per the NEC and/or State Codes.
- B. The Contractor shall provide switchboard factory authorized personnel for 1 day to perform the following:
 - 1. Inspecting for proper wiring and functionality.
 - 2. Set all circuit breakers, including the generator circuit breaker, per the coordination study specified herein.
- C. Provide Engineer with documentation on each setting of each circuit breaker as programmed. Omission of proper documentation shall result in start-up and testing Failure, and cause for the system to be re-tested and re-commissioned at the Contractor's expense.

END OF SECTION

SECTION 26 27 16 - CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) -Standard of Installation.
- B. National Electrical Manufacturers Association:
 - 1. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000V Maximum).

1.4 SUBMITTALS

- A. Sections 01 33 00 and 26 05 00
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

1.5 EXTRA MATERIALS

- A. Furnish two of each key.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.

2.2 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1, 3R, or 4; steel, stainless steel or fiberglass enclosure as indicated or specified.
- B. Covers: Continuous hinge, held closed by hasp and staple for padlock.
- C. Furnish interior metal panel for mounting terminal blocks and electrical components, finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.

2.3 CABINETS

- A. Boxes: Galvanized steel.
- B. Box Size: As shown or required.
- C. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- D. Furnish metal barriers to form separate compartments for wiring of different systems and voltages.
- E. Furnish accessory feet for free-standing equipment.

2.4 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Allen Bradley
 - 2. AMP
 - 3. Ideal Industries
 - 4. Ilsco Corp.
 - 5. Phoenix Contact
 - 6. Weidmuller
- B. Terminal Blocks: NEMA ICS 4
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- E. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation or provide access panel.
- B. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- C. Install cabinet fronts plumb.

3.3 CLEANING

- A. Clean electrical parts to remove conductive and harmful materials.
- B. Remove dirt and debris from enclosure.
- C. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Section Includes:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Device plates.
 - 4. Surface covers.

1.2 SYSTEM DESCRIPTION

- A. Provide devices and finish plates for a complete and operational electrical system.

1.3 SUBMITTALS

- A. Provide Product Data for the Following Equipment:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Finish plates.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of the NEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or another testing firm acceptable to AHJ.
- C. Federal Specification Compliance: Comply with Federal Specification WS896 and WC596 for switches and receptacles, respectively.
- D. NEMA Configuration: Comply with NEMA configurations and standards for general and special purpose wiring devices.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Characteristics: Toggle type, quiet acting, heavy duty industrial grade, 20-amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage. Manufacturers: Arrow-Hart, Leviton, Pass & Seymour, Bryant, Hubbell, or approved.
- B. Finish: Gray finish unless selected otherwise by Engineer. Provide Engineer with optional colors for selection prior to ordering.
- C. Appearance: Provide lighting switches and receptacles of common manufacturer and appearance.

2.2 RECEPTACLES

- A. Finish: Same exposed finish as switches. Receptacles connected to emergency circuits, red finish.
- B. Characteristics: NEMA 5-20R configuration, heavy duty industrial grade, 20-amp, 125 volts, 2-pole, 3-wire grounding. Manufacturers: Arrow-Hart, Leviton, Pass & Seymour, Bryant, Hubbell, or approved.
- C. Ground Fault Interrupter: Feed through type, 20 amp, 125VAC, specification grade. Manufacturers: Arrow-Hart, Leviton, Pass & Seymour, Bryant, Hubbell, or approved.
- D. Wet Locations: Weatherproof receptacles installed in wet locations, approved for location and use.
 - 1. Single Receptacle Cover: Continuous use approved.
 - 2. Duplex Receptacle Covers: Continuous use approved.
 - 3. Cord Caps: Equip utilization equipment connected to wet location receptacles with barrel type plug similar to Hubbell 5266-C.
 - 4. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.

2.3 FINISH PLATES

- A. Material: 18 percent chrome, 8 percent nickel, Type 302 stainless steel, smooth satin finish metal. Hubbell S Series, Arrow-Hart, Leviton, Pass & Seymour, Bryant.

2.4 SURFACE COVERS

- A. Material: Galvanized or cadmium plated steel, 1/2-inch raised industrial type with openings appropriate for devices installed on surface outlets.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protection:
 - 1. Devices: Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of substantial completion, replace those items which have been damaged, including those burned and scored by faulty receptacles or cord caps.
 - 2. Finish Plates and Devices: Do not install items until finish painting is complete. Scratched or splattered finish plates and devices not acceptable.

3.2 INSTALLATION

- A. Plumb: Install devices and finish plates plumb with building lines and equipment cabinets.
- B. Orientation:
 - 1. Wall Mounted Receptacles: Install with long dimensions oriented vertically at centerline height shown on Drawings or specified herein.
 - 2. Vertical Alignment: When more than one outlet is shown on Drawings in close proximity to each other, but at different elevations, align the outlets on a common vertical centerline for best appearance. Verify with Engineer.

3.3 FIELD QUALITY CONTROL

- A. Wiring Device Tests: Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.

END OF SECTION

SECTION 26 29 00 - MOTORS AND CONTROLS

PART 1 GENERAL

1.1 SCOPE

- A. Work consists of all motors and controls specified herein and in other divisions of the specifications. In general, all motors shall be furnished with the driven equipment. The requirements of all other sections of the specifications are equally applicable to the work to be performed under this section. Motors and controls are specified in this and other divisions of the specifications. In the event of conflicts, the more restrictive specifications shall apply.

1.2 SHOP DRAWINGS

- A. Submit shop drawings of the following for approval of the Engineer:
 - 1. Motor controllers
 - 2. Pilot control devices
 - 3. Prewired systems:
 - a. General descriptive literature of the manufacturer's standard equipment.
 - b. Complete equipment layout including construction details.
 - c. Complete bill for materials.
 - d. Schematic and ladder diagrams of internal control wiring of each unit and connections and functioning of outside control devices required in the particular installation.
 - e. Complete composite diagram showing wiring of power and control, interconnections between sections, terminal markings, and wire size.
 - 4. Complete schedule of nameplate legends.

1.3 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA).

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

- A. All equipment shall be designed and built for industrial service and be capable of operating successfully under the following applicable conditions:
1. 40 degrees C maximum ambient temperature.
 2. Voltage variations to +/- 10% of nameplate rating.
 3. Frequency variations to +/- 5% of nameplate rating.
 4. Combined voltage and frequency variations to +/- 10% total, as long as frequency does not exceed +/- 5%.
 5. 3,300-foot maximum altitude.

2.2 MOTOR CONTROL

- A. General:
1. Furnish and install a complete motor control system as specified, shown on the drawings or required for the control and protection of all motors and motor-operated equipment in conformance with manufacturer's recommendations and applicable codes.
 2. This section of the specification applies to all motor controls specified herein and in other sections of the specification.
 3. All controls shall conform to the requirements of NEMA standards latest revision.
- B. Control requirements: Provide for each motor a suitable controller and devices that will perform the functions specified or shown on the drawings for the respective motor. Each motor shall be provided with thermal overload protection.
1. Single-phase motors shall be self-protected, and control shall be through manual switches or automatic contacts as specified or indicated on the drawing.
 2. Polyphase motors shall have thermal overload heater elements provided integral in the motor controller for each ungrounded conductor.

C. Across-the-Line Motor Starters:

1. General:

- a. Provide combination type starters with motor circuit protector or thermal-magnetic circuit breaker and control power transformer with ratings as indicated on the drawings.
- b. NEMA size 1, minimum.
- c. Coordinate motor circuit protector, thermal magnetic circuit breaker, or fusible disconnect, and overload trip ratings with nameplate horsepower and current ratings of the installed motor:
 - 1) If motors provided are different in horsepower rating than those specified or indicated on the drawings, provide starters coordinated to the actual motors furnished.
- d. Provide starters NEMA size 2 and larger with arc quenchers on load breaking contacts.
- e. Mount extended overload reset buttons to be accessible for operation without opening starter enclosure door.

2. Full voltage starters (FVNR, FVR, TS1W, TS2W):

- a. Across-the-line full voltage magnetic starters.
- b. Rated for 600 volts.
- c. Electrical characteristics as indicated on the drawings.
- d. Provide positive, quick-make, quick-break mechanisms, pad lockable enclosure doors.
- e. Furnish starter with solid-state electronic overload relays.
- f. Double-break silver alloy contacts.

3. Reversing starters provided with both mechanical and electrical interlocks to prevent line shorts and energizing both contactors simultaneously.

D. Pilot Devices:

- 1. Operate 120-volts unless otherwise noted.

2. Pushbutton, selector switches and pilot lights shall be as follows unless otherwise indicated.
3. Push-buttons: Oil tight, heavy-duty type.
4. Pilot Lights: Provide oil tight heavy-duty, 125-volt transformer push-to-test type with LED lamp and lens colors.
5. Running time meter (H): Provide a semi-recessed running time meter for all pump motors. Utilize a non-resettable unit with four registers to indicate up to 9,999 hours.
6. Automatic control devices: Float switches and similar devices shall conform to the above requirements for push-buttons as applicable, shall be heavy-duty type and shall be applied within their electrical, mechanical and environmental rating.
7. Control relays and contacts: Provide control relays as specified and as required to accomplish the control functions indicated. Relays shall be industrial control relays conforming to NEMA Standard ICS, Part ICS 2-12. Contacts shall have current and voltage rating as required by the application but not less than required in NEMA Standard ICS for Class B1. Contact arrangement shall be Subclass B.

2.3 PREWIRED SYSTEMS

- A. Prewired systems shall be complete in all respects and shall provide all required functions. All components of the system shall conform in all respects to all portions of the specification. It is desired to take the fullest possible advantage of the manufacturer's standard methods and therefore, the drawings indicated general functions without details and the specifications generally call for the system, to be the "manufacturer's standard". Such specifications and drawings do not relieve the manufacturer from the requirement to alter his "standard" components and methods and usual scope of work in order to provide the completeness, quality, quantity, function and interchangeability with the function specified herein and shown on the drawings. Prewiring of systems shall be complete including all required interconnections, integral wiring and inter-unit conduit and wiring, ready for the indicated external connections. It is the Contractor's responsibility to review the extent of electrical work and connections shown on the electrical drawings and to provide compatible prewired systems for a complete, coordinated, and proper functioning system.

2.4 CONTROL PANEL WIRING

- A. All electric wiring 115 volts or greater in the panels shall be in accordance with the standards of the NEC. Wires shall be Type THWN stranded, 600-volt insulation and

shall be in sizes not less than No. 16 gage, suitable for the currents to be carried. All wiring shall be enclosed in either sheet metal raceway or plastic wiring duct. Connections to the terminal strips shall be made using pressure type lugs. Locate all fuses on a common fuse block with circuit designations. Terminate all connections to external equipment at numbered terminal blocks. One 20-amp circuit shall be extended to the panel.

- B. All electrical wiring shall be identified at each end with imprinted Mylar adhesive back wire markers. Show terminal numbers on as-built wiring diagram.

PART 3 EXECUTION

3.1 GENERAL

- A. Install equipment and materials in a neat and workmanlike manner and align, level, and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.
- B. Provide trip settings of all main and feeder circuit breakers as directed by the Engineer.
- C. After the equipment is installed, touch up any scratches, marks, and the like, incurred during shipment or installation of equipment. If required by the Engineer because of undue amount of scratches, repaint the entire assembly at no additional cost to the Owner.

3.2 FIELD TESTS

- A. Functional test: Prior to plant startup, all equipment shall be inspected for proper alignment, proper connection, and satisfactory performance by operation of each starter and feeder.

3.3 WIRING

- A. Arrange wiring in cabinets, panels and motor control centers neatly cut to proper length and remove surplus wire. Apply stak-on or similar terminals to control wiring for connection to terminals, and bridle and secure in an approved manner. List all circuits emanating from power, distribution, and lighting panelboards by function on the directory card. Identify all circuits entering motor control centers or other control cabinets by directory card listing terminal block number and function or by means of tags securely fastened to the conductors.

3.4 SUPPORTS

- A. Provide hangers or other devices such as pads, channels, struts, joists, anchors, etc., necessary for the support of electrical equipment. Provide the design, fabrication and erection of supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment.

END OF SECTION

SECTION 26 29 23 - VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SCOPE

- A. This section covers AC voltage source, vector pulse width modulated (PWM) type variable frequency drives for high performance, constant torque capable power and overload capability.
- B. Equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless the engineer notes exceptions.
- C. Governing Standards. Each variable frequency drive shall be designed, constructed, and tested in accordance with the applicable standards of NEMA, ANSI, UL and IEEE and shall be designed for installation in accordance with the NEC. The drives shall be UL listed.
- D. The VFD system shall be factory tested as a complete unit.

1.2 SUBMITTALS

- A. Submittals shall be done in accordance with specification section 26 05 00 Electrical General Requirements.
- B. A preliminary harmonic analysis must be submitted by the VFD manufacturer during the submittal process, which includes all voltage and current harmonics up to the 49th.

1.3 RELATED STANDARDS

- A. The complete enclosed drive assembly shall be UL listed.

1.4 QUALITY ASSURANCE

- A. Quality assurance shall be done in accordance with the requirements stated in the Division 01 specifications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery, Storage and Handling shall be handled by the Contractor and included in the bid price for the project. Equipment shall be stored in appropriate indoor environment protected from the weather so as not to void equipment warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The variable frequency drive shall be manufactured by Allen-Bradley, Eaton, Siemens, or approved equal. The Engineer has the sole discretion to reject any submitted equipment that does not comply with the project requirements.
- B. The VFD is to be manufactured within the United States of America to alleviate concerns of future serviceability and parts availability.
- C. The manufacturer shall be a reputable international drive manufacturer who shall be certified to ISO 9001-2000 quality and ISO 14001 environmental standards.
- D. The manufacturer must prove a minimum of 15 years' experience in the development and production of variable frequency drives.
- E. The manufacturer shall keep a stock of spare parts. These must be available for at least 10 years after the product has been discontinued.

2.2 GENERAL

- A. Provide variable frequency controllers suitable for operating high or low overloads. Controllers shall meet or exceed the ratings listed below:
 - 1. The VFD system shall consist of an active front end, power factor correction / harmonic filter unit (as necessary), input rectifier-grade phase-shifting transformer, Clean Power 18-pulse minimum converter section, output inverter and control logic section. All components listed including power factor correction / harmonic filter and transformer shall be integral to the VFD lineup, factory wired and tested as a complete system. If the power factor / harmonic filter and transformer are supplied as separate items and not factory pre-wired, the VFD manufacturer shall include in the base price of the VFD all costs for field assembly and onsite power and VFD system wiring. The labor services and material for field interconnection of the system are to be provided by the VFD manufacturer.
 - 2. Input circuit breaker, interlocked with the enclosure door, with flange mounted handle to provide positive disconnect of incoming AC power. The handle and mechanism shall remain attached to the circuit breaker at all times even when the enclosure door is open.
 - 3. The circuit breaker shall be rated in accordance with NEC and UL requirements.
 - 4. The drive system shall be at least 94% efficient at full load and full speed. Losses to be utilized in drive system efficiency calculation shall include input transformer, harmonic filter, and power factor correction if applicable, VFD converter and

output filter if applicable. Auxiliary controls, such as internal VFD control boards, cooling fans or pumps, shall be included in all loss calculations.

5. The controller(s) shall be suitable for use with any standard NEMA design B squirrel-cage induction motor.
 6. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors. A power failure shall not necessitate a reload of any drive parameter or configuration.
 7. The VFD shall be capable of communicating via Ethernet IP.
- B. The VFD comprises the power electronics, control section and operator panel in fully digital microprocessor-based technology. All firmware and configuration values shall be stored in non-volatile memory. All data shall be stored on a memory card that allows simple transfer in the event of a control unit exchange.
 - C. On the line side the drive shall have a self-commutated, pulsed IGBT rectifier with a Clean Power filter, a DC link with capacitors with a long service lifetime of at least 12 years and a motor-side inverter equipped with low loss IGBT power semiconductors.
 - D. The VFD shall meet all requirements as outlined in the 2014 edition of IEEE 519 for each individual and total harmonic voltage and current distortion and as indicated in this specification:
 1. When harmonic filters are required to meet these requirements, the VFD manufacturer shall provide as a minimum 5th, 7th, and 11th harmonic filters and is responsible for the design and manufacturing of the filters. The vendor shall supply cabling and installation for the filters. The filters are to be provided with a separate contactor such that the VFD can operate in the event of a filter failure. Failure of a filter shall not cause the entire drive system to shut down.
 - E. The line side IGBT converter shall operate at unity power factor.
 - F. The motor-side IGBT inverter shall be controlled using the pulse-width modulation technique with an efficiency-optimized pulse frequency of between 1.25 kHz and 2.5 kHz and operate with optimized pulse patterns to ensure the following properties:
 1. High efficiency of $\geq 96\%$.
 2. High output voltage of the VFD (output voltage = min. 97% of line supply voltage).
 3. Low stray load losses in the motor when fed from the VFD.
 - G. The motor-side IGBT inverter must allow long motor cables without the need for any supplementary components such as reactors or filters [a minimum of 980-ft (300 m) when using shielded or 1,480-ft (450 m) when using unshielded motor cables].

- H. To allow the use of non-inverter duty motors it must be possible to optionally equip the VFD with the required output filters (dv/dt filter or sine wave filter).
- I. The VFD shall comply with EMC Directive 2004/108/EC and the limit values of the EMC product standard EN 61800-3. The VFD must, as a minimum, include EMC filtering to conform to Category C3 (second or industrial environment).

2.3 VARIABLE FREQUENCY DRIVES

A. Ratings:

1. Power supply: 480 Volts $\pm 10\%$ (-15% for 1 minute), 3 phase, 50/60 Hz.
2. Output Power 350_HP, at 460 V_motor voltage 60 Hz:
 - a. Power Unit Rating Basis: 110% rated current for one minute, at rated temperature for low overload applications. 150% rated current for one minute, at rated temperature for high overload applications.
3. Installation altitude: Up to 6,600-ft (2000 m) mean above sea level without derating.
4. Ambient temperature:
 - a. Operation: 32°F to 104°F (0°C to 40°C) without derating [$>104^\circ\text{F}$ to 122°F ($>40^\circ\text{C}$ to 50°C) with derating].
 - b. Storage: -13°F to +131°F (-25°C to +55°C).
5. Relative air humidity: Up to 95 % without condensation.
6. Supply frequency range: 47 Hz to 63 Hz.
7. Power supply: Grounded (transformer neutral or phase), ungrounded or high resistance grounded power supplies.
8. Output voltage: 0 V to the line supply voltage, with max. deviation -3%
9. Output frequency: 0 to 300 Hz
10. Power circuit efficiency: $\geq 96\%$ at rated power or rated current.
11. Sound pressure level (LpA) < 75 dB at 60 Hz.
12. The VFD shall have a continuous output current rating of at least 100% of motor nameplate current. The current rating of the VFD shall be the rating of the power module mounted inside the enclosure (taking into consideration the temperature

rise above ambient temperature), and not simply the rating of a power module in free air. The ratings are to be confirmed by type testing.

B. Construction:

1. The VFD shall be provided in a NEMA 1 enclosure with gasketing.
2. The equipment shall be rugged enough to withstand damaging environmental effects such as aggressive gases, chemically active dust, and humidity. This is to be achieved using varnish coated electronics boards as well as tin, nickel, or silver-plated busbars.
3. The VFD enclosure shall be designed for front access only, with full access to connections and components when the enclosure door is opened. Bolt-on covers in place of hinged enclosure doors are not acceptable.
4. Live parts and components shall be provided with touch safe protection so that they cannot be accidentally touched when the door is opened. These covers must be easily removable with minimal tools required.
5. Exchange of components and access to connections shall be quick and easy without requiring the removal of other components, and without any special tools.
6. The enclosure shall be suitable for mounting against a wall without any restrictions. Multiple enclosures shall be able to be installed adjacent to one another without any intermediate clearances.
7. The input circuit breaker operator handle shall be interlocked with the enclosure door. The handle shall be pad-lockable and incorporate a defeat mechanism as specified by UL.
8. The circuit breaker shall be rated in accordance with NEC and UL requirements.
9. The VFD shall be supplied with an input contactor, to electrically isolate the VFD from the supply system.
10. Mounting of a braking controller (chopper) shall not require an increase in the enclosure size.

C. Drive Control Features

- D. The VFD shall include the following control functionality:
1. Regulator capable of operating in:
 - a. Sensorless vector control, closed-loop vector control with optional encoder interface, or V/Hz control modes. V/Hz control shall be selectable with linear characteristic, optionally with FCC (flux current control), as well as parabolic and user defined characteristics, and with independent voltage setpoint, including IR and slip compensation.
 - b. Speed or torque follower control modes.
 2. Speed control of induction and synchronous motors, including permanent magnet type motors.
 3. Automatic motor identification routine to automatically optimize the control for any type of induction motor.
 4. Voltage Dip Ride-Through: VFD shall be capable of sustaining continued operation with a 10% dip in nominal line voltage (15% dip for up to 60 seconds). Output speed may decline only if current limit rating of VFD is exceeded.
 5. With an external UPS supply for the control voltage, the VFD shall be capable of sustaining continued operation at the drive output rated current with a dip in nominal line voltage of up to 50%
 6. Power Loss Ride-through: VFD shall have the capability of riding through power loss or dips up to 10 seconds without a controller trip depending on load and operating condition. In this extended ride through, the drive shall use the energy generated by the load inertia of the motor to power the electronic circuits (kinetic buffering).
 7. Customer selectable automatic restart feature: When enabled, the VFD shall automatically attempt to restart after a trip condition (programmable to allow for individual fault selection) resulting from a supply failure, instantaneous overcurrent, overvoltage, or overload, for example. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function, programmable for up to 10 attempts, is not successful within a customer programmable time period. The customer programmable time period shall be programmable for up to 600 s.
 8. Flying restart to switch the frequency converter onto a rotating motor. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed without the use of an encoder.
 9. PID controller for setpoint control.

10. Free function blocks for the implementation of control and interlocking functions:
 - a. Arithmetic (Adders, Subtracters, Multipliers, Dividers, and Comparators)
 - b. Logic (AND, OR, XOR, NOT, Flip-Flop)
 - c. Timers
 11. Safety integrated: The VFD shall be capable of safety integrated functionality Safe Torque Off (STO) and Safe Stop 1 (SS1) in accordance with IEC 60204-1.
- E. Operator control:
1. The VFD shall be provided with an easy to operate, user-friendly operator panel or human interface module (HIM) for controlling and monitoring the VFD and setting drive parameters. The door mounted operator panel shall have an integral LCD display for plain text display.
 2. The operator interface shall include:
 - a. Dedicated LED indicators for RUN, ALARM and FAULT conditions.
 - b. MENU key
 - c. LOCK key to lock the AOP keys and switch access levels.
 - d. Numerical keys (0 to 9, decimal point, \pm)
 - e. LOCAL/REMOTE changeover key to select the signal source.
 - f. ON/OFF keys. It shall be possible to select the OFF key to be active at all times, including when in REMOTE control mode.
 - g. Speed INCREASE/DECREASE keys
 - h. Key for JOG mode
 - i. Key for FORWARD/REVERSE direction of rotation (can be disabled)
 3. The digital display may be selectively configured to display parameter names with setpoint and actual values selectable in percent or physical units. Parameter values to be displayed shall include at least:
 - a. Speed and/or speed setpoint in rpm.
 - b. Output current and/or current setpoint in Amperes.
 - c. Output Frequency and/or frequency setpoint in Hertz.
 - d. DC bus voltage.
 - e. Output voltage.
 - f. Total 3-phase output power in kW or HP.

- g. Torque in Nm.
 - h. Kilowatt-hours.
 - i. Elapsed time.
 - 4. Fault and alarm messages shall have plain text descriptions as well as fault codes. Messages shall be stored in the fault memory specifying the time that they occurred and the time that they were cleared.
 - 5. The text language for all messages and descriptions shall be user selectable. At a minimum, the following languages shall be provided as standard:
 - a. English
 - b. Spanish
- F. Bus communications:
 - 1. VFD shall have the capability of communicating via an industrial Ethernet port to higher level automation systems.
 - 2. Industrial Ethernet communications shall be available for Ethernet IP protocols.
 - 3. Data communication shall be preconfigured and not require special programming to access parameter values, status, and fault data.
- G. Hard-wired signal interface:
 - 1. The VFD shall have an analog and digital signal interface to allow easy integration into an automation system. At a minimum, the following is to be provided:
 - a. 8 digital inputs
 - b. 4 bidirectional inputs/outputs (programmable as either input or output)
 - c. 2 differential analog inputs
 - d. 2 analog outputs
 - e. 2 relay outputs
 - f. Temperature sensor input (KTY or PTC sensor)
 - g. ± 10 V supply for analog signals
 - h. 24 V supply for digital signals
 - 2. All input and output signals shall conform to the following:
 - a. Analog signals: -10 V to +10 V, or 0 to 20 mA, or 4 to 20 mA, or -20 to +20 mA
 - b. Digital signals: -3 to +30 V
 - c. Relay outputs: Form C contacts rated 250V AC/30 V DC, up to 8 A

- H. Protective Features and Circuits - The controller shall include the following alarms and protective features:
1. Line or DC bus undervoltage monitoring
 2. Line-side phase failure monitoring
 3. DC bus overvoltage monitoring
 4. Motor side overcurrent and maximum current monitoring. An electronic overload circuit designed to protect an AC motor operated by the VFD output from extended overload operation on an inverse time basis. This electronic overload shall be UL and NEC recognized as adequate motor protection. No additional hardware such as motor overload relays or motor thermostats shall be required.
 5. Motor side ground fault monitoring (when connected to a solidly grounded supply)
 6. Overtemperature monitoring for air intake, electronics, power unit heat sink, power semiconductors, etc. Upon sensing a high temperature condition, the VFD is to be programmable to either limit its pulse frequency, output frequency and/or output current to maintain operation below the temperature limit, or to automatically trip.
 7. The VFD shall be protected from damage due to the following:
 - a. Three-phase short circuit on VFD output terminals.
 - b. Loss of input power due to opening of VFD input disconnect device or utility power failure during VFD operation.
 - c. Loss of one (1) phase of input power.
 8. The VFD shall be able to withstand the following fault conditions without damage to the power circuit components:
 - a. Failure to connect a motor to the VFD output.
 - b. VFD output open circuit that may occur during operation.
 - c. VFD output short circuit that may occur during operation.
- I. Parameter Settings:
1. The following system configuring settings shall be provided and field adjustable, without exception, through the keypad/display unit. Except for Motor Nameplate and Power Supply data, all parameters must be adjustable while the processor is on-line, and the drive is running:

- a. Motor Nameplate Data:
 - 1) Motor type.
 - 2) Motor frequency.
 - 3) Number of poles or Full load speed.
 - 4) Motor volts.
 - 5) Motor full load amps.
 - 6) Motor HP or kW.
 - 7) Current limit, max.

- b. VFD Configuration Parameters:
 - 1) Independent accel/decel rates with or without smoothing.
 - 2) Max/Min speed (frequency).
 - 3) Catch-a spinning load selection.
 - 4) Kinetic buffering (extended power loss ride-through).
 - 5) No load boosts.
 - 6) Full load boost.
 - 7) Volts/Hertz ratio.
 - 8) Overspeed trip.
 - 9) Overload trip curve selection.
 - 10) Overload trip time selection.

- c. VFD Automatic Control:
 - 1) PID utilizing an internal or external setpoint.
 - 2) 4 selectable critical speed avoidance bands with programmable bandwidths.
 - 3) Programmable loss of signal control: Stop, maintain last speed, or default to preselected setpoint.

- 2. All drive setting adjustments and operation parameters shall be stored in a parameter file. This parameter file shall be accessible from a PC via an RS-232 or RS-485 serial or Ethernet port as well as from the operator panel. The controller shall have a slot to allow the parameter log to be downloaded on to a compact flash memory card by using the keypad. In addition, it shall be possible to store the parameter file on a PC, and to transfer the parameter settings from the PC or memory card to another drive without the need for recommissioning.

- J. Configuration/programming software:
 - 1. Windows based software for start-up/commissioning, optimization, monitoring and diagnostics shall be provided for all drives at no charge. This software shall operate as a standalone PC application and be suitable for integration into higher

level control engineering or automation systems. The software package shall support all types and ratings of drives supplied under this package. Updates and new versions of this software shall be provided on-line, free of charge.

2. First-time users shall be supported by solution-based dialog menus, with a standard graphics-based display maximizing clarity when setting the drive parameters. First commissioning is to be guided by wizards, which make all the basic settings in the drive. This shall enable a drive to be up and running after only setting a small number of parameters within the drive configuration process.
3. The software shall allow configuration including but not limited to the following:
 - a. Digital and analog I/O terminals
 - b. Bus interface
 - c. Setpoint channel (e.g., fixed setpoints)
 - d. Speed control (e.g., ramp-function generator, limits)
 - e. Logic and mathematical functions
 - f. Diagnostics
4. Experts shall be able to gain rapid access to the individual parameters via the expert list and not have to navigate dialogs.
5. In addition, the following functions shall be available for optimization purposes:
 - a. Motor identification
 - b. Self-optimization
6. A trace and trending function with the following features:
 - a. Suitable for drive optimization and troubleshooting/maintenance as well as to trace/record longer trends in operation.
 - b. It shall be possible to trace/record up to 2x eight continuous quantities - such as speed or torque and bit tracks, e.g., control word.
 - c. The usual trigger conditions, endless trace and sampling times must be user selectable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify that mounting surface is suitable for controller installation.

- B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.
- C. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- D. The manufacturer shall have the capability and personnel to assist in the start-up, training, service, and maintenance of the equipment.
- E. The contractor shall provide all labor, materials, equipment, and incidentals required, and install, place in operation and field test the variable frequency drive(s).
- F. VFD manufacturer shall provide the services of a factory technician for startup assistance and training.

3.2 ADJUSTMENTS AND CLEANING

- A. Remove debris from drives and wipe dust and dirt from all components.

3.3 TESTING

- A. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture's recommendations.
- B. Check all installed panels for proper grounding, fastening and alignment.
- C. The VFD manufacturer shall have a quality system certified in accordance with ISO 9001-2000, and provide as a minimum the following quality assurance steps within his factory:
 - D. Incoming inspection of components and raw materials based on strategic supplier base and experience.
 - E. All drives subject to routine tests (megger, functional, no load operation and final inspection).

3.4 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

3.5 FACTORY TESTING

- A. The VFD manufacturer shall have a quality system certified in accordance with ISO 9001-2000, and provide as a minimum the following quality assurance steps within his factory:
 - 1. Incoming inspection of components and raw materials based on strategic supplier base and experience.
 - 2. All drives shall be subject to routine testing (megger, functional, no load operation) and final inspection.

3.6 STARTUP AND TRAINING

- A. VFD manufacturer shall have a factory trained technician for startup and fault-finding assistance throughout the USA.
- B. Harmonic compliance shall be verified with onsite field measurements of both the voltage and current harmonic distortion with and without the VFDs operating. A recording type Fluke 41 or equivalent harmonic analyzer displaying individual and total harmonic currents and voltages shall be utilized.
- C. VFD manufacturer shall offer formal training courses for start-up, maintenance, and repairs at dedicated training facilities in the USA.

3.7 SPARE PARTS

- A. The following spare parts shall be furnished:
 - 1. One control unit.
 - 2. One compact flash card.
 - 3. Three of each type of fuse rated 460V or less.
 - 4. Three of each type of pilot lamp.

END OF SECTION

SECTION 26 32 13 - STANDBY POWER SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The work consists of furnishing electric generating set with features and accessories as specified herein and shown on the drawings.
- B. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.
- C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not it is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.
- D. The generator set supplier shall be responsible for complete compliance to all specification requirements for the entire onsite power supply system, including the generator set and power switching equipment.
- E. Prototype testing, factory testing, and site testing shall be included.
- F. Standby Power System shall consist of:
 - 1. A diesel engine-driven, standby generator with an alternator rated 480/277-volt, 3-phase, 60 Hz; digital (micro-processor based) electronic generator set control system, sub-base fuel tank; and fuel transfer pump, if required. Minimum rating of the generating set(s) will be as shown on the drawings.
 - 2. Automatic Transfer Switch (ATS), as described below.

1.2 GENERAL REQUIREMENTS

- A. Materials and workmanship:
 - 1. Materials and parts comprising the standby power system specified herein shall be new, unused, of current manufacture and of the highest grade, free from all defects.
 - 2. Workmanship shall be the highest grade, in accordance with modern practice.
- B. Parts and service: Bidders shall specify nearest location of permanent parts depots from which replacement parts may be obtained in necessary quantities at any time, day or night. Service facilities and personnel shall be equally available.

1.3 GENERATOR SET PERFORMANCE

- A. Steady-State Voltage Operational Bandwidth: 0.25% of rated output voltage from no load to full load.
- B. Steady-State Voltage Modulation Frequency: Less than one Hz.
- C. Transient Voltage Performance: Not more than 15 percent variation for 50 percent step-load increase; not more than 10 percent variation for 50 percent step-load decrease. Voltage recovers to remain within the steady-state operating band within 2 seconds.
- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- F. Transient Frequency Performance: Less than 4-Hz variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within 2.5 seconds.
- G. Output Waveform: At no load, harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, does not exceed 50.
- H. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at the system output terminals, the system will supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.
- I. Temperature Rise of Generator: Within limits permitted by NEMA MG 1 when operating continuously at full-rated load, including 2 hours per 24 hours at 110 percent of rated capacity.
- J. Starting Time: Maximum total time period for a cold start, with ambient temperature at the low end of the specified range, is 7 seconds. Time period includes output voltage and frequency settlement within specified steady-state bands.

1.4 SUBMITTALS

- A. Product Data: For each component. Include data on features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components.

- B. Shop Drawings: Show details of fabrication, piping, wiring, and installation of field-installed portions of system. Include general arrangement drawings showing locations of auxiliary components in relation to engine generator set and duct, piping, and wiring connections between generator set and auxiliary equipment. Show connections, mounting, and support provisions and access and workspace requirements.
 - 1. Wiring Diagrams: Show details of power and control connections and differentiating between factory-installed and field-installed wiring.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article.
- D. Field Test and Observation Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Certified Test Reports of Components and Accessories: For devices that are equivalent, but not identical, to those tested on prototype unit.
- F. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet critical performance criteria.
- G. Factory Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements.
- H. Exhaust Emissions Test Report: To show compliance with applicable, current regulations.
- I. Sound measurement test report.
- J. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- K. Field test report of tests specified in Part 3.
- L. Maintenance data for system and components to include in the maintenance manuals specified in Division 1. Include the following:
 - 1. List of tools and replacement items recommended to be stored at the site for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - 2. Detail operating instructions for both normal and abnormal conditions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing equipment of types and capacities similar to those indicated for this Project and with a service center maintained by engine generator set manufacturer capable of providing training,

parts, and emergency maintenance and repairs at the Project site with 24 hours maximum response time.

- B. Source Limitations: Obtain engine generator set and auxiliary components from a single manufacturer with responsibility for entire system.
- C. Listing and Labeling: Provide system components of types and ratings for which listing or labeling service is established and components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- D. Comply with NFPA 70.
- E. Comply with NFPA 99.
- F. Comply with NFPA 704, Hazard Identification signage.
- G. Engine Exhaust Emissions: Comply with all current, applicable federal, state, and local government requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty signed by Contractor and manufacturer, with single-source responsibility for engine generator and auxiliary components, agreeing to repair or replace items that do not meet requirements or that deteriorate as defined in this Section within the specified warranty period.

- C. Warranty Period: 5 years (for engine-generator set) from date of Substantial Completion. Warranty shall cover 100% parts (except consumables unless consumables were damaged by the failure) and labor.

1.8 MAINTENANCE SERVICE

- A. Maintenance: Beginning at Substantial Completion, provide 12 months full maintenance by skilled employees of the manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies as used in the manufacture and installation of original equipment.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver extra materials to Owner.
 - 1. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.
 - 2. Indicator Lamps: 2 for every 6 of each type used, but not less than 2 of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion air filters.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Cummins/Onan
 - 2. Caterpillar/Peterson Power
 - 3. Kohler
 - 4. MTU

2.2 SERVICE CONDITIONS

- A. Environmental Conditions: Engine generator system withstands the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 deg C to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 3,000 feet (909 m).

B. Unusual Service Conditions: Engine generator equipment and installation is required to operate in the following conditions:

1. Applicable seismic requirements as defined in the International Building Code (IBC) for the location of installation.

2.3 DIESEL ENGINE-GENERATOR SET

A. Rating: The generator rating is summarized below:

1. kW (Standby) rating as shown on the drawings, 480/277 V, 60 Hz, three-phase, 4 wire, 0.8 Power Factor.

B. Generator Set Performance: As specified in 1.04.

1. The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
2. The generator set shall be capable of starting a minimum of 90% of rated kVA load at no more than 35% voltage dip applied to the generator set.

C. AC Generator, Regulator and Exciter Units.

1. The AC Generator shall comply with NEMA MG 1 and specified performance requirements. The generator shall be synchronous, four pole, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc(s). Exciter shall rotate integrally with generator rotor. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation systems. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C. The generator shall have 2/3 pitch stator winding. The sub-transient reactance 15 percent, maximum.
2. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices. The automatic voltage regulator shall be temperature compensated, solid-state design.
3. The voltage regulator shall be equipped with three-phase RMS sensing. The regulator shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The regulator shall include an under frequency roll off torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58 hertz. The torque-matching characteristic shall

include differential rate of frequency change compensation to the maximum available engine torque and provide optimal transient load response. Regulators that use fixed volts per hertz characteristic are not acceptable. The voltage regulator shall have adjustable rheostat on control and monitoring panel to provide plus or minus 5 percent adjustment of output voltage operating band.

4. The generator shall be broad range, 12 lead reconnectable. Instrument transformers shall be mounted within generator enclosure. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage within the broad range.

D. Engine-Generator Set Controls

1. The controls shall be digital (microprocessor based) electronic, fully NFPA 110 compliant, and shall have automatic remote start capability from a panel-mounted 3-position (Stop, Run, Remote) switch.
2. Provide cycle cranking of 15 SEC (ON)/15 SEC (OFF) for three attempts (75 SEC). If engine fails to start, lockout the engine, and indicate overcrank on alarm status panel.
3. The control shall shut down and lock out upon:
 - a. Failing to start (overcrank)
 - b. Overspeed
 - c. Low lubricating oil pressure
 - d. High engine temperature
 - e. Operation of a remote manual stop station.
4. The NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. A front control panel illumination lamp with ON/OFF switch shall be provided. Control panel shall provide a multi-line LCD display capable of displaying the following:
 - a. Engine Oil Pressure
 - b. Coolant Temperature
 - c. DC Voltage
 - d. Total Run Time (hours)
 - e. Output AC Voltage, for each phase, simultaneously
 - f. Output AC Amperage, for each phase, simultaneously
 - g. Output Frequency
 - h. Alarms and Warnings - as a minimum, the following alarms and warning shall be displayed upon activation:
 - 1) Overcrank shutdown

- 2) Overspeed shutdown
- 3) Low oil pressure shutdown
- 4) High engine temperature shutdown
- 5) High engine temperature pre-alarm
- 6) Low engine oil pressure pre-alarm
- 7) Low coolant temperature
- 8) Low coolant level
- 9) Low fuel
- 10) Not in automatic start

E. Engine: The engines shall be 1800 RPM, diesel.

1. Governing: The unit shall have an engine speed electronic governor to provide isochronous generator set frequency control. The governor shall be capable of parallel operation with the addition of load sharing controls.
2. Cooling Systems: The engines shall be cooled by a skid-mounted closed loop horizontal radiator system, including centrifugal fan, coolant pump and thermostat temperature control. The cooling system shall be rated for full rated load operation in 122 degrees F (50 degrees C), minimum, ambient conditions. The size of radiator shall be adequate to contain expansion of total system coolant from cold start to 110 percent load condition. The cooling system, including cooling air flow paths, shall be designed to minimize noise. The cooling capability of the generator set shall be demonstrated by prototype tests on a representative generator set model. The provided engine thermostat shall regulate engine water temperature as recommended by the manufacturer. Provide a high-coolant temperature device to shut down the engine through the engine control panel when the engine temperature exceeds 200 degrees F. The engine cooling system shall be filled with an extended life coolant to protect the system to a temperature of 0 degrees F.
3. Engine Fuel System: Comply with NFPA 30. Fuel: Diesel fuel oil grade DF-2.
4. Lubrication System: Pressurized by a positive-displacement pump driven from engine crankshaft.
5. Accessories: To include:
 - a. An electric starter capable of three complete cranking cycles
 - b. Block (coolant) heater(s), size as recommended by manufacturer. Block heater(s) shall be 240V, 1-phase. For block heaters larger than 1500 Watts, provide an optional 480V-240V, 1-phase step-down transformer, sized to power the block heater, for connection to a 480V, 1-phase circuit.
 - c. Battery charger with "high charge" option.

- d. Positive displacement, mechanical, full pressure, lubrication oil pump.
 - e. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
 - f. Fuel filter with replaceable spin-on canister element.
 - g. Replaceable dry element air cleaner with restriction indicator.
 - h. Flexible supply and return fuel lines.
 - i. Engine mounted battery charging alternator, 45 ampere minimum, and solid-state voltage regulator.
 - j. Starting batteries with 1400-ccA, 200-AH operation and 425 minutes of reserve capacity.
6. Engine Exhaust System: Exhaust silencer (muffler) shall be provided for the engine of size as recommended by manufacturer. Silencer shall be low-profile (“disk” or “hockey puck”) with chambered construction of the super critical type and shall have aluminized finish for corrosion resistance. Contractor shall mount silencer, so the engine does not support its weight. Provide flexible exhaust connection as shown for connection between engine exhaust manifold(s) and exhaust line. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine. Contractor shall mount and install all exhaust components as shown on drawings and as required for code compliance. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings. Make provisions as required for pipe expansion and contraction. Contractor shall cover exhaust silencer (where mounted indoors) and all indoor exhaust piping with a proper insulating material in a manner not to interfere with flexible exhaust connection(s).
- a. Sound attenuation of the provided generator set is critical due to the location of the site within a residential neighborhood. Generator set bid shall include all necessary sound attenuation needs required to comply with local sound ordinances. Minimum sound attenuation levels shall comply with local ordinance Noise Control Code for City of Tigard. The maximum sound attenuation average level at 23-ft in a free-air environment shall be 75 dBA.
- F. Bases: The engine-generator set will be mounted with vibration isolators on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate a battery tray with battery hold down clamps within the base rails. The engine-generator sets will have Seismic Zone 3 isolator pads for mounting.

- G. Main Circuit Breaker: Provide a generator mounted circuit breaker, molded case, 3 pole, NEMA 1/IP22, which will disconnect the generator from the supply circuit. Circuit breaker to be sized as shown. Breaker shall utilize a solid-state trip unit and shall have the electrical characteristics, rating, and modifications as shown. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set and shall have a metal nameplate that contains a permanent record of the circuit breaker catalog number and maximum ratings. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.
1. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated drawing. The solid-state trip circuit breaker shall include the following adjustments: each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments:
 - a. An ampere trip setting (long time pickup) that is adjustable from 0.5 times (or less) to 1.0 times the plug ampere rating, in 0.1 (or less) increments.
 - b. An adjustable long time pickup delay, with a minimum of 5 different delay settings.
 - c. A short time pickup trip setting that is adjustable from 2 times (or less) to 9 (or greater) the long-time ampere trip setting.
 - d. An adjustable short time pickup delay, with a minimum of 5 different delay settings.
 - e. An instantaneous pickup that is capable of being disabled (preferable) or is adjustable from 1.5 times (or less) to 15 times (or greater) the long-time ampere trip setting. Units that are capable of disabling the instantaneous pickup shall be configured with the instantaneous pickup disabled.
 2. Main Circuit Breaker shall have a quick-make, quick break, over-center toggle type, trip-free mechanism to prevent holding contacts closed against a position between "ON" and "OFF" when tripped automatically. Breaker shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously.
 3. The interrupting capacity of the Main Circuit Breaker shall be 14 kAIC at 480 volts, minimum.

- H. Provide a UL-142 listed double walled, sub-base fuel tank suitable for full load operation of the generator set for up to 24 hours and complying with local requirements.
- I. The package generator shall come in the manufacturer's outdoor rated enclosure complying with the sound restrictions noted with the exhaust silencer. Package enclosure interior shall come furnished with LED lighting that automatically turn on when the enclosure doors open. All outdoor equipment shall be enclosed with corrosion-protected materials. Steel components used in enclosures shall be powder coated and baked and shall provide fade and corrosion resistance.

2.4 AUTOMATIC TRANSFER SWITCH

- A. Furnish and install where indicated a "programmed (delayed) transition" style automatic transfer switch with ratings, features/accessories, enclosures, etc. indicated on the drawings or noted herein. To maintain maintenance compatibility, automatic transfer switches shall be provided by engine-generator manufacturer.
 - 1. ATS shall be 3-pole with solid neutral.
- B. The transfer switch equipment as specified herein shall be 100% equipment rated for continuous duty at the ratings shown on the plans and shall conform to the applicable requirements for UL 1008 for emergency total system load. All transfer switch equipment supplied shall bear the UL label.
- C. All main power contacts shall be rated for multiple fault interruptions per UL 489, and/or UL 1087. Main contacts shall have independent "break-before-make" transfer action which shall positively prevent dangerous "source-to-source" connections.
- D. Automatic transfer switches specified herein shall consist of completely enclosed contact assemblies and a separately mounted control logic panel. Control power for all automatic transfer operations shall be derived from the line side of the source to which the load is being transferred.
- E. Automatic transfer switches specified here shall have full, 3-phase voltage monitoring, including phase imbalance as well as phase loss.
 - 1. Upon loss of phase-to-phase voltage of the normal power source on any phase to 70% of nominal, and after a time delay of 0-5 seconds (minimum; adjustable to meet conditions present) to override momentary dips and/or outages, starting of the emergency/standby power source shall be initiated.
 - 2. Transfer to the emergency standby power source shall take place 2-60 seconds (minimum; adjustable) after attainment of 90% of rated voltage and frequency of that source.

- F. When the normal power source has been restored to 90% of rated voltage and less than 10% voltage imbalance, and after a time delay adjustable from 0-30 minutes (minimum; to ensure the integrity of the normal power source), the load shall be retransferred to the normal source.
- G. Upon disconnecting from either source, the transfer switch shall be capable of switching to a neutral position for a user specified time delay of 0-120 seconds, minimum, to allow spinning motors to come to coast to a full stop and VFD control voltage to completely discharge before connecting to the alternate source.
- H. A time delay, adjustable 0-10 minutes (minimum), shall delay shutdown of the emergency/standby power source after retransfer to allow the generator to run unloaded for cool-down, after which the generator shall be automatically shut down.
- I. If the emergency/standby power source should fail while carrying the load, transfer to the normal power source shall be made instantaneously upon restoration of the normal source to satisfactory conditions.
- J. The following features/accessories shall be provided:
 - 1. Auto/test switch to provide test operation of the automatic transfer switch by simulating a loss of the normal power source.
 - 2. Pilot lights to indicate to which source the load is connected.
 - 3. Pilot lights to indicate that an integral overcurrent protective device has tripped.
 - 4. "Dry" Form C relay contacts for monitoring the switch position (both "normal" and "standby" sources). Contacts to be rated 10A (minimum) at 30VDC or 120VAC. Use of interposing relays to provide multiple contacts and/or ratings is permitted.
 - 5. Plant exerciser timer providing automatic test operation of the emergency/standby power source at pre-selected intervals at least once per week, including a selector switch to select exercise with or without load or a bypass of the exercise period. The clock timer shall be provided with a digital readout and include a lithium battery backup to assure continuity of power to the clock timer for a minimum of 72 hours during an outage.
- K. Installation of all transfer switch equipment specified herein shall be in accordance with all applicable codes, standards, and practices. Installation of all transfer switch equipment specified herein shall be in accordance with the recommendations of the manufacturer.
- L. Transfer switch enclosure shall be provided in a NEMA 1 rated enclosure , minimum.

PART 3 EXECUTION

3.1 GENERAL

- A. Install equipment and materials in a neat and workmanlike manner and align, level, and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.

3.2 SUPPORTS

- A. Provide hangers or other devices such as pads, anchors, etc., necessary for the support of the equipment.
- B. Provide anchorage according to manufacturer's written instructions, unless otherwise indicated.

3.3 INSTALLATION

- A. Material and Equipment Installation: Follow manufacturer's installation instructions explicitly, unless otherwise directed. Wherever any conflict arises between manufacturer's instructions and these Contract Documents, follow Engineer's direction, at no additional cost to the Owner. Keep copy of manufacturer's instructions on the job site available for review at all times.
- B. The generator set supplier shall install the load bank on the generator prior to delivery to the installation site.
- C. The Contractor shall be responsible and shall provide for the supply, installation adjustment, and startup of complete, coordinated systems, which shall reliably perform the specified functions.
- D. Maintain minimum workspace around components according to manufacturer's Shop Drawings and National Electrical Code.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise installation and connection of the generator-set unit and to report results in writing.
- B. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to Specifications. Load system using a variable resistive load bank simulating kW of loads for which unit is rated.

3.5 TESTING AND STARTUP

A. The following shall be provided:

1. The manufacturer shall provide a certified copy of a 4-hour full-load factory test of a prototype engine-generator unit of the same size as the one being provided with recordings of voltage, frequency, amperage, engine temperature, lube oil pressure, and load transfer results to the Engineer.
2. The actual generator unit shall be field tested with all standby loads picked up and operated for a minimum period of 4 hours. One electronic PDF copy of the test results shall be provided to the Engineer. This testing is to be accomplished only after control system startup and verification to ensure only the correct load is brought online with the generator in operation.

3.6 CLEANING

A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.7 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of system and to train Owner's maintenance personnel as specified below.

1. Conduct a minimum of 8 hours of training as specified in Division 1 Section "Contract Closeout."
2. Schedule training with at least 7 days' advance notice.

3.8 SPARE PARTS

A. Provide the following spare parts for each generator unit

1. Three sets fuel oil filter elements and gaskets.
2. Three lubricating oil filter elements and gaskets.
3. One air cleaner filter element.
4. Two sets packing for each auxiliary pump.
5. Two sets V-belts for pump drives.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 GENERAL

1.1 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. This section covers the work necessary to furnish and install and complete the electrical lighting system.

1.2 GENERAL

- A. A. See Division 1 and Section 26 05 00, ELECTRICAL GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are necessary for this project.

1.3 SUBMITTALS AFTER AWARD OF CONTRACT

- A. Submittals after award of Contract shall be made in accordance with Division 1 and Section 26 05 00 ELECTRICAL GENERAL REQUIREMENTS.

1.4 QUALITY ASSURANCE

- A. The Contractor shall test all lighting installations and demonstrate satisfactory operation of switching controls upon completion of the installation. The Contractor shall replace all defective lamps and/or ballasts/drivers prior to occupancy by the Owner. All luminaires shall be cleaned, and visible labels removed.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Refer to the drawings. The Contractor shall be responsible for the complete equipment of all luminaire types. All standard luminaires shall be approved by UL and shall have UL inspecting labels attached thereto. Luminaires shall be grounded in accordance with the NEC.

2.2 LED LUMINAIRES

A. General:

1. LED luminaires shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED luminaires shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
 - a. Field replaceable.
 - b. Indoors: 0-10V low voltage dimming.
 - c. Minimum efficiency: 85% at full load.
 - d. Minimum Operating Ambient Temperature: -20°C. (-4°F.)
 - e. Input Voltage: 120V (±10%) at 60 Hz.
 - f. Integral short circuit, open circuit, and overload protection.
 - g. Surge protection rated to meet ANSI category 2 for indoors, category C low for outdoors, and shall be field replaceable.
 - h. Power Factor: ≥ 0.95.
 - i. Total Harmonic Distortion: ≤ 20%.
 - j. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 4000°K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 100,000 hours per IES L70 and TM-21 with 70% rated lumen output at 40°C, ambient.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. Housing, LED driver, and LED module shall be products of the same manufacturer.

2.3 ACCESSORIES

- A. Luminaires shall be furnished complete with all lenses, trims, hangers, nipples, and extensions necessary for a complete installation. All light diffusing media shall be free of scratches or cracks. In general, diffusers shall be of acrylic material unless otherwise noted.

PART 3 EXECUTION

3.1 COORDINATION

- A. Verification of Conditions: Verify ceiling construction, recessing depth and other construction details prior to release of luminaires for shipment. Refer cases of uncertain applicability to Engineer for resolution prior to release of luminaires for shipment.
- B. Provide all lighting to comply with appropriate location.

3.2 INSTALLATION

- A. Install luminaire in accordance with manufacturer's written instructions and with recognized industry practices; to ensure that luminaires comply with requirements and serve intended purposes.
- B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- C. Avoid interference with and provide clearance for equipment. Where intended locations for luminaires conflict with locations of equipment, change locations for luminaire by minimum distance necessary.
- D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors. Unless otherwise shown, suspension mounting type shall be chain, cable, or stem (Contractor's option).
- E. Supports
 1. Luminaires 48 inches or longer shall not be supported from outlet box ears.
 2. Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
 3. Support luminaires without causing ceiling or partition to deflect.
 4. All recessed luminaires shall be installed using support brackets, grounds, plaster frames, etc. as recommended by the luminaire manufacturer. All supports for

luminaires shall be furnished. All stem lengths shall be adjusted to meet conditions. Mounting heights to bottom of luminaires are given as accurately as possible and shall be adjusted to conform to job conditions.

5. Clean all luminaire lenses prior to final acceptance. Maintain luminaire positions after cleaning and/or replacing/repairing.
 6. The Contractor shall provide adequate luminaire attachment to ceiling members in accordance with NEC. The Contractor shall inspect the mechanical plans and the actual site to verify that no interferences occur with diffusers, grills, or duct work.
- F. Grounding: Lighting system shall be securely grounded. For rigid conduit, a threaded hub or double locknut and bushing connection shall be considered adequate. For system employing flexible conduit feeds, a green insulated No. 12 AWG solid wire shall be run with the phase conductors and bonded to the box and luminaire at each end of the flexible conduit. The ground connection shall be accomplished by means of cadmium plated round head machine screws, lock washer, and nut.
- G. Prior to final acceptance, replace or repair luminaires which have failed.

3.3 ADJUSTING

- A. Focus and adjust floodlights, spotlights, and other adjustable luminaires, with Owner's Representative, at such time of day or night as required.

3.4 CLEANING

- A. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
- B. Where finish of luminaires has been damaged, touch up finish as directed by manufacturer's instructions.

END OF SECTION

SECTION 26 50 10 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Contactors.
 2. Time switches.
 3. Photoelectric switch.
 4. Selector switches.
 5. Relays.
 6. Time Delay Relays.

1.2 SUBMITTALS

- A. Product Data: Submit product catalog cut sheets for contactors, time switches and photoelectric switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Contactors: Asco, Cutler-Hammer/Westinghouse, General Electric, Square D, or approved.
- B. Electronic Time Switches: Paragon, Sangamo, Tork, or approved.
- C. Photoelectric Switches: Precision, Paragon, Tork, or approved.

2.2 CONTACTORS

- A. Lighting:
1. Continuously rated 20 amp per pole for all types of ballast and tungsten lighting and resistance loads, do not derate for use on high-inrush loads.
 2. Power Contacts:
 - a. Double break, silver-cadmium-oxide.
 - b. Auxiliary arcing contacts not acceptable.
 - c. Convertible Contacts, N.O. or N.C.
 - d. Contact status, N.O. or N.C., clearly visible.

3. Approved per UL 508.
 4. Design in accordance with NEMA ICS2-211B, rated for application to 600-volt maximum.
 5. Electrically Held Contactor Coil: Continuously rated and encapsulated.
 6. Mechanically Held Contactor: Encapsulated latch and unlatch coils, coil clearing contacts.
- B. Power Contactors:
1. Continuously rated 30 to 800 amperes per pole for all types of ballast and tungsten lighting, resistance, and motor loads.
 2. Power Contacts:
 - a. Totally enclosed contacts.
 - b. Double break, silver-cadmium-oxide.
 - c. Auxiliary arcing contacts not acceptable.
 - d. Provide for contact inspection or replacement without disturbing line or load wiring.
 3. Straight through wiring, all terminals clearly marked.
 4. Approved per UL 508.
 5. Design in accordance with NEMA ICS2-211B, rated for application to 600-volt maximum.
 6. Field Addition Accessories:
 - a. Auxiliary contacts, 6-amp, 600-volt, N.O. or N.C. Maximum of four.
 - b. Control circuit fuse holder, one or two fuses.
 - c. Transient-suppression module for control circuit of 120 volt.
 7. Electrically Held Contactor Coil: Continuously rated and encapsulated.
 8. Mechanically Held Contactor: Encapsulated latch and unlatch coils, coil clearing contacts.
- C. Enclosures: NEMA enclosure, suitable for location and use, flush or surface mount as indicated on Drawings.

2.3 ELECTRONIC TIME SWITCHES

- A. Double pole, single throw; one N.O. contact, one N.C. contact. 24-hour digital. Battery power source to provide minimum of 3 years of memory back-up. Eight event setpoints. Provide enclosure with separate hinged door, recessed or surface as indicated on Drawings.

2.4 PHOTOELECTRIC SWITCHES

- A. Characteristics:
 - 1. Hermetically sealed light sensitive element installed in diecast weatherproof enclosure.
 - 2. Adjustable external light level slide.
 - 3. Swivel adjustable enclosure.
- B. Electrical Rating: 120VAC, 1800VA, connected for pilot duty unless otherwise indicated.

2.5 SELECTOR SWITCHES

- A. All selector switches shall be knob type and black in color. Selector switches shall be 120VAC, full voltage type.
- B. Acceptable manufacturers are Allen-Bradley, Eaton, Schneider Electric, or approved equal.

2.6 RELAYS

- A. Auxiliary relays shall be provided where indicated, specified, or required to perform the functional requirements of the system, as specified. Relays shall be suitable for control, interfacing, and interposing functions.
- B. Plug-in general purpose, 2PDT minimum, power type relays rated for industrial use.
- C. Provide relays with push-to-test-pull-to-lock button and LED. Coil voltage shall match the control circuit voltage. Contacts shall be 10 Amp, 120 volt (resistive) rated. Provide DIN rail mounted relay bases with integrated clip and marking label.
- D. Acceptable manufacturers are Allen-Bradley, Eaton, Schneider Electric, or approved equal.

2.7 TIME DELAY RELAYS

- A. Time delay relays shall be provided where indicated, specified or required to perform the functional requirements of the system, as specified. Time delay relays shall be suitable for control, interfacing, and interposing functions.
- B. Provide time delay relays to control contact transition time. Time delay relays shall have 240V contact rating, 10A continuous rated contacts, and 120VAC coil voltage. Provide with pneumatic or electronic type on/off delay type as indicated on the drawings. Time delay relays shall be at a minimum 2PDT.
- C. Minimum timing range of relays shall be 0.1 seconds to 60 minutes.
- D. Acceptable manufacturers are Allen-Bradley, Eaton, Schneider Electric, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contactors:
 - 1. Provide vibration isolation mounting pads for electrically held contactors installed within or on walls, which are common to occupied spaces. Isolate terminals and operating mechanisms from enclosure.
 - 2. Install contactors and relays to reduce noise such that it will not create a disturbance or distraction in the areas in which such equipment is located.
- B. Control Devices:
 - 1. Install time switches and other automatic control devices in accessible locations near the source of power or grouped at a common location in mechanical rooms or similar spaces.
 - 2. Install photoelectric control devices at such locations as necessary to be most effective. Avoid locating photoelectric devices in or at locations where they can be influenced by other than natural light or under eaves. Verify location of equipment with Engineer.

END OF SECTION

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes range of soil and subsoil materials intended to be referenced by other sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other sections and on Drawing notes.
- B. Section includes:
 - 1. Subsoil materials
 - 2. Topsoil materials

1.2 RELATED SECTIONS

- A. Section 31 05 16 - Aggregates for Earthwork
- B. Section 31 10 00 – Site Clearing
- C. Section 31 22 13 - Rough Grading
- D. Section 31 23 16 – Excavation
- E. Section 31 23 17 - Trenching
- F. Section 31 23 18 – Rock Removal
- G. Section 31 23 23 - Fill
- H. Section 31 37 00 - Riprap

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-lb (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - 1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials source.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Furnish materials of each type from same source throughout the Work.
- B. Soil Testing:
 1. Soil sampling and testing to be completed by an independent laboratory approved by the Engineer.
 2. Frequency of testing shall be determined by the Engineer.
 3. All soil testing shall be paid for by the Contractor.
- C. Compaction Tests:
 1. Maximum density at optimum moisture content determined by ASTM D698 (AASHTO T99).
 2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Soil Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1, Select Native Material:
 1. Select earth obtained from on-site excavations approved for use by Engineer.
 2. Graded.
 3. Free of peat, humus, vegetative matter, organic matter and rocks larger than 6 inches in diameter.

4. Processed as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.
- B. Subsoil Type S2, Imported Fill Material:
1. Imported earth approved for use by Engineer.
 2. Meeting the requirements of Subsoil Type S1.

2.2 TOPSOIL MATERIALS

- A. Topsoil Type TS1, Select Native Topsoil Material:
1. Top 6 - 12 inches of existing soil containing organic matter.
 2. Engineer decision shall be final as to determination of what material is topsoil quality.
 3. Graded.
 4. Free of roots, rocks larger than 1/2-inch subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
- B. Topsoil Type TS2, Imported Topsoil Material:
1. Imported borrow.
 2. Friable loam.
 3. Reasonably free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
 4. Acidity range (pH) of 5-1/2 to 7-1/2.
 5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 SPOILS

- A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of at a location provided by the Contractor and approved by the Engineer.
- B. Make arrangements for disposal of the material at no additional cost to the Owner.

- C. Landfill permit to be obtained by the Contractor and provided to Engineer prior to commencement of disposal.

2.4 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698 (AASHTO T99).
- B. When tests indicate materials do not meet specified requirements, change material or vary compaction methods and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of facilities.
- B. Site within clearing limits shall be stripped of topsoil as required to obtain additional topsoil necessary to complete Work indicated in the Drawings or as specified.
- C. When practical, do not excavate wet topsoil.
- D. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- E. Remove excess excavated subsoil and topsoil not intended for reuse from Site.
- F. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from Site.

3.2 STOCKPILING

- A. Stockpile soils at locations shown in the Drawings or at locations as approved by Engineer for redistribution as specified.
 - 1. Site may not have sufficient area to stockpile excavated material that will be required for fill later in the project. If additional stockpile area is required to complete the Project on schedule, arrange off-site stockpile areas.
 - 2. No additional payments will be made for stockpiling excavated materials off-site.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.

- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.
- F. Stockpile unsuitable and/or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes a range of coarse and fine aggregate materials intended to be referenced by other Sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other Sections and in Drawing notes.
- B. Section Includes:
 - 1. Coarse aggregate materials
 - 2. Fine aggregate materials

1.2 RELATED SECTIONS

- A. Section 31 05 13 - Soils for Earthwork
- B. Section 31 22 13 - Rough Grading
- C. Section 31 23 17 - Trenching
- D. Section 31 23 19 - Dewatering
- E. Section 31 23 23 - Fill
- F. Section 31 37 00 - Riprap
- G. Section 32 11 23 - Aggregate Base Courses
- H. Section 33 11 10 – Water Utility Distribution and Transmission Piping
- I. Section 33 41 10 - Storm Utility Drainage Piping

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses
 - 2. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates
 - 3. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - 3. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
 - 4. AASHTO TP61 - Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate

B. ASTM International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Aggregate Testing:
 1. Aggregate sampling and testing to be completed by an independent laboratory approved by the Engineer.
 2. The frequency of testing shall be determined by the Engineer.
 3. All aggregate testing shall be paid for by the Contractor.
- C. Compaction Tests:
 1. Maximum density at optimum moisture content determined by ASTM D698 (AASHTO T99).

2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Aggregate Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate Type A1, Dense-Graded Aggregate: Crushed rock with ¾-inch-0, 1-inch-0, 1-1/2-inch-0, 2-inch-0 and 2-1/2-inch-0 gradation as shown in the Drawings and meeting the requirements provided below.
1. Grading - Dense-graded base aggregate shall be crushed rock, including sand. Uniformly grade the aggregates from coarse to fine.
 2. Sieve analysis shall be determined according to AASHTO T27.
 3. The aggregates shall conform to one of the grading requirements Table 31 05 16-A below.

Table 31 05 16-A
Grading Requirements for Dense-Graded Aggregate
Separated Sizes
Percent Passing (by weight)

Sieve Size	2-1/2" - 0	2" - 0	1-1/2" - 0	1" - 0	3/4" - 0
3"	100				
2-1/2"	95 - 100	100			
2"	-	95 - 100	100		
1-1/2"	-	-	95 - 100	100	
1-1/4"	55 - 75	-	-	-	
1"	-	55 - 75	-	90 - 100	100
3/4"	-	-	55 - 75	-	90 - 100
1/2"	-	-	-	55 - 75	-
3/8"	-	-	-	-	55 - 75
1/4"	30 - 45	30 - 45	35 - 50	40 - 55	40 - 60
No. 4*	-	-	-	-	-
No. 10	1	1	1	1	1

¹ Of the fraction passing the 1/4-inch sieve, 40 percent to 60 percent shall pass the No. 10 sieve.

* Report percent passing sieve when no grading requirements are listed.

4. Fracture of Rounded Rock:
 - a. Determined according to AASHTO TP61.

- b. Provide at least one fractured face based on the following percentage of particles retained on the 1/4-inch sieve for the designated size:

Minimum Percent of Fractured Particles
by Weight of Material

<u>Designated Size</u>	<u>Retained on 1/4-Inch Sieve</u>
1-1/2-inch – 0 and larger	50
Smaller than 1-1/2-inch – 0	70

5. Durability:

- a. Crushed rock aggregate shall meet the following durability requirements:

<u>Test</u>	<u>Test Method</u>	<u>Requirements</u>
Abrasion	AASHTO T 96	35.0 percent maximum
Degradation (Coarse Aggregate)	ODOT TM 208	30.0 percent maximum
Passing No. 20 Sieve, Sediment Height	ODOT TM 208	3.0-inch maximum

6. Sand Equivalent -- Crushed rock aggregate will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 50.

B. Coarse Aggregate Type A2, Granular Drain Backfill Material: Crushed or uncrushed rock or gravel as shown in the Drawings.

1. Material shall be clean and free draining.
2. Sieve analysis shall be according to AASHTO T27.
3. Grading: Meeting the gradation requirements provided in Table 31 05 16-B below.

Table 31 05 16-B
Grading Requirements for Granular Drain Backfill Material
Separated Sizes
Percent Passing (by weight)

Sieve Size	Separated Sizes 1-1/2-inch – 3/4-inch	Separated Sizes 3/4-inch – 1/2-inch
2-inch	100	
1-1/2-inch	90 - 100	
1-inch	20 - 55	100
3/4-inch	0 - 15	85 - 100
1/2-inch	-	0 - 15
3/8-inch	0 - 5	-

2.2 SAND

- A. Sand: Sand material shall consist of granular material, naturally produced or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash, and other deleterious material, meeting the gradations of Table 31 05 16-C below.

Table 31 05 16-C
Grading Requirements for Sand
Separated Sizes
Percent Passing (by weight)

Sieve Size	Coarse Sand	Medium Sand	Fine Sand
1-inch	100	100	100
3/8-inch	95 - 100	95 - 100	-
#4	80 - 100	70 - 95	90 - 100
#30	10 - 30	10 - 45	-
#100	-	2 - 10	2 - 10
#200	0 - 8	0 - 7	0 - 4
Sand Equivalent	50 min.	50 min.	50 in.

2.3 SOURCE QUALITY CONTROL

- A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698 (AASHTO T99).
- B. Sand - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698 (AASHTO T99).
- C. When tests indicate materials do not meet specified requirements, change material and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials imported to site as shown in the Drawings or at locations as approved by Engineer for redistribution as specified.
- B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

- C. Prevent intermixing of aggregate types or contamination.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in preparation for site or building excavation work.

1.2 RELATED SECTIONS:

- A. Section 01 56 39 – Temporary Tree and Plant Protection
- B. Section 02 41 00 - Demolition
- C. Section 31 22 13 - Rough Grading
- D. Section 31 23 18 - Rock Removal

1.3 DEFINITIONS

- A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.
- C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- D. Limits of Disturbance: Work area boundary as shown on the Plans.
- E. Root Wad: Tree stump and root mass including all roots greater than 1-inch diameter.
- F. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Clearing, Grubbing, and Stripping Plan: Drawings clearly showing proposed limits to clearing, grubbing, and stripping activities at Site.
- C. Certification or disposal permit for landfill and/or waste disposal site.
- D. A copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.5 QUALITY ASSURANCE

- A. Existing Conditions: Determine the extent of Work required and limitations before proceeding with Work.
- B. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits prior to commencing clearing, grubbing, and stripping.
- C. Conform to applicable local, state, and federal codes for environmental requirements and disposal of debris,
 - 1. Burning on project site will not be permitted.
 - 2. Use of herbicides will not be permitted.
- D. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.
- E. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of laborers, other persons, and property in the vicinity of the work and requirements of the General Provisions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or specifications.
- B. Wound Paint: Emulsified asphalt formulated for use on damaged plant tissues.

PART 3 EXECUTION

3.1 GENERAL

- A. Clear, grub, and strip areas needed for waste disposal, borrow, or Site improvements within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Remain within the property lines at all times.
- C. Do not injure or deface vegetation or structures that are not designated for removal.

3.2 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Identify waste and salvage areas for placing removed materials.

3.3 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-332-2344, not less than three working days before performing Work.
- C. Request underground utilities to be located and marked within and surrounding construction areas.
 - 1. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
 - 2. Keep all active utilities intact and in continuous operations.
- D. Prepare Site only after:
 - 1. Erosion and sediment controls are in place.
 - a. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls and in compliance with COP Erosion and Sediment Control Manual and ESC Permits.
 - 2. Tree and vegetation protection is installed.
 - a. Protect existing site improvements, trees, and shrubs to remain to preclude damage during construction.
 - b. Follow the provisions set forth in 01 56 39, Temporary Tree and Plant Protection for all temporary tree and plant protection measures.
 - 3. Temporary fencing is installed along the Limits of Disturbance.
 - 4. Notification of utility agencies; disconnect or arrange for disconnection of utilities (if any) affected by required work. Keep all active utilities intact and in continuous operation.

3.4 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.

- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.
- C. Preservation and Trimming of Trees, Shrubs, and Other Vegetation:
 - 1. Avoid injury to trees, shrubs, vines, plants, grasses, and other vegetation growing outside of the areas to be cleared and grubbed and those trees and shrubs designated to be preserved.
 - 2. Protect existing trees and shrubs against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of roots by stockpiling construction materials, excavated materials, excess foot or vehicular traffic, and parking of vehicles within drip line.
 - 3. Provide temporary guards, as necessary, to protect trees and vegetation to be left standing.
 - 4. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 - 5. Provide protection for roots and limbs over 1-1/2-inch diameter cut during construction operations. Coat cut faces with emulsified asphalt.
 - 6. Repairable damage to trees and shrubs designated to remain shall be made by a professional tree surgeon approved by the Engineer. Cost shall be borne by the Contractor.
- D. Landscaped Areas:
 - 1. When any portion of the Work crosses private property or landscaped areas, excavate topsoil separately and pile it on the opposite side of the trench from the subsoil.
 - 2. Conduct Work in a manner that will restore original conditions as nearly as practicable.
 - 3. Remove and replace any trees, shrubs, plants, sod, or other vegetative material as needed to complete Work.
 - 4. All shrubs or plants shall be balled by experienced workers, carefully handled and watered, and replaced in their original positions without damage. Sod shall be handled in a similar manner.
 - 5. Wherever sod cannot be saved and restored, the ground must be reseeded and cared for until a stand of grass is reestablished.

6. Plants or shrubs killed or destroyed shall be replaced and paid for by the Contractor.
 7. It is the intent of this paragraph that the Contractor shall leave the surface and plantings in substantially the same conditions as before the Work is undertaken.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, and curbs.
- F. Repair and Replacement:
1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.
 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.5 LIMITS

- A. As follows, but not to extend beyond Limits of Disturbance and property lines for project sites:
1. Excavation: 5 feet beyond top of cut slopes.
 2. Trench Excavation: 6 feet from trench centerline, regardless of actual trench width.
 3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping: 2 feet beyond toe of permanent fill.
 4. Structures: 15 feet outside of new structures.
 5. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.
 6. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within the Limits of Disturbance as material is generated. Stockpiling shall not be permitted without written approval of Owner.

3.6 CLEARING AND GRUBBING

- A. Clear and grub areas within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with the applicable sections of these Specifications.
- C. Clearing:
 - 1. Remove trees, saplings, snags, stumps, shrubs, brush, vines, grasses, weeds, and other vegetative growth within the clearing limits shown in the Drawings, except those trees and shrubs noted to remain in the Drawings or as directed by the Engineer.
 - 2. Clearing shall be performed in such a manner as to remove all evidence of the presence of vegetative growth from the surface of the project site and shall be inclusive of sticks and branches of thickness or diameter greater than 3/8-inch and of grasses, weeds, exceeding 12 inches in height except as otherwise indicated.
 - 3. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Grubbing: Clear areas required for access to site and execution of Work and remove all stumps, root wads, and roots over 1-inch diameter to the following depths:
 - 1. Future Structures and Building Areas 24 Inches
 - 2. Roads and Parking Areas 18 Inches
 - 3. All other Areas 12 Inches

3.7 TREE REMOVAL

- A. Exercise care in cutting, felling, trimming, and handling of those trees shown for removal to prevent damage to neighboring trees and structures to remain.
- B. Tree Salvage: As shown on the Plans.
- C. No trees may be removed unless approved and permitted by the Engineer.
- D. Do not top trees unless otherwise specified or approved by Owner in writing.
- E. Refer to Section 01 56 39, Temporary Tree and Plant Protection for tree protection requirements.

3.8 REMOVAL AND DISPOSAL

- A. Native vegetation may be mulched and used on Site.

- B. Asphalt and Gravel Surfaces:
 - 1. Asphalt, concrete, and gravel surfaces designated for removal shall be done to full depth.
 - 2. Asphalt, concrete, and gravel removed at Site may be reused at Site where shown in the Drawings or following approval of the Engineer.
 - 3. Haul removed asphalt, concrete, and gravel which is unsuitable for reuse or that exceeds quantity required.
- C. Remove debris, rock, abandoned piping, and extracted plant life from Site.
- D. Remove from the Site all debris, materials, equipment, and items found thereon and materials and debris resulting from the Work, except as otherwise indicated.
 - 1. All existing improvements designated on the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the Work.
 - 2. Unless otherwise specified, any resulting voids shall be thoroughly cracked out for drainage and backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.
- E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- F. Do not burn or bury materials on site. Leave site in clean condition.
- G. Removal: All material resulting from demolition, clearing and grubbing, and trimming operations shall be removed from the Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.
- H. Cleanup: During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, and debris.
- I. Adjacent areas shall be returned to their existing condition prior to the start of Work.

3.9 CLEANUP

- A. During the time Work is in progress, make every effort to maintain the Site in a neat and orderly condition.

- B. All refuse, broken pipe, excess fill material, cribbing, and debris shall be removed as soon as practicable.
- C. Should the Work not be maintained in a satisfactory condition, the Owner may cause the work to stop until the cleanup of the Work has been done to the satisfaction of the Engineer.
- D. The Work will not be considered complete or the final payment certificate issued until all rubbish, unused material, or equipment shall have been removed and the premises left in a condition satisfactory to the Owner and the Engineer.

END OF SECTION

SECTION 31 22 13 - ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes rough grading and filling associated with contouring of Site in preparation for building excavation and subsequent site work.
- B. Section Includes:
 - 1. Excavating topsoil
 - 2. Excavating subsoil
 - 3. Cutting, grading, filling, and rough contouring of Site

1.2 RELATED SECTIONS:

- A. Section 01 45 00 - Quality Control
- B. Section 31 05 13 - Soils for Earthwork
- C. Section 31 05 16 - Aggregates for Earthwork
- D. Section 31 10 00 - Site Clearing
- E. Section 31 23 16 - Excavation
- F. Section 31 23 17 - Trenching
- G. Section 31 23 18 - Rock Removal
- H. Section 31 23 23 - Fill

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

3. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
4. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Soils for Earthwork: As specified in Section 31 05 13, Soils for Earthwork.
- C. Aggregates for Earthwork: As specified in Section 31 05 16, Aggregates for Earthwork.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Subsoil Fill: Type S1 and S2 as specified in Section 31 05 13, Soils for Earthwork.
- B. Topsoil: As specified in Section 31 05 13, Soils for Earthwork.
 1. Type TS1, Select Native Topsoil Material, as may be available.
 2. TS2, Imported Topsoil Material, as may be required.
- C. Structural Fill: Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown in the Drawings.
- D. Granular Fill: Type A2, Granular Drain Backfill Material as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown in the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Notify Engineer of any potential conflicts resulting from utility locations and the Drawings.
 - 3. Notify utility company to remove and relocate utilities, as may be necessary.
- B. Identify required lines, levels, contours, and datum.
- C. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with the Work of this Section.

3.3 TOPSOIL EXCAVATION

- A. Excavate and stockpile topsoil as specified in Section 31 05 13, Soils for Earthwork.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded as shown in the Drawings.
- B. When practical, do not excavate wet subsoil. When wet subsoil must be excavated and is to be reused on site for the Work, process wet material to obtain optimum moisture content.
- C. Stockpile excavated material in area designated onsite in accordance with Section 31 05 13, Soils for Earthwork.
- D. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1:2 to key placed fill material to slope to provide firm bearing.

F. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

A. General:

1. Grading and filling operations shall not take place when weather conditions and moisture content of fill materials prevent the attainment of specified density.
2. Vertical curves or roundings at abrupt changes in slope shall be established as approved by Engineer.
3. Bring all graded areas to a relatively smooth, even grade and slope by blading or dragging. Remove high spots and fill depressions.

B. Fill areas to contours and elevations shown in the Drawings with unfrozen materials.

C. Topsoil Fill:

1. Scarify prepared subgrade to depth of 4 inches immediately prior to placing topsoil.
2. Place topsoil in areas to be seeded to depths indicated in the Drawings, minimum depth of 6 inches.
3. Place topsoil material loose; do not compact, do not place in wet or muddy conditions.

D. Place material in continuous layers as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.
2. Structural Fill: Maximum 12 inches compacted depth.
3. Granular Fill: Maximum 12 inches compacted depth.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

G. Make grade changes gradual. Blend slope into level areas.

H. Repair or replace items indicated in the Drawings to remain which are damaged by excavation or filling. All costs shall be borne by the Contractor.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10th of a foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D698 (AASHTO T99).
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- C. Frequency and location of testing is dependent upon type of material placed. See Section 01 45 00, Quality Control for testing requirements.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes excavation required for building foundations, site structures, or under slabs-on-grade or paving. Excavating for utilities outside building is included in Section 31 23 17, Trenching.
- B. Section Includes:
 - 1. Excavating for building foundations
 - 2. Excavating for paving, roads, and parking areas
 - 3. Excavating for slabs-on-grade
 - 4. Excavating for site structures
 - 5. Excavating for landscaping

1.2 RELATED SECTIONS

- 1. Section 01 45 00 - Quality Control
- 2. Section 02 41 00 - Demolition
- 3. Section 26 42 00 - Cathodic Protection
- 4. Section 31 05 13 - Soils for Earthwork
- 5. Section 31 05 16 - Aggregates for Earthwork
- 6. Section 31 10 00 - Site Clearing
- 7. Section 31 22 13 - Rough Grading
- 8. Section 31 23 17 - Trenching
- 9. Section 31 23 18 - Rock Removal
- 10. Section 31 23 19 - Dewatering
- 11. Section 31 23 23 - Fill
- 12. Section 31 50 00 - Excavation Support and Protection
- 13. Section 33 11 10 - Water Utility Distribution and Transmission Piping.
- 14. Supplemental Information: Geotechnical report; bore hole locations, and findings of subsurface materials.

1.3 DEFINITIONS

- A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. Common Excavation shall further include all debris, junk, broken concrete, and all other material. All excavation shall be classified as Common Excavation, unless provided as Rock for under Section 31 23 18, Rock Removal below.

- B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.
- C. Concrete Excavation: The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling, splitting and breaking methods, or a necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete excavation includes materials composed of Portland cement that are not identified other than manholes, structures, sewer pipe, or other appurtenances.
- D. Exploratory Excavation: The removal and replacement of material from locations shown on the Drawings, or as directed for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed utilities.
- E. Overbreak: Material beyond and outside of the slope limits established by the Owner's Representative, which becomes displaced or loosened during excavation and is excavated.
- F. Pothole Excavation: Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as exploratory excavation, for the purposes of locating an underground utility and to investigate underground conditions.
- G. Rock Removal: As defined in Section 31 23 18, Rock Removal.
- H. Spoils: Excavated materials from Site unsuitable for use as fill or not required for backfill and grading.
- I. Unsuitable Materials: See Spoils.

1.4 REFERENCES

- A. Local utility standards when working within 24 inches of utility lines.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: At a minimum, to include the following:
 - 1. Methods and sequencing of mass excavation.
 - 2. Proposed onsite and off-site spoil disposal locations.
 - 3. Anticipated difficulties and proposed resolutions.

4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.
 5. Proposed haul routes.
- B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.

1.6 QUALITY ASSURANCE

- A. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.
- B. Provide adequate survey control to avoid unauthorized over-excavation.
- C. Weather Limitations:
1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (F) shall not be used as fill or backfill until material completely thaws.
 2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.7 NOT USED

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to commencing work in this Section, become familiar with site conditions. In the event discrepancies are found, notify the Engineer as to the nature and extent of the differing conditions.
- B. Call Local Utility Line Information service at 1-800-332-2344 not less than 3 working days before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.
 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
- C. Identify required lines, levels, contours, and datum.

- D. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.
- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 EXISTING UNDERGROUND UTILITIES

- A. Protect active utilities encountered, located or otherwise, and notify persons or agencies owning same.
- B. Remove inactive or abandoned utilities from within the project grading limits in accordance with Section 33 11 50, Existing Pipe Abandonment.
- C. For sewer and other miscellaneous drainage facilities, fill and plug pipes as follows:
 - 1. General:
 - a. Remove all structures to a minimum of 3 feet below subgrade, unless otherwise noted.
 - b. Cover top surface of all abandoned structures with two sheets of nonwoven geotextile, extended at least 1-foot beyond the outside walls of the abandoned manhole, sump, or basin.
 - c. Plug all abandoned pipes with permanent plugs as specified in Section 33 11 50, Existing Pipe Abandonment.
 - 2. Sumps:
 - a. Remove existing sediment, soil, and water. Properly dispose of these materials in accordance with the requirements of these specifications.

- b. Remove top cone and first solid concrete section to a depth of approximately 8 to 10 feet below ground.
 - c. Fill sump with CLSM.
 - d. Backfill remaining voids for facilities within existing or proposed roadways with approved materials meeting the requirements of Section 32 11 23, Aggregate Base Courses.
3. Salvaging Manhole Frames, Covers, and Grates:
- a. Remove manhole frames, covers, and grates scheduled for salvage and store in approved location.
 - b. Frames, grates, and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the Work if of suitable size and condition.
 - c. Replace, at no additional cost to the Owner, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.
 - d. Clean salvaged components to be reused of foreign material by methods that will not harm the components.
4. Existing Manhole Frames and Covers: Manhole frames and covers removed by the Contractor are the property of the Owner. Notify the Engineer a minimum of 48 hours before removal to arrange for pickup of the removed frames and covers, if not reused.

3.4 PRESERVATION OF EXISTING IMPROVEMENTS

- A. Protect adjacent existing structures which may be damaged by excavation work.
- 1. Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place, will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.
 - 2. Open slopes shall not be cut within 5 feet of any existing spread footings unless approved by the Engineer.
 - 3. Do not interfere with 45 degree bearing splay of foundations unless approved by the Engineer.

4. Excavated material shall not be placed adjacent to existing or proposed structures.

3.5 EXCAVATION

A. General:

1. Method of excavation shall be the Contractor's option, but care shall be exercised as final grade is approached to leave it in undisturbed condition.
2. If the final grade for supporting structures is disturbed, it shall be restored to requirements of these Specifications and satisfaction of the Engineer at no additional cost to Owner.
3. The Contractor is advised that footings should be poured as soon as possible to minimize unfavorable final grade conditions from developing.
4. Provide all measures to ensure public safety.

B. Control of Water:

1. Provide and maintain equipment to remove and dispose of water during the course of the work of this Section and keep excavations dry and free of frost or ice.
2. Bearing surfaces that become softened by water or frost must be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.
3. Grade top perimeter of excavation to prevent surface water from draining into excavation.
4. See additional requirements in Section 31 23 19, Dewatering.

C. Frozen Ground: Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.

D. Excavate material of every nature and description to the lines and grades as indicated in the Drawings and/or as required for construction of the facility.

1. Allow for forms, shoring, working space, granular base, topsoil, and similar items, wherever applicable.
2. Trim excavations to neat lines. Remove loose matter and lumped subsoil.

- E. Excavated Materials: Soils excavated at Site will be treated and used as one of two general categories of material as provided below.
 - 1. Fill:
 - a. Subsoil Type S1, Select Native Fill, as approved for use by Engineer.
 - 2. Spoils:
 - a. Ensure there is sufficient suitable material available to complete embankments and other required fillings prior to disposing of any excavated materials.
 - b. Make arrangements for disposal of spoils and include as part of contract work in preparing of project bids.
 - c. Landfill permit or written permission from private property owner to be obtained by the Contractor and provided to the Engineer.

- F. Shoring:
 - 1. As specified in Section 31 50 00, Excavation Support and Protection.
 - 1. The Contractor shall be solely responsible for excavation protection and worker safety and shall provide sheeting and shoring wherever required, all in accordance with current local, state, and federal laws, codes, and ordinances.
 - 2. Where shoring, sheet piling, sheeting, bracing, lagging, or other supports are necessary to prevent cave-ins or damage to existing structures, it shall be the responsibility of the Contractor to design, furnish, place, maintain, and remove such supports in accordance with applicable ordinances and safety requirements.
 - 3. The design, planning, installation, and removal of all sheeting accomplished in such a manner as to maintain the undisturbed state of the soil below and adjacent to the excavation.

- G. Slope existing banks with machine to angle of repose or less until shored.
 - 1. Shape, trim, and finish cut slopes to conform to lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
 - 2. Protection of excavation side slopes:
 - a. Use excavation methods that will not shatter or loosen excavation slopes.
 - b. Where practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line.

- c. Avoid overbreaks. Overbreak is incidental to the Work, except in cases where the Owner's Representative determines that such overbreak was unavoidable.
 - d. Excavation in rock or rocky cuts:
 - 1) Once completed, thoroughly test the slopes with bars or other approved means to remove all loose, detached, broken, or otherwise unstable material.
 - 2) Remove jutting points. Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat, and stable condition.
 - 3) Dispose of the materials removed under this subparagraph in the same manner as other excavated material.
 - e. Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.
- 3. Construct slopes free of all exposed roots.
 - 4. Construct slopes free of unstable rock and loose stones exceeding 3 inches in diameter.
 - 5. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend off-site, outside of easements, outside of rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.
 - 6. Trim all surfaces neatly and smoothly.
- H. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 17, Trenching and Section 31 23 23, Fill.
 - I. Notify Engineer of unexpected subsurface conditions.
 - J. Over-excavation for Unsuitable Foundation Conditions:
 - 1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 - 2. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of

Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

3. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.

K. Rock Removal:

1. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section.
2. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.
3. Concrete removal, as defined herein, shall be treated as Rock Removal.

- L. Stockpile excavated material in area(s) designated on or off site in accordance with Section 31 05 13, Soils for Earthwork.

3.6 FIELD QUALITY CONTROL

- A. Perform excavation and controlled fill operations in accordance with the requirements of this Section.
- B. Coordinate the visual inspection and approval of all bearing surfaces by Engineer before installing subsequent work.

3.7 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability and store excavated materials at a distance from top of excavation.
- B. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for excavation and backfill of all utilities, including installation of pipe bedding, pipe zone backfill, trench backfill, and related Work as shown on the Drawings and as specified.
- B. Section includes:
 - 1. Excavating trenches for pipe, utility vaults, and other utilities.
 - 2. Compacted fill from top of utility bedding to final grades.
 - 3. Trench and utility vault backfilling and compaction.
- C. Related Sections
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 03 30 00 - Cast-In-Place Concrete
 - 3. Section 31 05 13 - Soils for Earthwork
 - 4. Section 31 05 16 - Aggregates for Earthwork
 - 5. Section 31 10 00 - Site Clearing
 - 6. Section 31 22 13 - Rough Grading
 - 7. Section 31 23 16 - Excavation
 - 8. Section 31 23 18 - Rock Removal
 - 9. Section 31 23 23 - Fill
 - 10. Section 31 23 24 - Flowable Fill
 - 11. Section 31 37 00 - Riprap
 - 12. Section 33 11 13 - Water Utility Distribution and Transmission Piping
 - 13. Section 33 31 10 - Sanitary Utility Sewerage Piping: Sanitary sewer piping and bedding
 - 14. Section 33 41 10 - Storm Utility Drainage Piping

15. Supplemental Information: Geotechnical report; bore hole locations and findings of subsurface materials.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 5. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.3 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill. Lean cement concrete fill. A self-compacting, cementitious material.
- B. Flexible Pipe: For the purposes of these Specifications, tubing between 1/2-inch and 4-inch diameter constructed of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) are considered flexible pipes. HDPE piping 4 inches in diameter and larger is also considered flexible pipe.
- C. Geosynthetics: Geotextiles, geogrids, geomembranes, and drainage composite materials.
- D. Imported Material: Materials obtained from sources offsite, suitable for specified use.

- E. Lift: Loose (uncompacted) layer of material.
- F. Obstructions: Items which may be encountered during utility and vault trenching which do not require replacement.
- G. Optimum Moisture Content:
 - 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 - 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- H. Pipe Bedding: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches below the bottom outside surface of pipe, conduit, cable, or duct bank to the trench foundation so as to uniformly support the barrel of the pipe.
- I. Pipe Zone: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 12 inches above the top outside surface of pipe, conduit, cable, or duct bank.
- J. Pipe Bedding, Pipe Zone, and Trench Backfill Classifications:
 - 1. Class A: Backfill with suitable native or imported material that is approved to meet the characteristics required for the specific surface loading or other criteria of the backfill zone.
 - 2. Class B: Backfill with imported granular material consisting of gravel or crushed rock meeting the requirements of this Section and Coarse Aggregate Type A1 as specified in Section 31 05 16, Aggregates for Earthwork; typical designated size shall be 1-inch-0 or 3/4-inch-0.
 - 3. Class C: Backfill with Fine Sand, as specified in Section 31 05 16, Aggregates for Earthwork.
 - 4. Class D: Backfill with approved pit run or bar run material, well-graded from coarse to fine; maximum dimension shall be 3 inches.
 - 5. Class E: Backfill with CLSM. See Section 31 23 24, Flowable Fill.
- K. Pothole Excavations: Removal and replacement of all materials via coring, vacuum extraction, or similar method for the purposes of locating an underground utility and to investigate underground conditions.
- L. Prepared Trench Bottom: The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.

- M. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM Standards.
- N. Rigid Pipe: For the purposes of these Specifications, pipe constructed of PVC, ductile iron, steel, concrete, and clay pipes are considered rigid pipes.
- O. Sewer, Pipes, and Mains: Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.
- P. Trench Backfill: Trench backfill zone for full trench width extending from the top of the pipe zone to pavement base rock, ground surface, or other surface material.
- Q. Trench Stabilization: Removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.
- R. Utility: Any buried pipe, duct, conduit, or cable.
- S. Well-Graded: A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: At a minimum, to include the following:
 - 1. Methods and sequencing of mass excavation.
 - 2. Proposed on-site and off-site spoil disposal locations.
 - 3. Anticipated difficulties and proposed resolutions.
 - 4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.
 - 5. Proposed haul routes.
- B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.
- C. Product Data:
 - 1. Geotextile fabric, indicating fabric and construction
 - 2. Marking tapes
 - 3. Tracer wire

4. Connectors for tracer wire and/or marking tapes
 5. Tracer wire locate boxes
 6. Marker balls
 7. Locator stations
 8. Ground wires
 9. Plastic or copper markers for service laterals.
- D. Imported Materials:
1. Materials Source: Submit name and location of imported fill materials suppliers.
 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- E. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.
- F. Concrete: Mix designs in accordance with Submittal requirements of Section 03 30 00, Cast-in-Place Concrete.

1.5 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.
- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.
- C. CLSM:
1. In-place testing: In accordance with ASTM C403.
 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

1.6 NOT USED

1.7 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.
- B. Coordinate trenching and utility installation work with other work at utility construction location occurring near or adjacent to specified herein.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type S1, Select Native Material as specified in Section 31 05 13, Soils for Earthwork.
- B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:
 - 1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).
 - 2. Structural concrete as specified in Section 03 30 00, Cast-in-Place Concrete with compressive strength of 3,000 psi.
- D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- E. Sand: As specified in Section 31 05 16, Aggregates for Earthwork.
- F. Trench Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 MARKING TAPE

- A. Detectable:
 - 1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
 - 2. Foil Thickness: Minimum 0.35 mils.
 - 3. Laminate Thickness: Minimum 5 mils.
 - 4. Width: 6 inches.
 - 5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
 - 6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.

7. Manufacturers and Products:

- a. Reef Industries; Terra Tape, Sentry Line Detectable
- b. Mutual Industries; Detectable Tape
- c. Presco; Detectable Tape

B. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities and as specified in NEMA Z535.1, Safety Color Code.

Color	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines

2.3 ELECTRONIC LOCATING MATERIALS

A. Marker Balls:

- 1. Exterior Material: High-density polyethylene.
- 2. Size: Maximum 4-1/2 inches in diameter.
- 3. Range: Locatable with standard electronic marker locating devices at depths up to 5 feet.
- 4. Field Type: Spherical RF field regardless of orientation.
- 5. Contain no floating or movable parts, and no batteries or active components.
- 6. Color: Provide colored marker balls per Article 2.03 B above.
- 7. Manufacturer and Product: Omni Marker Model 162 (green), Omni Marker Model 161 (blue), or approved equal.

B. Tracer Wire:

- 1. Direct burial No. 12 AWG solid, annealed copper-clad steel (CCS) high strength tracer wire.
- 2. Tensile Breaking Load: 380-pound average.
- 3. Jacket:

- a. High molecular weight high-density polyethylene complying with ASTM D1248, 30-volt rating.
 - b. Color: Provide in colors per Article 2.03 B above.
 4. Manufacturer and Product: Copperhead Industries; LLC, 12 CCS high strength reinforced tracer wire, or approved equal.
- C. Tracer Wire Connectors:
 1. Waterproof, corrosion proof and suitable for No. 12 AWG solid core wire.
 2. Prefilled with silicone and suitable for use with low-voltage tracer lines of less than 50 volts.
 3. Lug Connectors:
 - a. Waterproof plastic housing that encases the silicone prefilled lug terminals.
 - b. Manufacturer and Product: King Innovations; DryConn™ Direct Bury Lug or approved equal.
 4. Twist Connectors:
 - a. Waterproof epoxy-filled packaging that encases the silicone prefilled twist connectors.
 - b. Manufacturer and Product: 3M Division; DBY Direct Bury Splice Kit 09053 connectors or approved equal.
- D. Ground Wire: No. 12 AWG bare solid copper wire.
- E. Locator Station:
 1. Test Station:
 - a. Lexan® polycarbonate.
 - b. Color: Provide in colors per Article 2.03 B above.
 2. Terminals suitable for No. 12 AWG leads.
 3. Use single (two lead) locator stations with two terminals, one for ground wire and one for tracer wire, when only one tracer wire is terminated in manhole.
 4. Use multi-lead locator stations with the appropriate number of terminals when 2 or more tracer wire leads are terminated in manhole.

5. Manufacturer and Product: Cott Manufacturing Company; FlangeFink® Cathodic Protection Test Station.

2.4 NOT USED

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than three working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
 3. Maintain and protect above and below grade utilities indicated to remain.
- B. Identify required lines, levels, contours, and datum locations.
- C. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.
- D. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation in accordance with Section 31 10 00, Site Clearing.
- E. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.
 1. Intent of Drawings and Specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition.
 2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material, which is satisfactory to Owner.
- F. Potholing / Exploratory Test Pits: Dig such exploratory test pits and perform potholing as may be necessary in advance of trenching to determine the exact location and elevation of subsurface structures, pipelines, duct banks, conduits, and other obstructions which are likely to be encountered or need to be connected to and shall make acceptable provision for their protection, support, and maintenance of their continued operation.

G. Paved or Surfaced Streets:

1. Wherever paved or surfaced streets are cut, saw wheel or approved cutting devices shall be used.
2. Width of pavement cut shall be as shown in the Drawings.
3. Any cut or broken pavement shall be removed from site during excavation.

H. Traffic:

1. Maintain street traffic at all times as required by the Drawings and as specified herein.
2. Erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with the latest edition of Manual of Uniform Traffic Control Devices (MUTCD), Part 6, to protect the traveling public in any area applicable.
3. Provide flaggers as required during active work in roadway areas.

- I. Operations shall be confined to rights-of-way and easements provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Engineer.

3.2 EASEMENTS

- A. Where portions of the Work are located on private property, easements and permits will be obtained by the Owner. Easements shall provide for the use of property for construction purposes to the extent indicated on the easements.
- B. Copies of these easements and permits will be available from the Owner for inspection by the Contractor. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained in every case.
- C. Confine construction operations to within the easement limits or street right-of-way limits or make special arrangements with the property owners for the additional area required and notify the Engineer with a copy of the written approval from property owners of any such conditions.
- D. Any damage to private property, either inside or outside the limits of right-of-way or easements provided by the Owner, resulting from Work shall be the responsibility of the Contractor. Before the Engineer will authorize final payment, the Contractor will be required to furnish the Owner with written releases from property owners where the Contractor has obtained special agreements or easements or where the

Contractor's operations, for any reason, have not been kept within the construction right-of-way obtained by the Owner.

3.3 PROTECTION

A. Existing Facilities:

1. It is the intent of these specifications that all streets, structure, and utilities be left in a condition equal to or better than original condition at the completion of the Project.
2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material to the satisfaction to the Engineer.
3. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.

B. Removal of Water:

1. As specified in Section 31 23 19, Dewatering.
2. At all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work.
3. Keep all excavations dry until the utilities or vaults to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.
4. Dispose of water from the Work in a suitable legal manner without damage to adjacent property or structures.

C. Trench Protection:

1. Provide the materials, labor, and equipment necessary to protect trenches at all times.
2. Trench protection shall provide safe working conditions in the trench and protect the Work, existing property, utilities, pavement, etc.
3. The method of protection shall be according to the Contractor's design.
4. The Contractor may elect to use a combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided

the method meets the approval of all applicable local, state, and federal safety codes.

5. Damages resulting from improper shoring, improper removal of shoring, or from failure to shore shall be the sole responsibility of the Contractor.

3.4 LINES AND GRADES

- A. Trench excavation for piping, utility vaults, and other utilities shall be performed to the alignment and grade as indicated in the Drawings.
- B. Where grades are not shown in the Drawings, utilities shall be laid to grade between control elevations shown.
- C. Water mains shall be installed with a minimum cover of 36 inches.
- D. The Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- E. Changes in the grade and horizontal alignment of the pipeline as shown in the Drawings or as provided elsewhere in the Specifications may be necessary due to unanticipated interferences or other reasons.
 1. No additional compensation will be allowed the Contractor for changes in horizontal alignment.
 2. No additional compensation will be allowed for changes in grade which require additional depth of trench excavation and backfill up to 2 feet from those shown in the Drawings.
- F. Use laser-beam instrument with qualified operator to establish lines and grades.

3.5 OBSTRUCTIONS

- A. Obstructions to the construction of the trench, such as tree roots, stumps, abandoned pilings, abandoned buildings and concrete structures, logs, rubbish, and debris of all types shall be removed without additional compensation from the Owner.
- B. The Engineer may, if requested by the Contractor or Owner, make changes in the trench alignment to avoid major obstructions if such alignment changes can be made within the perpetual easement and right-of-way and without adversely affecting the intended function of the facility or increasing costs to the Owner.

3.6 INTERFERING ROADWAYS AND STRUCTURES

- A. Remove, replace and/or repair any damage done during trenching activities to fences, buildings, cultivated fields, drainage crossings, and any other properties without additional compensation from the Owner.
 - 1. Replace or repair these structures to a condition as good as or better than their pre-construction condition prior to commencing work in the area.
- B. Paved Roadways:
 - 1. Where paved roadways are cut as part of trenching activities, Class B trench backfill will be required to the bottom of pavement base.
 - 2. New pavement shall be equal to or better than the existing paved surface.
 - 3. New surface shall not deviate by more than 1/4-inch from the existing finish elevation.
- C. Existing Structures:
 - 1. If existing structures are encountered as part of trenching activities which will prevent construction and are not adequately shown in the Drawings, the Contractor shall notify the Engineer before continuing with the Work.
 - 2. The Engineer may make such field revisions to the utility alignment as necessary to avoid conflict with the existing conditions.
 - 3. The cost of waiting or “down time” during such field revisions shall be borne by the Contractor without additional cost to the Owner or liability to the Engineer.
 - 4. If the Contractor fails to so notify the Engineer when a conflict of this nature is encountered, but proceeds with construction despite this interference, the Contractor shall do so at the Contractor’s own risk with no additional payment.

3.7 TRENCHING

- A. Excavate subsoil as required for construction of utilities to elevations shown in the Drawings.
- B. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.
- C. Open Trench Limit:

1. Do not advance open trench beyond the distance which will be backfilled and compacted the same day.
 2. A maximum length of open trench shall not exceed 100 feet at any one time.
 3. Temporary resurfacing shall be completed within 300 feet of the associated open trench limit for each main pipe laying operation.
 4. Cover or backfill excavations at the end of each day.
 5. If the trench is not backfilled at the end of each working day:
 - a. Provide means to prevent caving of excavation sides, as necessary, during non-working hours.
 - b. Cover the excavation with a system as needed to provide public safety and prevention of entry during non-working hours.
 - c. Provide signed and stamped submittal of caving prevention system and cover system.
 6. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- D. Utility Crossings: Avoid horizontal and vertical conflicts with existing utilities.
1. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
 2. Vertical clearance between the new pipe and existing utilities shall be 12 inches minimum, unless otherwise noted on the Drawings.
 3. Where existing utility lines are damaged or broken during trenching activities, the utility shall be repaired or replaced. For water or sewer bearing lines, care being taken to insure a smooth flow line and absolutely no leakage at the new joints.
 4. All expenses involved in the repair or replacement of leaking or broken utility lines that have occurred due to the Contractor's operations shall be borne by the Contractor, and the amount thereof shall be absorbed in the unit prices of its bid.
- E. Water Lines Crossing Sewer Lines: Whenever water lines cross sewer lines, the Contractor shall comply with local Health Department requirements.

1. Wherever possible, the bottom of the water line shall be 18 inches or more above the top of sewer pipe. One full length of the water line pipe shall be centered at the crossing.
 2. For clearances less than 1-1/2 feet, the Contractor shall replace the existing sewer pipe with ductile iron or PVC of equal size, centered at the utility crossing, or shall encase existing sewer pipe with concrete for a minimum of 10 feet on both sides of crossing, as directed by the Engineer, at no additional cost to the Owner.
- F. Excavate trenches to width and depth as indicated on Drawings. No additional payment will be provided for trenching activities beyond dimensions shown in the Drawings.
1. Excavation for trenches in which pipelines are to be installed shall provide adequate space for workers to place and joint the pipe properly and safely, but in every case the trench shall be kept to a minimum width.
 2. The width of the pipe trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall not exceed 12 inches on either side of the pipe.
 3. Excavation for utility vaults and other structures shall be wide enough to provide 18 inches between the structure surface and the sides of the excavation.
 4. For pipe or utility vaults to have bedding material, excavate to a depth of 6 inches below the bottom of the pipe or utility vault. Care shall be taken not to excavate below depths required.
 5. If over digging occurs, the trench bottom shall be filled to grade with compacted bedding material.
- G. Remove water or materials that interfere with Work.
1. The trench at all times shall be kept free from water to facilitate fine grading, the proper laying and joining of pipe, and prevention of damage to completed joints.
 2. Adequate pumping equipment shall be provided to handle and dispose of the water without damage to adjacent property.
 3. Water in the trench shall not be allowed to flow through the pipe while construction work is in progress unless special permission to do so has been given by the Engineer.
 4. An adequate screen shall be provided to prevent the entrance of objectionable material into the pipe.

5. Remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the improvements.
 - a. Where the excavation activities require the removal of portions of an abandoned pipeline, masonry plugs shall be installed in the open ends of the pipe, unless otherwise noted in the Drawings or by the Engineer.
 - b. Coordinate with Engineer prior to plugging.
 - c. For plugs less than 36 inches in diameter, 8-inch deep masonry units shall be used. For plugs in larger pipelines, 12-inch deep masonry units shall be used.
 6. The costs associated with the removal of water and materials noted above will be considered incidental to trench excavation and backfill.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Over-excavation for Unsuitable Trench Foundation Conditions:
1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 2. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.
 3. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.
 4. Install nonwoven geotextile under trench stabilization material, over the soft or yielding excavated surface.
 - a. Install the nonwoven geotextile ahead of placement of the trench stabilization material, continuously along the excavation bottom and centered on the pipe centerline.
 - b. Use nonwoven geotextile width equal to the pipe diameter plus 2 feet.
 - c. Place laps or splices in the geotextile in the direction of the pipe laying.
- J. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

- K. Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic or interfere with the function of existing drainage facilities or system operation.
- L. Remove excess subsoil not intended for reuse from site.
- M. Stockpile excavated material in area designated on site in accordance with Section 31 05 13, Soils for Earthwork.

3.8 TUNNELING

- A. In lieu of open cut trenching as specified above, the Contractor may utilize tunnel methods for installation of pipe where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks and other structures.
 - 1. The Engineer must approve tunneling methods prior to utility installation.
 - 2. Where tunneling is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks, and other surface improvements whose replacement is avoided by the tunneling method.

3.9 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, new and existing structures, and adjacent and neighboring properties and to prevent caving, erosion, settlement, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.
- E. Design sheeting and shoring to be removed at completion of excavation work, unless shown otherwise in the Drawings.
- F. Construction Sheeting Left in Place:
 - 1. Furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.

2. Construction sheeting and bracing originally intended for temporary installation, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Engineer. All such sheeting and bracing left in place shall be included in the cost for excavation.
3. Any construction sheeting and bracing which the Contractor has placed to facilitate its work may be ordered in writing by the Engineer to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating an obligation on its part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of its responsibility under the contract.
4. For sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

3.10 COMPACTION

- A. Testing will be required to show specified densities of compacted backfill are being achieved by the Contractor's compaction methods.
- B. Moisture Control:
 1. Moisture condition backfill material to within 2 percent of optimum moisture content required for compaction throughout each lift of the fill.
 2. Add moisture to granular backfill by sprinkling during compaction operation.
 3. Compaction by ponding or jetting is not permitted.
- C. Compact all materials and areas that are not accessible for in-place density testing, as determined by the Engineer, in place by whatever equipment and method is practicable or specified, and as approved by the Engineer.
 1. Perform compaction at such moisture content as is required to produce well-filled, dense, and firm material in place that will show no appreciable deflection or reaction under the compacting equipment.

3.11 BEDDING

- A. All utility vaults, potable water pipe 4-inch nominal diameter and over, all steel pipe, all concrete sewer pipe, all plastic pipe, all pipe under existing or future structures or roadways, and any and all utilities at a depth greater than 6 feet shall be laid in pipe bedding material.

- B. Unless otherwise noted in the Drawings, pipe or conduit of less than 4-inch diameter, outside structure lines and at a depth of less than 6 feet shall be bedded in native material properly shaped as specified below, all as detailed on the Drawings.
- C. Compacted bedding material shall be placed the full width of the excavated trench to a depth as shown on the trench detail included in the Drawings.
 - 1. In lieu of a detail, the depth shall be 6 inches.
- D. Spread the bedding smoothly over entire width of trench to the proper grade so that the pipe is uniformly supported along the barrel.
- E. Hand grade and compact each lift to provide a firm, unyielding surface along the entire pipe length. For rigid pipe, compact to at least 90 percent relative compaction.
- F. Excavate bell holes at each joint to permit proper assembly and inspection of the joint.
- G. Check grade and correct irregularities in bedding material.
- H. Center pipes horizontally in trench width.

3.12 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Place fill material, with the exception of CLSM, in continuous layers and compact in 6- to 8-inch lifts.
 - 1. Prevent pipe from moving either horizontally or vertically during placement and compaction of pipe zone material.
 - 2. Where trenches are under existing or future structures, paved areas, road shoulders, driveways or sidewalks, or where designated on the Drawings or specified elsewhere in these specifications, the trench backfill shall be Class B or Class E and pipe zone backfill shall be Class B or Class E. Class B backfill shall be compacted to 95 percent of maximum density at optimum moisture content.
 - 3. Where trenches are outside existing or future structures, paved areas, road shoulders, driveways or sidewalks, or where designated on plans or specified elsewhere, the trench backfill shall be Class A and pipe zone backfill in these areas

shall be Class B. For these locations, compaction of Class B backfill shall be to not less than 90 percent of maximum density at optimum moisture content. Class B backfill shall be compacted to not less than 95 percent of maximum density at optimum moisture content.

- E. Employ placement method that does not disturb or damage nearby or adjacent foundation perimeter drainage or utilities in trench.
- F. Do not use power-driven impact compactors to compact pipe zone material.
- G. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe or conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible, unless otherwise directed by the Engineer.
- H. Under no circumstances shall water be permitted to rise in open trenches after pipe has been placed.
- I. Do not allow backfill material to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
- J. Use hand compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.
- K. Placement of Sand:
 - 1. Place medium sand in lifts not exceeding 8 inches in uncompacted thickness.
 - 2. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.
- L. Placement of CLSM:
 - 1. Discharge from truck-mounted drum-type mixer into trench.
 - 2. Place in lifts not exceeding 2 feet in thickness.
 - 3. No compaction of CLSM is allowed.
 - 4. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

- M. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- N. Do not leave trench open at end of working day.

3.13 MARKING TAPE INSTALLATION

- A. Continuously install marking tape along centerline of all buried piping, install 24 inches below finished grade. Coordinate with piping installation drawings.

3.14 ELECTRONIC LOCATING FACILITY INSTALLATION

A. Marker Balls:

1. Install according to manufacturer's recommendations and as shown or directed and according to the following requirements:
 - a. Install marker balls directly above the pipe alignment at a depth no less than 3 feet and no more than 4-1/2 feet below final surface grade.
 - b. Install marker balls during trench backfill operations by placing the marker ball in compacted backfill.
 - c. Cover marker ball with a minimum of 6 inches of backfill and compact backfill before continuing trench backfill operations.
 - d. Install markers balls with trenchless pipe installations by core-drilling hole of a minimal diameter needed to allow clearance for placement of marker ball. Backfill with approved trench backfill, pavement base and pavement, as applicable.
2. Water Marker Ball Locations: Install at locations as required by Sewer Marker Ball Locations specified herein.
3. Sewer Marker Ball Locations:
 - a. Install marker balls directly above connection points, termination points and all fitting locations, and at a minimum spacing of 50 linear feet on sewers with a straight horizontal alignment.
 - b. Install marker balls at a minimum spacing of 25 lineal feet directly above sewer mains installed on a radius.
 - c. Install marker balls on new or reconstructed sewer service laterals, directly above the centerline of the end of the lateral at the curb, property line or other end of lateral location, as directed.

- d. Install marker balls directly above every alignment change along sewer mains and service laterals.
 - e. Install marker balls directly above manholes for manholes with buried covers.
- B. Tracer Wire and Terminal Appurtenances:
- 1. Tracer Wire:
 - a. Install as shown or directed directly over the pipe centerline and on top of the pipe zone in all sewer trenches, including mainline sewers, service laterals and storm sewer inlet leads.
 - b. Connect mainline and service lateral tracer wires using either an approved direct-bury lug connector or direct-bury twist connector.
 - c. Extend tracer wire to locator stations in manholes, locator boxes, storm inlets, or other visually identifiable terminal appurtenances, allowing for access with electronic locating equipment, as shown or directed and according to the following requirements:
 - 2. Locator Stations:
 - a. Install locator stations as shown within manholes.
 - b. Mount locator station to manhole wall within 18 inches of manhole rim with two stainless steel expansion anchors.
 - c. Drill a minimum 3/8-inch diameter hole through the manhole wall within 18 inches of the finish grade of the manhole rim.
 - d. Extend the tracer wire from the pipe trench in one continuous piece up the outside of the manhole and through the hole and into a locator station and attach to one of the lugs in the locator station.
 - e. When multiple tracer wires are terminated in manhole install a multi-lead locator station.
 - f. Extend a ground wire from the locator station through a minimum 3/8-inch diameter hole in the manhole wall.
 - g. Install ground wire approximately 3 feet deep and extend from the outside manhole wall a minimum of 3 feet horizontally in any direction.
 - h. Seal all holes drilled in manhole walls with silicone sealant.

3. Storm Inlet Tracer Wire Termination: Terminate tracer wire inside inlet and directly over storm outlet pipe by placing tracer wire as follows:
 - a. Drill a minimum 3/8-inch diameter hole through inlet wall to pass tracer wire through to inside inlet wall.
 - b. Seal hole with silicon sealer or material approved by Engineer.
 - c. Leave 6 inches of coiled tracer wire along inside of inlet wall approximately 3 inches below the inlet frame and grate or as directed by Engineer.
4. Service Lateral Tracer Wire Termination: Terminate tracer wire at ends of service laterals as shown or directed, as follows:
 - a. Termination in Tracer Wire Locate Boxes: Extend the tracer wire in one continuous piece up vertically from the pipe trench and into the bottom of the locate box. Leave 18 inches of coiled tracer wire inside locate box.
 - b. Termination at 2-inch by 4-inch Markers: Extend tracer wire in one continuous piece directly up service lateral 2-inch by 4-inch markers and leave 18 inches of tracer wire wrapped around the exposed top end of 2-inch by 4-inch marker.

3.15 NOT USED

3.16 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D698 (AASHTO T99)..
- C. In-place compaction testing of pipeline backfill materials shall be performed at 2-foot elevation increments, one test per **200** lineal feet of pipeline trench as measured along pipe centerline.
 1. The Engineer may reduce the frequency when satisfied with method of compaction.
 2. The Engineer may direct testing at a higher frequency at no additional cost to the Owner upon failure to obtain specified densities or if the Contractor changes compaction equipment or methods of compaction.

3. The Engineer shall determine all test locations.
- D. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D2922
 2. Moisture Tests: ASTM D3017
- E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at the sole expense of the Contractor.

3.17 SURFACE RESTORATION AND CLEANUP

- A. Open Trenches: At the end of each workday, all open trenches shall be backfilled and all trenches within streets shall be temporarily paved or covered to the satisfaction of the Engineer and the local permitting agency.
1. Temporary paving shall be replaced with permanent street paving at the completion of construction within street rights-of-way, or sooner, if deemed necessary by the ENGINEER.
 2. No gravel-filled trenches shall be left open within the street right-of-way at the end of the workday.
- B. Topsoil:
1. Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil to the specified depth and place the material in a stockpile.
 2. Topsoil shall not be mixed with other excavated material.
 3. After the trench has been backfilled, the topsoil shall be replaced.
- C. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. The Contractor shall be responsible for seeing that lawns, shrubs, etc. remain alive and leave premises in condition equal to original condition before construction.

3.18 NOT USED

END OF SECTION

SECTION 31 23 18 - ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes removal of subsurface rock during excavation by mechanical method. The use of explosives for rock removal is not permitting for this project.
- B. Section Includes:
 - 1. Removing identified and discovered rock during excavation.
 - 2. Expansive tools to assist rock removal.
- C. Related Sections:
 - 1. Section 31 22 13 - Rough Grading
 - 2. Section 31 23 16 - Excavation: Building excavation
 - 3. Section 31 23 17 - Trenching: Trenching and backfilling for utilities
 - 4. Section 31 23 23 - Fill: Backfill materials
 - 5. Section 31 37 00 - Riprap
 - 6. Supplemental Information: Geotechnical report; bore hole locations and findings of subsurface materials.

1.2 DEFINITIONS

- A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. All excavation shall be classified as Common Excavation, unless provided for under Rock Removal below.
- B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.
- C. Rock: Solid mineral material, including boulders, solid bedrock, or ledge rock, with volume in excess of 1/2 cubic yard or solid material which, by actual demonstration, cannot be reasonably excavated with suitable machinery as defined herein. The Engineer may waive the requirements for actual demonstration if the material encountered is well-defined rock.

- D. Rock Removal: Removal of rock as defined herein by systematic and continuous drilling, hammering, breaking, splitting, or other methods approved by the Engineer.
- E. Suitable Machinery: A track-mounted hydraulic excavator of the 52,800- to 72,500-pound class equipped with a single shank ripper.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate proposed method of rock removal.
- C. Equipment: Manufacturer information regarding pound class of machinery proposed for rock removal.
- D. Survey Report: Submit survey report mapping extent and locations of rock encountered, to be used in calculating total volume of rock removal.

PART 2 PRODUCTS – NOT USED.

2.1 MATERIALS

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Engineer Approval for Rock Removal:
 1. Prior to commencement of rock removal, expose all material anticipated to be rock by removing the common material above it and then notify the Engineer.
 2. The Engineer, in association with the Contactor or the Contractor's representative, will measure the amount of material to be removed in an effort to reach a mutually agreeable volume for anticipated rock removal.
 3. Prior to commencing the proposed rock removal, the Contractor must receive written approval by the Engineer stating the approximate volume of excepted rock removal to receive payment.

4. During rock removal activities, should it become apparent the previously agreed upon volume of rock removal will be exceeded, notify the Engineer immediately. Should the Contractor proceed with rock removal in excess of the previously agreed upon volume, the Contractor will do so at their own risk and expense.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

- A. Excavate and remove rock by mechanical method.
 1. Use single shank ripper to fracture rock.
 2. Drill holes and use expansive tools and wedges to fracture rock.
- B. Cut away rock at bottom of excavation to form level bearing.
- C. Remove shaled layers to provide sound and unshattered base for footings and foundations.
- D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- E. For vaults and other structures, excavate to the depth necessary to install the structure and to a maximum of 18 inches beyond the outside walls of the vault or structure.
- F. Remove excavated materials from site. Excavated materials to be reused for site landscaping or rip rap installation on other areas of the project shall be stockpiled by the Contractor at a location other than the project site until such time as it is to be installed.
- G. Correct unauthorized rock removal associated with structural excavations in accordance with backfilling and compacting requirements of Section 31 23 16, Excavation and as directed by Engineer.
- H. Correct unauthorized rock removal associated with utility work in accordance with backfilling and compacting requirements of Section 31 23 17, Trenching and as directed by Engineer.
- I. If material which would be classified as rock as defined herein is mechanically removed with equipment of a larger size than specified as Suitable Machinery herein, it shall be understood that any added costs for the removal of rock by this method shall be included in the unit price for common excavation and not paid for under this pay item. If material which would be classified as rock as defined herein is mechanically removed without [blasting,] hammering, breaking, or splitting, it will be considered common excavation and not paid for under this pay item. If equipment larger than the suitable machinery as defined herein is brought on the project site for the sole purpose of rock removal without hammering, breaking or splitting, then such excavation will be considered rock removal.

3.4 FIELD QUALITY CONTROL

- A. Request visual inspection of foundation bearing surfaces by Engineer before installing subsequent work.

END OF SECTION

SECTION 31 23 19 - DEWATERING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes temporary dewatering and surface water control systems for open excavations and utility trenches.
- B. Section includes:
 - 1. Dewatering systems.
 - 2. Surface water control systems.
 - 3. System operation and maintenance.
 - 4. Water disposal.

1.2 RELATED SECTIONS

- A. Section 02 30 00 - Subsurface Investigations
- B. Section 31 05 16 - Aggregates for Earthwork
- C. Section 31 23 16 - Excavation
- D. Section 31 23 17 - Trenching

1.3 SUBMITTALS

- A. Dewatering Plan:
 - 1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this Section.
 - 2. Plan to be reviewed by the Engineer prior to the beginning of construction activities requiring dewatering. Review by the Engineer of the design shall not be construed as a detailed analysis of the adequacy of the dewatering system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.

1.4 DEFINITIONS

- A. Dewatering includes the following:
 - 1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and /or shafts.

2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and /or shafts.
3. Disposing of removed water.

B. Surface Water Control: Removal of surface water within open excavations.

1.5 QUALITY CONTROL

- A. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents.
- C. Secure all necessary permits to complete the requirements of this Section.
- D. Control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- E. Where the critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop.
 1. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor.
 2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 EXECUTION

3.1 DEWATERING

- A. Provide all equipment necessary for dewatering.
 - 1. Have on hand, at all times, sufficient pumping equipment and machinery in good working condition.
 - 2. Have available, at all times, competent workers for the operation of the pumping equipment.
 - 3. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.
- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. Site Grading:
 - 1. At all times, site grading shall promote drainage.
 - 2. Surface runoff shall be diverted from excavations.
 - 3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.
- F. Maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- G. Flotation shall be prevented by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent

pumping of fine sands or silts from the subsurface. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.

- I. Dispose of water from the work in a suitable manner without damage to the environment or adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.
- J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- K. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the work and all costs thereof shall be included in the various contract prices in the bid forms.

END OF SECTION

SECTION 31 23 23 - FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes backfilling required at building perimeter and site structures to subgrade elevations, fill under interior and exterior slabs-on-grade or pavement, and fill under landscaped areas. Backfilling for utilities within building proper is included within this section; backfilling for utilities outside building is included in Section 31 23 17, Trenching.
- B. Section includes:
 - 1. Backfilling building perimeter to subgrade elevations.
 - 2. Backfilling site structures to subgrade elevations.
 - 3. Fill under slabs-on-grade.
 - 4. Fill under paving.
 - 5. Fill for over-excavation.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 31 05 13 - Soils for Earthwork
- C. Section 31 05 16 - Aggregates for Earthwork
- D. Section 31 22 13 - Rough Grading
- E. Section 31 23 16 - Excavation
- F. Section 31 23 17 - Trenching
- G. Section 31 23 24 - Flowable Fill
- H. Section 31 25 00 - Erosion and Sediment Controls. [IN PROCESS]
- I. Section 31 37 00 - Riprap
- J. Section 33 11 10 - Water Utility Distribution and Transmission Piping
- K. Section 33 31 13 – Public Sanitary Utility Sewerage Piping
- L. Section 33 41 10 - Storm Utility Drainage Piping
- M. Supplemental Information: Geotechnical report; bore hole locations and findings of subsurface materials.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 5. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

1.4 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill elsewhere in these Specifications. A self-compacted, cementitious material.
- B. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- C. Lift: Loose (uncompacted) layer of material.
- D. Optimum Moisture Content:
1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Imported Materials:
1. Materials Source: Submit name and location of imported fill materials suppliers.

2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- C. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.6 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.
- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.
- C. CLSM:
1. In-place testing: In accordance with ASTM C403.
 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type S2, Imported Fill Material, as specified in Section 31 05 13, Soils for Earthwork.
- B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:
1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).
 2. Structural concrete as specified in Section 03 30 00, Cast-in-Place Concrete. Compressive strength as required by the application or as noted in the Drawings.
- D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

- E. Foundation Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to Work in this Section, become familiar with Site conditions. In the event discrepancies are found, notify Engineer as to the nature and extent of the differing conditions.
- B. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
- C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.
- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.
- D. See provisions for Work in Section 31 25 00, Erosion and Sediment Controls.

3.3 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Control of Water:
 - 1. Excavated areas shall be kept free of water and frost.
 - 2. Bearing surfaces which become softened by water or frost shall be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.

3. See Section 31 23 19, Dewatering for additional details.
- C. Compact subgrade to density requirements for subsequent backfill materials.
- D. Cut out soft areas of subgrade not capable of compaction in place and replace with specified granular fill material. See Article 3.5, Over-excavation for Unsuitable Foundation Conditions in Section 31 23 16, Excavation for additional details.
- E. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
- F. Subgrade to be approved by Engineer prior to placement of structures and commencement of backfill activities.
- G. Do not allow or cause any work performed or installed to be covered up or enclosed prior to required tests and approvals. Should any Work be enclosed or covered up, uncover at Contractor's expense.

3.4 BACKFILLING

- A. Backfill areas to contours and elevations shown in the Drawings with unfrozen materials.
- B. Do not place materials when weather conditions and/or moisture content prevent attainment of specified density.
- C. Maintain optimum moisture content of backfill materials to attain required compaction density.
- D. Employ placement method that does not disturb or damage other work.
- E. Mechanical tampers permitted in confined areas.
- F. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- G. Foundation Base for Structures:
 1. Bring excavation to required subgrade elevation shown in the Drawings.
 2. Place foundation base material to required grade shown in the Drawings.
 3. Place foundation base material in 6-inch lifts and compact to 95 percent maximum dry density.

4. Pump Station:
 - a. Concrete Footings: Place a 8-inch minimum layer of Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation to required grade under all concrete footings. See Drawings for requires overexcavation limits.
 - b. Concrete Slabs: Place an 8-inch minimum layer of Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation under all concrete slabs.
5. Foundations established near finished site grades:
 - a. Place a 3-inch thick layer of Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation in the bottom of footing excavations to minimize disturbance of silty foundation soils during wet weather.
 - b. Lightly compact material with a light-weight hand-operated vibratory plate compactor.
 - c. To provide uniform support, slabs should be underlain by a minimum 8-inch thick granular base course consisting of 1-1/2- or 3/4-inch - 0 gradation.
 - d. The base course material should be installed in a single lift and compacted to at least 95 percent of the maximum dry density. See Drawings for details.

H. Backfill for Structures:

1. Prior to placing backfill, remove forms, temporary construction, and debris below grade.
2. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour, unless otherwise approved by Engineer.
3. Heavy compactors and large pieces of construction equipment shall be kept away from any embedded wall a distance of a least 5 feet in order to avoid the build-up of excessive lateral pressures.
 - a. Over-compaction of fill near walls should be avoided.
4. Compaction within 5 feet of the walls shall be accomplished using hand-operated vibratory plate compactors or tamping units.
5. The maximum particle size of granular material placed against buried structures shall be limited to no greater than 1-1/2-inch diameter.

6. Structural fill backfill material shall be brought up on all sides of the walls and footings in such a manner as to avoid adverse differential lateral earth pressures on the vertical surfaces.
7. Appropriate lift thickness will depend on the type of compaction equipment used and the type of material being placed. All material shall be compacted to at least 95 percent of the standard maximum dry density.
 - a. For moderate- to heavy-weight compactors, a maximum loose lift thickness of 12 inches shall be used.
 - b. For hand-operated or small compactors, a maximum loose lift thickness of 8 inches shall be used.
8. Particular care must be taken to avoid damage to the pipe connections to the structure.
9. Utility trench backfill within 10 feet of all structural perimeters shall meet the requirements for structural fill.
- I. For areas receiving surface structures or existing paved areas to be constructed or replaced, such as, roadways, driveways, parking lots, and sidewalks:
 1. Place Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation in 6-inch lifts.
 2. Compact with vibratory equipment to 95 percent maximum density, unless otherwise specified or shown in the Drawings.
- J. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise in the Drawings.
- K. Make gradual grade changes. Blend slope into level areas.
- L. Remove surplus backfill materials from Site in accordance with Section 31 23 16, Excavation.

3.5 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D698 (AASHTO T99)

- C. In-place compaction testing for structural fill material shall be performed at 2-foot elevation increments in the fill material with at a minimum of one test per each 2,500 square feet of material placed. The Engineer shall be provided with the results of each compaction test at the time of testing.
- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at the sole expense of the Contractor.
- F. When testing of subgrade is not possible or feasible as detailed above, proof roll compacted fill surfaces under slabs-on-grade, pavers, paving, and as may be otherwise required by the Engineer.

3.6 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 24 - FLOWABLE FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes flowable lean concrete mix used for structure backfill, utility bedding and backfill and other subgrade Site Work. Applications also include filling abandoned structures and utilities that remain in place.
- B. Section Includes:
 - 1. Structure backfill
 - 2. Utility bedding
 - 3. Utility backfill
 - 4. Filling abandoned utilities

1.2 RELATED SECTIONS

- A. Section 33 11 50 - Existing Pipe Abandonment
- B. Section 31 23 16 - Excavation
- C. Section 31 23 17 - Trenching
- D. Section 31 23 23 - Fill
- E. Section 33 11 10 - Water Utility Distribution and Transmission Piping
- F. Section 33 31 10 - Sanitary Utility Sewerage Piping
- G. Section 33 34 00 - Sanitary Utility Sewerage Force Mains
- H. Section 33 41 10 - Storm Utility Drainage Piping

1.3 DEFINITIONS

- A. Flowable Fill: Also referred to as Controlled Low Strength Material (CLSM) elsewhere in the Specifications. Lean cement concrete fill.
- B. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.

1.4 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates
 - 2. ASTM C94 - Standard Specification for Ready-Mixed Concrete
 - 3. ASTM C150 - Standard Specification for Portland Cement
 - 4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete

5. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
6. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete
7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
9. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete in Place by Nuclear Methods
10. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Field Quality-Control Submittals:
 1. Mix Design:
 - a. Furnish flowable fill mix design for each specified strength.
 - b. Furnish separate mix designs when admixtures are required for the following:
 - 1) Flowable fill Work during hot and cold weather.
 - 2) Air entrained flowable fill Work.
 - c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
 2. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.
- D. Delivery Tickets:
 1. Furnish duplicate delivery tickets indicating actual materials delivered to Project Site.

1.6 QUALITY ASSURANCE

- A. In-place testing of Flowable Fill: In accordance with ASTM C403.
- B. Compressive testing of Flowable Fill: In accordance with ASTM D4832.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Minimum Conditions: The following minimum conditions shall be met at time of flowable fill placement.
 - 1. Do not install flowable fill during inclement weather.
 - 2. Ambient temperature must be at least 34 degrees Fahrenheit (F) (4 degrees Celsius (C)) and rising.
 - 3. Flowable fill shall be at 40 degrees F (4 degrees C).
 - 4. Subgrade on which flowable fill is to be placed shall be free of disturbed or soft material, debris and water.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

PART 2 PRODUCTS

2.1 FLOWABLE FILL

- A. Flowable Fill:
 - 1. Composed of cement, pozzolans, fine aggregate, water, and admixtures.
 - 2. Low cement content.
 - 3. Non-segregating, self-consolidating, free-flowing, and excavatable material which will result in a hardened, dense, non-settling fill.
 - 4. Compressive strength at 28 days of 100 to 200 pounds per square inch (psi), if not otherwise shown in Drawings or specified.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I, Normal.
- B. Fine Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.3 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical Admixture: ASTM C494.
 - 1. Type A - Water Reducing
 - 2. Type B - Retarding
 - 3. Type C - Accelerating
 - 4. Type D - Water Reducing and Retarding
 - 5. Type E - Water Reducing and Accelerating
 - 6. Type F - Water Reducing, High Range
 - 7. Type G - Water Reducing, High Range, and Retarding
- C. Fly Ash: ASTM C618 Class C or F, obtained from residue of electric generating plant using ground or powdered coal.
- D. Plasticizing: ASTM C1017 Type I, Plasticizing.

2.4 MIXES

- A. Mix and deliver flowable fill according to ASTM C94, Option C.
- B. Flowable Fill Design Mix:

ITEM	PROPERTIES
Cement Content	75 to 100 lb/cu yd
Fly Ash Content	[None]
Water Content	As specified
Air Entrainment	5 to 35 percent
28-Day Compressive Strength	Maximum 200 psi.
Unit Mass (Wet)	80 to 110 pcf
Temperature, Minimum at Point of Delivery	50 degrees F (10 degrees C)

- C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.
- D. Design mix air entrainment and unit mass are for laboratory design mix and source quality control only.

2.5 SOURCE QUALITY CONTROL

- A. Test and analyze properties of flowable fill design mix and certify results for the following:
 - 1. Design mix proportions by weight of each material.

2. Aggregate: ASTM C33 for material properties and gradation.
 3. Properties of plastic flowable fill design mix including:
 - a. Temperature
 - b. Slump
 - c. Air entrainment
 - d. Wet unit mass
 - e. Yield
 - f. Cement factor
 4. Properties of hardened flowable fill design mix including:
 - a. Compressive strength at 1-day, 7 days, and 28 days. Report compressive strength of each specimen and average specimen compressive strength.
 - b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.
- B. Prepare delivery tickets containing the following information:
1. Project designation
 2. Date
 3. Time
 4. Class and quantity of flowable fill
 5. Actual batch proportions
 6. Free moisture content of aggregate
 7. Quantity of water withheld

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavation specified in Section 31 23 16, Excavation and trenching specified in Section 31 23 17, Trenching is complete.
- B. Verify utility installation as specified in elsewhere in the specifications is complete and tested before placing flowable fill.
- C. Verify excavation is dry and dewatering system is operating, as may be required, prior to placement of flowable fill.

3.2 PREPARATION

- A. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.
- B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.
- C. Protect utilities and foundation drains to prevent intrusion of flowable fill.

3.3 INSTALLATION - FILL, BEDDING, AND BACKFILL

- A. Place flowable fill by chute, pumping, or other methods as approved by Engineer.
- B. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.
- C. Place flowable fill evenly on both sides of utilities to maintain alignment.
- D. Place flowable fill to elevations indicated on Drawings without vibration or other means of compaction.

3.4 INSTALLATION - FILLING ABANDONED UTILITIES

- A. As specified in Section 33 11 50, Existing Pipe Abandonment.

3.5 FIELD QUALITY CONTROL

- A. Perform inspection and testing according to ASTM C94.
 - 1. Take samples for tests for every 100 cubic yards of flowable fill, or fraction thereof, installed each day.
 - 2. Sample, prepare, and test four compressive strength test cylinders according to ASTM D4832. Test one specimen at 3 days, one at 7 days, and two at 28 days.
 - 3. Measure temperature at point of delivery when samples are prepared.
- B. Further construction proceeding upon placed flowable fill will be permitted only after initial set is attained, as measured by ASTM C 403.
 - 1. Perform in place penetration (density) tests using handheld penetrometer to measure penetration resistance of hardened flowable fill.
 - 2. Perform tests at locations as directed by Engineer.

C. Defective Flowable Fill: The Engineer reserves the right to reject all flowable fill failing to meet the following test requirements or flowable fill delivered without the following documentation.

1. Test Requirements:

- a. Minimum temperature at point of delivery.
- b. Compressive strength requirements for each type of fill.

2. Documentation: Duplicate delivery tickets.

D. No traffic or construction equipment shall be allowed on flowable fill for a least 24 hours after placement.

3.6 CLEANING

A. Remove spilled and excess flowable fill from Project Site.

B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation.

END OF SECTION

SECTION 31 37 00 - RIP RAP

PART 1 GENERAL

1.1 SCOPE

This Section consists of furnishing and placing an erosion-resistant cover material for protecting slopes and basins at locations shown or as directed.

1.2 RELATED SECTIONS

- A. Section 03 60 00, Grouting
- B. Section 31 22 13, Rough Grading
- C. Section 31 23 18, Rock Removal

1.3 DEFINITIONS

- A. Filter Blanket - A layer of graded granular material placed between the area prepared for it and the riprap.
- B. Grouted Riprap - Loose riprap with all or part of the spaces filled with Portland cement mortar.
- C. Keyed Riprap - Loose riprap placed on prepared slope, riprap geotextile, or filter blanket, as specified, and keyed in place by slapping the surface with a piece of armor plating.
- D. Loose Riprap - Specified classes of graded rock placed on prepared slope, riprap geotextile, or filter blanket, as specified.
- E. Riprap Backing - An option of using either riprap geotextile or a filter blanket placed between the area prepared for it and the riprap.
- F. Riprap Basin - Energy dissipater consisting of loose riprap placed at pipe outlets as specified.
- G. Riprap Geotextile - A geotextile placed between the area prepared for it and the riprap.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

PART 2 MATERIALS

2.1 RIPRAP GEOTEXTILE - FURNISH RIPRAP GEOTEXTILE AS SHOWN IN THE DRAWINGS.

2.2 RIPRAP REQUIREMENTS

A. General - Furnish rock for loose riprap meeting the following requirements:

1. Meet the test requirements of provided herein.
2. Be angular in shape. Thickness of a single rock shall not be less than 1/3 its length. Rounded rock will not be accepted unless authorized by the ENGINEER.
3. Meet the gradation requirements for the class specified.
4. Be free from overburden, spoil, shale, and organic material. Non-durable rock, shale, or rock with shale seams is not acceptable.

B. Test Requirements - Furnish the rock meeting the following test requirements:

Material Test	Requirement
Apparent Specific Gravity (AASHTO T 85)	2.50 Min.
% Absorption (AASHTO T 85)	6.0 Max.
Degradation (ODOT TM 208A)	
Passing No. 20 Sieve	35.0% Max.
Sediment Height	8.0" Max.
Soundness (AASHTO T 104)	
Average Loss of 2 1/2" - 1 1/2" and 1 1/2" - 3/4" fraction after 5 alternations	16.0% Max.

C. Gradation Requirements - Grade loose riprap by class and weight of rock according to the following:

Class 50	Class 100	Class 200	Class 700	Class 2000	Percent (by Weight)
Weight of Rock (pounds)					
50 - 30	100 - 60	200 -	700 -	2000 -	20.0
30 - 15	60 - 25	140	500	1400	30.0
15 - 2	25 - 2	140 - 80	500 -	1400 -	40.0
2 - 0	2 - 0	80 - 8	200	700	10.0 - 0
		8 - 0	200 - 20	700 - 40	
			20 - 0	40 - 0	

Uniformly grade each load of riprap from the smallest to the largest weight specified. Control of gradation will be by visual inspection.

1. Control Sample - If directed, provide, at a satisfactory location near the project site, a rock sample of at least 5 tons meeting the gradation for the class specified. This sample will be used as a frequent visual reference for judging the gradation of the riprap supplied.
2. Sampling and Testing Assistance - Any difference of opinion between the ENGINEER and the CONTRACTOR shall be resolved by dumping and checking the gradation of two random truckloads of rock. Mechanical equipment, a sorting site, and labor needed to assist in checking gradation shall be provided by the CONTRACTOR at no additional cost to the OWNER.

D. Grouted Riprap

1. Furnish rock for grouted rip rap meeting the requirements of stated herein for class and size specified.
2. Furnish non-shrink Portland cement grout meeting the requirements of Section 03 60 00, Grouting.

E. Filter Blanket - Furnish filter blanket material meeting the following requirements according to riprap class:

Riprap Class	Filter Blanket
Class 2000	16-inch layer of Class 50 riprap conforming to the requirements of this section
Class 700	9-inch layer of 6-inch - 0 stone embankment meeting the test requirements of this section
Class 200	6-inch layer of 4-inch - 0 stone embankment meeting the test requirements of this section
Class 100	No filter blanket required
Class 50	No filter blanket required

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove brush, trees, stumps, and other organic material from slopes to be protected by riprap and dress to a smooth surface.
- B. Remove all unsuitable material to the depth shown or directed and replace with approved material.
- C. Compact filled areas as specified in Section 31 23 23, Fill.

- D. Provide riprap protection as early as the structure foundation construction permits. Prepare the surfaces to be protected as shown.
- E. Maintain the trench slopes, riprap geotextile, or filter blanket until the riprap is placed.

3.2 RIPRAP GEOTEXTILE

- A. Install riprap geotextile as shown in the Drawings or as directed by the ENGINEER.

3.3 FILTER BLANKET CONSTRUCTION

- A. If required, place the filter blanket on the prepared area to the full specified thickness in one operation, using methods which will not cause segregation.
- B. The surface of the finished layer shall be reasonably even.

3.4 RIPRAP BACKING

- A. When indicated on the Drawings, the CONTRACTOR shall have the option of placing either riprap geotextile or a filter blanket behind the riprap.
- B. Install the backing per these specifications or as shown in the Drawings.

3.5 RIPRAP

- A. General - Unless otherwise directed, place the riprap protection as the embankment is constructed. Its placement shall lag behind embankment construction only as necessary to allow proper embankment construction and prevent mixture of embankment and riprap material.
- B. Loose Riprap - Place riprap on the prepared area:
 - 1. With a clamshell, orange-peel bucket, skip, or similar approved device which will contain the riprap material to its final destination. Do not open the bucket until it has been lowered to the slope on which the material is being placed.
 - 2. To its full course thickness in one operation.
 - 3. According to the compaction requirements of Section 31 23 23, Fill if riprap is placed on geotextile
 - 4. By methods that do not cause segregation of riprap or displace the underlying material.
 - 5. To produce a compact riprap protection in which all sizes of material are placed in their proper proportion.

6. With some hand placing, or rearranging of individual stones by mechanical equipment, or some other approved means to provide a smooth finished surface.

Where filter material and/or riprap are placed under water, increase their thicknesses as shown or as directed.

- C. Keyed Riprap - After placing loose riprap material, key the riprap into place by slapping the surface with a piece of armor plating (approximately 4 feet by 5 feet in size with a weight of approximately 5,000 pounds) or other approved means which will produce a nearly smooth surface.
- D. Grouted Riprap - Place loose riprap material. If the depth specified for grouting is more than 12 inches, place the riprap in lifts of 12 inches or less and grout each lift before placing the next lift. Construct and grout the succeeding lifts before the grout in the previous lift has hardened.

Thoroughly moisten the stones and sluice any excess fines to the underside of the riprap before grouting. Deliver the grout to the place of final deposit by any means that will ensure uniformity and prevent segregation of the grout. Spade or rod the grout into the spaces to completely fill the voids in the riprap. Control pressure grouting and do not unseat the stones. Penetration of the grout shall be to the depth shown on the plans. If a rough surface is specified, brush the stone until 25 percent to 50 percent of the depth of surface stone is exposed. For a smooth surface, grout the crevices to within 5/8-inch of the surface.

Provide weep holes through the riprap as shown or as directed.

Place and cure grout according to 03 60 00, Grouting, except as provided above.

- E. Riprap Basins - Excavate, backfill, and construct riprap basins, without a riprap geotextile or filter blanket, at pipe outlets with Class 50 riprap as shown or as directed.

- 3.6 MAINTENANCE - maintain the riprap protection until accepted. Replace any material displaced by any cause at no additional cost to the owner.

END OF SECTION

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes construction of an aggregate subbase and base course for placement under asphalt or concrete paving, unit paving, or placed and left exposed.
- B. Section Includes:
 - 1. Aggregate subbase
 - 2. Aggregate base course

1.2 RELATED REQUIREMENTS:

- A. Section 31 22 13 - Rough Grading
- B. Section 31 23 17 - Trenching
- C. Section 31 23 23 - Fill
- D. Section 31 37 00 - Riprap
- E. Section 31 05 16 - Aggregates for Earthwork
- F. Section 32 12 16 - Asphalt Paving

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications
 - 2. T11, Standard Method of Test for Materials Finer Than 75 μ m (No. 200) Sieve in Mineral Aggregates by Washing
 - 3. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - 4. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - 5. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
5. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.4 DEFINITIONS

- A. Completed Course: Compacted, unyielding, free from irregularities and standing water, with smooth, tight, even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform cross-section thickness.
- C. Keystone: Fine aggregate used to aid in binding of loose surface stone.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit data for geotextile fabric and herbicide.
- C. Materials Source: Submit name of aggregate materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SHOULDER AGGREGATE

- A. Of the size shown on the Plans.

- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.2 DENSE-GRADED BASE AGGREGATES

- A. Of the size shown on the Plans.
- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.3 OPEN-GRADED BASE AGGREGATES

- A. Of the size shown on the Plans.
- B. Coarse Aggregate: Type A2, Granular Drain Backfill Material as specified in Section 32 05 16, Aggregates for Earthwork.

2.4 SOURCE QUALITY CONTROL

- A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.
- B. Final approval of aggregate material will be based on test results of installed materials.
- C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

2.5 EQUIPMENT

- A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

2.6 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

- B. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate with equipment approved by the Engineer in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place base course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.3 HAULING AND SPREADING

A. Hauling Materials:

- 1. Do not haul over surfacing in process of construction.
- 2. Loads: Of uniform capacity.
- 3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

- 1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
- 2. Produce even distribution of material on prepared surface without segregation.
- 3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.
- 4. Maintain consistent gradation of material. Widely varying gradation will be cause for rejection.

3.4 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

- 1. If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.
- 2. Completed Course Total Thickness: As shown on the Plans, 8-inch minimum.

3. Spread lift on preceding course to required cross-section. Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.
 4. Lightly blade and roll surface until thoroughly compacted.
 5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
 - a. Use 3/4-inch leveling course or surfacing material as keystone.
 - b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
 - c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
 - d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
 6. Blade or broom surface to maintain true line, grade, and cross-section.
- B. Gravel Surfacing and Leveling Course:
1. Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.
 2. Spread on preceding course in accordance with cross-section shown.
 3. Blade lightly and roll surface until material is thoroughly compacted.
 4. Complete Total Thickness: As shown on the Plans, 8-inch minimum.

3.5 ROLLING AND COMPACTION

- A. Commence compaction of each layer of base immediately after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO T99.
- B. Roll each layer of material until there is no appreciable reaction or yielding under the compactor before succeeding layer is applied.
- C. Shape and maintain the surface of each layer during compaction operations. Commence rolling at outer edges and continue toward center; do not roll center of road first.
- D. Apply water as needed to obtain specified densities.

- E. Place and compact each lift to the required density before succeeding lift is placed.
- F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.
- G. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

- A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.
- B. Finished Surface of Untreated Aggregate: Within plus or minus 0.04-foot of grade shown at any individual point.
- C. Overall Average: Within plus or minus 0.04-foot from crown and grade specified.

3.7 FIELD QUALITY CONTROL

- A. Quality control testing shall be performed by an independent testing laboratory provided by the Owner.
- B. Refer to table below for minimum sampling and testing requirements for aggregate base course and surfacing. The OWNER reserves the right to complete additional testing.

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T99	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO T310	One for each 500 ton but at least every 10,000 square feet of area	In-place completed, compacted area

3.8 CLEANING

- A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate. Restore per Specifications as applicable.

END OF SECTION

SECTION 32 12 16 - ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SCOPE

This section includes the construction of asphalt concrete pavement.

1.2 REFERENCE STANDARDS

- A. References herein to "AASHTO" shall mean Association of American State Highway Transportation Officials.
- B. Standard Specifications: Where the term "Standard Specifications" is used, such reference shall mean the current edition of the Oregon Department of Transportation (ODOT) Standard Specifications for Highway Construction. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.3 DEFINITIONS

- A. Maximum Density Test (MDT): Theoretical maximum density of the bituminous mixture determined by multiplying the theoretical maximum specific gravity, determined by ASTM D2041 (Rice), by 62.4 pounds per cubic foot.

1.4 SUBMITTALS

- A. Aggregate Qualification Tests: In accordance with Standard Specifications Section 00640 for aggregate used in aggregate base.
- B. Aggregate Qualification Tests: In accordance with Standard Specifications Section 00745 for aggregate used in asphalt concrete.
- C. Job mix formula shall be an approved job mix formula. Submit formula, supplier, and product identification to the Engineer 30 days prior to start.
 - 1. Definite percentage for:
 - a. Each sieve fraction.
 - b. New asphalt cement.
 - c. Recycled asphalt pavement.
 - 2. Temperature of completed mix when discharged from mixer.

3. Character and quantity of anti-strip and recycling agents.

1.5 QUALITY ASSURANCE

- A. All testing to determine compliance with the specifications shall be performed by an independent testing laboratory contracted by the Contractor and approved by the Engineer. All testing costs shall be borne by the Contractor.
- B. A minimum of five nuclear densometer readings shall be taken in random locations within every test area. Each test area shall not exceed 200 tons of asphalt; however, smaller areas may be designated by the Engineer.
- C. The surface smoothness of the new asphalt concrete pavement shall be such that when a 10-foot straightedge is laid longitudinally across the paved area in any direction, the new pavement shall not deviate from the straightedge more than 1/8-inch. Surface drainage shall be maintained. Additionally, paving must conform to the design grade and crown and contain no abrupt edges, low or high areas or any other imperfections as determined by the Engineer. Pavement construction not meeting these requirements will be repaired by grinding the existing pavement to a 1-1/2-inch depth and replacing with Level 3, 1/2-inch dense graded Asphaltic Concrete the full width at no cost to Owner.

1.6 PRE-PAVING CONFERENCE

- A. Any supervisory personnel of the Contractor and any subcontractors who are to be involved in the paving work shall meet with the Engineer, at a time mutually agreed upon, to discuss methods of accomplishing all phases of the paving work.
- B. The Contractor shall be prepared to review the size and type of equipment to be used and the anticipated rate of placement to determine equipment needs.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIAL

- A. Aggregate Base for Dense Graded Asphalt Concrete: The aggregate material shall be a clean, well-graded crushed base aggregate conforming to the Standard Specifications. Base course shall be 1-1/2-inch minus aggregate and leveling course shall be 3/4-inch minus aggregate.

2.2 ASPHALT CONCRETE PAVEMENT

A. Dense Graded Hot Mix Asphalt Concrete

1. Use Level 3, 1/2-inch-dense graded, PG 70-22 HMA. Conform to the requirements as specified in Section 00745 of the Standard Specifications. Conform to the requirements as specified in Section 00745 of the Standard Specification.
2. Asphaltic concrete pavement delivered to the site shall be accompanied by a ticket with the approved "job mix formula" number shown. Loads without tickets identifying the job mix formula will not be accepted.
3. Percent of recycled asphalt pavement used in new asphalt pavement shall not exceed 30 percent. Recycled asphalt pavement may not be used in top wearing course unless otherwise approved by the Engineer.

B. Tack Coat

In accordance with Standard Specifications. Use AR 4000, AC-20 asphalt or CSS-1 emulsified asphalt C.

C. Seal and Cover Coat

Asphalt material shall be CRS-2 cationic emulsified asphalt. Cover stone shall conform to size 1/4-inch #10 aggregate in the Standard Specifications.

D. Subgrade Geotextile

1. Dense Graded AC Mix-For subgrade separation using dense graded asphalt concrete, use subgrade geotextile with Certification Level B as specified in Section 02320 of the Standard Specifications.

E. Subgrade Stabilization

In the event that unstable materials are encountered during excavation, the additional excavation and installation of geotextile fabric and 12 inches of rock substructure will be required, as directed. Conform to the requirements as specified in Section 00331 of the Standard Specifications. For subgrade separation, use subgrade geotextile with Certification Level B as specified in Section 02320 of the Standard Specifications.

PART 3 EXECUTION

3.1 AGGREGATE PAVEMENT BASE

- A. Place pavement base to the depth shown on the plans or as specified in all cases, pavement base shall be compacted to a minimum depth of 6 inches. Bring the top of

the pavement base to a smooth, even grade at a distance below finished grade equivalent to the required pavement depth.

- B. Compact the pavement base with mechanical vibratory or impact tampers to a density of not less than 95 percent of the maximum density, as determined by AASHTO T-99.
- C. Obtain the Engineer's acceptance of the subgrade before beginning construction of the aggregate base course.
- D. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be secured, suspend operations. Place no aggregate base course in snow or in soft, muddy, or frozen subgrade.
- E. If the required compacted depth of aggregate base course exceeds 6 inches, construct in two or more lifts of approximately equal thickness. Maximum compacted thickness of any one lift shall not exceed 6 inches. Compact each layer to the specified density before a succeeding lift is placed.

3.2 ASPHALT CONCRETE PAVEMENT

- A. Construct asphalt concrete pavement in accordance with Section 00745 of the Standard Specifications.
- B. Conform to the requirements for prime coat and tack coat in the Standard Specifications. Tack coat all edges of existing pavement, manhole and clean out frames, inlet boxes, and like items. When rate is not specified, asphalt will be applied at the rate of 0.1-gallon per square yard.
- C. Obtain the Engineer's acceptance of the aggregate base course before beginning construction of the asphalt concrete wearing course.
- D. Hot mix asphalt shall be placed on dry, prepared surfaces, when air temperature in the shade of 40 degrees Fahrenheit (F) or warmer, unless otherwise authorized by the Engineer.
- E. Placing asphalt pavement during rain or other adverse weather conditions will not be permitted unless otherwise authorized by the Engineer, except that asphalt mix in transit at the time these adverse conditions occur may be placed provided it is of proper temperature, the mix has been covered during transit, and it is placed on a foundation free from mud or free-standing water.
- F. Correct any defects in material and workmanship, as directed, when determined detrimental by the Engineer. These include segregation of materials, non-uniform texture, and fouled surfaces preventing full bond between successive spreads of mixture. The corrections or replacement of defective material or workmanship shall be at the Contractor's expense.

- G. Compact the bituminous mixture to at least 92 percent of the Theoretical Maximum Density.
- H. The finished surface of each course of layer of mixture shall be of uniform texture, smooth, and free of defects and shall closely parallel that specified for the top surface finished grade. Remove and replace boils and slicks immediately with suitable materials.
- I. The surface of each layer when tested with a Contractor-furnished 10-foot straightedge shall not vary from the testing edge by more than 0.02-foot for underlying courses of pavements and 0.015-foot for finished top courses or wearing courses of pavements. At no point shall the finished top of the wearing course vary more than 0.03-foot from the specified finished grade.
- J. Lift thickness shall be as shown on the drawings or specified, but not to exceed 3 inches.
- K. Do not place asphalt concrete pavement on emulsified asphalt (tack coat) until the asphalt separates from the water (breaks) but before it loses its tackiness.
- L. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

3.3 FIELD QUALITY CONTROL

- A. Job mix will be sampled immediately behind the paving machine.
- B. Temperature of the mix will be measured immediately behind the paver.
- C. The theoretical maximum specific gravity of the bituminous mixture will be determined in accordance with ASTM D2041.
- D. Properties of the job mix will be measured using ASTM D2041.
- E. Density of the compacted job mix will be measured in accordance with ASTM D2922.

3.4 ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES

Prior to placing asphalt concrete pavement, the CONTRACTOR shall make all necessary adjustments to existing manhole frames and covers and valve box covers to ensure that the tops of the manhole covers or valve box lids are flush with the finished grade of the adjoining pavement or ground surface, and that valve boxes and PVC pipes are centered and plumb over operating nut valve.

END OF SECTION

SECTION 32 31 13 - CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes chain link steel fencing and gates as shown on the Drawings or specified elsewhere. All fences and gates shall be furnished with top rails and knuckled periphery edges.
- B. Section includes:
 - 1. Chain link fabric
 - 2. Posts
 - 3. Rails
 - 4. Tension wires
 - 5. Braces
 - 6. Fittings
 - 7. Gates
 - 8. Lock assemblies and gate stops

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Chain Link Fence Manufacturer's Institute:
 - 1. Galvanized Steel Chain Link Fence Fabric
 - 2. Industrial Steel Specifications for Fence-Posts, Gates and Accessories
- B. ASTM International (ASTM):
 - 1. A121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
 - 2. A313, Standard Specification for Stainless Steel Spring Wire
 - 3. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - 4. A491, Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
 - 5. A497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
 - 6. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 7. A780, Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

8. A824, Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence
 9. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 10. C94, Standard Specification for Ready-Mixed Concrete
 11. C150, Standard Specification for Portland Cement
 12. C387, Standard Specifications for Packaged, Dry, Combined Materials for Mortar and Concrete
 13. F552, Standard Terminology Relating to Chain Link Fencing
 14. F567, Standard Practice for Installation of Chain-Link Fence
 15. F626, Standard Specification for Fence Fittings
 16. F900, Standard Specification for Industrial and Commercial Swing Gates
 17. F1043, Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
 18. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 19. F1183, Standard Specifications for Aluminum Alloy Chain Link Fence Fabric
 20. F1184, Standard Specifications for Industrial and Commercial Horizontal Slide Gates
 21. F1916, Standard Specification for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications
- C. Conflicts in requirements shall use this Section to take precedence.

1.3 SUBMITTALS

- A. Section 01 30 00, Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 1. Product Data: Include construction details, material descriptions, dimensions of individual components, and finishes for chain link fences and gates.

2. Fence, gate posts, rails, and fittings.
 3. Chain link fabric.
 4. Gates and hardware.
- C. Manufacturer's recommended installation instructions.
- D. Evidence of Supplier and installer qualifications.

1.4 QUALITY ASSURANCE

- A. Use skilled workers thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Provide each type of steel fence and gate as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings, and fastenings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Site in undamaged condition.
- B. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fabric
1. Continuous chain link fence.
 2. Height: As shown on the Drawings.
 3. Mesh: 2-inch. All mesh shall have knuckled periphery to eliminate sharp appendages.
 4. #9-gauge steel core wire.
 5. Top and bottom selvage: Knuckled finish.
 6. Galvanized after weaving.
 7. Zinc coating shall not be less than 0.9 ounces per square foot.

8. Chain link fabric shall be black powder-coated.

B. Line Posts

Line posts shall be hot dipped galvanized 2.375-inch outside diameter hot dipped galvanized pipe, weighing 3.12 pounds per lineal foot. Posts shall be black powder-coated

C. Terminal Posts

End, corner, and pull posts shall be hot dipped galvanized pipe 2.875 inches outside diameter and weighing not less than 4.64 pounds per lineal foot. Posts shall be black powder-coated.

D. Top Rail

1. Top rail shall be hot dipped galvanized 1.660-inch outside diameter pipe, weighing 1.83 pounds per lineal foot and powder-coated in black.
2. Furnish in random lengths of approximately 20 feet.
3. Jointed using a pressed steel or malleable sleeve, not only allowing for expansion and contraction, but also providing a continuous brace from end to end of each stretch of fence.

E. Tension Wire

Bottom tension wire shall be #6-gauge heavy galvanized high carbon steel coil spring wire, securely fixed to the fabric, line posts, and terminal posts. Tension wire shall be coated in black powder coated.

F. Braces

1. All terminal posts shall be braced with 1.660-inch outside diameter horizontal pipe bracing of the same material as the top rail, securely attached to the terminal and first line post with malleable iron fittings. Braces shall be black powder-coated.
2. Braces shall be truss-braced from the first line post to the bottom of the terminal post, with a 3/8-inch galvanized truss rod assembly.
3. Corner posts shall be braced in both directions.

G. Fittings

1. Malleable, cast iron, or pressed steel.
2. Hot dip galvanized.
3. Black powder-coated

H. Fabric Ties

1. #11-gauge galvanized wire ties shall be used to tie the fabric to the line posts and rails. Tie shall be black powder-coated.

I. Chain Link Gates

1. Frames:
 - a. Made of heavy galvanized 1.90-inch outside diameter pipe, weighing 2.28 pounds per lineal foot.
 - b. Welded or assembled with corner fittings.
2. Corner fittings, ball and socket hinges, catch stops, and center rest to be heavy galvanized malleable iron.
3. Hinges as required.
4. Provide diagonal cross-bracing.

J. Gate Posts

Posts shall be hot dipped galvanized pipe 2.875-inch outside diameter weighing 4.64 pounds per lineal foot.

K. Framework Material

All posts, rails, and braces to be heavy galvanized and coated in black PVC.

L. Lock Assembly and Gate Stop

1. Provide for each gate one double-hasp drive gate drop rod lock assembly set in concrete and one gate stop set in concrete.
2. All lock assemblies and gate stops shall be fabricated from heavy galvanized malleable iron.
3. Provide one vandal-proof keyed lock and three keys for each gate assembly.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All materials and workmanship shall be first class in all respects and shall be done in a neat and workmanlike manner.

- B. Installation shall be conducted in accordance with the requirements of the Chain Link Fence Manufacturers Institute and these Drawings & Specifications.
- C. All line, terminal, gate stops, gate drop, and gate posts shall be fixed with a minimum of 3-foot embedment in concrete poured into a 1-foot diameter hole and plumb upon curing of the concrete.
- D. Line posts shall be spaced not further than 10-foot on-center.
- E. Gates shall have 3-inch clearance above ground surface and sized for the application shown.
- F. Space ties at 14 inches on center.

END OF SECTION

SECTION 32 90 00 - PLANTING

PART 1 GENERAL

1.1 SCOPE

- A. This Section includes the planting and establishment of plant materials, complete, including furnishing, delivery, planting, and maintenance of all trees, shrubs, and ground covers.
- B. Section Includes:
 - 1. Topsoil.
 - 2. Imported topsoil.
 - 3. Soil conditioners.
 - 4. Fertilizer.
 - 5. Mulch.
 - 6. Anti-desiccant.
 - 7. Fungi.
 - 8. Tree staking and guying.
 - 9. Standpipes.
 - 10. Plant materials.
 - 11. Plant guards.
 - 12. Guarantee, maintenance and warranty.

1.2 RELATED SECTIONS

- A. Section 31 05 13, Soils for Earthwork.
- B. Section 32 91 21, Finish Grading and Seeding.

1.3 SUBMITTALS

- A. The following submittals are required as part of this work:
 - 1. Proof of procurement and contract for delivery of plant material.
 - 2. Schedule for delivery of plant material for inspection prior to planting.
 - 3. Sources of plant materials, and identification tags visible for each plant.
 - 4. Color-coded tagging system for all plant material species. (Flag all plant materials prior to installation.)
- B. Maintenance Plan: Provide a proposed method and schedule for performing watering of plant material and seeded areas for the duration of the two-year guarantee and

maintenance period, or through two growing seasons. The watering contract shall provide for the following:

1. During dry spells, or generally between the months of June through October, water newly planted trees and shrubs with more frequency than established trees and shrubs. They should be watered at planting time followed by watering at the following intervals:
 - a. Daily watering during 2 weeks after planting.
 - b. Every 2-3 days watering during 3-12 weeks after planting.
 - c. Once a week watering until establishment.
2. Trees and shrub beds to receive 1 inch of water per week.
3. Seeded areas to receive 2-inches of water per week.
4. Water sufficiently to maintain soil moisture depth between 6"-8" of the finish grade.
5. Watering operations shall not cause erosion or surface runoff onto paved areas.

PART 2 MATERIALS

2.1 TOPSOIL

- A. Topsoil Type TS1, Select Native Topsoil Material, in accordance with Section 31 05 13, Soils for Earthwork.

2.2 IMPORTED TOPSOIL

- A. Topsoil Type TS2, Imported Topsoil Material, in accordance with Section 31 05 13, Soils for Earthwork.

2.3 WATER QUALITY SWALE GROWING MEDIUM

- A. Topsoil Type TS3, Water Quality Swale Growing Medium, in accordance with Section 31 05 13, Soils for Earthwork.

2.4 SOIL CONDITIONERS

- A. Organic Material
 1. Peat: A natural material formed by the decomposition of reeds, sedges, or mosses from freshwater sites. Peat shall be free from lumps, roots, or stones, and organic matter shall be not less than 90 percent on a dry weight basis.

2. Garden Compost: Compost shall be derived from plant material and provided by a member of the US composting Council Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of local providers.

The compost shall be the result of the biological degradation and transformation of plant derived materials under conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have no visible free water and produce no dust when handled. It shall meet the following criteria, as reported by the US composting Council STA Compost Technical Data Sheet provided by the vendor. It shall meet the following criteria, as reported by the US Composting Council STA Compost Technical Data Sheet provided by the vendor.

- a. 100 % of material shall pass through a ½ inch screen.
 - b. The pH of the material shall be between 5.5 min. and 8.5 max.
 - c. Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight.
 - d. Organic matter content shall be between 30 and 70% (dry weight basis)
 - e. Soluble salt content shall be less than 6.0mmhos/cm.
 - f. Carbon/Nitrogen (C/N) ration shall be less than 25:1.
 - g. Trace metals test result = "Pass"
3. Rotted Sawdust: Nitrogen stabilized, 1/4-inch minus, clean sawdust or shavings, free from weed seed, and containing no chemicals or materials harmful to plant life.
 4. Manure: Well-rotted stable or cattle manure, reasonably free from weed seed and refuse, containing no chemicals or materials harmful to plant life. Manure shall be no less than 2 months or more than 1 year old. Sawdust and shavings shall not exceed 50 percent content of manure.
 5. Mushroom Compost: Spent mushroom growing compost.

B. Sand

Clean, coarse, ungraded sand, meeting the requirements of ASTM C 33 for fine aggregate.

2.5 FERTILIZER

A. Commercial Fertilizer: A complete plant food containing 22% nitrogen, 16% phosphorous, 8% soluble potash, and a minimum 2% sulfur, conforming to applicable State fertilizer laws. Fertilizer shall be uniform in composition, dry, free-flowing, and delivered in original, unopened containers bearing manufacturer's guaranteed analysis.

B. Plant Tablets

Plant tablets shall consist of compressed urea-formaldehyde containing added phosphorous and potassium to yield a 20:10:5 ratio of N-P-K plus 1.4 percent sulfur.

2.6 GARDEN MULCH

An approved, commercially manufactured, garden mulch made from composted yard debris and amended with inorganic materials. Mulch shall be free from noxious weed seed and all chemicals or materials harmful to plant life.

2.7 ANTI-DESICCANT

A transpiration retarding material to be used where any plant material is moved during the normal growing season. Anti-desiccant may be composed of an acrylic polymer or vinyl latex compound such as Foliguard and Wiltpruf, respectively.

2.8 FUNGI

Commercially produced ectomycorrhizal and endomycorrhizal fungi that improve plant root absorption of soil nutrients.

A. Furnish mycorrhizae inoculum in granular or concentrated powder form for areas to be seeded. The product shall have an OMRI Listed™ seal from the Organic Materials Review Institute.

B. The product shall contain a minimum of the following four (4) species of Endomycorrhizae fungi: *Glomus intraradices*, *G. mosseae*, *G. aggregatum*, and *G. etunicatum*. The product shall contain a minimum of the following seven (7) species of Ectomycorrhizae fungi: *Rhizopogon villosullus*, *R. luteolus*, *R. amylopogon*, *R. fulvigleba*, *Pisolithus tinctorius*, *Scleroderma Cepa*, and *S. citrinum*.

C. The product shall be MycoApply® Endo/Endo Plus by Mycorrhizal Applications, Inc., or EcoLive™ Organics by Sunmark Environmental Services, LLC, or an approved equivalent.

2.9 TREE STAKING AND GUYING

A. Staking Materials

1. Vertical stakes shall be 2" x 2" x 8' (minimum) or 2" round X 8' sound new fir, or hemlock, free of knots and other defects.
2. Tree ties shall be placed on the tree to allow natural movement in the wind. Tree ties shall be placed to allow for two years growth of the trunk.

B. Guying Material

1. Anchors shall be 2" x 4" x 3' sound new heart cedar, or redwood or treated fir or hemlock, free of knots or other defects.
2. Wires and tree ties shall be same as for staking with additional galvanized turnbuckle, centered in wire line with white industrial rubber hose, or manufactured product specific for this use.

2.10 STANDPIPES

Standpipes to facilitate watering large trees (over 10' in height) shall be heavy-duty ADS plastic, 4" in diameter and a minimum of 2' long. Fill with 1" minus, 3/8" plus, washed gravel.

2.11 PLANT MATERIALS

- A. The Plant List is shown on the Drawings. Names of some species and varieties not included therein conform to names generally accepted in the native grown nursery trade. Information on sources for native plant material species can be obtained through the publication titled "Hortus Northwest."
- B. Nursery grown plant material shall be grown with a quality and habit of growth that is sound, healthy, vigorous, and free from insects, diseases, and injuries. Size shall be equal to or exceeding measurements indicated in the Plant List and measured before pruning with branches in normal position. Sizes and methods for handling shall be according to the American Standard for Nursery Stock recommended by the AAN.
- C. Trees: Balled and burlapped trees shall be of height and caliper shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Single stem trees shall be provided except where special forms are shown or listed. Container grown trees are subject to AAN specifications for container grown stock.
- D. Shrubs: Shrubs shall be of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrubs and vines required. Shrubs are balled and burlapped (B&B) or container grown.

- E. Ground cover shall be plants established and well rooted in removable containers, and with not less than a minimum number of and length of runners required by ANSI Z60.1 for the pot size indicated on the drawings.

2.12 PLANT GUARDS

Provide animal browse guards for all shrub and tree planting. Protective guards may be flexible plastic mesh, spirals or wire cages with stake fasteners. Submit proposed product or methodology for review prior to installation.

PART 3 EXECUTION

3.1 INSPECTIONS AND REPORTS

All plant materials shall be inspected prior to installation. Notify the ENGINEER 10 days prior to delivery date for inspection at the site. Each individual species shall bear a tag indicating species and source. Material not inspected prior to planting will be rejected at the ENGINEER's sole discretion.

3.2 TIME OF PLANTING

Conduct planting operations under favorable weather conditions during seasons which are normal for such work, generally during the periods of April 1 to June 1, and from September 1 to November 1. Planting operations outside these time periods may be conducted with approval of the Landscape Architect.

3.3 EXAMINATION

- A. Examine the site for conditions that might adversely affect execution, performance, quality of the Work, and survival of plantings.
- B. Take field measurements of landscape areas to determine if differences exist between plans and actual ground dimensions. Notify ENGINEER prior to proceeding with Work.
- C. Verify that grades and slopes of landscaped areas insure positive drainage and that they are acceptable to ENGINEER prior to commencing Work.

3.4 DELIVERY

Supply plants designated B&B (balled and burlapped) in the Plant List with firm, natural balls of earth, or diameter and depth sufficient to encompass the fibrous and feeding root system necessary for vital plant growth. Rootball shall be firmly wrapped with burlap and bound with twine, cord or wire mesh. Manufactured rootballs or rootballs less than the diameter indicated the for the caliper or size of plant material (American Standard for Nursery Stock) will be rejected.

Furnish plants designated CG or “gallon” (container grown) in the Plant List with self-established root systems sufficient to hold earth together after removal from the container but not root-bound, in a container of specified size.

3.5 PROTECTION DURING DELIVERY

A. Small Plant Material

1. If plants are not in a dormant state, spray with anti-desiccant to cover foliage as recommended by manufacturer. During shipment, protect plants with a tarpaulin or other covering to prevent excessive drying from sun and wind.
2. Cover balls of B&B plants and containers of CG plants which cannot be planted immediately upon delivery with moist mulch to protect from drying.

B. Trees

Spray trees with anti-desiccant immediately prior to digging. Protect the top of the tree by wrapping with burlap. Pad all parts of the tree to be cabled or roped. Keep soil balls and exposed roots moist during all digging and transporting operations.

Transport trees during favorable weather conditions. Trees damaged by exposure during transport will be rejected at the site. Damaged trees, as a result of improper or haphazard moving or planting techniques, will be rejected. Right of rejection shall be at the sole discretion of the ENGINEER.

3.6 LOCATION OF PLANTS

- A. Locate new planting where shown on the Drawings except where obstructions below ground are encountered or where changes have been made in the construction. Review necessary adjustments with the ENGINEER and begin planting only after approval from the ENGINEER.
- B. All plant material species to be flagged prior to planting, (see Part 1, paragraph 1.03, item 4.)
- C. Plant trees in locations shown. Plant shrubs and ground cover plants in random patterns within designated areas with the quantities indicated in the plant list.

3.7 PLANTING PROCEDURES

- A. Planting Soil Mix: Prepare planting soil mix for plant pits and beds using stockpiled or imported topsoil, soil conditioners, and fertilizer. Thoroughly mix in the following proportions with rotary mixer or other method. Store and protect mixture from excessive leaching by covering with tarpaulin.

<u>Material</u>	<u>Parts by Volume</u>
Topsoil	2
Sand	1
Organic Material	1

B. Plant Pits: Excavate circular pits with vertical sides for all plants as shown in the details. Dispose of excavated subsoil. The diameter of the pits shall be a minimum of twice the diameter of the rootball. Compact planting soil mix at the bottom of plant pit.

C. Setting Small Plants

Remove the top 2/3 of burlap and all twine or cord from the top and sides of balled and burlapped plant material. Cut containers or water and lift plant material out of containers. Set base of all plants 2 inches above finish grade and backfill with planting soil mix and water to fill voids. When hole is 2/3 filled place planting tablets evenly around ball, (see below.) Form a shallow saucer around plant at the edge of the pit.

D. Setting Evergreen Trees

1. Prepare pits to receive trees prior to digging trees in situ. Break up side surfaces of tree pits with a pick or spade. Do not disturb the bottom of pit to ensure a solid base of support for the tree.
2. Lower tree into hole and stabilize in three locations before watering and backfilling with planting soil mix. All trees shall be properly aligned to be vertical after lowering rootball into hole. Take care when moving soil ball to avoid cracking and damaging roots.
3. Install standpipes for all trees over 10' in height as shown on the drawings. Backfill tree pit with planting soil mix. Use hand shovels and work soil into the hole, watering to ensure all air pockets are eliminated. Tamp backfill after the tree pit is 1/2 full to stabilize the lower half of the rootball. Place plant tablets as indicated below.
4. Do not plant trees deeper than the level at which they originally grew. Do not plant in frozen ground or in freezing weather. All trees shall be planted in an upright, vertical position. Lopsided trees will be rejected.

E. Planting Tablets: Planting tablets shall be placed evenly in the following indicated quantities:

4" pots	one 5 gram tablet
1 CG Shrub	one 10 gram tablet
5 CG Shrub/tree	three 10 gram tablets
Evergreen Trees	three 21 gram tablets

- F. Install tree staking and guying as shown in the details. Submit alternative staking and guying products for review prior to installation.
- G. Mulching: Mulch all tree pits and shrub layer areas with a 3-inch layer of garden mulch within 2 days of planting. Mulch to entirely cover area around saucer of trees.

3.8 GUARANTEE

- A. Guarantee all trees, shrubs, and seeded areas for a minimum of 2 years to be alive and in vigorous growing condition at the end of the guarantee period or through two growing seasons.
- B. Perform plant replacements and reseeding operations at the first opportunity during a season favorable for planting as defined herein and in Section 32 91 21, Finish Grading and Seeding.
- C. Plant Materials:
 - 1. Remove and replace any unsatisfactory plants and replace with plants of the same kind, quality and size as specified in the Plant List.
 - 2. Furnish and plant replacements as specified herein.
 - 3. Replacements shall be at the Contractor's sole expense.
- D. Seeded Areas:
 - 1. Repair any damage to seeded areas by filling with topsoil, fertilizing, and seeding as specified. Reseed as specified under Section 32 91 21, Finish Grading and Seeding.
 - 2. Reseeding shall be at the Contractor's sole expense.

3.9 MAINTENANCE

- A. The Contractor is responsible for watering all plant material and seeded areas for two years. Watering may be accomplished by installation of a temporary irrigation system.
 - 1. Note water service and backflow prevention device provided for Contractor's use in developing a temporary irrigation system.
- B. Perform the following maintenance operations during the two-year guarantee period:
 - 1. Water as often as required to meet the requirements of the watering contract as stated above.
 - 2. Remove all noxious weeds from plant beds and saucers by hand.

3. Mulch to maintain 3-inch garden mulch depth.
 4. Reset plants to finish grade and restoration of plant saucers, as necessary
 5. Repair damaged or washed out erosion control seeding.
- C. Report any problems that may be a hindrance to completing and fulfilling the conditions of the plant guarantee within 7 days to the Owner.

3.10 INSPECTIONS

- A. Start of the Maintenance and Guarantee Period:
1. Notify the Engineer two weeks in advance of anticipated substantial completion of planting and seeding operations.
 2. Observations will be performed prior to the start of the formal guarantee and maintenance period.
- B. Quarterly Inspections:
1. The Owner will make quarterly inspections of the site for compliance with the maintenance requirements.
 2. Unsatisfactory conditions will be noted and forwarded in writing to the Contractor for correction. Respond and/or provide remedy for unsatisfactory conditions within two weeks of Owner notification.
- C. Final Acceptance:
1. Notify the Owner within 15 days of the date for final inspection.
 2. Before final acceptance, the terms of the plant/seeding guarantee must be met.
 3. The duration of the guarantee and maintenance periods may be extended in order that the Contractor may fulfill obligations required under the guarantee.

END OF SECTION

SECTION 32 91 21 - FINISH GRADING AND SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil Preparation
2. Weed control
3. Fertilizing
4. Seeding
5. Mulching
6. Hydroseeding
7. Hydromulching
8. Erosion Control Blanket
9. Maintenance and Establishment Period

B. Related Sections:

1. Section 31 22 13 - Rough Grading
2. Section 31 23 17 - Trenching
3. Section 32 05 13 - Soils for Exterior Improvements
4. Section 32 83 00 – Planting
5. Section 32 84 00 - Irrigation

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
2. 7 USC 1551-1611 - Federal Seed Act.

1.3 DEFINITIONS

- A. Certified Seed: A grass or legume seed named variety that has been reviewed and accepted into the State Certified Seed program. Currently certified seed is individually sold in bags with a Certification Tag.
- B. Pure Live Seed (PLS): Is a measure used to describe the percentage of a quantity of seed that will germinate. PLS is obtained by multiplying the purity percentage by the percentage of total viable seed, then dividing by 100.

- C. Establishment Period: A period when planting work has been performed and initially accepted, and there is a contract requirement to care for the planted areas in some way until the period ends.
- D. Sensitive Areas: Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.
- E. Weeds: Vegetative species other than specified species to be established in given area.
- F. Weed Control: Removal and prevent regrowth of specified weeds, weed parts, and weed seeds from area within the project limit.

1.4 SUBMITTALS

- A. Product Data: Submit data for seed mix, mulch, tackifier, erosion control blanket, soil amendment materials, pesticides, herbicides, and other accessories. The product should meet or exceeds all product requirements specified herein.
- B. Grass Seeds Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 - 1. Certification of seed analysis, germination rate, and inoculation. Include the year of production and date of packaging. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing within 12 months of delivery date. Also include:
 - a. Name and address of laboratory
 - b. Date of test
 - c. Lot number for each seed certified
 - d. Test Results: Name, percentages of purity and of germination, and weed content for each seed mix.
- C. Operation and Maintenance Data: Include maintenance instructions and weed control.

1.5 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.
- B. Pesticide shall not be used in this project.

1.6 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum 3 years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 2 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Deliver tackifier sealed containers showing weight, chemical analysis, and name of manufacturer.

1.8 MAINTENANCE SERVICE

- A. Maintain seeded areas immediately after placement for 12 months from Date of Substantial Completion. Grass shall be well established and exhibits vigorous growing condition.

PART 2 PRODUCTS

2.1 SEED MIXTURE

- A. Suppliers:
 - 1. Sunmark Seeds, Portland, OR
 - 2. PT Lawn Seed, Portland, OR
 - 3. NaturesSeed.com
 - 4. Approved Equal
- B. Seed Mixes: The following are the functional categories of seed mixes that may be included on projects (a category may have multiple functions on a project site):
 - 1. **Temporary Seeding** - To provide short-term erosion control of disturbed soils and slopes that are not at finished grade and which will be exposed for 2 months or longer before being disturbed again, until permanent seeding is performed, or all potential for erosion is removed.
 - 2. **Permanent Seeding** - The final seeding or only seeding performed for erosion control.

3. **Lawn Seeding** - Seeding for areas where finished turf appearance is desired.
4. **Wildflower Seeding** - Seeding to develop growth of wildflowers. The seed mix will typically contain grass or other plant seed to provide erosion control.
5. **Plant Seeding** - Seeding which typically includes more than just grass species, such as seeds of woody or herbaceous plants.
6. **Water Quality Seeding** - For use in water quality facilities such as swales or settling basins.
7. **Wetland Seeding** - To vegetate existing or constructed wetlands.
8. **Native Plant Seeding** - Seeding to restore native vegetation.

C. Types of Seed Mixes: Seed mixes, quantities, standards, and other information

1. **Erosion Control Seed Mix 1:** Easy to establish, maintain, and drought-tolerant NW native grasses for erosion protection. Suitable for dry areas with minimum or no irrigation

Botanical Name	Common Name	PLS Lbs. per Acre
<i>Elymus glaucus</i>	Blue Wildrye	21.9
<i>Festuca rubra rubra</i>	Native Red Fescue	13.1
<i>Bromus carinatus</i>	California Brome	4.4
<i>Agrostis exarata</i>	Spike Bentgrass	4.4
TOTALS:		43.71

2. **Erosion Control Seed Mix 2:** Fast establishment NW native erosion control grass mix, low growing with good root masses for reduced erosion of soils. Mychorrhize may be added to enhance root system growth. Less than 24 inches in height with shade and drought tolerance. May work on wet and dry sites.

Botanical Name	Common Name	PLS Lbs. Per Acre
<i>Hordeum brachyantherum</i>	Meadow Barley	17.45
<i>Bromus carinatus</i>	California Brome	15.27
<i>Festuca rubra rubra</i>	Native Red Fescue	8.73
<i>Deschampsia cespitosa</i>	Tufted Hairgrass	1.31
<i>Agrostis exarata</i>	Spike Bentgrass	0.87
TOTALS:		43.63

3. **Erosion Control Seed Mix 3:** NW Native seed mix with low/no maintenance. It has a high percentage of wildflowers and legumes which provide excellent nitrogen fixation. It is drought tolerant low-growing native grasses and low-growing wildflowers.

Botanical Name	Common Name	PLS Lbs. Per Acre
Bromus carinatus	California Brome	16.26
Lupinus albaculus	Sicklekeel Lupine	16.26
Elymus elymoides	Squirreltail	12.36
Gailardia aristata	Blanketflower	7.8
Lotuspurshianus	Spanish Clover	5.2
Festuca occidentalis	Western Fescue	2.6
Eschscholzia californica	California Poppy	2.6
Koeleria macrantha	Prairie Junegrass	0.98
Clarkia unguiculata	Elegant Clarkia	0.65
Achillea millefolium	Common Yarrow	0.33
TOTALS:		65.04

4. **Swale Seed Mix:** NW Native species that establish quickly and provide phytoremediation of stormwater.

Botanical Name	Common Name	PLS Lbs. per Ac
Elymus glaucus	Blue Wildrye	21.74
Festuca rubra rubra	Native Red Fescue	6.52
Hordeum brachyantherum	Meadow Barley	4.35
Glyceria occidentallis	Northwestern Mannagrass	4.35
Beckmannia syzigachne	American Sloughgrass	4.35
Deschampsia caespitosa	Tufted Hairgrass	2.17
TOTAL:		43.48

5. **Water Quality Seed Mix:** Water quality facilities NW Native bio-filtration seed mix, salmon-friendly, will perform well in the bottom of drainage swales, storm water retention ponds, and bio-filtration swales. This mixture will range from the continuously wet lowlands, up into the riparian zone, offering erosion control and habitat development.

Botanical Name	Common Name	PLS Lbs. per Acre
<i>Elymus glaucus</i>	Blue Wildrye	20
<i>Festuca rubra rubra</i>	Native Red Fescue	16.5
<i>Deschampsia caespitosa</i>	Tufted Hairgrass	5.2
<i>Glyceria occidentalis</i>	Western Mannagrass	0.9
<i>Beckmania syzigachne</i>	American Sloughgrass	0.9
TOTALS:		43.38

6. **Roadside Seed Mix:** Erosion control mix for vegetation along roadsides. It is also salt tolerant.

Botanical Name	Common Name	PLS Lbs. per Acre
<i>Hordeum vulgare</i> var Poco	Poco Barley	52.24
<i>Hordeum brachyantherum</i>	Meadow Barley	36.57
<i>Bromus carinatus</i>	California Brome	23.51
<i>Festuca idahoensis romerii</i>	Roemer's Fescue	7.18
<i>Trifolium fragiferum</i>	Strawberry Clover	5.22
<i>Clarkia amonea</i>	Farewell to Spring	1.96
<i>Oenothera elata hookeri</i>	Hooker's Evening Primrose	1.96
<i>Deschampsia cespitosa</i>	Tufted Hairgrass	1.31
<i>Agrostis exarata</i>	Spike Bentgrass	0.65
TOTALS:		130.6

7. **Wildflowers/Grasses Seed Mix:** Low growing grass, wildflower, and ground cover mix with drought tolerant, soil stabilization, and aesthetically colors.

Botanical Name	Common Name	PLS Lbs. per Acre
<i>Festuca brevipila</i>	Spartan II Hard Fescue	34.4
<i>Festuca ovina</i> var covar	Covar Sheep Fescue	12.9
<i>Dalea purpurea</i>	Purple Prairie Clover	12.9
<i>Centaurea cyanus</i> , dwarf	Dwarf Bachelor Buttons	10.3
<i>Poa sandbergii</i>	Sandberg Bluegrass	5.2
<i>Nemophila menziesii</i>	Baby Blue Eyes	4.3
<i>Trifolium repens</i>	White Clover	1.7

Lobularia maritimum	Sweet Alyssum	1.7
Sphaeralcea coccinea	Scarlet Globemallow	1.7
Achillea millefolium	Common Yarrow	0.86
TOTALS:		86.12

2.2 ACCESSORIES

- A. Straw Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Wood and Bark Mulching Material: Chipped wood and bark, sawdust, and ground wood mulch should be free of growth or germination inhibiting ingredients.
- C. Compost: Commercially manufactured fine and medium compost materials.
- D. Tackifier: Commercial tackifier containing no agent toxic to plant life and exhibits no growth or germination inhibiting factors at one of the following forms:
 - 1. Liquid Stabilizer Emulsion - Tackifier with a base material of liquid containing not less than 55 percent total solids by weight. It should allow exchange of air and moisture to the seeds and have an effective life of 1 year or more.
 - 2. Dry Powder Tackifier - Tackifier base consisting of one or more active hydrocolloids from natural plant sources, which hydrates in water and blends with other slurry materials, and upon application tacks the slurry particles to the Soil surface.
- E. Fertilizer: Commercial grade; recommended for grass to eliminate deficiencies of topsoil and suitable for application with equipment designed for that purpose.
 - 1. Deliver fertilizers in separate or mixture containers that have the percentage of total nitrogen, available phosphoric acid, and water-soluble potash (NPK) in the amounts specified. Label each container with a quality compliance certificate.
 - 2. Application rate shall be determined by the soil conditions, as indicated in analysis to determine the proportions of Nitrogen percent, phosphoric acid percent, soluble potash percent.
- F. Lime: ASTM C602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- G. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.
- H. Erosion Control Blanket shall be open, flexible, and dimensionally stable network of fully-biodegradable, bonded, interlocking fibers. The blanket shall have a functional

longevity of up to 12 months. Blanket fibers shall be turf green color or natural wood/straw color.

- I. Pesticides/Herbicide: Submit proposed pesticides and receive approval before using. Submit a copy of the manufacturer's federal registered label and, if requested, a Material Safety Data Sheet. The Agency reserves the right to restrict chemicals from being used on sensitive areas.
 1. Pesticide registered and approved by the Environmental Protection Agency (EPA), acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application.
 2. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
 3. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the erosion control layer.
 4. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.3 SOURCE QUALITY CONTROL

- A. Analyze soil to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of soil testing.
- C. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Planting Season: Plant seeds when growing conditions are conducive to seed germination and quick but thorough establishment of seedlings.

1. Depending on latitude and elevation in the Pacific Northwest, these conditions occur either in mid-August through early October or mid-April to late May.
 2. Avoid planting seed during the heat of summer or in late fall to avoid freezes that kill sprouting grass seeds.
- C. Weed Control Coordinator - Submit certification at the preconstruction conference that the weed control coordinator meets the following minimum requirements:
1. Demonstrates ability to identify noxious and other weed species commonly seen in site location for at least 1 year conducting weed surveys.
 2. Has successful weed control experience, with similar duties to those stated under typical duties below, on at least three construction or vegetation management projects. Certification of Pesticide Consultant License is preferred.
 3. The weed control coordinator duties include:
 - a. Identify Specified Weeds.
 - b. Prepare and update the Weed Control Program.
 - c. Coordinate Contractor's weed removal Work and records.
 - d. Ensures the removed weeds are disposed of at an approved off-site facility.
- D. Pesticide Applicator - Submit certification before application of pesticide Work begins, that when chemical weed control is used, that each applicator possesses a Commercial Pesticide Applicator's License held in the individual's name. Submit a certification each time a new applicator begins application Work on the Project.
- E. Conduct soil analysis to determine soil fertility. The soil test should at least analyze the current nitrogen, phosphorus, potassium, and PH rates in the soil. Accordingly, the soil test result would suggest the proper soil amendment application including the rates of fertilizers and lime. Obtain the Engineer approval before applying soil amendment.
- F. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 2. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
 3. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3.2 SOIL PREPARATION

- A. Prepare area for seeding while generally considering the following:
 - 1. Remove any matter detrimental or toxic to the growth of plants, including weeds, clods, rocks, or debris.
 - 2. Application rates of fertilizer or lime shall be based on soil testing results.
 - 3. Prepare a tilled, fine, but firm seedbed.
 - 4. The soil shall have a pH range of 5.5 to 8.0.
- B. Refer to Section 32.93.00 Planting, for area preparation for the following kind of seeding:
 - 1. Temporary Seeding - Method E
 - 2. Permanent Seeding - Method D
 - 3. Water Quality Seeding - Method B
 - 4. Wetland Seeding - Method B
 - 5. Lawn Seeding - Method C

3.3 WEED CONTROL

- A. Do not harm or disturb any vegetation that was planted as proposed on the planting plans. Do not compact soil with heavy equipment.
- B. Inspect the Project for new growth of specified weeds at least monthly during the plants growing season and apply weed control measures as appropriate.
 - 1. Inspect the area at least every 30 days after growing season has begun or as directed for continuing control of all vegetation considered as weeds.
 - 2. Provide schedule of weed control measures.
 - 3. Request to use wheeled or tracked construction equipment in sensitive areas.
- C. Remove and control weeds according to the following:
 - 1. Verify the weed control methods before proceeding with weed control activities.
 - 2. Remove all specified weeds and ensure that weed seeds or reproducing plant parts such as vines, runners, or rhizomes do not remain or become disbursed during control activities.
 - 3. Place weeds and related materials in an approved container and transport to an approved offsite disposal facility according to applicable laws and regulations.

4. Keep the site weed free including weeds not initially documented.
- D. Weed Control at Sensitive Areas - as determined by The Engineer:
1. Use only hand or light mechanical weed control methods within 50 feet of sensitive areas.
 2. Hand methods include the use of hand tools. Light mechanical methods include the use of hand carried, motorized machinery.
- E. Weed Control Corrective Work - If corrective work for areas identified as deficient by the Engineer, it should be completed within a 15 Calendar Day period,

3.4 SEEDING

- A. Apply Seed mix at manufacturer recommended rate or as directed in areas shown in the Drawings.

3.5 HYDROSEEDING & HYDROMULCHING

- A. Mix seeds, fertilizers, mulch, and tackifier with water in specific tank as follows:
1. Hydraulic Equipment should continuously mix and agitates the slurry providing a continuous, non-fluctuating delivery.
 2. Provide a uniform distribution of the slurry.
 3. Place seed, fertilizer, mulch, and tackifier in the hydroseeder tank no more than 30 minutes prior to application.
- B. Hydroseeding operation: Perform hydroseeding according to the following:
1. One-Step Operation - Apply materials in one step only for the following situations:
 - a. When seeding in conjunction with erosion control matting. Apply seed, fertilizer, and tracer before installing matting.
 - b. When treating small areas that are 1,500 square feet or less and totaling no more than 0.5 acre, double the amount of seed to compensate for seed suspended above Soil by the mulch.
 2. Two-Step Operation – for areas over 0.5 acre, use the two-step method for all hydroseeding/hydromulching operations:
 - a. Step 1 - Apply seed, fertilizer, and tracer.
 - b. Step 2 - Apply mulch and tackifier.

- C. Seed -Thoroughly mix seeds when more than one kind is to be used.
- D. Mulch - Apply at the following rates based on dry fiber weight:
 - 1. Slopes Flatter Than 1V:2H - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.
 - 2. Slopes 1V:2H or Steeper - Apply cellulose fiber that includes a tackifier at a rate of 3,000 pounds per acre.
- E. Tackifier for Cellulose Fiber Applications – apply dry tackifier to water tank at the following rates unless the manufacture recommends a greater rate of application:
 - 1. Slopes Flatter Than 1V:2H - 60 pounds per acre mixed with hydromulch fibers at the rate specified.
 - 2. Slopes of 1V:2H or Steeper - 100 pounds per acre mixed with hydromulch fibers at the rate specified.

3.6 MECHANICAL SEEDING

- A. Seeding, fertilizing, and covering: The following may be used to stabilize small disturbed areas that are 1,500 square feet or less and totaling no more than 0.5 acre:
 - 1. Seeds and fertilizer - Seed the disturbed area with the seed mix at the specified rate by mechanical spreader.
 - 2. Cover - Cover seeded areas with one of the following:
 - a. Straw mulch at a rate of 100 pounds per 1,000 square feet. Spread the mulch uniformly approximately 2 inches deep, in loose condition, which requires roughly 2-1/2 tons per acre of dry mulch. Do not use straw mulch on slopes of 1V:1.5H or steeper.
 - b. Bark mulch spread uniformly at an approximate depth of 1/2-inch. Use well-decomposed mulch for seed mulching. Do not use bark mulch on slopes of 1V:1.5H or steeper.
 - c. Suitable open-weave, biodegradable erosion control matting installed according to manufacturer's instructions.

3.7 SEEDING OVER MULCHED AREAS

- A. If an area has been previously mulched for erosion control or temporary seed and mulch is present on the soil surface, double the pound rate for each seed type used. Apply seed and fertilizer hydraulically or mechanically and add a green dye to the

mixture to visibly aid uniform application. Upon approval, fertilizer and seed may only be applied after mulching if one of the following conditions apply:

1. Mulch is punched into the soil by mechanized means. Avoid heavy equipment that may compact the soil. Roll seeded area with roller not exceeding 112 pounds/linear foot.
2. Mulch that is held down with netting or like material
3. Mulch is removed prior to seeding.

3.8 WORK QUALITY

- A. After application, apply water with fine spray immediately after each area has been hydroseeded. Apply water with fine spray immediately after each area has been mulched.
- B. Drift - Prevent drift and displacement of seed and fertilizer regardless of equipment and methods used.
- C. Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto other areas where grass is detrimental. Remove material that falls on plants, roadways, gravel shoulders, structures, and other surfaces where material is not specified.
- D. Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace all material that becomes displaced before acceptance of the work.

3.9 MAINTENANCE

- A. Control growth of weeds. Remedy damage resulting from improper use of herbicides.
- B. Weed Control - Remove specified weeds prior to plants going to seed and keep weed control and seeded areas "Weed Free" throughout the Establishment Period.
- C. Immediately reseed areas showing bare spots.
- D. Repair washouts or gullies.
- E. Protect seeded areas with warning signs during maintenance period.
- F. Ensure that each seeded area has a uniform, healthy and weed-free stand of grass or other seeded plants growing at the end of the Establishment Period. The minimum

living plant coverage standards for acceptance of seeding in a planted area are as follows:

1. Temporary Seeding:
 - a. West of the Cascades - 70 percent coverage of ground surface.
 - b. East of the Cascades - 30 percent coverage of ground surface.
 2. Permanent Seeding:
 - a. West of the Cascades - 90 percent coverage of ground surface.
 - b. East of the Cascades - 30 percent coverage of ground surface.
 3. Wetland Seeding - 70 percent coverage of ground surface.
 4. Water Quality Seeding - 100 percent of ground surface.
- G. Protection - Protect seeded areas from trespass and other hazards of damage. Use protective fences and signs at no additional cost to the Agency. Obtain approval of protective methods used.
- H. Fertilizing and Watering - Apply fertilizer according to grass and soil requirements. Apply water according to good horticultural practice under the prevailing conditions, as required to promote a healthy stand of plants. Obtain water at no additional cost to the Agency.
- I. Mowing – If mowing is required, do the first mowing of grass when soil is firm enough to prevent rutting and grass is about 3 inches tall. After mowing, leave grass that is approximately 2 inches tall. At each subsequent mowing, leave about 1-1/2 inches of growth. After the second mowing, grass clippings may be left in place upon written approval.
- J. Repair and Restore - Repair and restore soil grades and re-seed damaged, settled, or unproductive areas to the specified conditions of this Section at no additional cost to the Agency.
- K. Finishing and Cleaning Up Cleanup - Remove weeds, trash, debris, stones, and other extraneous matter from seeded areas as directed and dispose of.

END OF SECTION

SECTION 33 01 30.13 - SEWER AND MANHOLE TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes methods for testing of gravity sewer piping, pressure sewer piping, and manholes.
- B. Section includes:
 - 1. Testing of Gravity Sewer Piping:
 - a. Low pressure air testing
 - 2. Testing of pressure piping
 - 3. Deflection testing of plastic sewer piping
 - 4. Testing of Manholes:
 - a. Vacuum testing
 - b. Exfiltration testing

1.2 RELATED SECTIONS

- A. Section 33 05 13 - Manholes
- B. Section 33 13 00 - Testing and Disinfection of Water Utility Piping
- C. Section 33 41 10 - Storm Utility Drainage Piping

1.3 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
 - 2. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- B. American Water Works Association (AWWA):
 - 1. AWWA C600 - Installation of Ductile Iron Mains and Their Appurtenances
 - 2. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Submit following items prior to start of testing:
 - 1. Testing procedures
 - 2. List of test equipment
 - 3. Testing sequence schedule
 - 4. Provisions for disposal of flushing and test water
 - 5. Certification of test gage calibration
 - 6. Deflection mandrel drawings and calculations
- C. Test and Evaluation Reports: Indicate results of manhole and piping tests.

PART 2 PRODUCTS

2.1 VACUUM TESTING

- A. Equipment:
 - 1. Vacuum pump
 - 2. Vacuum line
 - 3. Vacuum Tester Base:
 - a. Compression band seal
 - b. Outlet port
 - 4. Shutoff valve
 - 5. Stopwatch
 - 6. Plugs
 - 7. Vacuum Gage: Calibrated to 0.1-inch hectogram (Hg) (0.34 kilopascal (kPa)).

2.2 EXFILTRATION TESTING

- A. Equipment:
 - 1. Plugs
 - 2. Pump
 - 3. Measuring device

2.3 AIR TESTING

A. Equipment:

1. Air compressor
2. Air supply line
3. Shutoff valves
4. Pressure regulator
5. Pressure relief valve
6. Stopwatch
7. Plugs
8. Pressure Gage: Calibrated to 0.1 pounds per square inch (psi)

2.4 HYDROSTATIC TESTING

A. Equipment:

1. Hydro pump
2. Pressure hose
3. Water meter
4. Test connections
5. Pressure relief valve
6. Pressure Gage: Calibrated to 0.1 psi

2.5 DEFLECTION TESTING

A. Equipment:

1. "Go, no go" mandrels
2. Pull/retrieval ropes

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify manholes and piping are ready for testing.
- B. Verify trenches are backfilled.
- C. Verify pressure piping thrust restraint system is installed, as may be required.

3.2 PREPARATION

A. Obstructions:

1. After backfilling and restoration of surfaces, gravity pipelines shall be inspected for obstructions and shall be cleaned.

2. Pipes less than 24 inches in diameter shall be cleaned using the sewer ball method.
3. Lines larger than 36 inches in diameter may be cleaned by flushing as long as they are first visually inspected to assure that no physical obstructions exist.
 - a. Flushing shall be such that velocities are at least 2-1/2 feet per second.

B. Lamping:

1. Lamp gravity piping after flushing and cleaning of lines, checking manholes for unfinished work.
2. Perform lamping operation by shining light at one end of each pipe section between manholes.
3. Observe light at the other end.
4. Pipe not installed with uniform line and grade will be rejected.
5. Remove and reinstall rejected pipe sections.
6. Reclean and lamp until pipe section is installed to uniform line and grade.

C. Plugs:

1. Plug outlets, wye branches, and laterals.
2. Brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

A. Testing of Gravity Sewer Piping:

1. Low Pressure Air Testing:
 - a. Test each reach of gravity sewer piping between manholes.
 - b. Introduce air pressure slowly to approximately 4 pound-force per square inch gauge (psig).
 - 1) Determine ground water elevation above spring line of piping.
 - 2) For every foot of ground water above spring line of piping, increase starting air test pressure by approximately 0.4 psi.
 - 3) Do not increase pressure above 10 psig.
 - c. Allow pressure to stabilize for at least 5 minutes.

- d. Adjust pressure to 3-1/2 psig or to increased test pressure as determined above when ground water is present.
- e. Testing:
 - 1) Determine test duration for reach of sewer with single pipe size from following table; do not make allowance for laterals.

**Table 33 01 30.13 -1
Air Testing Duration for Gravity Sewer Piping**

NOMINAL PIPE SIZE, INCHES	MINIMUM TESTING TIME, MIN/100 FEET
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

- 2) Record drop in pressure during testing period.
- 3) If air pressure drops more than 1.0 psi during testing period, piping has failed.
- 4) If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
- 5) If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.

B. Testing of Pressure Piping:

- 1. Test system according to AWWA C600 and the requirements of Section 33 13 00, Testing and Disinfection of Water Utility Piping.

C. Deflection Testing of Plastic Sewer Piping:

1. Perform vertical ring deflection testing on PVC and acrylonitrile butadiene styrene (ABS) sewer piping after backfilling has been in place for at least 30 days but not longer than 12 months.
2. Allowable maximum deflection for installed plastic sewer pipe is no greater than 5 percent of original vertical internal diameter.
3. Perform deflection testing using properly sized rigid ball or "go, no go" mandrel.
4. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe, as determined by ASTM standard to which pipe is manufactured; measure pipe diameter in compliance with ASTM D2122.
5. Perform testing without mechanical pulling devices.
6. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

D. Testing of Manholes:

1. Description:

- a. Option of air testing or exfiltration testing.
- b. If air testing, test whenever possible prior to backfilling in order to more easily locate leaks.
- c. Repair both outside and inside of joint to ensure permanent seal.
- d. Test manholes with manhole frame set in place.

2. Vacuum test according to ASTM C1244 and following:

- a. Plug pipe openings; securely brace plugs and pipe.
- b. Inflate compression band to create seal between vacuum base and structure.
- c. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10-inch Hg.
- d. Close valve.
- e. Testing:

- 1) Determine manhole testing duration using following table:

MANHOLE DIAMETER (feet)	TEST PERIOD
4	60 seconds
5	75 seconds
6	90 seconds

- 2) Record vacuum drop during test period.
 - 3) If vacuum drop is greater than 1-inch Hg during testing period, repair and retest manhole.
 - 4) If vacuum drop of 1-inch Hg does not occur during test period, manhole is acceptable; discontinue testing.
 - 5) If vacuum test fails to meet 1-inch Hg drop-in specified time after repair, repair and retest manhole.
3. Exfiltration Testing:
- a. Plug pipes in manhole.
 - b. Remove water from manhole.
 - c. Observe plugs over period of not less than two hours to ensure that there is no leakage into manhole.
 - d. Determine ground water level outside manhole.
 - e. Fill manhole with water to its rim at the start of the test.
 - f. Prior to testing, allow manhole to soak from minimum of 4 hours to maximum of 72 hours.
 - g. After soak period, adjust water level to rim of manhole.
 - h. Leakage in the manhole shall not exceed 0.2 gallons per foot of head above the highest invert after a one-hour test period.
4. If unsatisfactory testing results are achieved, repair manhole and retest until result meets criteria.
 5. Repair visible leaks regardless of quantity of leakage.

END OF SECTION

SECTION 33 05 13 - MANHOLES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes cast-in-place and precast concrete manholes and covers for access to subsurface drainage piping or utilities.
- B. Section Includes:
 - 1. Cast-in-place concrete manholes with transition to cover frame, covers, anchorage, and accessories.
 - 2. Modular precast concrete manhole with tongue-and-groove joints with precast transition to cover frame, covers, anchorage, and accessories.
 - 3. Bedding and cover materials.

1.2 RELATED SECTIONS

- A. Section 03 11 00 - Concrete Work
- B. Section 03 21 00 - Reinforcing Steel
- C. Section 31 05 13 - Soils for Earthwork
- D. Section 31 05 16 - Aggregates for Earthwork
- E. Section 31 23 16 - Excavation
- F. Section 31 23 23 - Fill
- G. Section 33 01 30.13 - Sewer and Manhole Testing
- H. Section 33 41 10 - Storm Utility Drainage Piping

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M-198B – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- B. American Concrete Institute (ACI):
 - 1. ACI 301 – Building Code Requirements for Structural Concrete
 - 2. ACI 315 – Details and Detailing of Concrete Reinforcement
 - 3. ACI 318 – Building Code Requirements for Structural Concrete
- C. ASTM International (ASTM):
 - 1. ASTM A48 - Standard Specification for Gray Iron Castings

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 3. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 4. ASTM C55 - Standard Specification for Concrete Building Brick
 5. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
 6. ASTM C150 - Specifications for Portland Cement
 7. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
 8. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
 10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 11. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
 12. ASTM C913 - Standard Specification for Precast Concrete Stormwater and Wastewater Structures
 13. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
 14. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- D. Federal Specifications:
1. SS-S-00210 (210-A) – Specification for Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
- E. US Army Corp of Engineers:
1. CRD-C 621 – Specifications for Non-Shrink Grout

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Pre-cast concrete manholes:
 - a. Design criteria and calculations.
 - b. Details of reinforcement.
 - 2. Steps.
 - 3. Cover and frame construction, features, configuration, dimensions and material specifications.
 - 4. Rubber gaskets.
 - 5. Grout and mortar.
- C. Shop Drawings:
 - 1. Indicate manhole by location.
 - 2. Provide dimensions, elevations, joints, location, and type of lifting inserts.
 - 3. Indicate connecting piping material, piping size, piping connection angles and offsets, and sizes of penetrations.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing, and moving precast manholes and drainage structures.

- C. Storage:
 - 1. Store precast concrete manholes as to prevent damage to Owner's property or other public or private property.
 - 2. Repair property damaged from materials storage.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA FOR MANHOLES

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.
- B. Design of Lifting Devices for Precast Components: According to ASTM C913.
- C. Design of Joints for Precast Components:
 - 1. According to ASTM C913.
 - 2. Lipped male/female joints.
 - 3. Maximum Leakage: 0.025 gallons per hour per foot of joint at 3 feet of head.
- D. Shaft Construction:
 - 1. Reinforced concrete.
 - 2. Concentric with eccentric cone top section
 - 3. Sleeved to receive pipe connections.
- E. Wall Thickness:
 - 1. Minimum wall thickness shall be 5 inches.
 - 2. Cones shall have the same wall thickness and reinforcement as riser sections.
- F. Shape: Cylindrical.
- G. Clear Inside Dimensions:
 - 1. As indicated on Drawings.
 - 2. Sections shall consist of circular sections in standard nominal inside diameters of 42, 48, 54, 60, 72, 84, 96, 108, 120, 132, or 144 inches.
- H. Design Depth:
 - 1. As indicated on Drawings.

- I. Clear Cover Opening: As indicated on Drawings, minimum of 30 inches.
- J. Pipe Entry: Furnish openings as required and as indicated on the Drawings.
- K. Steps:
 - 1. Rungs:
 - a. Material: Formed polypropylene with 1/2-inch diameter, Grade 60 reinforcing bar.
 - b. Comply with ASTM C478.
 - c. Reinforcing bar to comply with ASTM A615.
 - 2. Formed integral with manhole sections.
 - 3. Width: Minimum 12 inches.
 - 4. Spacing: 12 inches on center vertically.

2.2 MANHOLES

- A. Precast Concrete Manholes:
 - 1. Sections:
 - a. Description: Reinforced precast concrete according to ASTM C478.
 - b. Gaskets: According to ASTM C923.
 - c. Heights: Multiples of 6 inches.
 - 2. Bases:
 - a. Base slab integral with sidewalls.
 - b. Monolithic construction, conforming to ASTM C478.
- B. Cast-in-Place Concrete Manholes:
 - 1. Sections: Reinforced cast-in-place concrete as specified in Section 03 30 00 - Cast-in-Place Concrete.
 - 2. Concrete forming in accordance with Section 03 10 00, Concrete Forming and Accessories.

C. Joint Materials:

1. Mortar:

a. Conform to ASTM C387.

b. Admixtures

1) Allowable, not exceeding the following percentages of weight of cement:

a) Hydrated lime, 10 percent

b) Diatomaceous earth or other inert materials, 5 percent

c. Consistency: Shall be such that it will readily adhere to the precast concrete if using the standard tongue and groove type joint.

d. Mortar not used within 30 minutes of initial mixing shall be discarded and not be used.

2. Non-Shrink Grout:

a. Description: Non-metallic, cementitious, commercial grout exhibiting zero shrinkage per ASTM C827 and CRD-C-621.

b. Manufacturers:

1) Preco-Patch

2) Sika 212

3) Euco N-S

4) Five-Star

5) Approved equal

3. Grout shall not be amended with water after initial mixing.

4. Grout not used within 20 minutes of initial mixing shall be discarded and not be used.

5. Commercial Concrete Bonding Agent:

a. Non-shrink grout shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

b. Bonding agent shall be compatible with the brand of grout used.

c. Water shall not be used as a substitute for the commercial bonding agent.

- D. Preformed mastic gaskets for manhole joints shall meet Federal Specifications SS-S-00210 (210-A), AASHTO M-198B and ASTM C990.
- E. Reinforcement:
 - 1. Formed steel wire.

2.3 FRAMES AND COVERS

- A. Description:
 - 1. Construction: ASTM A48, Class 30B cast iron.
 - 2. Lid:
 - a. Machined flat bearing surface.
 - b. Removable.
 - c. Boltable at locations shown on the Drawings.
 - 3. Cover Design: Closed.
 - 4. Live Load Rating: AASHTO H20 loading.
 - 5. Cover: Molded with "S" cast in.
 - 6. Coefficient of Friction on Outside Face: Minimum of 0.60.

2.4 RISER RINGS

- A. Description:
 - 1. Four inches to 6 inches Thick:
 - a. Material: Precast concrete.
 - b. Comply with ASTM C478.
 - 2. Less than 4 inches Thick:
 - a. Material: Cast iron.
 - b. Comply with AASHTO M306.
 - 3. Rubber Seal Wraps:
 - a. Wraps and Band Widths: Conform to ASTM C877, Type III.
 - b. Cone/Riser Ring Joint: Minimum 3 inches overlap.
 - c. Frame/Riser Ring Joint: 2 inches overlap.
 - d. Additional Bands: Overlap upper band by 2 inches.

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
2. Backfill Around Structure: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
3. Soil Backfill from Above Pipe to Finish Grade:
 - a. In existing or future roadways, right-of-way:
 - 1) Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 - b. In non-paved areas outside of footprint of existing or future structures, outside of right-of-way:
 - 1) Soil Type S1, as specified in Section 31 05 13, Soils for Earthwork.
 - 2) Subsoil: No rocks over 6 inches in diameter, frozen earth, or foreign matter.

2.6 FINISHES

A. Steel:

1. Galvanizing:
 - a. ASTM A123.
 - b. Hot dip galvanize after fabrication.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify items provided by other Sections of Work are properly sized and located.
- B. Verify built-in items are in proper location and ready for roughing into Work.
- C. Verify correct size of manhole excavation.

3.2 PREPARATION

- A. Design the method of placement for all precast items and add all reinforcing steel, embeds, bracing, and other items necessary for placement. All portions of embeds which remain embedded in the concrete shall be made of stainless steel.

- B. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- D. Do not install manholes where site conditions induce loads exceeding structural capacity of manhole components.
- E. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage; remove and replace damaged units.
- F. Subgrade
 - 1. Subgrade shall be compacted to 95 percent of maximum density.
 - 2. Compacted subgrade shall be covered with a minimum of 6 inches of aggregate base compacted to 95 percent of maximum density, extending a minimum of 6 inches beyond the outside limits of the manhole, unless otherwise indicated on Drawings.
 - 3. Grade the aggregate base to a uniform, level surface which will fully support the structure and to an elevation that will ensure proper positioning of the top slab or lid.

3.3 INSTALLATION

- A. Excavation and Backfill:
 - 1. Excavate manholes as specified in Section 31 23 16, Excavation in location and to indicated depth.
 - 2. Provide 12 inches of clearance around sidewalls of structure for construction operations.
 - 3. When groundwater is encountered, prevent accumulation of water in excavations and place manholes in dry trench.
- B. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Engineer.
- C. Base Pad:
 - 1. Place base pad.

2. Trowel top surface level.
- D. Backfill excavations for manholes as specified in Section 31 23 23, Fill.
 - E. Form and place manhole cylinder plumb and level and to correct dimensions and elevations.
 - F. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.
 - G. Set cover frames and covers level without tipping and to correct elevations.
 - H. Coordinate with other Sections of Work to provide correct size, shape, and location.
 - I. Precast Concrete Manholes:
 1. Assembly:
 - a. Install precast structures in accordance with the manufacturer's recommendations unless otherwise required by the Contract Documents.
 - b. Verify installed manholes meet required alignment and grade.
 - c. Lift precast components at lifting points designated by manufacturer.
 - d. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
 - e. Set precast structures bearing firmly and fully on crushed stone bedding, compacted as specified in Section 31 23 23, Fill or on other support system as indicated on Drawings.
 - f. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.
 - g. Place manhole sections plumb and level, trim to correct elevations, and anchor to base pad.
 - h. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
 - i. Maintain alignment between sections by using guide devices affixed to lower section.
 2. Joints:
 - a. Sealing materials may be installed onsite or at manufacturers plant.

- b. All joints shall be sealed watertight by the use of rubber gaskets or other approved preformed sealant.
 - c. All joints shall then be filled with non-shrink grout on both the inside and outside surfaces to produce smooth interior and exterior surfaces.
3. Concrete Base Installation:
- a. Bases shall be set at the proper grade to allow pipe openings to match the grades for connecting pipes.
 - b. Invert shall be constructed to a section identical with that of the sewer pipe.
 - c. Where the size of sewer pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces.
 - d. Prevent sewage or water from contacting the new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.
 - e. Manhole bases shall be set level so base gravel fully and uniformly supports them in true alignment with uniform bearing throughout full circumference.
 - f. Do not level the base sections by wedging gravel, or other material, under the edges.
 - g. Flexible connectors shall be installed in the base section to form a permanently watertight seal.
4. Manhole Riser Sections:
- a. Precast manhole components may be used to construct standard, drop and carry-through manholes. Manholes less than 4 feet in depth measured from the spring line of the pipe to the bottom of the lower riser ring shall be flat-top manholes.
 - b. Install manhole riser sections at the location shown on the plans. All sanitary sewer and pollution control manholes joints shall be watertight and shall use rubber gaskets or a preformed sealant. All joints shall then be filled with non-shrink grout inside and out so as to produce smooth interior and exterior surfaces. All manhole penetrations shall be watertight. Complete manholes shall be rigid. Compact backfill in accordance with the provisions stated elsewhere in this document.

- c. All lift holes shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.
 - d. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the flat slab top or cone.
 - e. Properly locate and plumb each manhole riser section.
 - f. Install manhole extensions and top slabs in accordance with manufacturer's specifications and as shown on the plans. Lay section risers with the sides plumb and the tops level. Make joints and penetrations watertight.
 - g. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
5. Entrances/Exits:
- a. Cut pipe flush with interior of structure.
 - b. Shape inverts through manhole as indicated on Drawings.
 - c. All rigid non-reinforced pipe entering or leaving the manhole (new or existing manhole) shall be provided with flexible joints within 1-foot of the structure and shall be placed on compacted bedding.
 - d. Ribbed HDPE pipe connections shall be grouted watertight with non-shrink grout.
 - e. PVC pipe shall be connected to manholes using an approved adapter specifically manufactured for the intended service.
 - 1) Adapters shall be Fernco, Kor-N-Seal, or approved equal.
6. Grates, Frames, and Covers:
- a. Manhole frames, grates, and covers shall be installed in such a manner as to prevent infiltration of surface or groundwater between the frame and the concrete of the manhole section. Use preformed rubber ring to form a watertight seal.
 - b. Manhole frames and covers shall be installed to grades shown on the drawings or as directed.
 - c. Adjustment of manhole castings shall be made using specified precast grade rings and approved rubber ring joints.

- d. The maximum depth of adjustment below any manhole casting shall be 16 inches, and a minimum depth of adjustment shall be 4 inches.

J. Cast-in-Place Concrete Manholes:

1. Prepare crushed stone bedding or other support system as indicated on Drawings to receive base slab as specified for precast structures.
2. Erect and brace forms against movement as specified in Section 03 11 00, Concrete Work.
3. Install reinforcing steel as indicated on Drawings and as specified in Section 03 11 00, Concrete Work.
4. Place and cure concrete as specified in Section 03 11 00, Concrete Work.
5. Frames and Covers:
 - a. Set frames using mortar and masonry.
 - b. Install radially laid concrete brick with 1/4-inch thick vertical joints at inside perimeter.
 - c. Lay concrete brick in full bed of mortar and completely fill joints.
 - d. If more than one course of concrete brick is required, stagger vertical joints.
 - e. Set frame and cover as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Test concrete manhole and structure sections according to ASTM C497.
- B. Perform manhole testing according to Section 33 01 30.13, Sewer and Manhole Testing.
- C. Test cast-in-place concrete as specified in Section 03 11 00, Concrete Work.
- D. Vertical Adjustment of Existing Manholes:
 1. If required, adjust top elevation of existing manholes to finished grades as indicated on Drawings.
 2. Reset existing frames, grates, and covers that were carefully removed and cleaned of mortar fragments to required elevation according to requirements specified for installation of castings.

3. When removal of existing concrete wall is required, remove concrete without damaging existing vertical reinforcing bars, clean concrete from vertical bars, and bend into new concrete top slab or splice to required vertical reinforcement as indicated on Drawings.
4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete as specified in Section 03 11 00, Concrete Work.

END OF SECTION

SECTION 33 05 17 - PRECAST CONCRETE VALVE VAULTS AND METER BOXES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast concrete valve vaults.
 - 2. Precast concrete meter boxes.

1.2 RELATED SECTIONS

- A. Section 05 50 00, Metal Fabrications
- B. Section 31 05 16, Aggregates for Earthwork
- C. Section 31 23 16, Excavation
- D. Section 31 23 23, Fill.
- E. Section 33 11 10, Water Utility Distribution and Transmission Piping

1.3 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A48 - Standard Specification for Gray Iron Castings.
 - 2. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 3. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 6. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 7. ASTM C150 - Standard Specification for Portland Cement.
 - 8. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

11. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
12. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
13. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
14. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
15. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
16. ASTM D4104 - Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests).
17. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 COORDINATION

- A. Coordinate Work with utilities within construction area.
- B. The drawings identify precast vaults and meter boxes by manufacturer and model number. This information is provided for dimensional information only. Provide precast items in accordance with the requirements of this Section.

1.5 PREINSTALLATION MEETINGS

- A. Convene a minimum of 1-week prior to commencing Work of this Section.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on valve vaults and meter boxes.
- C. Shop Drawings for Precast Concrete Valve Vaults:
 1. Indicate plan, location, and inverts of connecting piping.
 2. All interior and exterior dimensions.
 3. Location and type of lifting inserts, connection embeds, and joints.
 4. Details of reinforcement.
 5. Covers or hatches.

- 6. Ladders and grating.
- D. Manufacturer's Certificate: Certify that precast concrete valve vaults and meter boxes meet or exceed ASTM standards and specified requirements.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and inverts of buried pipe, components, and connections.

1.8 QUALITY ASSURANCE

- A. Perform Work according to standards identified in Article 1.2 herein.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Transport and handle precast concrete units with equipment designed to protect units from damage.
- C. Storage:
 - 1. Store precast concrete valve vaults and meter boxes according to manufacturer instructions.
 - 2. Do not place concrete units in position to cause overstress, warping, or twisting.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Performance and Design Criteria:
 - 1. Watertight, Precast, Reinforced, Air-Entrained Concrete Structures:
 - a. Manufactured to conform to ASTM C913.
 - 2. Loading:
 - a. Design to ASTM C890-A16 / AASHTO HS20 live loading and installation conditions.

- b. Where vaults are below grade, a dead load of 125 pounds per cubic foot shall be added for the soil.
- c. Lateral loads:
 - 1) Static: 105 x Depth of fill per square foot (psf) triangular equivalent fluid pressure plus a surcharge of an additional 3 feet of soil depth in areas subject to vehicular traffic (assume traffic load in all areas, unless indicated otherwise by the Contract Documents).
 - 2) Seismic acceleration: UBC Zone 3 requirements ($I = 1.25$) where $I =$ importance factor, $I = 1.25$, but not less than 0.20 grams (g) acting on structure mass. Seismic loading need not be considered simultaneously with traffic surcharge.
- 3. Minimum 28-Day Compressive Strength: 3,000 pounds per square inch (psi).
- 4. Honeycombed or re-tempered concrete is not permitted.
- 5. No knockouts shall be cast into vault walls. All pipe penetrations shall be pre-formed or core-drilled at the required locations.
- 6. Accessories: Accessories such as ladders, floor grates at sumps, and other features shall be provided as shown on the Drawings.
- 7. Size: Vault dimensions shall be as required by the Drawings.

2.2 PRECAST CONCRETE VALVES AND METER BOXES

A. Manufacturers:

- 1. Furnish materials according to OWNERr standards as shown in the details of the Drawings.

B. Valve Vault and Meter Box Frames and Covers:

1. Cast Iron Castings:

- a. ASTM A48, Class 30 or better.
- b. Free of bubbles, sand, air holes, and other imperfections.

C. Access Steps:

1. Steel reinforced formed polypropylene:

- a. ASTM C478
- b. Reinforced rod: ASTM A615, Grade 60, 1/2-inch diameter

2. Aluminum: ASTM B221, Alloy 6061-T6
3. Width: Minimum 12 inches
4. Spacing: 12 inches on center vertically.

2.3 ACCESS HATCHES AND LIDS

- A. Unless noted otherwise elsewhere in the Contract Documents, vaults shall have concrete top slabs with access openings as shown on the Drawings.
- B. Vault manufacturer shall provide the access hatches per the requirements of Section 05 50 00, Metal Fabrications.
- C. Lids shall have lifting holes.
- D. When leveling bolts are used to set the vault top sections, ensure the load from the top slab is transferred through grout to the vault walls so that the load is not carried by the leveling bolts.

2.4 MATERIALS

- A. Portland Cement:
 1. ASTM C150, Type II
- B. Coarse Aggregates:
 1. ASTM C33
 2. Graded 1 inch to No. 4 sieve
- C. Sand:
 1. ASTM C33
 2. Fineness Modulus: 2.35
- D. Water:
 1. Potable.
 2. Clean and free of injurious amounts of acids, alkalis, salts, organic materials, and substances incompatible with concrete or steel.
- E. Air-Entraining Admixtures: ASTM C260

F. Reinforcing Steel:

1. Deformed Bars: ASTM A615, Grade 40 minimum
2. Welded Wire Fabric: ASTM A185

G. Gaskets:

1. Rubber gaskets: ASTM C443

H. Joint Sealant:

1. ASTM C990

I. Bedding:

1. Aggregate Bedding Material: Fill Type A1 as specified in Section 31 05 16, Aggregates for Earthwork. Size as shown in the Drawings.

2.5 FABRICATION

A. Fabricate precast reinforced concrete structures according to ASTM C913, to dimensions indicated on Drawings, and to specified design criteria.

B. Vaults may be formed with separate top and bottom slabs.

C. Walls shall be cast so that all sides are continuous at corners and their full length with no block-outs or knockouts.

D. Horizontal joints may be provided so that walls can be placed in horizontal segments.

E. All horizontal joints shall be keyed to prevent offsets and shall be provided with a watertight gasket.

F. Finish:

1. Formed surfaces shall be smooth and uniform with no fins, bulges, or other irregularities.
2. Any void greater in width than 1/2-inch or deeper than 3/8-inch shall be repaired.
3. Unformed interior slab surfaces shall have a smooth steel trowel finish.
4. Unformed exterior slab surfaces shall have a light broom finish applied to a steel trowel finish.

2.6 MIXES

- A. Design concrete mix to produce required concrete strength, air-entrainment, watertight properties, and loading requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping connections, sizes, locations, and inverts are as indicated on Drawings.

3.2 PREPARATION

- A. Ream pipe ends and remove burrs.
- B. Remove scale and dirt from components before assembly.
- C. Establish invert elevations for each component in system.
- D. Hand trim excavation to suit valve vaults and meter boxes; remove stones, roots, and other obstructions.

3.3 INSTALLATION

- A. Vaults/Meter and Bedding:
 - 1. Excavate as specified in Section 31 23 16, Excavation for Work of this Section.
 - 2. Hand trim excavation for accurate placement of vaults and meter boxes to elevations indicated.
 - 3. Place bedding material level in one continuous layer to a minimum compacted depth of 8 inches.
 - 4. Compact bedding material to 95 percent maximum density.
 - 5. Bases for precast concrete structures shall be set level so that bedding material fully and uniformly supports them in true alignment with uniform bearing throughout full perimeter. Do not level bases by wedging gravel under the edges.
 - 6. Backfill around sides of vaults and meter boxes as required by the Drawings.
- B. Connect piping.

3.4 FIELD QUALITY CONTROL

- A. Request examination of subgrade by Engineer prior to placing aggregate base under precast materials.
- B. Compaction Testing: In accordance with Field Quality Control requirements of Section 31 23 23, Fill.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- D. Frequency of Compaction Tests: In accordance with Section 01 45 00, Quality Control.

END OF SECTION

SECTION 33 11 10 - WATER UTILITY DISTRIBUTION AND TRANSMISSION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this Section applies to furnishing and installation of pipe materials, fittings, and appurtenances normally encountered with water distribution and, including potable water and fire water systems.
- B. Section includes:
 - 1. Pipe and fittings
 - 2. Flexible couplings
 - 3. Flanged coupling adapters
 - 4. Insulating flanged joints
 - 5. Tapping sleeves and valves
 - 6. Flexible expansion joints
 - 7. Bedding and cover materials
- C. Related Requirements:
 - 1. General
 - a. Furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents.
 - b. Each buried piping system shall be complete, with all necessary fittings, valves, accessories, lining and coating, testing, excavation, backfill and encasement, to provide a functional installation.
 - c. Piping layouts shown in the Drawings are intended to define the general layout, configuration, and routing for pipe, as well as the size and type of piping to be installed. The piping plans are not pipe construction or fabrication drawings.
 - d. The Contractor shall cause the Supplier of pipes, valves, fittings, and appurtenances to coordinate piping installation such that all equipment is compatible and is capable of achieving the performance requirements specified in the Contract Documents.
 - e. It is the Contractor's responsibility to develop the details necessary to construct all piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, valves, gaskets, fittings, appurtenances etc., for a complete and functional system.

1.2 RELATED SECTIONS

- A. Section 03 11 00 - Concrete Work
- B. Section 31 05 13 - Soils for Earthwork
- C. Section 31 05 16 - Aggregates for Earthwork
- D. Section 31 23 16 - Excavation
- E. Section 31 23 17 - Trenching
- F. Section 31 23 23 - Fill
- G. Section 31 23 24 - Flowable Fill
- H. Section 33 05 17 - Precast Concrete Valve Vaults and Meter Boxes
- I. Section 33 12 13 - Water Service Connections
- J. Section 33 12 16 - Water Utility Distribution Valves
- K. Section 33 12 19 - Fire Hydrants
- L. Section 33 13 00 - Testing & Disinfecting of Water Utility Piping

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
 - 3. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
 - 4. ASME B31.10 - Standards of Pressure Piping
- C. ASTM International (ASTM):
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel
 - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 - 4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

5. ASTM A536, Standard Specification for Ductile Iron Castings.
 6. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 7. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 8. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
 9. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 10. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 11. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 12. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 13. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
 14. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- D. American Water Works Association (AWWA):
1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems
 3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings
 4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast
 7. AWWA C153 - Ductile-Iron Compact Fittings
 8. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe
 9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

- 10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
- 11. AWWA C606 - Grooved and Shouldered Joints
- 12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
- 13. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm) for Water Transmission and Distribution
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves
- F. NSF International (NSF):
 - 1. NSF Standard 61 - Drinking Water System Components – Health Effects
 - 2. NSF Standard 372 - Drinking Water System Components – Lead Content
- G. SUBMITTALS
- H. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- I. Product Data: Submit data on pipe materials, pipe fittings, restrained joint systems, and accessories.
- J. Shop Drawings: Indicate piping layout, including piping specialties.
 - 1. Layout Schedule for applicable segments of proposed transmission main alignment. Schedule shall include layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, pipe supports, and any special provisions required for assembly.
- K. Lining and coating data.
- L. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- M. Manufacturer's handling, delivery, storage, and installation requirements.
- N. Field Quality-Control Submittals:
 - 1. Pipeline hydrostatic testing plan.
 - 2. Indicate results of Contractor-furnished tests and inspections.

O. Preconstruction Photographs:

1. Submit digital files of colored photographs of Work areas and material storage areas.

1.4 CLOSEOUT SUBMITTALS

A. As-Built Drawings:

1. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the project shall be new, of first-class quality and shall be made by reputable manufacturers.
2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.
3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.
4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

B. Markings:

1. Pipes and Fittings: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, inside diameter of pipe, dimension ratio as applicable, pipe class as applicable, pipe number for laying purposes as applicable, and other information required for type of pipe.
2. Bolting materials (washers, nuts, and bolts) shall be marked with material type.

C. Testing:

1. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.

1.6 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. In accordance with manufacturer's written recommendations and as specified in these Contract Documents.

- B. Pipe, specials, and fittings delivered to Project Site in damaged condition will not be accepted.
- C. Storage:
 - 1. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
 - 2. Pipe and fittings shall not be stored on rocks, gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.
 - 3. Do not store materials in direct sunlight.
 - 4. Gaskets: Do not allow contact with oils, fuels, petroleum, or solvents.
- D. Handling:
 - 1. Pipe and appurtenances shall be handled in accordance with manufacturer's recommendations or requirements contained in this section or subsequent sections dealing with the specific pipe material, whichever is more stringent.
 - 2. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
 - 3. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
 - 4. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

PART 2 PRODUCTS

2.1 WATER PIPING

A. General

- 1. All piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.
- 2. All coatings and materials specified herein which may come in contact with potable water shall conform to National Sanitation Foundation (NSF) Standard 61 and 372.

3. Minimum Pressure Ratings: Unless otherwise specified herein or shown in the Drawings, the minimum working pressure rating of all water works materials specified herein shall be 1-1/2 times the operating pressure or 150 pounds per square inch (psi) minimum.
 4. Gaskets:
 - a. Material: Styrene Butadiene Rubber (SBR) composition.
- B. Ductile Iron Pipe:
1. Centrifugally cast, conforming to AWWA Standard C151.
 2. Coating: Asphaltic exterior coating in accordance with AWWA Standard C151.
 3. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.
 4. Pipe Thickness Class:
 - a. Comply with AWWA C151.
 - b. Class 52, unless shown to be greater in the Plans.
 - 1) The Contractor shall be aware ductile iron piping with thickness class greater than Class 52 may have long fabrication and supplier lead times. The Contractor shall be responsible for coordinating product submittal and delivery times accordingly such as not to delay construction.
 5. Gauged Pipe:
 - a. All ductile iron pipe 24-inch diameter or greater to be cut in the field shall be gauged full length and, along the full length, shall meet the outside diameter standard dimensions and tolerances required for spigot ends along the full length of pipe to within 2 feet of the bell end.
 - b. In addition to pipe supplied for anticipated cutting, a minimum of 5 percent of each size of piping 24-inch diameter or greater shall be provided gauged full length as described above.
 - c. Pipe shall be externally marked, in manufacturer's color, indicating gauged pipe.
 6. Polyethylene Encasement:
 - a. Comply with AWWA C105.
 - b. Polyethylene film shall be minimum 8-mil thick virgin linear low-density polyethylene (LLDPE).

7. Joints:
- a. Joint types shall be provided as identified in the Drawings and as required for the application.
 - b. Mechanical Joints:
 - 1) Comply with AWWA C111.
 - c. Push-on Joints:
 - 1) Comply with AWWA C111.
 - 2) Manufacturers, without exception:
 - a) Tyton Joint by American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, McWane, and Pacific States Cast Iron Pipe.
 - b) Fastite Joint by American Cast Iron Pipe Company.
 - d. Restrained Joints:
 - 1) Joint restraint for pipe shall be accomplished with an integral lock mechanism, except as may be otherwise specified.
 - a) Any such system shall be a manufacturer's standard proprietary design, shall be as recommended by the manufacturer for the application, and shall be performance proven.
 - 2) Restraining components:
 - a) Ductile iron complying with AWWA C110 and/or C153, with the exception of a manufacturer's proprietary design dimensions.
 - b) Push-on joints for such fittings shall comply with AWWA C111.
 - 3) Deflection:
 - 4) The maximum pipe deflection shall not exceed one-half of the manufacturer's stated joint deflection allowance.
 - 5) Manufacturers:
 - a) "Thrust-Lock", Pacific States Cast Iron Pipe Company.
 - b) "Fast Grip", American Cast Iron Pipe Company.
 - c) "TR Flex", United States Pipe and Foundry Company.

- d) "Snap-Lok", Griffin Pipe Products Company.
- e) "Field-Lok", United States Pipe and Foundry Company.
- f) "Super Lock", Clow
- g) "Restrained Joint", McWane
- h) "MJ-TJ" pipe with "MEGALUGs", Pacific States Cast Iron Pipe Company.
- i) "Flex-Ring", American Cast Iron Pipe Company
- j) "MEGALUG", EBAA Iron, Inc.

- (1) Where any restrained joint system requires the use of a wedge-type mechanical restraint gland for restraint, the glands shall be provided in quantities as may be required and shall be considered incidental to the joint restraint system.
- (2) Wedge-type mechanical restraining glands shall not be used to restrain the plain end of plain end ductile iron or cast-iron fittings.

e. Flanged Joints:

- 1) Flat faced, complying with AWWA C111 and C115, unless otherwise specified.
- 2) Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.
- 3) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.
- 4) Pressure rating of flange joints shall not exceed the rating of the pipe or fitting of which they are a part and the maximum pressure rating of the joint shall be 250 psi.
- 5) Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.
- 6) Threaded flanges:
 - a) Ductile iron pipe spools with threaded flanges shall conform to AWWA C115.
 - b) Installed only on pipe with a minimum Class 53 wall thickness.

7) Buried flanges:

- a) Flanged connections shall not be buried unless shown as such on the Drawings.
- b) Buried flanges shall be wrapped with 2 layers of 10-mil tape along edges of flanges.

8) Gaskets:

- a) Full faced, composed of synthetic rubber and 1/8-inch thick conforming to ASME B21.1 and AWWA C111.
- b) Ring gaskets will be permitted only where specifically noted in the Drawings and Specifications.
- c) Gaskets for flanged joints shall be as follows:
 - (1) Pipe sizes between 6-inch and 24-inch diameter, service pressures of 150 psi or greater shall be Garlock 3760-U or equal.
 - (2) Pipe sizes 4-inch diameter and under, service pressures of 150 psi or greater shall be Garlock 3505 or equal.
 - (3) All pipe sizes with service pressures of 150 psi or less shall be Garlock 98206 or equal.
- d) Insulating flanged joints:
 - (1) Full faced, conform to ANSI 16.21.
 - (2) Material: Non-asbestos.
 - (3) Suitable for operating and test pressures of the pipe system.
 - (4) Manufacturer:
 - (a) Garlock GYLON Style 3505 or equal.

C. PVC:

- 1. All PVC pressure pipe shall be manufactured with an integral bell design capable of receiving an elastomeric gasket.
- 2. All PVC pressure pipe shall be dimensionally compatible with standard cast/ductile iron fittings produced according to AWWA C110 or AWWA C153, as applicable.

3. Deflection:
 - a. PVC pressure pipe may be deflected both horizontally and vertically at the joints after assembly.
 - b. Deflection by bending of the pipe rather than at the joints is not allowed.
 - c. The maximum pipe deflection shall not exceed one half of the manufacturer's stated joint deflection allowance.
4. Joints:
 - a. Solvent-cement couplings are not permitted.
5. Gaskets: Comply with ASTM F477.
6. Size: 4-inch through 12-inch diameter
 - a. Comply with AWWA C900, DR 14, Class 305, unless shown otherwise in the Drawings or specified elsewhere.
7. Size: 14-inch through 48-inch diameter
 - a. Comply with AWWA C905, DR 18, Class 235, unless shown otherwise in the Drawings or specified elsewhere.
8. Restrained Joints:
 - a. For push-on pipe joint at pipe bells:
 - 1) Material:
 - a) Body: Ductile iron. Comply with ASTM A536.
 - b) Bell Restraint Systems: Corten steel tie rods.
 - 2) Coatings: Shop-applied liquid epoxy.
 - 3) Construction:
 - a) A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.
 - b) System shall be designed for a minimum 2 to 1 safety factor.
 - 4) Manufacturers:
 - a) 4-inch through 12-inch diameter: EBAA Iron, Inc. - Series 1900 Bell Restraint Harness.

b) 14-inch through 48-inch diameter: EBAA Iron, Inc. - Series 2800 Bell Restraint Harness.

b. At mechanical joint fittings:

1) Material: Ductile iron. Comply with ASTM A536.

2) Coatings: Shop-applied liquid epoxy.

3) Construction:

a) Restraint accomplished by a restraint device consisting of a follower gland utilizing multiple gripping wedges.

b) The restraint system shall have a sufficient number of fastening bolts to connect the ring to the mechanical joint.

c) System shall be designed for a minimum 2 to 1 safety factor.

4) Fasteners:

a) T-bolts and nuts: High strength, low alloy steel.

b) Comply with AWWA C111.

5) Manufacturers:

a) EBAA Iron, Inc. - MEGALUG, Series 2000PV

b) Romac Industries, Inc. – 470 Series Pipe Restraining System

2.2 FITTINGS:

A. Material: Ductile iron, complying with AWWA Standard C110.

1. Fittings conforming to AWWA C153 may be substituted in lieu of AWWA C110 fittings.

B. Fittings used for joining ductile iron and PVC pipe shall be of the type, size, and strength designated on the Plans, elsewhere in the specifications.

1. Fittings shall be mechanical joint, push-on type, flanged or plain-end as required and shown on the Drawings.

2. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.

C. Pressure ratings: As specified for joining pipe above and as shown on the Drawings.

- D. Coating and Lining:
 - 1. Asphaltic exterior coating in accordance with AWWA Standard C110.
 - 2. Cement Mortar Lining: Comply with AWWA C104.
- E. Following information cast upon fittings:
 - 1. Manufacturer's identification.
 - 2. Country of manufacture.
 - 3. Pressure rating.
 - 4. For bends, number of degrees and/or fractions of a circle.
- F. Owner may require additional metallurgical documentation or other certifications.

2.3 NUTS, BOLTS, AND WASHERS:

- A. All bolts shall have heavy hex head with heavy hex nuts.
- B. For operating pressures greater than 150 psi:
 - 1. Bolts: Steel alloy composition. Comply with ASTM A193.
 - 2. Nuts: Comply with ASTM A194, Grade 2H.
 - 3. Washers: Comply with ASTM F436.
- C. For operation pressures of 150 psi or less:
 - 1. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.
 - 2. Nuts: Comply with ASTM A563A, Heavy Hex.
 - 3. Washers: Comply with ASTM F844.
- D. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.

2.4 FLEXIBLE COUPLINGS

- A. General
 - 1. All flexible couplings shall be constructed to inside diameters that properly fit the connecting pipes.
 - 2. The Contractor shall be responsible for selecting sleeve lengths appropriate to the application, subject to review and approval of the Engineer, recognizing that longer sleeves allow for larger deflections and may ease installation.

B. Flexible Couplings:

1. Description:

- a. Comply with AWWA C219.
- b. Type: Bolted, sleeved.
- c. Configuration: Straight, transition, or reducing as shown in the Drawings.
- d. Center rings and end rings: Ductile iron. Comply with ASTM A536.
- e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
- f. Bolts and nuts: High strength low alloy steel. Comply with AWWA C111.
- g. Lining and coating: Factory-applied fusion bonded epoxy.
- h. Working pressure: Up to 260 psi.

2. Manufacturers:

- a. For 2-inch to 24-inch diameter:
 - 1) Romac Industries, Inc. – Style 501 or equal.
- b. For 12-inch diameter and larger:
 - 1) Romac Industries, Inc. – 400 Series or equal.

C. Insulating Flexible Couplings:

1. The Contractor shall be responsible for selecting couplings appropriate to the application, subject to review and approval of the Engineer, recognizing that different pipe materials will require specific sizing and material selection for couplings.

2. Description:

- a. Comply with Flexible Coupling specifications above.
- b. Insulating Boot: Ethylene propylene diene monomer (EPDM) compounded for water service. Comply with ASTM D2000.

3. Manufacturers:
 - a. For 4-inch to 14-inch diameter:
 - 1) Romac Industries, Inc. – Style IC501 or equal.
 - b. For 12-inch to 96-inch diameter:
 - 1) Romac Industries, Inc. – Style IC400 or equal.

D. Restrained Flexible Couplings:

1. Description:
 - a. Body: Steel. Comply with ASTM A36.
 - b. Restrained gland: Ductile iron. Comply with ASTM A536, Grade 65-45-12.
 - c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
 - d. Bolts and nuts: All-thread rod, at a minimum complying with ASTM A193 Grade B7. Nuts per ASTM A194 Grade 2H.
 - e. Lining and coating: Factory-applied fusion bonded epoxy.
 - f. Working pressure: 250 psi. Test pressure: 500 psi.
2. Manufacturers:
 - a. Romac Industries, Inc. – Style 400RG
 - b. EBAA Iron – 3800 MEGA-COUPLING

2.5 FLANGED COUPLING ADAPTERS

A. Flanged Coupling Adapters:

1. All flanged coupling adapters shall be constructed to diameters that properly fit the connecting plain end pipe and the flanged fitting.
2. Description:
 - a. Comply with AWWA C219.
 - b. Flange: AWWA Class D E Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles.

- c. End ring and body:
 - 1) Steel. Comply with ASTM A36.
 - 2) Ductile iron. Comply with ASTM A536, Grade 65-45-12.
- d. Flange: Compatible with ANSI Class 125 and 150 bolt circles.
- e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
- f. Bolts and nuts: High strength low alloy steel bolts and nuts. Comply with AWWA C111 composition requirements.
- g. Lining and coating: Factory-applied fusion bonded epoxy.
- h. Working pressure rating: Equal to the maximum rating of the flange.

3. Manufacturers:

- a. Romac Industries, Inc.
 - 1) Style FCA501
 - a) For 3-inch to 16-inch diameter.
 - 2) Style FC400.
 - a) For 12-inch to 96-inch diameter.

B. Restrained Flanged Coupling Adapters:

1. Description:

- a. Gland and flange body: Ductile iron. Comply with ASTM A536.
- b. Flange: Compatible with ANSI Class 125 and 150 bolt circles.
- c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
- d. Restraining bolts and lugs: Ductile iron. Comply with ASTM A536.
- e. T-bolts, Bolts, and nuts: High strength low alloy steel. Comply with AWWA C111 composition requirements.
- f. Lining and coating: Factory-applied fusion bonded epoxy.

2. Manufacturers:

- a. Romac Industries, Inc. – RFCA Restrained Flanged Coupling Adapters.
- b. EBAA Iron – MEGAFLANGE Restrained Flange Adapter.

2.6 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Description:

- a. Type: Dual compression.
- b. Material:
 - 1) Body: Stainless steel, Type 304.
 - 2) Flanged outlet: Stainless steel, Type 304.
- c. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class 150 and MSS SP-60.
- d. Outlet Gasket:
- e. Provide with Type 304 stainless steel test plug.
- f. Nuts, bolts, and washers: Stainless steel, Type 304.

2. Manufacturers:

- a. Romac Industries, Inc. – Model STS 420
- b. JMC Industries, Inc.

B. Tapping Valves:

- 1. Resilient wedge gate valves specified in Section 40 05 61, Gate Valves.

2.7 FLEXIBLE EXPANSION JOINTS

A. Description

- 1. Installed at locations indicated in the Drawings.
- 2. End connections: As shown in the Drawings.
- 3. Material: Ductile iron, AWWA C153.
- 4. Working pressure: 350 psi, minimum.

5. Construction:

- a. An expansion joint designed and cast as an integral part of a double ball and socket type flexible joint.
 - b. Manufactured of ductile iron, conforming to requirements of AWWA C153 and ASTM A536.
 - c. Deflection: Minimum of 15 degrees deflection per ball.
 - d. Expansion:
 - 1) 12-inch diameter and under: 8-inch.
 - 2) Greater than 12-inch diameter: 16 inches.
 - e. Each flexible expansion joint shall be hydrostatically tested to the manufacturer's published pressure rating prior to shipment.
 - f. Lining: All interior "wetted" parts shall be shop-lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be holiday tested with a 1500-volt spark test conforming to said specification.
 - g. Coating: Coal tar epoxy.
6. Quality Assurance: Hydrostatically tested to manufacturer's published pressure rating prior to shipment.
7. Appropriately sized polyethylene sleeves, meeting AWWA C105 requirements, shall be included for direct bury applications.

B. Manufacturers

1. EBAA Iron, Inc. – Flex-Tend or equal.

2.8 UNDERGROUND PIPE MARKERS

- A. As specified in Section 31 23 17, Trenching.

2.9 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 30 00 - Cast-in-Place Concrete.
2. Type: reinforced, air entrained as shown in the Drawings.
3. Compressive Strength: Minimum 3,000 psi at 28 days.
4. Finish: Rough troweled.

- B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.10 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 - c. Subsoil Type S1 and/or S2, as specified in Section 31 05 13, Soils for Earthwork.

2.11 ACCESSORIES

- A. Concrete for Thrust Restraints: As specified in Section 03 30 00 - Cast-in-Place Concrete.
- B. Manhole and Cover: As specified in Section 33 05 13- Manholes.
- C. Miscellaneous Steel Rods, Bolt, Lugs, and Brackets:
 1. Comply with ASTM A36 or ASTM A307.
 2. Grade A carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

A. Preconstruction Site Photos:

1. Take photographs along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.

2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
 3. Include Project name, date taken, and sequential number of each photograph in physical log or CD.
- B. Inspection:
1. All pipe sections, specials, and jointing materials shall be carefully examined for defects.
 2. No piping or related materials shall be laid that is known to be defective. Any defective piece installed shall be removed and replaced with a new pipe section in a manner satisfactory to the Engineer at the Contractor's expense.
 3. Defective material shall be marked and removed from the job site before the end of the day.
- C. Pipe Cutting:
1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
 2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
 3. Grind edges smooth with beveled end for push-on connections.
 4. Prior to assembly of field cut pipe, the reference mark shall be re-established with a pencil or crayon. The location of the reference mark at the proper distance from the bevel end shall be in accordance with the manufacturer's recommendations.
- D. Remove scale and dirt on inside and outside before assembly. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, blowing out with compressed air, or washing to remove all foreign matter.
- E. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Bedding:

1. Excavation:

- a. Excavate pipe trench as specified in Section 31 23 17, Trenching for Work of this Section.

- b. All pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.
 - c. Remove large stones or other hard matter which could damage pipe or impede consistent pipe bedding backfilling or compaction.
 - d. Trench base shall be inspected prior to placement of pipe.
 - e. Hand trim excavation for accurate placement of pipe to elevations as indicated on Drawings.
 2. Dewater excavation as specified in Section 31 23 19, Dewatering to maintain dry conditions and to preserve final grades at bottom of excavation.
 3. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.
 4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent of maximum density.
- B. Piping:
 1. Install pipe according to AWWA C600.
 2. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.
 3. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
 4. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
 5. Sanitary Sewer Separation:
 - a. Install new water lines and appurtenances in compliance with local and state regulations governing the horizontal and vertical separations between water and sewer facilities.
 - b. Variance:
 - 1) If a variance is proposed due to requested design revisions or if an existing facility has been installed at a different location or elevation than indicated on the Plans, submit written proposal for review and approval by the Engineer.

- 2) Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and corrective measures proposed.
 - 3) Each variance will be considered on a case-by-case basis.
 - 4) Review Time: Allow a minimum of 5 working days review and response to each proposal.
6. Install ductile iron fittings according to AWWA C600.
 7. Joints:
 - a. Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining.
 - b. Lubricants, primers, adhesives, etc. shall be used as recommended by the pipe or joint manufacturer's specifications.
 - c. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint.
 - d. Trenches shall be kept water-free and as dry as possible during bedding, laying and jointing.
 - e. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.
 8. Flanged Joints: Not to be used in underground installations except within structures, unless shown otherwise in the Drawings.
 9. Deflection:
 - a. The maximum pipe deflection shall not exceed one-half of the manufacturer's stated joint deflection allowance.
 - b. Set a laser, string line, or other approved alignment guide along the centerline of previously installed pipe to the point where pipe joint deflection is required. The approved alignment guide shall extend to the end of the proposed subsequent pipe length. A measurement will be taken from the alignment guide to the centerline of the subsequent pipe length to determine the amount of pipe joint deflection proposed. Measured deflection shall not exceed the specified allowable deflection for the purposes of aligning the pipe.

10. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb. Re-lay pipe that is out of alignment or grade.
 11. High Points:
 - a. Install pipe with no high points, unless otherwise shown in the Drawings.
 - b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by Engineer.
 12. Bearing:
 - a. Install pipe to have bearing along entire length of pipe.
 - b. Excavate bell holes to permit proper joint installation where necessary or as directed by Engineer.
 - c. Do not lay pipe in wet or frozen trench.
 13. Prevent foreign material from entering pipe during placement.
 14. Install pipe to allow for expansion and contraction without stressing pipe or joints.
 15. Close pipe openings with watertight plugs during Work stoppages.
 16. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.
 17. Install access fittings to permit disinfection of water system performed under Section 33 13 00 – Testing and Disinfecting of Water Utility Piping.
 18. Cover:
 - a. Establish elevations of buried piping with not less than 36 inches of cover.
 - b. Measure depth of cover from final surface grade to top of pipe barrel.
- C. Tapping Sleeves and Valves:
1. As indicated on Drawings and according to manufacturer instructions.
- D. Polyethylene Encasement:
1. Encase piping in polyethylene where indicated on Drawings to prevent contact with surrounding backfill material.
 2. Comply with AWWA C105.

E. Thrust Restraints:

1. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks at locations shown in the Drawings and as required to facilitate testing of lines.
2. Pour concrete thrust blocks against undisturbed earth.
3. Locate thrust blocks to ensure that pipe and fitting joints will be accessible for repair.
4. Provide thrust restraint bearing area on subsoil as shown in details within the Drawings.
5. Install tie rods, clamps, setscrew retainer glands, or restrained joints.
6. Protect metal-restrained joint components against corrosion with polyethylene film as specified herein.
7. Do not encase pipe and fitting joints to flanges.

F. Backfilling:

1. Backfill of piping systems shall be as specified in Section 31 23 17, Trenching.

G. Testing and Disinfection of Potable Water Piping System:

1. In accordance with AWWA C600, AWWA C651 and as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.
2. All chlorinated water used in disinfection of the water main shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the Oregon State Department of Environmental Quality (DEQ) prior to discharge into any storm drainage system or open drainage way.
3. No chlorinated water shall be discharged into a storm drainage system or open drainage way without a dechlorination under a plan meeting DEQ's requirements.

3.4 FIELD QUALITY CONTROL

- A. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

END OF SECTION

SECTION 33 11 50 - EXISTING PIPE ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the removal of existing buried piping and abandonment in place of existing buried piping.
- B. Section includes:
 - 1. Pipe removal.
 - 2. In-place abandonment of pipe.

1.2 RELATED SECTIONS

- A. Section 03 60 00, Grouting.
- B. Section 31 23 16, Excavation.
- C. Section 31 23 17, Trenching.
- D. Section 31 23 19, Dewatering.
- E. Section 31 23 23, Fill.
- F. Section 31 23 24, Flowable Fill.

1.3 SUBMITTALS

- A. Provide all submittals in accordance with Section 01 33 00, Submittal Procedures.
- B. Piping Abandonment Plan:
 - 1. Identify locations specified for pipe abandonment.
 - 2. Provide method to be utilized to abandon the pipe, including whether the pipe will be left in place or removed in its entirety.
- C. Non-Shrink Grout: Product data in accordance with Section 03 60 00, Grouting.
- D. Controlled low-strength material (CLSM): Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the work described herein.

- B. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the work and requirements of the General Provisions.

1.5 PROTECTION OF EXISTING WORK

- A. Carefully examine the Contract Documents to determine the extent of the work of this Section.
- B. Carefully coordinate the work of this Section with all other work and construction.
- C. Take all necessary precautions to prevent damage to existing facilities or utilities which are to remain in place and be responsible for any damages to existing facilities or utilities, which are caused by the operations.

1.6 REPAIR OF DAMAGE

- A. Work procedures shall provide for safe conduct of the work; careful removal and disposition of materials and equipment; protection of facilities, utilities and property which are to remain undisturbed; coordination with existing facilities and utilities to remain in service.
- B. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired to acceptance of Engineer.
- C. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

1.7 EXISTING CONDITIONS

- A. If the pipe material contains any hazardous materials, such as asbestos, requiring special handling upon removal, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 OWNERSHIP OF EXISTING MATERIALS

- A. All materials, equipment, miscellaneous items and debris involved, occurring or resulting from pipe removal work shall become the property of the Contractor at the place of origin, unless otherwise specified in the Drawings or by the Engineer.

2.2 CONTROLLED LOW STRENGTH MATERIAL

- A. As specified in Section 31 23 24, Flowable Fill.

PART 3 EXECUTION

3.1 PIPE REMOVAL

- A. Where identified on the Drawings, remove and dispose of all pipe material and associated appurtenances.
 - 1. All fire hydrants, air release valves service lines and appurtenances being abandoned shall be removed to 36 inches below finished grade.
 - 2. Existing service line appurtenances, including valve and meter boxes, shall be removed to 36 inches below finished grade.
- B. All exposed ends of pipes and fittings to remain in service shall be capped or plugged with an appropriate ductile iron blind flange, cap or plug and restrained.
 - 1. A pipe shall be considered in service if it is possible to flood the pipe with water by opening valves in the water system.
- C. All excavation and backfilling associated with pipe removal shall be performed in accordance with 31 23 17, Trenching.

3.2 IN-PLACE ABANDONMENT OF PIPING

- A. Where identified on the Drawings, abandon pipe in place.
- B. All exposed ends of pipes being abandoned in place shall be cut and plugged with a minimum of 2 feet of non-shrink grout.
- C. Prior to placing grout, roughen interior pipe surface and apply epoxy bonding agent.

3.3 FILLING PIPE WITH CLSM

- A. Where identified on the Plans, pipes greater than 12 inches in diameter to be abandoned-in-place shall be filled with CLSM.
- B. CLSM shall be placed in a manner to ensure complete filling of the pipe, leaving no cavities or voids.
- C. Install hot taps, saddles, fill lines, and appurtenances as necessary for pumping CLSM from the surface into the pipe being filled.

- D. CLSM shall be pumped up grade from fill lines rigidly connected to the pipes being filled.
- E. Placement of CLSM by free flowing (non-pumped) methods will not be acceptable.
- F. Fill lines shall be located at elevations lower than the pipe being filled.
- G. As the CLSM is being placed, use other fill lines as view ports to ensure complete filling of the pipes.
- H. Relocate pumping equipment as necessary to complete filling of the pipes.
- I. Excavate and cut access holes in the pipes as necessary to complete filling operations.
- J. Perform pipe filling operations in a manner to eliminate all air pockets.
- K. Submit volume calculations for CLSM placed in each filled segment of piping to verify that pipelines have been completely filled.

3.4 CLEANUP

- A. During and upon completion of work of this Section, promptly remove all unused tools and equipment, surplus materials and debris.
- B. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 33 12 13 - WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes pipe materials, fittings, valves, meters and backflow preventers encountered with service connections 2 inches in diameter and smaller from the main to a water.
- B. Section Includes:
 - 1. Pipe and fittings for 2- inch diameter and smaller water service connections.
 - 2. Corporation stop assemblies.
 - 3. Curb stop assemblies.
 - 4. Meter setting equipment.
 - 5. Water meters.
 - 6. Backflow preventers.
 - 7. Sampling stations.
 - 8. Underground pipe markers.
 - 9. Precast concrete vaults.
 - 10. Bedding and cover materials.
- C. Related Requirements:
 - 1. Section 31 05 13 - Soils for Earthwork: Backfill soil type.
 - 2. Section 31 05 16 - Aggregates for Earthwork: Bedding and cover material type.
 - 3. Section 31 23 17 - Trenching: Excavation of pipe trench.
 - 4. Section 31 23 23 - Fill: Backfilling of trench.
 - 5. Section 33 05 13 - Manholes and Structures: Soil backfill type, manholes, and covers.
 - 6. Section 33 05 16.13 - Precast Concrete Utility Structures: Valve vaults.
 - 7. Section 33 05 17 - Precast Concrete Valve Vaults and Meter Boxes: Valve vaults.
 - 8. Section 33 13 00 - Testing and disinfecting of Water Utility Distribution: Flushing and disinfecting of water system.

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society of Mechanical Engineers:
 - 1. ASME B16.15 - Cast Bronze Threaded Fittings.
- C. American Society of Sanitary Engineering:
 - 1. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.
 - 2. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.
- D. ASTM International:
 - 1. ASTM A48 - Standard Specification for Gray Iron Castings.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 4. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
 - 5. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m<sup>3 - 6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m<sup>3 - 7. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 8. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 9. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.</sup></sup>

11. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- F. American Water Works Association:
1. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
 2. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
 3. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
 4. AWWA C800 - Underground Service Line Valves and Fittings.
 5. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
 6. AWWA C904 - Cross-linked Polyethylene (PEX) Pressure Pipe, 1/2 in. (12mm) through 3 in. (76mm) for Water Service.
 7. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
- G. National Sanitation Foundation International:
1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
 2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.
- C. Shop Drawings: Indicate details showing meter boxes, vaults and accessories.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping mains, connections, thrust restraints, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Unless otherwise noted, all water works materials provided shall be new, of first class quality and shall be made by reputable manufacturers.
- B. All material of like kind shall be provided from a single manufacturer unless otherwise approved by the Engineer.
- C. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage and handling.
- D. Where an item is to be used but does not have its quality specified herein, it shall be equal to that specified in the appropriate American Water Works Association (AWWA) Standard Specification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store products and materials off ground and under protective coverings and away from walls.
- C. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 PRODUCTS

2.1 GENERAL

- A. Service line material shall conform to the latest version of AWWA C800 and as follows:
 - 1. Minimum working pressure rating of all service line material shall be 150 psi.
 - 2. All water works materials provided shall be rated for the test pressures indicated for the water main and as specified in Section 331300, Testing and Disinfection of Water Utility Pipelines.

- B. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 WATER PIPING AND FITTINGS

A. Copper Tubing:

- 1. Comply with ASTM B88.
- 2. Type K, annealed, seamless.
- 3. Fittings: Cast bronze alloys, threaded. Conform to ASTM B584, meeting “lead free” requirements above, and ASME B16.15.
 - a. Mechanical surfaces shall have a 100% machine finish with no gaps or low spots due to insufficient parent material.
 - b. All fittings shall either be stamped or embossed with the manufacturer’s name.
 - c. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - d. Manufacturers:
 - 1) Ford.
 - 2) Mueller.
- 4. Joints: Compression.

B. Polyethylene Pipe:

- 1. Comply with AWWA C901.
- 2. Tubing shall be high molecular mass with a minimum 200 psi rating.
 - a. 3/4-inch and 1-inch diameter tubing: SDR 7 (iron pipe size) or SDR 9 (copper tube size).
 - b. 1 1/2-inch and 2-inch diameter tubing: SDR 9 (copper tube size).

3. Fittings: Comply with AWWA C901, molded.
 4. Joints:
 - a. Compression: Utilize stainless steel liners.
 - b. Stab: Utilize internal grip ring and O-ring seal.
- C. Cross-linked Polyethylene (PEX) Pressure Pipe:
1. Comply with AWWA C904.
 2. Tubing shall be manufactured using the high-pressure peroxide method of crosslinking with a minimum 200 psi rating.
 - a. Shall have a co-extruded UV shield made from UV resistant high density polyethylene, color blue.
 - b. Pipe shall have the minimum markings: PEXa 3306, CSA B137.5, ASTM F876, F2023 and F2080, NSF-pw-g
 3. Fittings: Comply with AWWA C800
 4. Joints:
 - a. Compression sleeve

2.3 CORPORATION STOP ASSEMBLIES

- A. Corporation Stops:
1. Body: Bronze / Brass alloy.
 2. Valve Type: Ball.
 - a. Constructed of the same material as the body.
 - b. A seat to support the ball or coating for the ball shall be composed of Teflon, Nitrile or another material proven not to deteriorate when exposed to chemicals seat such as chloramines.
 3. Direct Tapping: Corporation stops for direct tapping shall have AWWA tapered thread inlet and outlet connections compatible with service piping specified.
 4. Less Than or Equal to 1-Inch Diameter:
 - a. Inlets: AWWA tapered thread or male iron pipe thread.

- b. Outlets: Connections compatible with either copper or polyethylene tubing.
 - c. Thread patterns for the saddle outlet and corporation stop inlet shall be compatible for proper installation.
 - 5. Greater Than 1-Inch Diameter:
 - a. Inlets: Male iron pipe thread.
 - b. Outlets: Connections compatible with connecting service pipes.
- B. Service Saddles:
 - 1. Material: Ductile iron, bronze or stainless steel.
 - 2. Coating: Epoxy or nylon.
 - 3. For Services Less Than or Equal to 1-Inch Diameter:
 - a. Single strap.
 - b. AWWA tapered thread or female iron pipe thread outlet.
 - 4. For Services Greater Than 1-Inch Diameter:
 - a. Double strap.
 - b. Female pipe thread outlet.
 - 5. Designed to hold pressures in excess of pipe working pressure.
 - 6. Saddles used on PVC shall be formed for PVC pipe and shall have flat, stainless steel straps.
- C. Manufacturers:
 - 1. Ford.
 - 2. Mueller.

2.4 CURB STOP ASSEMBLIES

- A. Curb Stops:
 - 1. Body: Bronze alloy. Comply with ASME B16.15.
 - 2. Valve Type: Ball.
 - a. Constructed of the same material as the body.

- b. A seat to support the ball or coating for the ball shall be composed of Teflon, Nitrile or another material proven not to deteriorate when exposed to chemicals seat such as chloramines.

3. Sealing: Positive pressure.

B. Manufacturers:

1. Ford.
2. Mueller.

2.5 METER SETTING EQUIPMENT

A. Description:

1. Height: 12 inches.
2. Material: Copper.
3. Construction:
 - a. Angle meter stop with drilled padlock wing.
 - b. Angle check valve.
 - c. Inlets and Outlets: Horizontal setting, with matching couplings, fittings, and stops.
4. Furnish test valves.
5. For services 1-inch and smaller:
 - a. Meters saddle nuts for installation and removal of meter.
6. For services greater than 1-inch:
 - a. Equip with a locking bypass.

B. Manufacturers:

1. Ford.
2. Mueller.

2.6 WATER METERS

A. Supplied by Owner.

2.7 BACKFLOW PREVENTERS

- A. As specified in Section 40 05 13, Common Work Results for Process Piping.

2.8 SAMPLING STATIONS

- A. Manufacturers:

- 1. Kupferle Foundry Company, Eclipse No. 88.

- B. Sampling Stations:

- 1. Enclosure: Cast-aluminum. Lockable, non-moveable.
- 2. Interior Piping: Brass, 3/4-inch diameter FIP.
- 3. Exterior Piping: Galvanized steel, 3/4-inch diameter FIP. Depth of bury as shown in the Drawings.
- 4. Vent Tube: Copper, with 1/4-inch diameter pet cock.

2.9 UNDERGROUND PIPE MARKERS

- A. As specified in Section 33 11 10, Water Utility Distribution Piping.

2.10 METER BOXES

- A. As specified in Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes.

2.11 MATERIALS

- A. Bedding and Cover:

- 1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
- 2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
- 3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 - c. Subsoil Type S1 and/or S2, as specified in Section 31 05 13, Soils for Earthwork.

PART 3 EXECUTION

3.1 GENERAL

- A. All service lines shall be installed continuous, without joints or splices, complete from the new water main (insulating corporation stop) to the new meter location or as otherwise shown.
- B. Install service pipelines perpendicular to the main, unless shown otherwise.
- C. Install service runs parallel to existing services with a perpendicular distance of 2 feet, minimum to 5 feet, maximum from existing services and a minimum perpendicular distance of 18 inches from property line for new services.
- D. For service renewals, terminate service run inside of existing meter box as described below.

3.2 INSTALLATION

- A. Construct the depth of trench for service connection piping to provide a minimum of 30 inches of cover over the top of the pipe, unless otherwise shown.
- B. Excavation, backfill and surface restoration shall be performed in accordance with provisions stated in Section 31 23 17, Trenching.
- C. Do not damage the main in any way during the service installation.
- D. Water Main Tap
 - 1. All direct service taps shall be made with a drilling and tapping machine intended for use on ductile iron pipe as manufactured by Mueller or approved equal. Hand held equipment is not allowed. Coupons shall be removed from pipe.
 - a. The drilling and tapping machine shall have alignment tool guides and a placement strap.
 - 2. Direct threaded taps shall engage a minimum of four (4) full threads.
 - 3. Direct taps shall require the use of two (2) layers of 3 mil tetrafluoroethylene (TFE) tape on the threads of the corporation stop. Liquid TFE will not be allowed.
 - 4. Direct taps for 1-inch diameter services are allowed only on mains that are 6 inches in diameter or larger.
 - 5. Service saddles are required on water mains 4 inches in diameter and larger and for all services taps larger than 1-inch diameter.

6. Install corporation stop at a 45-degree angle from the cross section vertical axis of the water main being tapped, unless otherwise shown on the Plans.
 7. Install swing joint on all 2-inch diameter services.
- E. Piping
1. Cut service pipes using tools specifically designed to leave a smooth, even, and square end on the material being cut.
 2. Ream cut ends to the full inside diameter of the pipe.
 3. Clean pipe ends to a sound, smooth finish prior to using compression connections which seal to the outside surface of the pipe.
- F. Water Meters:
1. Install positive displacement meters according to AWWA M6 and as shown in the Drawings.
- G. Backflow Preventers:
1. Install backflow preventers where indicated on Drawings and according to manufacturer instructions.
 2. Testing and Installation Requirements: Comply with local water company requirements and plumbing codes.
- H. Service Connections:
1. Install water service according to details in the Drawings.
 2. Install water meter precast concrete meter box located on Site as specified in Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes
 3. Locate meter box as shown in the Drawings. Final location to be determined in the field by Engineer.
- I. Service Renewal:
1. Install service line and angle meter stop from the water main to the inside of existing meter box location.
 2. Where service renewals are to be connected to existing meters, stub up and terminate service run at angle meter stop where shown.

3. Where no meter is to be installed, place angle meter stop at 18 inches from face of curb with 12 inches to the springline in an approved box.
 4. Owner will connect all service lines at the new meters or to existing service piping as shown.
 5. Adjust meter box to finished grade after the service piping has been installed and surface has been restored to the satisfaction of the Engineer.
- J. Trenchless Installation:
1. All water service installations under existing pavement, curbs, sidewalks or other surface improvements may be installed by trenchless construction techniques at Contractor option where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks and other structures.
 2. The Owner's Representative must approve all trenchless installation methods.
 3. Where trenchless pipe installation is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks and other surface improvements whose replacement is avoided by use of a trenchless method, such as tunneling.

3.3 CORROSION PROTECTION

- A. Install cathodic protection items where required, including dielectric insulating corporation stops, dielectric insulating joints, tape wrap, and grounding rod in accordance with Section 264201, Pipeline Cathodic Protection Systems.

3.4 FLUSHING AND DISINFECTION

- A. Flush and disinfect all service connections and appurtenances in accordance with Section 331300, Testing and Disinfection of Water Utility Distribution Pipelines.

3.5 FIELD QUALITY CONTROL

- A. Pressure test water distribution system according to AWWA C600 and Section 33 11 10, Water Utility Distribution Piping.
- B. Compaction Testing for Bedding: See Section 33 11 10, Water Utility Distribution Piping for compaction testing requirements. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes valves and valve boxes for installation with buried water distribution and transmission main, including fire hydrants and tapping sleeves.
- B. Section Includes:
 - 1. Valves.
 - 2. Valve boxes.
 - 3. Valve operator extensions.
- C. Related Requirements:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints
 - 2. Section 33 11 10 - Water Utility Distribution and Transmission Piping: Piping trenching, backfilling, and compaction requirements.
 - 3. Section 33 12 13 - Water Service Connections: Pipe materials, fittings, and service connection appurtenances and installation requirements.
 - 4. Section 33 12 19 - Water Utility Distribution Fire Hydrants: Execution requirements for fire hydrants.
 - 5. Section 33 13 00 - Testing and Disinfecting of Water Utility Distribution: Flushing and disinfection requirements.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
 - 3. ASME 1.20.1 - General Purpose Pipe Threads (Inch)
- B. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
 - 2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service

3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants
 4. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- C. ASTM International (ASTM):
1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications
- D. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects
 2. NSF 372 - Drinking Water System Components - Lead Content

1.3 COORDINATION

- A. The Contractor shall cause the Supplier of valves to coordinate installation such that all pipes, valves, fittings, appurtenances, and equipment are compatible and capable of achieving the performance requirements specified in the Contract Documents.
- B. Coordinate Work of this Section with City of Tigard standards and utilities within construction area.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Lining and coating data.
- F. Valve Labeling: Schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the valve.
- G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Tools: Furnish one tee wrench of required length to Owner.

1.7 QUALITY ASSURANCE

- A. Cast manufacturer's name, maximum working pressure, size of valve, and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, American National Standards Institute (ANSI), ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.
- D. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
- E. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves and accessories for shipment according to applicable AWWA standards.
- B. Seal valve and ends to prevent entry of foreign matter.
- C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- D. Storage:
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.

- 2. Do not store materials directly on ground.
- E. Handle products carefully to prevent damage to interior or exterior surfaces.
- F. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT WEDGE GATE VALVES

- A. As specified in Section 40 05 61, Gate Valves.
- B. Connecting Hardware:
 - 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Gaskets:
 - 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 DOUBLE-DISC GATE VALVES

- A. As specified in Section 40 05 61, Gate Valves.
- B. Connecting Hardware:
 - 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Gaskets:
 - 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.4 SOLID WEDGE, METAL-SEATED GATE VALVES

- A. As specified in Section 40 05 61, Gate Valves.
- B. Connecting Hardware:
 - 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Gaskets:
 - 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.5 RUBBER-SEATED BUTTERFLY VALVES

- A. As specified in Section 40 05 64, Butterfly Valves.
- B. Operation:
 - 1. All buried valves shall be provided with 2-inch square operating nuts.
- C. Connecting Hardware:
 - 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- D. Gaskets:
 - 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.6 ACTUATORS

- A. Unless otherwise indicated, all valves shall be furnished with manual actuators.
- B. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.
- C. All gear-assisted valves that are buried and submerged shall have the actuators hermetically sealed and grease-packed.
- D. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

2.7 VALVE BOXES

- A. Provide all buried valves with valve boxes, covers and risers. All valve boxes to be surrounded by 4-inch thick, 24-inch by 24-inch square concrete maintenance pad.
- B. Valve Boxes:
 - 1. Materials: 18-inch Cast iron 910 box.
 - 2. Construction:
 - a. Walls not less than 3/16-inch thick at any point.
 - b. Internal diameter not less than 5 inches.
 - 3. Type: Two-piece extension.
 - 4. Manufacturers:
 - a. Olympic Foundry.
 - b. Brooks Products.
- C. Covers:
 - 1. Construction:
 - a. Prevents dislodging and rotation from traffic.
 - b. Allows a hand-held pry bar to be applied for easy removal.
 - 2. Materials: Cast iron.
 - 3. Lid Inscription: **W**
 - 4. Manufacturers: Matching that of valve box.
- D. Riser:
 - 1. Polyvinyl Chloride (PVC) Pipe:
 - a. ASTM D3034, SDR 35 PVC.
 - b. White, Schedule 40, 8-inch diameter.
 - c. Length as shown on details in the Drawings.

2.8 VALVE OPERATOR EXTENSIONS

- A. As shown in the Drawings.

- B. Provide operator extensions to a maximum of 12 inches below grade where depth to valve exceeds 36 inches.

2.9 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Locate, identify, and protect from damage utilities to remain.
- D. Access:
 - 1. All valves shall be installed to provide easy access for operation, removal, and maintenance.
 - 2. Avoid conflicts between valve operators and above grade construction such as structural members or handrails.
- E. Valve Accessories:
 - 1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.
 - 2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.2 INSTALLATION

- A. General:
 - 1. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown in the Drawings and as specified herein.
 - 2. Valves shall be firmly supported to avoid undue stresses on the pipe.

3. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment, where applicable.
- B. Perform trench excavation, backfilling, and compaction as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Install valves in conjunction with pipe laying.
- D. Set valves plumb.
- E. Provide buried valves with valve boxes installed flush with finished grade.
 1. Valves installed out of paved or otherwise hard-surfaced areas shall be set in a concrete pad at finished grade.
 2. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick.
- F. Disinfection of Water Piping System:
 1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Distribution.

3.3 FIELD QUALITY CONTROL

- A. Pressure test valving for water distribution system according to AWWA C600 and in accordance with Section 33 13 00, Testing and Disinfecting of Water Utility Distribution.
- B. Field Testing of Valves:
 1. All valves 24-inch diameter or larger, and all in-line transmission main valves, shall be pressure and leakage tested at the Site and shall pass the field testing prior to installation.
 2. Valves shall be tested at 1.5 times normal operating pressure, 150 pounds per square inch (psi) minimum.
 3. No valve shall be accepted for installation that fails to pass the field pressure test. Any valves failing field pressure tests shall be replaced by the Contractor at no additional cost to the Owner.
 4. Engineer shall witness field testing.

END OF SECTION

SECTION 33 12 19 - FIRE HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section addresses dry-barrel fire hydrants used in water supply service.
- B. Section includes:
 - 1. Fire hydrants used in water main installations.

1.2 RELATED SECTIONS:

- A. Section 03 11 00 – Concrete Work
- B. Section 31 05 16 - Aggregates for Earthwork
- C. Section 31 23 17 - Trenching
- D. Section 33 13 00 – Testing and Disinfecting of Water Utility Piping

1.3 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA C502 - Dry-Barrel Fire Hydrants
 - 2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
 - 3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.4 COORDINATION

- A. All hydrants supplied for the Project shall be of like kind from a single manufacturer.

1.5 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's latest published literature, including illustrations, installation and maintenance instructions, and parts lists.
- C. Shop Drawings: Submit description of proposed installation.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of fire hydrants and service valves.
- B. Operation and Maintenance Data: Submit data for hydrants.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare hydrants and accessories for shipment according to AWWA standards.
- B. Seal hydrant and ends to prevent entry of foreign matter.
- C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- D. Storage:
 - 1. Store materials in areas protected from weather, moisture, or potential damage.
 - 2. Do not store materials directly on ground.
- E. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

- A. Manufacturers:
 - 1. Mueller Company, Super Centurion Model A-423
- B. Dry-Barrel Breakaway Type:
 - 1. Comply with AWWA C502.
 - 2. Body: Cast iron.
 - 3. Valve: Compression type.
 - 4. Burial Depth: As indicated on Drawings.
 - 5. Inlet Connection Size: 6 inches (150 millimeters).
 - 6. Valve Opening: 5-1/4 inches (133 millimeters) in diameter.
 - 7. End Connections: Mechanical joint or bell end.
 - 8. Bolts and Nuts: Galvanized steel.

9. Interior Coating: Comply with AWWA C550.
10. Direction of Opening: Counterclockwise unless otherwise indicated.

C. Hose Connections:

1. One 4-1/2-inch diameter pumper, two 2-1/2-inch diameter hose nozzles.
2. Obtain thread type and size from local fire department.
3. Attach nozzle caps by separate chains.

D. Finishes:

1. Primer and two coats of enamel.
2. Color: R-1317, Safety Yellow.

2.2 NSF INTERNATIONAL (NSF) REQUIREMENTS

- A. All fire hydrants must be NSF/ANSI Standard 61 certified and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.

2.3 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 1 00, Concrete Work.
- B. Aggregate: Aggregate for hydrant drainage as specified in Section 31 05 16, Aggregates for Earthwork.

2.4 OUT OF SERVICE COVERS/OUT OF SERVICE RINGS

- A. Provide orange plastic bag with reflective tape, or red plastic hydrant out of service rings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify location and size of hydrants from Drawings. Final location of hydrants to be determined by Engineer in the field.
- B. Obtain clarification and directions from Engineer prior to execution of Work.
- C. If installing a hydrant on an existing water system, verify invert elevation of existing piping is as indicated on Drawings prior to excavation and installation of fire hydrant.

3.2 PREPARATION

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Locate, identify, and protect from damage utilities to remain.
- D. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
 - 1. Notify Owner and Engineer not less than 48 hours in advance of proposed utility interruption.
 - 2. Do not proceed without written permission from Engineer.
 - 3. Only District staff shall operate valves in existing system.

3.3 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 17, Trenching.
- B. Install pier support block and drainage gravel for fire hydrants; do not block drain hole.
 - 1. Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.
 - 2. Place textile fabric to cover drain rock prior to placement of backfill.
 - 3. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.
- C. Set fire hydrants plumb with pumper nozzle facing roadway.
- D. Set fire hydrants with centerline of pumper nozzle 18 inches (450 millimeters) above finished grade, and with safety flange not more than 6 inches (150 millimeters) nor less than 2 inches (50 millimeters) above grade. Install hydrant extensions where required and as approved.
- E. Paint hydrants according to color scheme of local authorities having jurisdiction. Touch up paint after hydrant installation and testing.
- F. After hydrostatic testing, flush hydrants and check for proper drainage.

G. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

- A. Pressure test water distribution system according to AWWA C600 and Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.5 CONCRETE HYDRANT PADS

- A. When hydrant is place within sidewalks, form and pour-in-place 36-inch by 36-inch by 6-inch, 4,000 pounds per square inch (psi) concrete pad around the hydrant after the hydrant has been installed and set to grade.
- B. Center hydrant pad on the hydrant. Set hydrant pad so top of pad is flush with surrounding surface, or as directed by the Engineer.
- C. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than 1-foot in any one direction.

3.6 OUT-OF-SERVICE HYDRANTS

- A. To indicate that the fire hydrant is NOT operational, secure reflective tape, an orange plastic bag over the entire hydrant assembly or an approved out-of-service cover.
- B. An out-of-service ring may also be used in addition to the bag or cover in case of removal of the cover.
- C. Maintain the plastic bag up until the waterline is accepted by the Owner.

END OF SECTION

SECTION 33 13 00 - TESTING AND DISINFECTING OF WATER UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes hydrostatic pressure testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.
- B. Section Includes:
 - 1. Pressure testing and disinfection of potable water distribution and transmission piping systems and appurtenances.
 - 2. Testing and reporting of results.
- C. Related Requirements:
 - 1. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 2. Section 33 12 16 - Water Utility Distribution Valves
 - 3. Section 33 12 19 - Fire Hydrants
 - 4. Section 33 12 13 - Water Service Connections

1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA B300 - Hypochlorites
 - 2. AWWA B301 - Liquid Chlorine
 - 3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 - 4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
 - 5. AWWA C651 - Disinfecting Water Mains
 - 6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

- A. Section 01 33 00 –Submittals Procedures: Requirements for submittals.
- B. Product Data: Submit procedures, proposed chemicals, and treatment levels.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Engineer a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:

1. Testing schedule.
2. Hydrostatic Testing Plan:
 - a. Narrative of the proposed process.
 - b. Proposed equipment to be used.
 - c. Disposal location for excess water used to fill mains.
3. Disinfection Plan:
 - a. Narrative of the proposed process.
 - b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.
 - c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.
 - d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.
 - e. Proposed plan for testing chlorine levels throughout the length of pipeline.
4. Proposed testing locations.
5. Proposed plan for water conveyance, including flow rates.
6. Proposed plan for water control.
7. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.
8. Proposed measures to be incorporated in the project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

- A. Disinfection Report:
 1. Type and form of disinfectant used.
 2. Date and time of disinfectant injection start and time of completion.
 3. Test locations.
 4. Name of person collecting samples.

5. Initial and 24-hour disinfectant residuals in treated water in parts-per million (ppm) for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

1.5 QUALITY ASSURANCE

- A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer’s review. No materials shall be used which would be injurious to the construction or its future functions.
- B. All temporary thrust restraint and equipment and facilities required for hydrostatic testing will be considered incidental.
- C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Engineer.
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as needed and required for the testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Engineer, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

- A. Chemicals:
 1. Hypochlorite: Comply with AWWA B300.
 2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 HYDROSTATIC TESTING OF WATER PIPING

A. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.

B. No section of the pipeline shall be hydrostatically tested until backfill has been placed, compacted, and passed required density testing and all field-placed concrete or mortar has attained full strength.

1. At the Contractor's option, early strength concrete may be used when the full-strength requirements conflict with schedule requirements.
2. All such substitutions and installations shall be approved by the Engineer prior to installation.

C. Provide 72-hour notification to the Engineer and Owner prior to conducting hydrostatic testing.

1. Provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner's existing system during hydrostatic testing and disinfecting procedures.
2. The Contractor shall not operate any part of the existing water systems.

D. Pipe Filling:

1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.
2. Take all required precautions to prevent entrapping air in the pipes.
3. Allow for natural absorption of water by the lining of the pipe to occur.
4. Apply specified test pressure by pumping.

E. Testing of Mains:

1. Ductile Iron: In accordance with AWWA C600.

2. Polyvinyl chloride (PVC): In accordance with AWWA C605.
3. General:
 - a. Tests shall be conducted under a hydrostatic test pressure not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, minimum 150 psi, unless otherwise shown in the Drawings.
 - b. In no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.
 - c. Testing shall be performed by applying the specified test pressure by pumping.
 - d. Once the test pressure has been attained, the pump shall be valved off.
 - e. The test will be conducted for a 2-hour period with the allowable leakage not to exceed the value as calculated per the Allowable Leakage formula below.
 - f. During the test period, there shall be no appreciable or abrupt loss in pressure.
4. Allowable Leakage:
 - a. Flanged Joints: Pipe, fittings, and valves with flanged joints shall be completely watertight. No leakage allowed.
 - b. Mechanical or Push-on Joints: Pipe, fittings and valves with rubber gasketed joints shall have a measured loss not to exceed the rate given in the following Allowable Leakage formula:

$$AL = \frac{LD(P)^{1/2}}{148,000}$$

In the above formula:

- AL = Allowable leakage, in gallons per hour
- L = Length of pipe tested, in feet
- D = Nominal diameter of pipe, in inches
- P = Average test pressure during the leakage test, in pounds per square inch.

5. Maintaining Pressure:

- a. During the test period, operate the pump as required to maintain pressure in the pipe within 5 psi of the specified test pressure at all times.
- b. At the end of test period, operate the pump until the specified test pressure is again obtained.
 - 1) The pump suction shall be in a clean, graduated barrel, or similar device or metered so that the amount of water required to restore the test pressure may be accurately measured.
 - 2) Sterilize this makeup water by adding chlorine to a concentration of 25 milligrams per liter (mg/L).
- c. The Engineer will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.
- d. Each hour's loss stands on its own and will not be averaged.

6. Defects, Leakage, Failure:

- a. If the test reveals any defects, leakage in excess of the allowable, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.
- b. Correct any visible leakage regardless of the allowable leakage specified above.
- c. All leaks shall be repaired in a manner acceptable to the Engineer.
- d. The testing of the line shall be repeated until a test satisfactory to the Engineer has been achieved.

3.2 DISINFECTION OF WATER PIPING

- A. Disinfection shall be in accordance with the latest version of AWWA C651 following Engineer's acceptance of hydrostatic testing.
- B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.
- C. Flush all foreign matter from the pipeline, branches and services.
 1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.
 2. Flushing velocities shall be at least 2.5 feet per second (fps).

3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.
- D. Chlorine Application:
1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.
 2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.
- E. Chlorine Residual:
1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.
 2. Adjust the dose rate as necessary to maintain the target dose rate.
- F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.
1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Engineer.
 2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.
 3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.
- G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.
1. There is no minimum flushing velocity for this step.
- H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.
1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.
 2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by <_____>.

3.3 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

- A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.
- B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.
- C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.
- D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.
 - 1. During the system startup, the Engineer and Contractor shall visually inspect all new fittings, piping, valves and appurtenances for evidence of leakage.
 - 2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Engineer.

3.4 FIELD QUALITY CONTROL

- A. Bacteriological Sampling and Testing:
 - 1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.
 - a. The locations for sample collection shall be at the sole discretion of the Owner and Engineer.
 - b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.
 - 2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:
 - a. Bacterial Sampling
 - 1) Option A:
 - a) Take an initial set of samples using sampling site procedures outlined herein.

- b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.
 - c) Both sets of successive samples must pass for the main to be approved for service.
- 2) Option B:
 - a) Allow main to sit for a minimum of 24 hours without any water use.
 - b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.
 - c) Both sets of samples must pass for the main to be approved for service.
- 3) Allow 24 hours for the test results for each sample set.
- b. Sampling Locations
 - 1) The Owner will take one bacteriological sample from the end of the main and on each branch.
 - 2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.
- c. Sample Testing
 - 1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.
- d. Evaluating the Test Results
 - 1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Engineer.
 - 2) When two consecutive sample sets test negative (passing) for coliform bacteria, the bacterial testing is complete.
- e. Completion of Bacterial Testing
 - 1) Upon completion of bacterial testing, notify the Owner shall notify the Engineer and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

- 1) If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.
3. Results of the bacteriological testing shall be satisfactory with the <_____> and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 33 31 10 - SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes pipe materials, manholes, and accessories normally used with gravity sanitary sewers.
- B. Section includes:
 - 1. Sanitary sewerage pipe and fittings.
 - 2. Pipe markers.
 - 3. Connection to existing manholes.
 - 4. Manholes.
 - 5. Wye branches and tees.
 - 6. Sanitary laterals.
 - 7. Bedding and cover materials.

1.2 RELATED SECTIONS

- A. Section 03 21 00 - Reinforcing Steel
- B. Section 03 11 00 - Concrete Work
- C. Section 03 60 00 - Grouting
- D. Section 09 80 00 - Protective Coatings
- E. Section 31 05 13 - Soils for Earthwork
- F. Section 31 05 16 - Aggregates for Earthwork
- G. Section 31 23 16 - Excavation
- H. Section 31 23 17 - Trenching
- I. Section 31 23 23 - Fill
- J. Section 33 01 30.13 - Sewer and Manhole Testing
- K. Section 33 05 13 - Manholes

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
 - 1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
6. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
7. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
8. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
10. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
11. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
12. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
13. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
14. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
16. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
17. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

18. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153 - Ductile-Iron Compact Fittings.
8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.4 COORDINATION

- A. Notify affected utility companies at least 72 hours prior to construction.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.
- B. Shop Drawings:
1. Indicate layout of sewer system and appurtenances.
 2. Show size, materials, components of system, and burial depth.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the manufacturer.
- D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.
- E. Manufacturer Instructions:
1. Indicate special procedures required to install specified products.

2. Submit detailed description of procedures for connecting new sewer to existing sewer line.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Materials:
1. Unless otherwise noted, all water works materials provided for the project shall be new, of first-class quality and shall be made by reputable manufacturers.
 2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.
 3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.
 4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
1. Store materials according to manufacturer instructions.
- C. Protection:
1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.
 2. Block individual and stockpiled pipe lengths to prevent moving.
 3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 SANITARY SEWERAGE PIPE AND FITTINGS

A. Plastic Pipe:

1. Material:

- a. Polyvinyl chloride (PVC), manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454-B.
- b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.

2. Fittings: PVC.

3. Pipe and fittings 4 inches to 15 inches in diameter:

- a. Comply with ASTM D3034, SDR 35.

4. Pipe and fittings 18 inches and larger in diameter:

- a. Comply with ASTM F679, PS46.
- b. Pipe shall have a minimum stiffness of 46 pounds per square inch (psi).

5. AWWA C900 Pipe:

- a. 4 inches to 12 inches in diameter.
- b. DR 25.
- c. Pipe shall have minimum stiffness of 149 psi.

6. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.

7. Joints:

- a. Integral bell push-on type: Comply with ASTM D3212.
- b. For use with AWWA C900 pipe: Integral bell push-on type: Comply with ASTM D3139.

8. Gaskets:
 - a. Factory installed.
 - b. Elastomeric gaskets: Comply with ASTM F477.
- B. Ductile-Iron Pipe:
 1. Comply with AWWA C151.
 2. Minimum Special Thickness Class: 52.
 3. End Connections: Bell and spigot or plain, as shown in the Drawings.
 4. Outside Coating:
 - a. Type: Asphaltic coating, minimum 1-mil uniform thickness.
 - b. Comply with AWWA C151.
 5. Lining:
 - a. Cement mortar lined.
 - b. Comply with AWWA C104.
 6. Polyethylene encasement: Comply with AWWA C105.
 7. Fittings:
 - a. Material: Ductile iron.
 - b. Comply with AWWA C153 or AWWA C110.
 - c. Lining: Cement-mortar lined according to AWWA C104.
 8. Coating:
 - a. Coat pipe and fittings exposed inside of structures with two coats of bituminous paint to achieve minimum dry film thickness of 6 mils per coat.
 - b. Material as specified in Section 09 90 00 - Painting and Coating.
 9. Joints:
 - a. Rubber gasket joint devices.
 - b. Comply with AWWA C111.
- C. Reinforced Concrete Pipe:
 1. Comply with ASTM C76, Class V, with Wall Type C.

2. Reinforcement: Mesh.
3. End Connections: Bell and spigot.
4. Fittings: Reinforced concrete.
5. Joints:
 - a. Rubber compression gasket.
 - b. Comply with ASTM C443.

2.2 FLEXIBLE COUPLINGS

A. Description:

1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
2. Attachment: Two [Series 300] stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

1. Material: Ethylene propylene rubber (EPDM).
2. Comply with ASTM C923.
3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.
2. Strength: Minimum 3,000 psi at 28 days.
3. Air entrained.
4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.5 MANHOLES

A. Description:

1. As specified in Section 33 05 13 - Manholes.
2. Material: Precast concrete.
3. Diameter: As shown in the Drawings.
4. Top: Eccentric cone.
5. Frames and Covers: Watertight cast iron.
6. Cover Inscription: "SS"

2.6 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 - c. Subsoil Type S1 and/or S2 as specified in Section 31 05 13, Soils for Earthwork.

2.7 MIXES

- ### A. Grout: As specified in Section 03 60 00, Grouting.

2.8 ACCESSORIES

- ### A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut, or excavation base is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over-excavation in accordance with Section 31 23 17, Trenching.
- B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- C. Protect and support existing sewer lines, utilities, and appurtenances.
- D. Utilities:
 1. Maintain profiles of utilities.

2. Coordinate with other utilities to eliminate interference.
3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17, Trenching.
2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.
3. Pipe base shall be observed by Engineer prior to placement of the pipe.
4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
5. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.
6. Placement:
 - a. Place bedding material at trench bottom.
 - b. Level materials in continuous layer not exceeding 6 inches compacted depth.
 - c. Compact to 95 percent of maximum density.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.
 - a. PVC: Comply with ASTM D2321.
 - b. Ductile Iron: Comply with AWWA C600.
 - c. Reinforced Concrete: Comply with ASTM C1479.
2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
3. Lay pipe to slope gradients and line as indicated on Drawings.
4. Variations:
 - a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.
 - b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than 1/4-inch.

c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.

5. Begin at downstream end and progress upstream.
6. Assemble and handle pipe according to manufacturer's instructions, except as may be modified on Drawings or by Engineer.
7. Make straight field cuts without chipping or cracking pipe.
8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.
9. Assemble pipe joints in accordance with manufacturer's recommendations/specifications.
10. Cap open ends during periods of Work stoppage.
11. Lay bell and spigot pipe with bells upstream.
12. Polyethylene Pipe Encasement: Conform to AWWA C105.
13. Backfill and compact as specified in Section 31 23 17, Trenching.
14. Do not displace or damage pipe when compacting.
15. Pipe Markers: As specified in Section 31 23 17, Trenching.

C. Joints:

1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.
2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.
3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the pipe manufacturer.
4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.
5. The pipe is then forced "home" firmly and fully.

6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.
- D. Connection to Existing Manholes:
1. Drilling:
 - a. Core drill existing manhole to clean opening.
 - b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.
 2. Install watertight neoprene gasket and seal with non-shrink concrete grout.
 3. Encasement:
 - a. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint.
 - b. Use epoxy binder between new and existing concrete.
 4. Prevent construction debris from entering existing sewer line when making connection.
- E. Manholes:
1. Install manholes as specified in Section 33 05 13, Manholes and Structures.
- F. Wye Branches and Tees:
1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.
 2. Use standard fittings of same material and joint type as sewer main.
 3. Maintain minimum 5-foot separation distance between wye connection and manhole.
 4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
 5. Mount saddles with solvent cement or gasket and secure with metal bands.
 6. Lay out holes with template and cut holes with mechanical cutter.
- G. Sanitary Laterals:
1. Construct laterals from wye branch to terminal point at right-of-way or where otherwise shown in the Drawings.

2. Where depth of main pipeline warrants, construct riser-type laterals from wye branch.
 3. Minimum Depth of Cover over Piping: 2 feet.
 4. Minimum Separation Distance between Laterals: 5 feet.
 5. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral.
 6. Marker Stake:
 - a. Install temporary marker stake extending from end of lateral to 12 inches above finished grade.
 - b. Paint top 6 inches of stake with fluorescent orange paint.
- H. Backfilling:
1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.
 2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to and immediately after placing bedding.
- B. Testing:
1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
 2. Pipe Testing: As specified in Section 33 01 30.13, Sewer and Manhole Testing.
 3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 41 10 - STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes pipe materials and accessories normally used with gravity storm drainage sewers.
- B. Section includes:
 - 1. Storm drainage piping
 - 2. Piping accessories
 - 3. Connection to existing manholes
 - 4. Catch basins and area drains
 - 5. Cleanouts
 - 6. Bedding and cover materials

1.2 RELATED SECTIONS

- A. Section 03 11 00 – Concrete Work
- B. Section 03 60 00 - Grouting
- C. Section 31 05 13 - Soils for Earthwork
- D. Section 31 05 16 - Aggregates for Earthwork
- E. Section 31 23 16 - Excavation
- F. Section 31 23 17 - Trenching
- G. Section 31 23 23 - Fill
- H. Section 33 01 30.13 - Sewer and Manhole Testing
- I. Section 33 05 13 - Manholes

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 5. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
 6. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
 7. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
 8. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 9. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 10. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 11. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 13. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 14. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

15. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 16. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 17. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 18. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 19. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- C. American Water Works Association (AWWA):
1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 4. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
 5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
 6. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.4 COORDINATION

- A. Notify affected utility companies at least 72 hours prior to construction.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Product Data: Submit manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the manufacturer.

- D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.
- E. Manufacturer Instructions:
 - 1. Indicate special procedures required to install specified products.
 - 2. Submit detailed description of procedures for connecting new storm sewer to existing storm sewer line.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
 - 1. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.
 - 2. Block individual and stockpiled pipe lengths to prevent moving.
 - 3. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Polyvinyl Chloride (PVC) Pipe:

1. Material:
 - a. Manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454-B.
 - b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.
2. Pipe and fittings 4 inches to 15 inches in diameter, non-pressurized:
 - a. Comply with ASTM D3034, SDR 35.
3. Pipe and fittings 18 inches and larger in diameter, non-pressurized:
 - a. Comply with ASTM F679, PS46.
 - b. Pipe shall have a minimum stiffness of 46 pounds per square inch (psi).
4. AWWA C900 Pipe:
 - a. At locations shown in the Drawings.
 - b. Four inches to 12 inches in diameter.
 - c. DR 25.
 - d. Pipe shall have minimum stiffness of 149 psi.
5. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.
6. Joints:
 - a. Integral bell push-on type: Comply with ASTM D3212.
 - b. For use with AWWA C900 pipe: Integral bell push-on type comply with ASTM D3139.
7. Gaskets:
 - a. Factory installed.
 - b. Elastomeric gaskets: Comply with ASTM F477.

B. Ductile Iron Pipe:

1. Comply with AWWA C151.

2. Minimum Special Thickness Class: 52.
 3. End Connections: Bell and spigot or plain, as shown in the Drawings.
 4. Outside Coating:
 - a. Type: Asphaltic coating, minimum 1-mil uniform thickness.
 - b. Comply with AWWA C151.
 5. Lining:
 - a. Cement mortar lined.
 - b. Comply with AWWA C104.
 6. Fittings:
 - a. Material: Ductile iron.
 - b. Comply with AWWA C153 or AWWA C110.
 - c. Lining: Cement-mortar lined according to AWWA C104.
 7. Coating:
 - a. Asphaltic exterior coating in accordance with AWWA Standard C151.
 8. Joints:
 - a. Rubber gasket joint devices.
 - b. Comply with AWWA C111.
- C. High Density Polyethylene (HDPE) Pipe:
1. Double wall, ribbed pipe with smooth interior.
 2. Solid pipe, perforated pipe, and fittings shall meet the requirements of ASTM F-405 and F-667
 3. Pipe 3 inches to 10 inches in diameter: Comply with AASHTO M-252.
 4. Pipe 12 inches to 36 inches in diameter: Comply with AASHTO M-294.
 5. Joints: Integral bell push-on type.
 6. Manufacturers:
 - a. ADS, N-12 with Pro Link joints, or approved equal.

D. Acrylonitrile-Butadiene-Styrene (ABS) Pipe:

1. Single walled. Comply with ASTM D2680, SDR 23.5.
2. Perforated.
 - a. Three-eighths-inch diameter holes, 3 inches on center.
3. Inside Nominal Diameter: 4 inches.
 - a. Minimum Wall Thickness: 0.140 inches.
 - b. One row of perforations on each side of pipe, approximately 45 degrees above bottom centerline of pipe.
4. Inside Nominal Diameter: 6 inches.
 - a. Minimum Wall Thickness: 0.200 inches.
 - b. Two rows of perforations on each side of pipe, approximately 45 degrees above bottom centerline of pipe.
5. Ends:
 - a. Style: Bell and spigot.
 - b. Type: Solvent sealed.
6. Fittings: ABS.
7. Joints:
 - a. Type: Solvent weld.
 - b. Comply with ASTM D2235.

E. Reinforced Concrete Pipe:

1. Comply with ASTM C76, Class V, with Wall Type C.
2. Reinforcement: Mesh.
3. End Connections: Bell and spigot.
4. Fittings: Reinforced concrete.
5. Joints:
 - a. Rubber compression gasket.
 - b. Comply with ASTM C443.

2.2 FLEXIBLE COUPLINGS

A. Description:

1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
2. Attachment: Two Series 300 stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

1. Material: Ethylene propylene rubber (EPDM).
2. Comply with ASTM C923.
3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 11 00, Concrete Work.
2. Strength: Minimum 3,000 psi at 28 days.
3. Air entrained.
4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 11 00, Concrete Work.

2.5 MANHOLES

A. Description:

1. As specified in Section 33 05 13 - Manholes and Structures.
2. Material: Reinforced precast or cast-in-place concrete.
3. Diameter: As shown in the Drawings.
4. Top: Eccentric cone.
5. Frames and Covers: Watertight cast iron.
6. Cover Inscription: "S".

2.6 CATCH BASINS AND AREA DRAINS

A. Construction:

1. Material: Reinforced concrete pipe sections.
 - a. Minimum compressive strength of 3,000 psi at 28 days.
 - b. Precast concrete inlets shall conform to ASTM C913.
2. Joints: Lipped male/female.

3. Nominal Interior Dimensions: As shown in the Drawings.
- B. Lids and Frames:
1. Materials: Cast iron.
 2. Lid:
 - a. Removable.
 - b. Design: Linear grill.
 3. Nominal Lid and Frame Size: As shown in the Drawings.

2.7 CLEANOUTS

- A. Construction:
1. Per details provided in the Drawings.
- B. Lids and Frames:
1. Materials: Cast iron. Meet H2O load requirement.

2.8 MATERIALS

- A. Bedding and Cover:
1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 - c. Subsoil Type S1 and/or Type S2, as specified in Section 31 05 13, Soils for Earthwork.

2.9 MIXES

- A. Grout: As specified in Section 03 60 00, Grouting.

2.10 ACCESSORIES

- A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut, or excavation base is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over-excavation in accordance with Section 31 23 17, Trenching.
- B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- C. Protect and support existing sewer lines, utilities, and appurtenances.
- D. Utilities:
 - 1. Maintain profiles of utilities.
 - 2. Coordinate with other utilities to eliminate interference.
 - 3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

- A. Bedding:
 - 1. Excavate pipe trench as specified in Section 31 23 17, Trenching.
 - 2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.
 - 3. Pipe base shall be observed by Engineer prior to placement of the pipe.
 - 4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
 - 5. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.
 - 6. Placement:
 - a. Place bedding material at trench bottom.
 - b. Level materials in continuous layer not exceeding 6 inches compacted depth.

c. Compact to 95 percent of maximum density.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.
 - a. PVC, HDPE, ABS: Comply with ASTM D2321.
 - b. Ductile Iron: Comply with AWWA C600.
 - c. Reinforced Concrete: Comply with ASTM C1479.
2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
3. Lay pipe to slope gradients and line as indicated on Drawings.
4. Variations:
 - a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.
 - b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than 1/4-inch.
 - c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.
5. Begin at downstream end and progress upstream.
6. Assemble and handle pipe according to manufacturer's instructions, except as may be modified on Drawings or by Engineer.
7. Make straight field cuts without chipping or cracking pipe.
8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.
9. Assemble pipe joints in accordance with manufacturer's recommendations/specifications.
10. Cap open ends during periods of Work stoppage.
11. Lay bell and spigot pipe with bells upstream.
12. Backfill and compact as specified in Section 31 23 17, Trenching.

13. Do not displace or damage pipe when compacting.

14. Pipe Markers: As specified in Section 31 23 17, Trenching.

C. Joints:

1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.
2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.
3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the pipe manufacturer.
4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.
5. The pipe is then forced "home" firmly and fully.
6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.

D. Connection to Existing Manholes:

1. Drilling:
 - a. Core drill existing manhole to clean opening.
 - b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.
2. Install watertight neoprene gasket and seal with non-shrink concrete grout.
3. Encasement:
 - a. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint.
 - b. Use epoxy binder between new and existing concrete.
4. Prevent construction debris from entering existing sewer line when making connection.

E. Manholes:

1. Install manholes as specified in Section 33 05 13, Manholes.

F. Wye Branches and Tees:

1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.
2. Use standard fittings of same material and joint type as sewer main.
3. Maintain minimum 5-foot separation distance between wye connection and manhole.
4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
5. Mount saddles with solvent cement or gasket and secure with metal bands.
6. Lay out holes with template and cut holes with mechanical cutter.

G. Catch Basins

1. Form bottom of excavation clean and smooth, and to indicated elevation.
2. Cast-in-place Concrete Construction:
 - a. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.
 - b. Level top surface of base pad.
 - c. Sleeve concrete shaft sections to receive storm sewer pipe sections.
 - d. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
3. Mount lid and frame level in grout, secured to top cone section to indicated elevation.

H. Backfilling:

1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.
2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to and immediately after placing bedding.
- B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
2. Pipe Testing: As specified in Section 33 01 30.13, Sewer and Manhole Testing.
3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 40 05 13 - COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping.

1.2 RELATED SECTIONS

- A. Section 05 50 00, Metal Fabrications
- B. Section 09 90 00, Painting and Coating
- C. Section 31 23 17, Trenching
- D. Section 33 11 10, Water Utility Distribution and Transmission Piping
- E. Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes.
- F. Section 33 13 00, Testing and Disinfecting of Water Utility Piping
- G. Section 40 05 23, Stainless Steel Process Pipe and Tubing

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B1.20.1 Pipe Threads, General Purpose (inch)
 - 2. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 3. ASME B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
 - 4. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
 - 5. ASME B31.3 - Process Piping.
 - 6. ASME B31.9 - Building Services Piping.
- B. ASTM International (ASTM):
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile.
 3. ASTM A325 - Specification for High-Strength Bolts for Structural Steel Joints.
 4. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 6. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 7. ASTM D792 - Test Methods for Specific Gravity and Density of Plastics by Displacement.
 8. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 10. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 11. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.
 12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 13. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
 14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- C. American Water Works Association (AWWA):
1. AWWA C200 - Steel Water Pipe - 6 In. (150 mm) and Larger.
 2. AWWA C207 - Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
 3. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 4. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 5. AWWA C510 - Double Check Valve Backflow Prevention Assembly.

6. AWWA C511 - Reduced-Pressure Principle Backflow Prevention Assembly.
 7. AWWA C606 - Grooved and Shouldered Joints.
 8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
- D. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code.
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:
1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- F. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects.
 2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

- A. Coordinate installation of specified items with installation of valves and equipment.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Submit manufacturer catalog information for each product specified.
- C. Shop Drawings:
1. Identification:
 - a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
 - b. Comply with ASME A13.1.
 2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.

3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.
- D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.
- F. Manufacturer Instructions: Submit special procedures and setting dimensions.
- G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping appurtenances.
- B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Drawings:
 1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.
- B. Inspection:
 1. All pipe shall be subject to inspection at the place of manufacture.
 2. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. Welding:

1. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1.
2. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welders:

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding.
2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency prior to commencing work on the pipeline.
3. Machines and electrodes similar to those used in the Work shall be used in qualification tests.
4. The Contractor shall furnish all material and bear the expense of qualifying welders.

E. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. Welds shall be tested as specified. The Contractor shall perform all tests at no additional cost to the Owner.

1.8 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection:

1. Accept materials on Site in manufacturer's original packaging and inspect for damage.
2. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to manufacturer instructions.
2. Store materials off the ground, to provide protection against oxidation caused by ground contact

- C. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
 3. Provide additional protection according to manufacturer instructions.
- D. All defective or damaged materials shall be replaced with new materials.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 2. All brass in contact with potable water shall comply with ASTM B584.
- B. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Material
Drainage/Sanitary Sewer	See Division 33.
Exposed ≥ 4”	Class 52 Ductile Iron or Heavy Wall Welded Steel
Buried ≥ 4”	Class 52 Ductile Iron
Submerged/Buried < 4”	Stainless Steel - Type 316 Schedule 40 Threaded - ASTM A 312 Fittings Welded or Threaded
Exposed < 4”	Brass - ASTM B 43, Fittings - Bronze - ASTM B 62 Threaded - ANSI/ASME B 16.15

Buried < 4"	Copper Tubing - ASTM B88 Type K Soft / Fittings - Wrought Copper - ANSI B16.22, Joints-Soldered
Miscellaneous Pipelines	As shown in the Drawings

2.2 DUCTILE IRON PIPE AND FITTINGS

- A. See Article 2.1.B, Ductile Iron Pipe of Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 STEEL PIPE AND FITTINGS

- A. General Service Piping:
 1. ASTM A53, seamless, Grade B.
 2. Schedule: 40, unless indicated otherwise on Drawings.
- B. Water Piping, 6 Inches and Larger: See Section 33 11 10.30, HDPE Water Utility Piping.

2.4 COPPER PIPE AND FITTINGS

- A. Description:
 1. Seamless; ASTM B88.
 2. Type:
 - a. Type L, hard drawn.
 - b. For pipe under floor slabs, underground or cast in concrete: Type K, annealed, seamless.
- B. Joints:
 1. Compression.
 2. Manufacturer: Mueller Model 110 or approved equal
- C. Dissimilar Metals: See Dielectric Unions specified herein.

2.5 BRASS PIPE AND FITTINGS

- A. Pipe: ASTM B43, chrome plated.
- B. Fittings:
 1. ASTM B584, brass.
 2. ASTM B16.15.

- C. Joints:
 - 1. Mechanical compression.
 - 2. Threaded: Tapered and smooth threads, ASME B1.20.1 and ASTM B43.
- D. Dissimilar Metals: See Dielectric Unions specified herein.

2.6 POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS

- A. PVC Pipe and Fittings:
 - 1. Four-inch diameter and smaller:
 - a. Pipe: ASTM D1785, Schedule 40.
 - b. Fittings: ASTM D2466, Schedule 40.
 - c. Joints: Socket, solvent-welded, ASTM D2855, for cold water service. For PVC pipe in chemical service, provide the following primer and cement, or equal certified by the manufacturer for chemical service:
 - 1) Primer: IPS Corp., Type P70.
 - 2) Cement: IPS Corp., Type 724 cement.
 - d. Materials: ASTM D1784, minimum cell classification 12545-C.
 - 2. Six-inch diameter and larger:
 - a. Pipe: AWWA C900, Class 235.
 - b. Fittings: AWWA C111, cast iron.
 - c. Joints: ASTM D3139, compression gasket ring.
 - d. Materials: ASTM D1784, minimum cell classification 12545-C.

2.7 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

- A. Materials:
 - 1. CPVC pipe: Schedule 40 or Schedule 80, as specified, in accordance with ASTM F441 and Appendix, CPVC 4120:
 - a. Pipe: Extruded from Type IV, Grade 1, Class 23447 material in accordance with ASTM D1784.
 - b. Manufacturers:
 - 1) Charlotte Pipe and Foundry Co.
 - 2) Eslon Thermoplastics, Inc.

- 3) GF Harvel.
 - 4) Or equal
2. Fittings:
- a. In accordance with ASTM F438 or ASTM F439 for pressure fittings, as appropriate to the service and pressure requirement:
 - b. Fittings shall be supplied by the same manufacturer as the pipe.
 - c. Manufacturers: One of the following or equal:
 - 1) Spears Manufacturing Co.
 - 2) Colonial Engineering.
 - 3) Eslon Thermoplastics, Inc.
 - 4) Chemtrol.
3. Solvent cement: In accordance with ASTM F493:
- a. For CPVC pipe in chemical service, utilize IPS Corp., Type 724 cement or another cement certified by the manufacturer for high strength hypochlorite service.

2.8 FLEXIBLE TUBING

A. Polyethylene thermoplastic tubing:

1. Standard weight, conforming to ASTM D1248 Type 1, Class A, Category 4, Grade E5.

2.9 GALVANIZED STEEL PIPE AND FITTINGS

A. Pipe: Seamless, or electric resistance welded, ASTM A53, Schedule 40.

B. Joints: Threaded.

C. Fittings:

1. Threaded, 150-pound malleable iron, galvanized, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.
2. Unions, 300-pound malleable iron, galvanized with dimensions conforming to ANSI B16.3, brass to iron seat.
3. Thread lubricant shall be Teflon tape or joint compound that is insoluble in water.

D. Buried Service:

1. Galvanized pipes shall be spirally wrapped with polyvinyl chloride or polyethylene pressure sensitive tape, applied with a suitable primer.
2. The wrap shall have a nominal thickness of 20 mils, consisting of either one layer of 20-mil tape or two separate layers of 10-mil tape.
3. Before the primer and wrap is applied, the piping shall be thoroughly cleaned so that all surfaces shall be dry and free of dirt, dust, rust, oil scale, oil, grease, or other foreign matter.
4. Any solvents used shall be totally volatile so as to leave no trace of oil.
5. Weld spatters, burrs, or sharp points and edges shall be removed by chiseling, ball peening or filing.
6. After thorough cleaning, the piping shall be coated with a primer applied in accordance with the tape manufacturer's recommendations. Spiral wrappings shall be applied with an overlap of at least 1-inch.

2.10 STAINLESS STEEL TUBING AND FITTINGS

- A. Type 316 stainless steel, unless otherwise specified or shown in the Plans.
- B. Meet the material standards set forth in ASTM A269.
- C. Fittings: ASTM A276 and ASTM A182.
 1. Threaded fittings: National pipe thread meeting the requirements of ASME B1.20.1.
 2. Compression fittings: Two-ferrule, mechanical grip design.
- D. Unions: Provide to facilitate installation and maintenance of tubing.
- E. Manufacturer:
 1. Swagelock, or approved equal.

2.11 STAINLESS STEEL PIPE AND FITTINGS

- A. Pipe:
 1. Size: 4 inches and smaller, schedule 80, type 304, unless otherwise specified.
 2. Conforming to ASME B36.19 dimensions.
 3. Conforming to ASTM A312 material requirements.
- B. Fittings: Conform to ASME B16.11 dimensions and ASTM A182 material requirements.

- C. Threads: Conform to ASME B1.20.1.
- D. Socket welds: Conform to ASME B16.11.

2.12 FLEXIBLE COUPLINGS

A. Description:

1. Sleeve-type, couplings. Comply with AWWA C219.
2. Minimum design pressure rating: 150 pounds per square inch (psi).
3. Middle Ring: As required for coupling based upon connecting pipe materials, steel or ASTM A536, ductile iron.
4. Followers: As required for coupling based upon connecting pipe materials, steel or ASTM A536, ductile iron.
5. Gaskets:
 - a. Material: Buna-N.
 - b. Comply with ASTM D2000.
6. Bolts:
 - a. Buried: Steel.
 - b. Submerged: Stainless steel.
7. Center Pipe Stop: Required where shown on the Drawings.

B. Finishes:

1. Buried Couplings, Bolts: Factory epoxy coated.

C. Manufacturers:

1. For ductile iron and steel pipe:
 - a. Dresser, Style 38.
 - b. Romac, Model 501.
 - c. Smith-Blair.
2. For PVC pipe:
 - a. Romac, Model 501 or approved equal.

3. For flanged steel and ductile pipe:
 - a. Dresser, Style 128 or approved equal.

2.13 RESTRAINED FLANGE ADAPTERS FOR DUCTILE IRON PIPE

A. Description:

1. ASTM A536, ductile iron.
2. Flange bolt circles compatible with ANSI/AWWA C115/A21.15.
3. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.
4. Capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
5. Safety factor of 2:1 minimum.
6. Manufacturer:
 - a. EBAA Iron, Series 2100 Megaflange or approved equal.

2.14 FLANGED INSULATING JOINTS

- ##### A. Set shall include a full faced gasket, a full-length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt.
1. Gaskets:
 - a. Full-face, comply with ASME 16.21.
 - b. Non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder.
 - c. Manufacturer: Garlock, Style 3505, or equal.
 2. Insulating sleeves:
 - a. G-10 glass epoxy.
 - b. Extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.

3. Insulating washers:
 - a. G-10 glass epoxy.
 - b. One-eighth-inch thickness.
 4. Washers:
 - a. Buried: Cadmium plated steel.
 - b. Submerged: Stainless steel.
- B. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.
- C. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.

2.15 INSULATING UNION

- A. Description:
1. Material: Galvanized malleable iron with a ground joint.
 2. Iron pipe threads: Conform to ANSI B2.1.
 3. Insulations: Nylon, bonded, and molded onto the metal body.
 4. Union: Rated for the operating and test pressures of the pipe system.
 5. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.
 6. Isolation Barrier: Impervious to water.

2.16 BACKFLOW PREVENTERS

- A. Manufacturers:
1. Nibco.
 2. Watts.
- B. Reduced-Pressure Backflow Preventers:
1. Size: 3/4-inch to 2 inches.
 2. Comply with AWWA C511.

3. Materials:
 - a. Body: Bronze.
 - b. Internal Parts: Bronze.
 - c. Springs: Stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Spring loaded.
 - c. Third Check Valve: Open under back pressure in case of diaphragm failure.
 5. Differential Pressure Relief Valve:
 - a. Type: Diaphragm.
 - b. Located between check valves.
 6. Ball Valves:
 - a. Type: Full port, resilient seated.
 - b. Quantity: Two.
 - c. Operation: Quarter turn.
 - d. Material: Bronze.
 7. Accessories: Strainer and test cocks.
- C. Reduced-Pressure Backflow Preventers with Detector Assembly:
1. Size: 3/4-inch to 2 inches.
 2. Comply with AWWA C511.
 3. Materials:
 - a. Body: Bronze.
 - b. Internal Parts: Bronze.
 - c. Springs: Stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Spring loaded.
 - c. Third Check Valve: Open under back pressure in case of diaphragm failure.
 5. Differential Pressure Relief Valve:
 - a. Type: Diaphragm.

- b. Located between check valves.
 - 6. Ball Valves:
 - a. Type: Full port, resilient seated.
 - b. Quantity: Two.
 - c. Operation: Quarter turn.
 - d. Material: Bronze.
 - 7. Accessories: Strainer and test cocks.
- D. Reduced-Pressure Backflow Preventers:
 - 1. Size: 3 inches to 10 inches.
 - 2. Comply with AWWA C511.
 - 3. Materials:
 - a. Heavy-duty cast iron.
 - b. Finish: Fusion epoxy coating inside and outside.
 - 4. Check Valves:
 - a. Quantity: Two, operating independently operating.
 - b. Spring loaded.
 - c. Third Check Valve: Open under back pressure in case of diaphragm failure.
 - 5. Differential Pressure Relief Valve:
 - a. Type: Diaphragm.
 - b. Located between check valves.
 - 6. Gate Valves:
 - a. Type: Resilient seated according to AWWA C509.
 - b. Quantity: Two.
 - c. Operation: Non-rising stem.
 - 7. Accessories:
 - a. Strainer.
 - b. Four resilient-seated ball valve test cocks.
- E. Reduced-Pressure Backflow Preventers with Detector Assembly:
 - 1. Size: 3 inches to 10 inches.

2. Comply with AWWA C511.
 3. Materials:
 - a. Heavy-duty cast iron.
 - b. Finish: Fusion epoxy coating inside and outside.
 4. Check Valves:
 - a. Quantity: Two, operating independently operating.
 - b. Spring loaded.
 - c. Third Check Valve: Open under back pressure in case of diaphragm failure.
 5. Differential Pressure Relief Valve:
 - a. Type: Diaphragm.
 - b. Located between check valves.
 6. Gate Valves:
 - a. Type: Resilient seated according to AWWA C509.
 - b. Quantity: Two.
 - c. Operation: Non-rising stem.
 7. Accessories:
 - a. Strainer.
 - b. Four resilient-seated ball valve test cocks.
- F. Double Check Valve Backflow Preventer Assemblies:
1. Size: 1/2-inch to 3 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Body: Bronze.
 - b. Internal Parts: Corrosion resistant.
 - c. Springs: Stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Intermediate atmospheric vent.

5. Ball Valves:
 - a. Type: Full port, resilient seated.
 - b. Quantity: Two.
 - c. Operation: Quarter turn.
 - d. Material: Bronze.
 6. Accessories: Strainer and test cocks.
- G. Double Check Valve Backflow Preventer with Detector Assembly:
1. Size: 1/2-inch to 3 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Body: Bronze.
 - b. Internal Parts: Corrosion resistant.
 - c. Springs: Stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Intermediate atmospheric vent.
 5. Ball Valves:
 - a. Type: Full port, resilient seated.
 - b. Quantity: Two.
 - c. Operation: Quarter turn.
 - d. Material: Bronze.
 6. Accessories: Strainer and test cocks.
- H. Double Check Valve Backflow Preventer Assemblies:
1. Size: 2-1/2 inches to 10 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Heavy-duty cast iron.
 - b. Finish: Fusion epoxy coating inside and outside.
 - c. Springs: Stainless steel.

4. Check Valves:
 - a. Quantity: Two, operating independently.
 5. Gate Valves:
 - a. Type: Resilient seated according to AWWA C509.
 - b. Quantity: Two.
 - c. Operation: Non-rising stem.
 6. Accessories: Strainer.
- I. Double Check Valve Backflow Preventer with Detector Assembly:
1. Size: 2-1/2 inches to 10 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Heavy-duty cast iron.
 - b. Finish: Fusion epoxy coating inside and outside.
 - c. Springs: Stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 5. Gate Valves:
 - a. Type: Resilient seated according to AWWA C509.
 - b. Quantity: Two.
 - c. Operation: Non-rising stem.
 6. Accessories: Strainer.
- J. Double Check Valve Backflow Preventer Assemblies:
1. Size: 4 inches to 12 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Main Valve Body: Series 300 stainless steel.
 - b. Internal Metal Parts: Series 300 stainless steel.

4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Material: Stainless steel.
 5. Gate Valves:
 - a. Type: Resilient seated according to AWWA C509.
 - b. Quantity: Two.
 - c. Material: Stainless steel.
 - d. End Connections: Flanged.
 - e. Operation: Non-rising stem.
 6. Accessories: Cast iron strainer.
- K. Double Check Valve Backflow Preventer with Detector Assembly:
1. Size: 4 inches to 12 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Main Valve Body: Series 300 stainless steel.
 - b. Internal Metal Parts: Series 300 stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Material: Stainless steel.
 5. Gate Valves:
 - a. Type: Resilient seated according to AWWA C509.
 - b. Quantity: Two.
 - c. Material: Stainless steel.
 - d. End Connections: Flanged.
 - e. Operation: Non-rising stem.
 6. Accessories: Cast iron strainer.

2.17 DISMANTLING JOINT

- A. Description:
1. Comply with AWWA C219, where applicable.

2. Self-contained flanged restrained joint fitting, including both flanged components and sufficient harness bars to withstand the imposed thrust.
 3. Design: No part of the restraint system extends outside the flange diameter. The internal bore shall match that of the pipe system.
 4. Dismantling joints will allow for a minimum of 2 inches of longitudinal adjustment.
 5. Furnish as a complete assembly consisting of spigot piece, flange adaptor, tie bars, and gasket.
 6. The gasket seal and compression stud and nut arrangement shall be independent of the tie rod restraint system. Tie Rod diameter shall be compatible with the corresponding bolt diameter of the mating flange. The Tie Rod restraint system shall be capable of withstanding the full pressure thrust that the pipe system can develop at no more than 50 percent of the yield strength of tie rod material.
 7. Pressure Rating:
 - a. Determined by the flange configuration, and all commonly used flanges shall be available.
 - b. Design pressure rating shall be equal to or greater than the mating flanges.
 - c. Dismantling joints will be specially fabricated to accommodate pressure requirements with ANSI B16.5 or ANSI B16.47 300-pound class flanges, depending on size of dismantling joint.
 8. Lining and Coating:
 - a. Shop-applied fusion bonded epoxy coating applied by fluidized bed method, complying with the requirements of NSF 61 and AWWA C550 as applicable.
 - b. As an alternative, a shop-coat primer suitable for field applied coatings can be supplied.
 9. Flanges: Flat-faced, rated to pressure requirements as shown on the Drawings.
 - a. Where design pressure is greater than 300 psi, flanges shall conform to ASME B16.5 and ASME B16.47 300-pound class.
- B. Materials:
1. Spigot piece: Steel, ASTM A283 Grade C.

2. Flange adaptor:
 - a. Up to 12-inch diameter: Ductile iron, ASTM A536 Grade 65-45-12.
 - b. Above 12-inch diameter: Steel, ASTM A283 Grade C.
 3. Tie bars: ASTM A193 Grade B7 threaded rod with rolled threads.
 4. Gasket: EPDM Grade E.
 5. Nuts, Bolts, and Washers: Type 304 stainless steel.
- C. Manufacturer:
1. Romac or approved equal.

2.18 PIPE SUPPORTS

- A. Floor Support for Pipe:
1. Flanged Pipe Support:
 - a. Construction:
 - 1) Adjustable vertical pipe support, flange plate, extension pipe from base cup to top collar cup with threaded stud.
 - 2) Bolts directly to flange.
 - 3) Anchorable base plate.
 - b. Material: Steel, comply with ASTM A36.
 - c. Finish: Corrosion resistant, electro-galvanized, or prime coated.
 - d. Manufacturers:
 - 1) Standon - Model S89.
 2. Cradle Pipe Support:
 - a. Construction:
 - 1) Adjustable vertical pipe support with saddle strap, extension pipe from base cup to top collar cup with threaded stud.
 - 2) Anchorable base plate.
 - b. Material: Steel, comply with ASTM A36.

- c. Finish: Corrosion resistant, electro-galvanized, or prime coated.
- d. Manufacturers:
 - 1) Standon - Model S92.

2.19 PIPE PENETRATIONS

- A. Sleeves for Pipes through Walls and Floors:
 - 1. Material: Galvanized steel.
 - 2. Thickness: Schedule 40.
 - 3. Inside surface of all wall sleeves shall be coated with coal-tar.
 - 4. Annular space between penetrating pipe and wall sleeve shall be filled with an approved permanently flexible sealant.
 - 5. Diameter of wall sleeve shall be as shown in the Drawings.
- B. Mechanical Sleeve Seals:
 - 1. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
 - 2. Manufacturer: Link-Seal or approved equal.
- C. Pipes Cast-In Walls and Floors:
 - 1. Material: Ductile iron or steel pipe, as required by the Drawings and the intended service.
 - 2. Diameter: As shown in the Drawings.
 - 3. End Type: As shown in the Drawings.
- D. Seep Rings:
 - 1. Material: 3/8-inch thick steel plate conforming to ASTM A36, unless otherwise noted.
 - 2. Inside diameter: Equal to the outside diameter of the pipe or sleeve to which it is attached plus 1/4-inch.

3. Outside diameter: As shown in the Drawings.
4. Attach to the pipe or sleeve by means of a continuous seal weld located on both sides of the ring.

2.20 PIPE COATINGS

- A. See Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement, to provide a functional installation.
- B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Engineer shall be made.

3.2 INSTALLATION

- A. Buried Piping Systems:
 1. Establish elevations of buried piping with not less than 3 feet of cover.
 2. Remove scale and dirt from inside of piping before assembly, as may be required.
 3. Excavate pipe trench as specified in Section 31 23 17, Trenching.
 4. Install pipe to accurate lines, elevations, and grades as shown on the Drawings.
 5. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.
 6. Place bedding material at trench bottom to provide uniform bedding for piping.
 7. Level bedding material in one continuous layer not exceeding 6 inches compacted depth.
 8. Install pipe on prepared bedding.

9. Route pipe in straight line.
 10. Install pipe to allow for expansion and contraction without stressing of pipe or joints.
 11. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.
 12. Pipe Cover and Backfilling:
 - a. Backfill trench as specified in Section 31 23 17, Trenching.
 13. All buried non-ferrous piping shall be installed with detectable tracer tape.
 - a. Tape shall be buried 12 inches above the top of the pipe or as recommended by manufacturer.
 - b. Tape shall be continuous and labeled the same as the piping system.
- B. Interior Piping Systems:
1. Install non-conducting dielectric connections wherever joining dissimilar metals.
 2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.
 3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.
 4. Install water piping according to ASME B31.9.
 5. Install unions downstream of valves and at equipment or apparatus connections.
 6. Install brass male adapters each side of valves in copper piped system, solder adapters to pipe.
- C. Backflow Preventer Assemblies:
1. Install backflow preventers of type, size, and capacity indicated.
 2. Comply with applicable code and authority having jurisdiction.
 3. Install airgap fitting on units with atmospheric vent connection.
 4. Pipe relief outlet drain to nearest floor drain.
 5. Do not install bypasses around backflow preventers.
- D. Pipe Supports and Hangers
1. Install pipe supports according to MSS SP-58 & ASME B31.10.

2. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment.
3. Special hangers and supports are shown on the Drawings.
4. The Contractor shall be responsible for determining the location of and providing all additional supports.
5. Hanger supports shall be as noted below with at least one support adjacent to the joint for each length of pipe, at each change in direction and at each branch connection. Sufficient hangers shall be provided to maintain proper slope without sagging. Support spacing shall not exceed manufacturer's recommendations, nor as listed below.

<u>Pipe</u>	<u>Maximum Support Spacing (Feet)</u>
Steel Pipe	
Under 3 inches	6
3 inches and Over	12
Cast or Ductile Iron	
Under 4 inches	6
4 inches and Over	12
Stainless Steel and Galvanized Iron	
Under 1-1/2 inches	4
1-1/2 inches to 4 inches	6
Over 4 inches	12
Copper Pipe	6
PVC Pipe	
Under 2-1/2 inches	4
2-1/2 inches and Over	6

6. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall be more than 12 feet.
7. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine threaded. Continuous threaded rods will not be allowed.
8. Clevis or band-type hangers (B-Line FIG B3100) or approved equal shall be provided as required. Strap hangers not permitted.

9. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.
10. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of pipework.
11. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

E. Pipe Penetrations:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals or grout, as shown in the Drawings.
2. Whenever a pipeline of any material terminates at or through a structural wall or floor, install piping or sleeve in advance of pouring of concrete required for the particular installation.
3. Plastic pipe shall not be cast in concrete or masonry walls.
4. Set sleeves in position in forms and provide reinforcing around sleeves.
5. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
6. Extend sleeves through floors 1-inch above finished floor level and caulk sleeves.
7. Pipe other than concrete, to be cast in water-bearing walls or more than 4 feet below grade shall have seep rings.
8. All buried piping entering structures shall have a flexible connection installed less than 2 feet outside the structure line or as close to the wall as practical.

3.3 CLEANING, TESTING, AND DISINFECTION

- A. Testing and Disinfection: Piping shall be hydrostatically tested, flushed, and disinfected as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

END OF SECTION

SECTION 40 05 23 - COMMON WORK RESULTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes basic materials and methods related to valves commonly used for process systems, including utility vaults.
- B. Section Includes:
 - 1. Valves.
 - 2. Valve actuators.

1.2 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete.
- B. Section 05 50 00, Metal Fabrications.
- C. Section 09 90 00, Painting and Coating.
- D. Section 33 11 10, Water Utility Distribution Piping.
- E. Section 33 12 16, Water Utility Distribution Valves.
- F. Section 40 05 13, Common Work Results for Process Piping.
- G. Section 40 05 23.15, Gate Valves.
- H. Section 40 05 23.18, Butterfly Valves
- I. Section 40 05 23.72, Miscellaneous Valves

1.3 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
 - 2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 - 3. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
 - 4. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.
 - 5. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
- B. ASTM International (ASTM):
 - 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
 1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.
- D. National Electrical Manufacturers Association (NEMA):
 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. National Fire Protection Association (NFPA):
 1. NFPA 70 - National Electrical Code (NEC).
- F. NSF International:
 1. NSF 61 - Drinking Water System Components - Health Effects.
 2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

- A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
 2. Submit valve cavitation limits.
 3. Submit manufacturer data for actuator with model number and size indicated.
- C. Shop Drawings:
 1. Submit description of proposed installation, including associated wiring diagrams and electrical data as may be specified elsewhere in the contract documents.
 2. Coordinate shop drawing submittals for in-plant valve service with the requirements of Section 25 32 13, Integrated Operation Actuators and Operators.

- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.
- F. Lining and coating data.
- G. Valve Labeling Schedule: Indicate valve locations and nametag text.
- H. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and actuators.
- B. Operation and Maintenance Data: Submit information for valves.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.
- B. Tools:
 - 1. Furnish special wrenches and other devices required for Owner to maintain equipment.
 - 2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.8 QUALITY ASSURANCE

- A. Cast manufacturer's name, pressure rating, size of valve and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with

the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

- D. Maintain clearances as indicated on Drawings and Shop Drawings.
- E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first class quality and shall be made by reputable manufacturers.
- F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.
 - 2. Do not store materials directly on ground.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to manufacturer instructions.
- D. Handle products carefully to prevent damage to interior or exterior surfaces.
- E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.
- B. Operation:
 - 1. Open by turning counterclockwise; close by turning clockwise.
 - 2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.
- C. Valve Construction:
 - 1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.
- D. Connecting Nuts and Bolts: Stainless steel.

2.3 RESILENT-SEATED GATE VALVES

- A. As specified in Section 40 05 23.15, Gate Valves.

2.4 RUBBER-SEATED BUTTERFLY VALVES

- A. As specified in Section 40 05 23.18, Butterfly Valves.

2.5 VALVE ACTUATORS

- A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.

- B. Valves in sizes up to and including four inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer's best standard design.
- C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.
- D. Provide actuators with position indicators for shutoff valves 6 inches and larger.
- E. Comply with AWWA C541 and C542, where applicable.
- F. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above floor.
- G. Provide gear and power actuators with position indicators.
- H. Gear-Assisted Manual Actuators:
 - 1. Provide totally enclosed gears.
 - 2. Maximum Operating Force: 60 lbf.
 - 3. Bearings: Permanently lubricated bronze.
 - 4. Packing: Accessible for adjustment without requiring removal of actuator from valve.
- I. Handwheel:
 - 1. Furnish permanently attached handwheel for emergency manual operation.
 - 2. Rotation: None during powered operation.
 - 3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.
 - 4. Maximum Operating Force: 60 lbf.
- J. Valve Actuators in NEC Class I, Group D, Division 1 or 2 Hazardous Locations: UL approved.
- K. Electric Motor Actuators:
 - 1. As specified in Section 25 32 13, Integrated Operation Actuators and Operators.

2.6 SOURCE QUALITY CONTROL

- A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

- A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.3 INSTALLATION

- A. Install valves, actuators, extensions, and accessories according to manufacturer instructions.
- B. Firmly support valves to avoid undue stresses on piping.
- C. Coat studs, bolts, and nuts with anti-seizing lubricant.
- D. Clean field welds of slag and splatter to provide a smooth surface.
- E. Install valves with stems upright or horizontal, not inverted.
- F. Install valves with clearance for installation of insulation and allowing access.
- G. Provide access where valves and fittings are not accessible.
- H. Comply with Section 40 05 13, Common Work Results for Process Piping for piping materials applying to various system types.

- I. Valve Applications:
 - 1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.
 - 2. Install shutoff and isolation valves.
 - 3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.
 - 4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.
- J. Disinfection of Water Piping System:
 - 1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Distribution.

3.4 FIELD QUALITY CONTROL

- A. Valve Field Testing:
 - 1. Test for proper alignment.
 - 2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.
 - 3. Engineer will witness field testing.

END OF SECTION

SECTION 40 05 23.60 - AQUIFER STORAGE AND RECOVERY VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Work consists of furnishing and installing one (1) Aquifer Storage and Recovery (ASR) downhole control valve complete, as shown on the drawings and/or specified herein, including the downhole control valve, aboveground control components, the hydraulic control lines connecting the aboveground control components to the downhole control valve components, and other appurtenances, and accessories as necessary for a complete system. Valve designation is FCV308.
- B. Related Requirements:
 - 1. Section 43 21 52 – Deep Well Vertical Turbine Pumps

1.2 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for Submittals.
- B. Shop Drawings: furnish complete shop drawings for the valve including:
 - 1. The downhole valve components
 - 2. Hydraulic pump, pistons and hydraulic hoses
 - 3. All components of the valve control panel
- C. Operation and Maintenance Manual containing the required information for the complete downhole valve assembly.
- D. Certification that the hydraulic fluid used is listed by NSF for contact with drinking water or food grade.

PART 2 PRODUCTS

2.1 DOWNHOLE VALVE

- A. Materials: All metal parts for the downhole control valve shall be stainless steel. All other downhole components shall be made of corrosion resistant materials.
- B. Performance: The downhole control valve shall provide cavitation free control of the recharge rate under the operating conditions described herein and shown on the plans. The downhole control valve shall close tight during pumping of the well (recovery) to prevent any recycling of water within the well during pumping.

Coordinate with technical submittal for the vertical turbine pump for the internal pressure against which the downhole control valve shall remain closed.

C. Valve operating conditions

1. Installed in a vertical turbine pump column sized per the plans and section 43 21 52.
2. Maximum well recharge flow rate: 900 gpm.
3. Maximum flow through valve during recovery: 1,200 gpm.
4. Maximum residual pressure at the ground surface at the well head during recharge: 90 psi.
5. Minimum residual pressure at the ground surface at the well head during recharge: 5 psi.
6. Static water level: 353 feet below ground surface (BGS).
7. Maximum water level during recharge: 88 feet BGS.
8. Minimum water level during recovery: 676 feet BGS.

2.2 VALVE CONTROLS

- A. The aboveground components for control of the downhole control valve, including a PLC in the valve control panel and the control logic program for that PLC, shall be supplied and warranted by the manufacturer of the downhole control valve. ASR valve control panel shall interface with a programmable logic controller (PLC) to be located in a main control panel in the electrical room and specified elsewhere in these Contract Documents. The main control panel PLC shall direct the ASR valve control panel PLC to inject water at a specified rate and the ASR valve control panel PLC shall control the opening and/or closing of the downhole valve, the starting the hydraulic pump and the energizing of the appropriate solenoid valves. The valve control panel shall provide a means for bypassing or overriding the ASR valve PLC control to allow for local, manual control of the valve.
- B. Position indicators and limit switches shall be supplied for indicating when the valve is in the closed position and for generating an alarm if the valve has lost hydraulic pressure. The position indicators/alarms shall interface with the PLC main control panel.
- C. Two (2) hydraulic control lines shall extend from the valve control components located above ground to the downhole control valve. The control lines shall be supplied and warranted by the manufacturer of the downhole valve. Hydraulic fluid shall be food grade mineral oil, NSF certified for potable water.

- D. All electrical components for control of the downhole control valve, including solenoid valves and pump motors, shall comply with the requirements of Division 26 - Electrical.
- E. Aboveground components shall be protected against corrosion. Coatings shall comply with Section 09 90 00 - Painting and Coatings.

2.3 ACCEPTABLE MANUFACTURERS

- A. 3R of Echo, OR
- B. Or approved equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Aboveground and downhole components of the downhole control valve shall be installed in accordance with the manufacturer's written instructions and as shown and specified in the Contract Documents.
- B. The downhole control valve and the control conduits within the well casing shall be installed by the supplier of the vertical turbine pump as specified in Section 43 21 52.

3.2 TESTING

- A. The hydraulic control conduits shall be tested for leakage after installation. A written procedure for the leakage test shall be prepared by the downhole control valve manufacturer and presented to the Engineer for approval at least one week prior to the testing.
- B. The downhole control valve shall be functionally tested after installation. A written procedure for the functional testing shall be prepared by the Contractor in conjunction with the downhole control valve manufacturer, the vertical turbine pump supplier and the Systems Integrator. The proposed testing procedure shall be presented to the Engineer for approval at least one week prior to the testing.

3.3 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of the downhole control valve manufacturer's representative to observe and verify the proper installation of the downhole control valve and control lines within the well by the installer of the vertical turbine pump specified in Section 43 21 52 Deep Well Vertical Turbine Pumps.
- B. The downhole control valve manufacturer's representative, having observed the installation of the downhole control valve, shall submit a written report indicating

whether the installation was done in accordance with the manufacturer's written instructions and detailing any reservations or shortcomings that the manufacturer's representative may have regarding the installation of the downhole control valve and control conduits. The Certificate of Substantial Completion shall not be issued prior to receipt of the report from the downhole control valve manufacturer's representative.

- C. Inspection, Startup and Field Adjustment - The downhole control valve manufacturer's representative shall be present at the site for not less than 3 work days, in addition to those days provided in the previous paragraphs, to furnish the following services.
 - 1. Inspect, check, adjust if necessary and approve the installation of all the downhole control valve components.
 - 2. Start-up and field-test the downhole control valve for proper operation.
 - 3. Perform necessary field adjustments during the test period until the downhole control valve installation and operation are satisfactory to the Engineer.
 - 4. Instruct the Owner's personnel in the operation and maintenance of the downhole control valve. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- D. The costs of all inspection, startup, testing, adjustment and instruction work performed by the downhole control valve manufacturer's representatives shall be borne by the Contractor.
- E. For the purposes of this paragraph, a work day is defined as an 8 hour period at the site, excluding travel time.

END OF SECTION

SECTION 40 05 23.72 - MISCELLANEOUS VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes miscellaneous valves not included in other Sections for use in buried service, pump stations, and utility vaults.
- B. Section Includes:
 - 1. Mud valves.
 - 2. Solenoid valves.
 - 3. Air release valves.
 - 4. Combination air/vacuum valves.
 - 5. Blow-off hydrant assemblies.
 - 6. Flap valves.
 - 7. Shear gates.
 - 8. Ball valves, 2 inches and under.

1.2 RELATED SECTION

- A. Section 05 50 00, Metal Fabrications
- B. Section 09 90 00, Painting and Coating
- C. Section 33 11 10, Water Utility Distribution and Transmission Piping.
- D. Section 40 05 13, Common Work Results for Process Piping.
- E. Section 40 05 51, Common Requirements Results for Process Valves.

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 - 4. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 5. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

1.4 COORDINATION

- A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
 - 2. Submit valve cavitation limits.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.
- E. Lining and coating data.
- F. Valve Labeling Schedule: Indicate valve locations and nametag text.
- G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and actuators.

- B. Operation and Maintenance Data: Submit information for valves.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts:

- 1. Furnish one set of manufacturer's recommended spare parts.

- B. Tools:

- 1. Furnish special wrenches and other devices required for Owner to maintain equipment.
 - 2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.8 QUALITY ASSURANCE

- A. Cast manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.
- D. Maintain clearances as indicated on Drawings.
- E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
- F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.
- C. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 3. Provide additional protection according to manufacturer instructions.
- D. Handle products carefully to prevent damage to interior or exterior surfaces.
- E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 MUD VALVES

- A. Description:
1. Type: Non-rising, threaded stem.
 2. Furnish coupling nut, extension stem, stem guides, and operating stand as indicated on Drawings.
 3. Operation: [Wheel] [Nut with wrench].
 4. End Connections: ASME B16.1, ASME B16.5, ASME B16.42, flanged.

B. Materials:

1. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
2. Stem, Seat Ring, and Gate Ring: ASTM B62, bronze.
3. Connecting Hardware: Type 316 stainless steel.
4. Linings and Coatings:
 - a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
 - b. All internal and external ferrous surfaces.
 - c. Do not coat flange faces of valves.

2.3 SOLENOID VALVES

A. Description:

1. Type: As indicated on Drawings.
2. Minimum Working Pressure: 150 pounds per square inch gauge at 50-75 degrees Fahrenheit (F).
3. Coil: Continuous duty.
4. Operation: Fail closed, energize to open.
5. Enclosures: National Electrical Manufacturers' Association (NEMA) psig rated according to area designation as indicated on Drawings.
6. Electrical Characteristics: As indicated on Drawings.
7. End Connections: As shown on Drawings.
8. Conduit Connection: As shown on Drawings

B. Materials:

1. Body: Brass or Bronze
2. Trim and Spring: Stainless steel.
3. Seals: Resilient material.

2.4 AIR RELEASE VALVES

A. Description:

1. Inlet Size: 2-inch diameter and smaller.
2. Cast-iron body and cover. Comply with ASTM A126, Class B.
3. Stainless steel orifice and float. Comply with ASTM A240.
4. Design test pressure: 450 psig.

B. Manufacturers:

1. DeZurik - APCO Series 200A or approved equal.

2.5 COMBINATION AIR/VACUUM VALVES

A. Description:

1. Construction: Two independent valves: one air/vacuum valve, one air release valve.
2. Inlet Size: Greater than 2-inch diameter.
3. Cast iron body and cover. Comply with ASTM A126, Class B.
4. Stainless steel orifice and float. Comply with ASTM A240.
5. Valves seats: Buna-N.

B. Manufacturers:

1. DeZurik - APCO Series 1700 or approved equal.

2.6 DEEP WELL PUMP SERVICE AIR VALVES

A. Description:

1. Air valves on deep well vertical turbine pump discharge pipes shall be of the double acting, throttling-air-out/full-air-flow-in type with an air release valve to release small quantities of air during prolonged operation.
2. The valve shall be designed:
 - a. to allow for air throttling during pump start to create backpressure on the water column and reduce hydraulic shock;
 - b. to allow for large volumes of air to enter when the pump is stopped to prevent column separation; and,
 - c. to release small quantities of air during operation when the pump is operated for more than six hours.
3. Body and cover materials shall be cast iron ASTM A126, Class B.

4. Orifice floats and orifices shall be ASTM A240 stainless steel.
 5. Valve shall have low durometer seat for low pressure application.
- B. Manufacturers
1. As manufactured by DeZurik – APCO, Val-Matic, or approved equal.

2.7 BLOW-OFF HYDRANT ASSEMBLIES

- A. Description:
1. Material: 100 percent low-lead brass.
 2. Inlet: 2-inch diameter female iron pipe (FIP) vertical straight inlet.
 3. Outlet: 2-inch diameter male iron pipe (MIP).
 4. Operation:
 - a. By turning a top-mounted square operating nut.
 - b. Operation must seal drain outlet in all positions from 1/4-open to fully open.
 5. Hydrant shall be non-freezing, self-draining.
 6. Accessories: Provide Owner with one operating wrench.
- B. Manufacturers:
1. Kupferle – Truflo #TF500 or approved equal.

2.8 FLAP VALVES

- A. Description:
1. Material: ASTM A126, cast iron.
 2. Seat and hinge pin: Bronze.
 3. End connection: 125-pound flange, unless otherwise noted on the Drawings.
 4. Two pivot points.
 5. Valves 14-inches and smaller shall have the hinge pin secured with cotter pins.
 6. Valves 16-inches and larger shall have the hinge pin secured with nuts.
- B. Manufacturers:
1. M & H, Style 47 or approved equal.

2.9 SHEAR GATES

A. Description:

1. Frame: ASTM A126, cast iron.
2. Seat: Bronze to bronze.
3. Latch and hinge pin: Bronze.
4. Double wedge and latch.
5. Wedge: ASTM A126, cast iron with bronze facing. Field replaceable.
6. The valve shall be equipped with a pull rod made of galvanized steel that is long enough to facilitate valve operation without entering manhole.
7. Pull rods shall be equipped with an adjustable cast iron hook for positioning the valve.
8. Flanged shear gates shall have 125-pound flanged ends, unless otherwise noted on the drawings.

B. Manufacturer:

1. M & H, Style 44 or approved equal.

2.10 BALL VALVES, 2 INCHES AND UNDER

A. Description:

1. Four hundred-pound. Water, oil, and gas rating (WOG) with bronze body and trim, unless otherwise shown on the Drawings.
2. Seat ring: Tetrafluoroethylene (TFE).
3. O-ring seals: Fluorocarbon.
4. Three-piece construction so that maintenance can be performed without distributing the valve body after installation.

B. Manufacturer:

1. Nibco T-590-Y or equal.

2.11 SOURCE QUALITY CONTROL

A. Testing Pressure-Reducing and Pressure-Sustaining Valves:

1. Leakage Testing:

- a. Test each assembled valve hydrostatically at 1-1/2 times rated working pressure for minimum five minutes.
- b. Test each valve for leakage at rated working pressure against closed valve.
- c. Permitted Leakage: None.

2. Functional Testing:

- a. Test each valve to verify specified performance.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install valves per manufacturer requirements and recommendations.
- B. Install all valves with valve seats level.
- C. Install protective strainers upstream of solenoid valves, pressure-reducing valves, and pressure-sustaining valves.

3.2 ATTACHMENTS

- A. The attachments listed below, following "END OF SECTION", are part of this Section.
 1. Attachment 1 – Schedule for Miscellaneous Valves.

END OF SECTION

SECTION 40 05 23.73 - PRESSURE REDUCING VALVES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section includes pressure reducing valves, complete and operable, including coatings and linings, appurtenances, operators, and accessories, in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 40 05 23, Common Work Results for Process Valves.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. In accordance with Article 1. 3, Reference Specifications, Codes, and Standards of Section 33 12 16, Water Utility Distribution Valves.

1.4 SUBMITTALS

- A. As required by Section 40 05 23, Common Work Results for Process Valves.

1.5 QUALITY ASSURANCE

- A. As required by Section 40 05 23, Common Work Results for Process Valves.

PART 2 PRODUCTS

2.1 PRESSURE REDUCING VALVES

- A. Construction:
 - 1. Valve shall be single-seated, globe style, hydraulically operated and diaphragm actuated.
 - a. Diaphragm assembly shall be guided top and bottom by a precision-machined stem.
 - b. Resilient valve disc, retained on three sides by disc retainers, shall form a drip-tight seal with a renewable seat when pressure is applied above the diaphragm.
 - c. Control of valve operation shall be by means of an externally mounted, hydraulic pilot system.

2. Main Valve Body and Cover: ASTM A536 ductile iron.
 3. Flanged Ends: ASME/ANSI B16.42 Class 150 flanges.
 4. Main valve trim shall be stainless steel.
 5. Pilot control components: Bronze ASTM B62 with Type 303 stainless steel trim, and pilot tubing shall be copper.
 6. Rubber parts shall be Buna-N synthetic rubber.
- B. Protective Coating:
1. Valve body and cover shall be lined and coated with an NSF/ANSI 61 listed fusion bonded epoxy coating system suitable for use with cast iron, ductile iron or steel valves.
 2. The epoxy coating thickness and application shall be in accordance with American Water Works Association (AWWA) C550.
- C. Operating Conditions:
1. Flow through the valve shall be one-way.
 2. Inlet and downstream pressures for individual valves are shown in the attached Supplement 1 of this Section.
 3. Valve shall be capable of maintaining downstream pressure over a range of plus or minus 15 pounds per square inch (gauge) from the initial setting as specified in Supplement 1 of this Section.
- D. Operating Requirements
1. Pressure Reducing Control:
 - a. A pressure reducing control, located in the pilot system, shall sense the main valve outlet pressure, and shall cause the main valve to modulate (open and close) as required to maintain a constant pressure at the main valve outlet at all times.
 - b. Adjusting the spring force in the pressure reducing control shall set the desired constant pressure.
 - c. Valves shall have a check feature to positively prevent return flow when pressure reverses.

- E. Accessories: The following accessories shall be furnished with all pressure reducing valves:
1. Self-cleaning strainer for pilot system.
 - a. H-Style strainer.
 - b. Ductile iron body.
 - c. Manufacturer:
 - 1) Model 131G-47BCSYKCOX as manufactured by Cla-Val Co., Newport Beach, CA, without exception.
 2. Pilot system isolation valves on inlet, outlet, and cover lines.
 3. Inlet and outlet pressure gauges installed on valve.
 - a. Inlet pressure gauge: Range, 0 - 120 pounds per square inch (psi).
 - b. Outlet pressure gauge: Range, 0 - 60 psi.
 4. Pressure reducing control.
 - a. Spring range: 5-25 psi. Set at 5 psi +/-.
 5. Pressure Sustaining control.
 - a. Set range: 20-105 psi
 6. Opening speed control.
 7. Closing speed control.
 8. Check feature control.
 9. Valve position indicator.
 10. KO anti-cavitation trim.
 11. Integrated flow measurement and control.
 12. Two-way solenoids
 13. VC-22D Controller
 14. Pressure Transmitter

F. Valve Model & Manufacturer:

1. Model 131G-47BCSYKCOXpressure reducing valve as manufactured by Cla-Val Co., Newport Beach, CA, without exception.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Valve installation shall be in accordance with Section 40 05 23, Common Work Results for Process Valves and manufacturer's requirements.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVES

- A. Provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 51.15 - GATE VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes gate valves for use in buried service, pump stations, and utility vaults. Coordinate with Section 33 12 16, Water Utility Distribution Valves and Section 40 05 23, Stainless Steel Process Pipe and Tubing.
- B. Section Includes:
 - 1. Resilient-seated gate valves.
 - 2. General duty gate valves smaller than 3 inches.

1.2 RELATED SECTIONS

- A. Section 33 12 16, Water Utility Distribution Valves
- B. Section 33 11 10, Water Utility Distribution and Transmission Piping
- C. Section 40 05 13, Common Work Results for Process Piping
- D. Section 40 05 51, Common Requirements Results for Process Valves.

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 3. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

- C. American Water Works Association (AWWA):
 - 1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 - 2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
 - 1. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.
 - 2. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
- E. NSF International (NSF):
 - 1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
 - 2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 33 12 16 - Water Utility Distribution Valves and/or Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT-SEATED GATE VALVES

- A. Description:
 - 1. Comply with AWWA C509.
 - 2. Minimum Pressure Rating:
 - a. Twelve-inch Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
 - b. Sixteen-inch Diameter and Larger: 150 psig.

3. End Connections: As shown in the Drawings.
 - a. Standard mechanical joint ends comply with ANSI/AWWA C111.
 - b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 & ASME 16.5.
 - 1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.
 4. Gear Actuators: Conforming to AWWA C509 for manual valves.
 5. Linings and Coatings:
 - a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
 - b. All internal and external ferrous surfaces.
 - c. Do not coat flange faces of valves.
 6. Bi-directional flow.
- B. Operation:
1. Non-rising stem.
 2. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.
 3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.
 4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.
- C. Materials:
1. Wedge:
 - a. ASTM A126, cast iron or ASTM A536, ductile iron.
 - b. Fully encapsulated with molded rubber.
 2. Body and Bonnet:
 - a. ASTM A126, cast iron or ASTM A536, ductile iron.

3. Stem, Stem Nuts, Glands, and Bushings: ASTM B584, bronze.
4. Valve Body Bolting: Stainless steel.

D. Manufacturers:

1. Clow Valve Company.
2. M&H Valve.
3. U.S. Pipe.
4. American Flow Control.
5. Mueller Company.

2.3 NOT USED

2.4 NOT USED

2.5 GENERAL-DUTY GATE VALVES - SMALLER THAN 3 INCHES

A. Two inches and Smaller:

1. MSS SP 80, Class 125.
2. Body and Trim: ASTM B584, bronze.
3. Bonnet: Union.
4. Operation: Handwheel.
5. Inside screw [with back-seating stem].
6. Wedge Disc: Solid; ASTM B584, bronze.
7. End Connections: Threaded.

B. Two and one-half inches to 3 inches:

1. MSS SP 70, Class 125.
2. Stem: Non-rising.
3. Body: ASTM A126, cast iron.
4. Trim: Bronze.
5. Bonnet: Bolted bonnet.
6. Handwheel, outside screw and yoke.
7. Wedge Disc: Solid, with bronze seat rings.
8. End Connections: ASME B16.1, ASME B16.5, ASME B16.42, flanged.

2.6 SOURCE QUALITY CONTROL

- A. Testing: Test gate valves according to AWWA C509.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As required by Section 33 12 16, Water Utility Distribution Valves and/or Section 40 05 51 - Common Requirements Results for Process Valves.
- B. Install according to manufacturer's instructions.
- C. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

SECTION 40 05 51.18 - BUTTERFLY VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes butterfly valves for use in buried service, pump stations, utility vaults, and water and wastewater treatment plants. Coordinate with Section 33 12 16, Water Utility Distribution Valves and Section 40 05 51, Common Requirements Results for Process Valves.
- B. Section Includes:
 - 1. Rubber-seated butterfly valves.

1.2 RELATED SECTIONS

- A. Section 33 12 16, Water Utility Distribution Valves
- B. Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Section 40 05 13, Common Work Results for Process Piping.
- D. Section 40 05 51, Common Requirements Results for Process Valves.

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

- C. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
 - 2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.
- D. NSF International (NSF):
 - 1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
 - 2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 33 12 16 - Water Utility Distribution Valves and/or Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RUBBER-SEATED BUTTERFLY VALVES

- A. Description:
 - 1. Comply with AWWA C504, Class 150B and 250B as indicated in the Drawings.
 - 2. Minimum Pressure Rating:
 - a. Twelve-inch (300-millimeter) Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
 - b. Sixteen-inch (400-millimeter) Diameter and Larger: 150 psig.

3. End Connections: As shown in the Drawings.
 - a. Standard mechanical joint ends comply with ANSI/AWWA C111.
 - b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125, unless shown otherwise. Comply with AWWA C115 & ASME 16.5.
 - 1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.
 4. Gear Actuators: Conforming to AWWA C504 for manual valves.
 5. Linings and Coatings:
 - a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
 - b. All internal and external ferrous surfaces.
 - c. Do not coat flange faces of valves.
 6. Bubble-tight at the rated pressure for bi-directional flow.
 7. Style: Wafer.
 8. Shaft: Self-lubricating, sleeve-type bearings. One-piece, through-shaft construction.
 - a. Valve shafts shall be full size for that portion of the shaft extending through the valve bearings, valve disc, and shaft seal.
 - b. Any portion of the shaft turned down for any reason shall have fillets with radii equal to the offset to minimize stress concentrations at the junction of the different shaft diameters. The turned down portion of the shaft shall be capable of transmitting the maximum operator torque without exceeding a torsional steel stress of 11,500 pounds per square inch (psi).
 9. Seats: Mounted on body for valves 24 inches and smaller; field replaceable (mechanically retained in a machined groove) for valves larger than 24 inches.
 10. Packing: Replaceable without dismantling valve.
- B. Operation:
1. Open counterclockwise, unless otherwise indicated in the Drawings.
 2. Operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering.

3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.
4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Body: ASTM A126, cast iron or ASTM A536, ductile iron. Integrally cast flanged or mechanical end joints.
2. Shaft: Stainless steel.
3. Disc: ASTM A126, cast iron or ASTM A536, ductile iron.
4. Seats: Resilient, replaceable, Buna-N.
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings:
 - a. Sleeve: Corrosion-resistant and self-lubricating.

D. Manufacturers:

1. M&H Valve.
2. Henry Pratt Company.
3. Mueller Company.
4. Kennedy Valve Company.
5. Dezurik.
6. Val-Matic Valve & Manufacturing Corporation.

2.3 SOURCE QUALITY CONTROL

- A. Testing: Test butterfly valves according to AWWA C504.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As required by Section 33 12 16, Water Utility Distribution Valves and/or Section 40 05 51 - Common Requirements Results for Process Valves.
- B. Install according to manufacturer's instructions.

END OF SECTION

SECTION 40 05 51.24 - CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Work in this Section includes check valves for use in water and wastewater facilities. Work includes the furnish and install of all swing and silent check valves, complete, as shown on the Drawings and specified herein, including coating and lining, appurtenances, operators, and accessories.
- B. Section includes:
 - 1. Swing check valves, 1-inch through 4-inch diameter.
 - 2. Swing check valves, 4-inch diameter and larger
 - 3. Silent check valves.

1.2 RELATED SECTIONS:

- A. Section 22 05 23 - General-Duty Valves for Plumbing Piping
- B. Section 40 05 23 - Common Requirements Results for Process Valves

1.3 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.
 - 5. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

6. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 7. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
 8. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
- C. American Water Works Association (AWWA):
1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
- D. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 SWING CHECK VALVES, 1-INCH THROUGH 4-INCH DIAMETER

- A. Description:
 1. Horizontal T-pattern style.
 2. 200# WOG.
 3. Capable of functioning in the vertical position.
 4. Connections shall be standard threaded or threaded for fire hose connections where shown on plans
- B. Materials:
 1. Body Cap and Disc: Brass conforming to ASTM B584 C85400.
- C. Manufacturer:
 1. Figure 246 as manufactured by Red White Valve.

2.2 SWING CHECK VALVES, 4-INCH DIAMETER AND LARGER

A. Description:

1. Meeting requirements of AWWA C508.
2. Type: Swing, resilient-seated, with outside lever and adjustable spring.
3. Flow Area: Full open.
4. Mounting: Horizontal or vertical.
5. Shall close tightly when the pressure downstream of the valve disc exceeds the upstream pressure.
6. Working Pressure: 150 psi or 250 psi as indicated on the drawings.
7. Tight sealing, shockless in operation and absolutely prevent the return of water back through the valve.
8. The disc shall be attached to the sic arm by means of a center pin, disc nut, and washer providing 360-degree angular articulation but not rotation.
9. Pin Shaft:
 - a. Discs shall be suspended from a non-corrosive hinge pin shaft that shall rotate freely without the need for external lubrication.
 - b. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing.
10. End Connections: As shown on Drawings. End connections shall be rated to the working pressure requirements specified above.

B. Materials:

1. Body and Disc: Constructed of heavy cast iron conforming to ASTM A126 class B, or ductile iron conforming to ASTM A536.
2. Cover: Steel conforming to ASTM A36 or Ductile iron conforming to ASTM A536.
3. Disc Arm: Ductile iron conforming to ASTM A536.
4. Body Seat: Type 316 stainless steel or Bronze ASTM B62.
5. Disc Seat: Field-replaceable, NBR or Buna-N.

6. Hinge Pin and Key: Stainless steel.
 7. Rubber Components: NBR or Buna-N.
 8. Connecting Hardware: Stainless steel.
- C. Finishes:
1. Epoxy lining and coating conforming to AWWA C210.
 2. For potable water service, epoxy lining and coating shall meet be provided with NSF 61 certification.
- D. Manufacturer:
1. GA Industries, Figure No. 220-D.
 2. Cla-Val, 585 Series.
 3. Approved equal.

2.3 NOT USED

2.4 SILENT CHECK VALVES

- A. Description:
1. Type: Globe-style, silent operating type that begins to close as the forward velocity diminishes and be fully closed at zero velocity, preventing flow reversal and resultant water hammer or shock.
 2. Valve design shall incorporate a center-guided, spring-loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe.
 3. Valve Interior: Contoured and unrestricted to achieve maximum flow capacity along with minimum pressure drop.
 4. Installation: Operation of the valve shall not be affected by the position of installation. It shall be capable of operating in the horizontal or vertical position with the flow up or down.
 5. Valve Disc: Concave to the flow direction providing for disc stabilization, maximum strength and minimal flow velocity to fully open the valve.
 6. All component parts shall be field replaceable without the need of special tools.
 7. A replaceable guide bushing shall be provided and held in position by the valve's spring.

8. Spring: Designed to withstand 100,000 cycles without failure and exert a force which allows the valve to start opening at a differential pressure of .5 pounds per square inch (psi) (.04 kilograms per square centimeter (kg/cm²)) and to fully open at a flow velocity of 4 feet per second (1.22 meters per second).
9. The valve disc and seat shall be field replaceable and have a seating surface finish of 32 micro-inch or better to insure positive seating at all pressures.
10. Valve shall be hydrostatically tested at 1.5 times the rated working pressure.
11. Working Pressure: 150 or 250 psi as indicated on the Drawings.
12. End Connections: As shown on Drawings. End connections shall be rated to the working pressure requirements specified above.

B. Materials:

1. Body: ASTM A536, ductile iron.
2. Trim: Stainless steel.
3. Spring: Stainless steel.
4. Resilient Seat: Buna-N

C. Finishes:

1. Epoxy lining and coating conforming to AWWA C210.
2. For potable water service, epoxy lining and coating shall meet be provided with NSF 61 certification.

D. Manufacturer:

1. Val-Matic, 1800 series.
2. Cla-Val, 581 series.
3. Approved equal.

2.5 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure, in conformance with requirements of AWWA C508.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install check valves according to AWWA C508, Section 40 05 51 Common Requirements Results for Process Valve, and as recommended by manufacturer.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVES

- A. Provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 65.16 – ELECTRICALLY CONTROLLED GLOBE STYLE DIAPHRAGM VALVES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section includes electrically controlled, hydraulically operated globe style diaphragm valves, complete and operable, including coatings and linings, appurtenances, operators and accessories, in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 40 05 23, Common Requirements Results for Process Valves.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. In accordance with Article 1.3, Reference Specifications, Codes, and Standards of Section 33 12 16, Water Utility Distribution Valves and Article 1.3, Reference Specifications, Codes, and Standards of Section 40 05 23, Common Work Results for Process Valves.

1.4 SUBMITTALS

- A. As required by Section 40 05 23, Common Work Results for Process Valves.

1.5 QUALITY ASSURANCE

- A. As required by Section 40 05 23, Common Work Results for Process Valves.

PART 2 PRODUCTS

2.1 GLOBE STYLE DIAPHRAGM VALVES, GENERAL

- A. Construction:
 - 1. Valve shall be single-seated, globe style, hydraulically operated and diaphragm actuated.
 - a. Diaphragm assembly shall be guided top and bottom by a precision-machined stem.
 - b. Resilient valve disc, retained on three sides by disc retainers, shall form a drip-tight seal with a renewable seat when pressure is applied above the diaphragm.

- c. Control of valve operation shall be by means of an externally mounted, hydraulic pilot system. Where required by the plans or by this specification, the pilot system shall include a solenoid valve for electrical override of the pilot system.
 2. Main Valve Body and Cover: ASTM A536 ductile iron.
 3. Flanged Ends: ASME/ANSI B16.42 Class 150 flanges.
 4. Main valve trim shall be stainless steel.
 5. Pilot control components: Bronze ASTM B62 with Type 303 stainless steel trim, and pilot tubing shall be copper.
 6. Rubber parts shall be Buna-N synthetic rubber.
- B. Protective Coating:
1. Valve body and cover shall be lined and coated with an NSF/ANSI 61 listed fusion bonded epoxy coating system suitable for use with cast iron, ductile iron or steel valves.
 2. The epoxy coating thickness and application shall be in accordance with American Water Works Association (AWWA) C116.

2.2 FV-302, PUMP TO WASTE PRESSURE SUSTAINING VALVE WITH PRESSURE RELIEF

- A. Pressure Rating: Valve shall be suitable for a working water pressure of 250 psig.
- B. Valve shall function with an external water pressure source supplied to the pilot system, independent of the line pressure. Independent, external water pressure source shall be approximately 40 to 60 psig.
- C. Valve shall provide a pressure sustaining function when an electrically actuated solenoid in the pilot system is energized.
- D. Solenoid valve shall be designed to operate on the voltage shown on the plans and the coil shall be contained in a NEMA Type 4 enclosure. The solenoid valve shall have a manual bypass to permit actuation of the solenoid valve in the absence of power.
- E. Pilot system shall include a pressure relief function that operates to relieve pressure from the line, independently of the solenoid valve and the external water pressure source.

F. Operating Requirements

1. Pressure Sustaining Control:

- a. When the electrically actuated solenoid in the pilot system is energized, pressure sustaining control located in the pilot system shall sense the main valve inlet pressure and shall cause the main valve to modulate as required to maintain a constant pressure at the main valve inlet.
- b. Adjusting the spring force in the pressure sustaining control shall set the desired constant upstream pressure.
- c. Valve shall close drip-tight upon de-energizing of the solenoid valve.

2. Pressure Relief Control:

- a. A normally closed pressure relief control valve, located in the pilot system, shall sense the main valve inlet pressure, and shall cause the main valve to open when the inlet pressure at the main valve increases to the set point of the pressure relief control feature, regardless of the status of the solenoid valve.
- b. Adjusting the spring force in the pressure relief control shall set the desired relief pressure.

3. Operating Conditions

- a. Valve shall be capable of maintaining upstream pressure over a range of 0 psig to 60 psig at a flow rate of 1,400 gpm. Initial setting for the pressure sustaining valve shall be 15 psig.
- b. Valve shall be capable of relieving upstream pressure over a range of 15 psig to 70 psig. Initial setting for the pressure relief valve shall be 50 psig.

G. Accessories: The following accessories shall be furnished with the valve:

1. Wye-style strainer for pilot system.
2. Pilot system isolation valves on inlet, outlet, cover and sensing lines.
3. Opening speed control.
4. Closing speed control.
5. Valve limit switch, weather proof, actuated when valve is fully closed.

H. Model & Manufacturer: Valve shall be model 61G-32-B-Y-KCX pressure sustaining valve with solenoid shut-off and X105LCW position switch, as manufactured by Cla-Val Co., Newport Beach, CA.

2.3 FV-303, PRESSURE REDUCING VALVE WITH CHECK FEATURE

- A. Pressure Rating: Valve shall be suitable for a working water pressure of 250 psig.
- B. Flow through the valve shall be one-way.
- C. Valve shall function using line pressure.
- D. Valve shall provide a pressure reducing function when an electrically actuated solenoid in the pilot system is energized.
- E. Solenoid valve shall be designed to operate on the voltage shown on the plans and the coil shall be contained in a NEMA Type 4 enclosure. The solenoid valve shall have a manual bypass to permit actuation of the solenoid valve in the absence of power.
- F. Operating Requirements
 - 1. Pressure Reducing Control:
 - a. When the electrically actuated solenoid in the pilot system is energized, pressure reducing control located in the pilot system shall sense the main valve outlet pressure and shall cause the main valve to modulate as required to maintain a constant pressure at the main valve outlet.
 - b. Adjusting the spring force in the pressure reducing control shall set the desired constant downstream pressure.
 - c. Valve shall close drip-tight upon de-energizing of the solenoid valve.
 - d. Upstream line pressure shall be approximately 65 to 71 psig.
 - e. Valve shall be capable of maintaining downstream pressure over a range of 15 psig to 60 psig with flow of 1,100 gpm through the valve. Initial setting shall be 25 psig.
- G. Accessories: The following accessories shall be furnished with the valve:
 - 1. Wye-style strainer for pilot system.
 - 2. Pilot system isolation valves on inlet, outlet, cover and sensing lines.
 - 3. Opening speed control.
 - 4. Closing speed control.
 - 5. Valve limit switch, weather proof, actuated when valve is fully closed.
- H. Model & Manufacturer: Valve shall be model 93EG-01B-C-D-S-Y-KC pressure reducing valve with solenoid shut-off and an X105LCW position switch, as manufactured by Cla-Val Co., Newport Beach, CA.

2.4 FV-304, PRESSURE SUSTAINING VALVE WITH CHECK FEATURE

- A. Pressure Rating: Valve shall be suitable for a working water pressure of 250 psig.
- B. Flow through the valve shall be one-way.
- C. Valve shall function with an external water pressure source supplied to the pilot system, independent of the line pressure. Independent, external water pressure source shall be approximately 40 to 60 psig.
- D. Valve shall provide a pressure sustaining function when an electrically actuated solenoid in the pilot system is energized.
- E. Solenoid valve shall be designed to operate on the voltage shown on the plans and the coil shall be contained in a NEMA Type 4 enclosure. The solenoid valve shall have a manual bypass to permit actuation of the solenoid valve in the absence of power.
- F. Pilot system shall include a check function that operates to prevent reverse flow, regardless of the status of the solenoid valve and the external water pressure source.
- G. Operating Requirements
 - 1. Pressure Sustaining Control:
 - a. When the electrically actuated solenoid in the pilot system is energized, pressure sustaining control located in the pilot system shall sense the main valve inlet pressure and shall cause the main valve to modulate as required to maintain a constant pressure at the main valve inlet.
 - b. Adjusting the spring force in the pressure sustaining control shall set the desired constant upstream pressure.
 - c. Valve shall close drip-tight upon de-energizing of the solenoid valve.
 - 2. Check function: The valve shall have a check feature to positively prevent return flow when pressure reverses.
 - 3. Operating Conditions
 - a. Valve shall be capable of maintaining upstream pressure over a range of 0 psig to 30 psig at a flow rate of 1,400 gpm. Initial setting for the pressure sustaining valve shall be 15 psig.
 - b. Valve shall be capable of preventing reverse flows regardless of the status of the solenoid valve.

- H. Accessories: The following accessories shall be furnished with the valve:
 - 1. Wye-style strainer for pilot system.
 - 2. Pilot system isolation valves on inlet, outlet, cover and sensing lines.
 - 3. Opening speed control.
 - 4. Closing speed control.
 - 5. Valve limit switch, weather proof, actuated when valve is fully closed.

- I. Model & Manufacturer: Valve shall be model 60-G-82KX pressure sustaining valve with solenoid shut-off, check feature and X105LCW position switch, as manufactured by Cla-Val Co., Newport Beach, CA.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Valve installation shall be in accordance with Section 40 05 23, Common Work Results for Process Valves and manufacturer's requirements.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVES

- A. Provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 91 00 - PROCESS INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.1 THE REQUIREMENT

A. GENERAL

1. This project consists of the following work items related to the Aquifer Storage and Recovery well site 3 (ASR3), Aquifer Storage and Recovery well site 2 (ASR2) and Reservoir Site #4:
 - a. ASR3:
 - 1) Supply, configuration, and commissioning of process instrumentation.
 - 2) Detail design, supply, and testing of ASR3 control panel.
 - 3) Provide spare parts as designated in plans and specifications.
 - b. ASR2:
 - 1) Supply, configuration, and commissioning of water quality instrumentation. Terminate water quality instrument IO points on existing control panel terminals previously connected to old instruments.
 - 2) Detail design and supply of equipment to modify the existing ASR2 control panel and supply a control panel for the new PLC. This includes converting the existing Micrologix 1500 PLC into a remote IO base and installing a Compactlogix PLC panel and replacing an old Panelview terminal with a newer model.
 - 3) Provide labor to remove existing Micrologix 1500 and install new 5069-AENTR remote IO adapter. Install 1769-IQ16 and 1769-OW16 in existing panel to and terminate existing wires to these IO modules. These wires had previously been connected to the Micrologix 1500 base unit digital inputs and outputs. The parts listed here are called out as "Loose Part to be installed in existing control panel" on the ASR2 schematics bill of materials.
 - 4) Provide labor to install 2711P-B7C22D9P Panelview terminal (replaces obsolete Panelview in existing ASR2 control panel). The parts listed here are called out as "Loose Part to be installed in existing control panel" on the ASR2 schematics bill of material.

c. Reservoir Site 4:

- 1) Detail design and supply of equipment to modify the existing Site 4 control panel and supply a control panel for the new PLC. This includes converting the existing Micrologix 1500 PLC into a remote IO base and installing a Compactlogix PLC panel.
- 2) Provide labor to remove existing Micrologix 1500 and install new 5069-AENTR remote IO adapter. Install 1769-IQ16 and 1769-OW16 in existing panel to and terminate existing wires to these IO modules. These wires had previously been connected to the Micrologix 1500 base unit digital inputs and outputs. The parts listed here are called out as "Loose Part to be installed in existing control panel" on the Site 4 schematics bill of materials.

2. Supervisory control programming and integration will be provided by the engineer or client system integrator.

- B. The Contractor/vendor shall provide local Process and Instrumentation Control System (PICS) for each subsystem or piece of equipment that is complete and operable in accordance with the Contract Documents.
- C. The Work is located at various sites within the City of Tigard water distribution system. The Contractor/vendor shall coordinate its work to minimize disruption of existing facilities.

1.2 RESPONSIBILITIES

A. The Contractor/vendor shall perform the following work:

1. Implementation of PICS

- a. Prepare submittals as called out in this and following Sections in Division 40.
- b. Procure (PICS) hardware
- c. Design, build, test, and implementation of local control panels/systems
- d. Oversee and certify installation, startup and commissioning of PICS contractor supplied equipment.
- e. Conduct performance test
- f. Prepare Owner's O&M manual
- g. Conduct training classes

- h. Prepare record drawings
- i. Provide spare parts for PLC/Control components.

PART 2 PRODUCTS

2.1 THE REQUIREMENT

A. General

1. ASR3 Control Panel:

- a. The PICS contractor shall provide:
 - 1) Final detail design of the main control panel based on Specifications and Drawings.
 - 2) Control panel and component submittals.
 - 3) Procurement, testing and verification of UL508 certified control panel system.
- b. The Engineer or Client representative will provide control programming.

2. ASR2 Control Panel Modifications:

- a. The PICS contractor shall provide:
 - 1) Final detail design of the control panel modifications based on Specifications and Drawings
 - 2) Equipment and component submittals
 - 3) Procurement, testing and verification of supplied equipment.
- b. The Engineer or Client representative will provide control programming.

3. Reservoir Site 4:

- a. The PICS contractor shall provide:
 - 1) Final detail design of the control panel modifications based on Specifications and Drawings
 - 2) Equipment and component submittals
 - 3) Procurement, testing and verification of supplied equipment.

- b. The Engineer or Client representative will provide control programming.
4. Instrument Supply and Commissioning:
- a. The PICS contractor shall provide:
 - 1) Process instruments as shown in Specifications, instrument list, and Drawings.
 - 2) Instrumentation submittals
 - 3) Onsite instrument configuration, testing and verification of proper function.

PART 3 EXECUTION

3.1 THE REQUIREMENT

- A. Perform the system testing described below.
 - 1. For each sub system or piece of equipment or instrument, the PICS contractor shall perform startup checkout activities to ensure the item operates and performs the desired function.

3.2 RESPONSIBILITIES

- A. Submittals:
 - 1. The contractor shall provide submittals for the Instrumentation and control panel systems. Submittal shall provide the following information.
 - a. Control system hardware including controllers, PLC's, Operator Interface Terminals, power supplies, network components.
 - b. Detailed panel design drawings and wiring schematics.
 - c. Control panel components including relays, push buttons, indicator lights, display meters, enclosures, terminal blocks, annunciators. See Section 40 92 00 for specific requirements of control panel and component submittal.
 - d. Instrumentation submittals shall contain at a minimum:
 - 1) Product data sheet
 - 2) Part number

3) Product details included size, range, process connections, electrical connections, power requirements

4) Accessories.

B. Shop Testing/Quality Assurance:

1. All control panels shall be fully tested in the shop to ensure all internal wiring or component problems are identified and resolved prior to shipment to the job site. This includes:

- a. Checking power distribution is per panel drawings and verify circuit breaker and fuse sizes.
- b. Energize all power supplies and check for proper output.
- c. Energize PLC's and IO modules and perform point to point check for all IO to ensure terminals are wired to correct IO points.
- d. Check each PLC digital input and output modules point for correct operation.
- e. Check each PLC analog input and output module point for correct operation.
- f. Check function of all relays.
- g. Energize and check all operator interface terminals and network switches.
- h. Check operation of panel lights, indicators, display meters, switches.
- i. Check operation of panel heaters
- j. Check tightness of all terminal block screw connections.

2. PICS contractor shall keep records of shop testing.

C. Installation and Field Work

1. At ASR2 and Site #4, the Micrologix PLC in the existing control panel shall be removed and components installed to convert this to a remote IO base. The contractor shall complete the following work:

- a. Remove the Micrologix 1500 from the existing control panel.
- b. Install remote IO adapter module.
- c. Install IO modules.

- d. Re-terminate IO wires (previously terminated on PLC base that was removed) on new IO modules per plans.

D. Startup Testing/Quality Assurance:

1. Upon completion of installation of control panels and instrumentation the Contractor/vendor shall complete startup testing. At a minimum, startup testing shall consist of the following.
 - a. Power verification: Verify proper supply power voltage is applied to the PLC system.
 - b. Field IO checkout to ensure each IO signal is functioning and wired to the correct point in the control panel.
 - c. Verify proper operation of all instruments, sensors, gauges, and displays.
 - d. Verify proper operation of all motors and actuators.
2. For vendor-supplied or skid-mounted system if applicable. System commissioning includes at a minimum:
 - a. Operation of each major component of the system in manual mode.
 - b. Operation of the system in automatic mode such that it responds to the remote demand and run signal.
 - c. Check all vendor or skid mount instrumentation for correct function.

E. Guarantee:

1. The PICS contractor shall repair or replace any control system components that fail or are found defective during the original equipment manufacturer's warranty period.

F. Product Handling:

1. The Contractor/vendor shall crate or package control equipment and instrumentation as needed to prevent damage during shipping to the work site. This includes protection from physical damage and moisture.

G. Manufacturer's Representative Services:

1. The Contractor shall employ the services of the manufacture to startup and commission vendor supplied standalone packaged control systems at the site. The representative shall ensure proper operation of the equipment and control system in local mode prior to running the system in remote automatic mode.

Manufacturer's representative services for individual instruments are not required unless called out in the individual instrument specification section.

3.3 INSTRUMENT LIST

SITE	ID	DESCRIPTION	SIZE/RANGE	SPECIFICATION
ASR3	FS-306	PRELUBE FLOW SWITCH	1.5 INCH	40 91 03
ASR3	FIT-301	WELL DISCHARGE FLOW	12 INCH	40 91 02
ASR3	PIT-301	WELL DISCHARGE PRESSURE	0-30 psi	40 91 09
ASR3	AIT TRANSMITTER	WATER QUALITY CONTROLLER/TRANSMITTER	NA	40 91 11
ASR3	AIT-323	WATER QUALITY PH	2-14	40 91 11
ASR3	AIT-324	WATER QUALITY CONDUCTIVITY	0-1000 uS/cm	40 91 11
ASR3	AIT-322	WATER QUALITY FREE CHLORINE	0-10 mg/L	40 91 11
ASR3	AIT-321	WATER QUALITY TURBIDITY	0-5 NTU	40 91 11
ASR3	ZS-335	PUMP ROOM DOOR SWITCH	NA	40 91 12
ASR3	ZS-336	ELECTRICAL ROOM DOOR SWITCH	NA	40 91 12
ASR3	ZS-1621	SEISMIC VAULT INTRUSION	NA	40 91 12
ASR3	YA-330	PUMP ROOM SMOKE DETECTOR	NA	40 91 14
ASR3	YA-331	ELECTRICAL ROOM SMOKE DETECTOR	NA	40 91 14
ASR3	LIT-300	WELL LEVEL	0-304 psi (0-702 feet of water)	40 91 06
ASR3	PI-301	WELL DISCHARGE PRESSURE GAUGE	0-30 psi	40 91 09
ASR3	AIT-333	HYDROGEN GAS DETECTOR	0-4%	40 91 10
ASR3	YA-333	HYDROGEN GAS ALARM HORN	NA	40 91 10
ASR3	LSHH-1622	SEISMIC VAULT FLOOD	NA	40 91 07
ASR2	AIT TRANSMITTER	WATER QUALITY CONTROLLER/TRANSMITTER	NA	40 91 11
ASR2	REPLACE EXISTING	WATER QUALITY PH	2-14	40 91 11
ASR2	REPLACE EXISTING	WATER QUALITY CONDUCTIVITY	0-1000 uS/cm	40 91 11
ASR2	REPLACE EXISTING	WATER QUALITY FREE CHLORINE	0-10 mg/L	40 91 11
ASR2	REPLACE EXISTING	WATER QUALITY TURBIDITY	0-5 NTU	40 91 11
SITE 4	ZS-100	VAULT INTRUSION SWITCH	NA	40 91 12
SITE 4	LSH-100	VAULT FLOOD SWITCH	NA	40 91 07
SITE 4	ZS-101	RESERVOIR HATCH INTRUSION	NA	40 91 12

END OF SECTION

SECTION 40 91 01 - PROCESS CONTROL DESCRIPTION

PART 1 GENERAL

- A. The ASR3 site includes two major processes: ASR3 Well operations and the existing reservoir storage.
- B. Work under this Section includes programming and system integration to allow for independent and reliable control of the existing reservoir and the new ASR3 well facilities, such that they function as described herein.
- C. The instrumentation, control and telemetry system is designed to provide overall control for the ASR3 Treatment Facility using locally sensed flow and pressure, continuous online chemical analyses and facility status conditions. The application software shall be programmed to allow for autonomous operation of the systems based on setpoint parameters provided via the City's central SCADA facility or upon local interaction at the ASR3 facility.
- D. The Drawings illustrate electrical interconnection requirements between the I&C system and field equipment and sensors. The loop descriptions briefly describe each of the instrument loops and the major instrument components involved. The System Integrator shall be responsible for the design of the system and developing all software for the system.
- E. Software shall be provided for the new PLC control system. The PLCs shall be programmed to provide local automatic as well as supervisory control of the equipment via data exchange. All alarm and control functions are monitored locally on the HMI as well as transmitted to the City's central SCADA facility. Fail-safe features shall be included for all operations.

PART 2 PROCESS DESCRIPTIONS

2.1 ASR3 WELL OPERATIONS

The ASR3 Well system operates in two modes; aquifer recharge for storage and pumped withdrawal for recovery. Recharging the aquifer for storage is conducted during off-peak water demand seasons with water flowing from the 713-ft zone. Recovery operation uses the vertical turbine pump, P-301, to lift water from the aquifer where it is treated within the building using hypochlorite solution for secondary disinfection prior to flowing to the reservoir. In both modes, water quality parameters are measured and process control will stop operation and generate alarms when certain measurements are outside the range of monitored parameters.

A. Aquifer Storage Operation

The aquifer is recharged by routing water from the 713-ft zone through FV-303 to the wellhead and using the downhole valve FCV-308 to regulate flow in the well column and aquifer.

1. Startup preconditions for recharge operation.
 - a. FCV-308 is not in an alarm shutdown condition, a power source is available and no phase, power failure or seismic alarms are current.
2. Recharge Operation.
 - a. Upon request for recharge, FCV-308 is held closed and FV-303 is opened to allow flow from the 713-ft zone. Wellhead pressure is measured by PIT-301 to confirm the pipeline is pressurized and ready for recharge. The controller for FCV-308 is provided with an operator adjustable flow rate set point. If the pipeline does not fill, the recharge operation fails, FV-303 closes and a Recharge Operation Faults alarm is generated. When the pressure reading from PIT-301 stabilizes, FCV-308 is instructed to open to achieve the flow rate set point.
 - b. FCV-308 is operated by a hydraulic pump with solenoid valves that position the downhole valve. The control panel for FCV-308 controls the position of the downhole valve to achieve the flow rate set point.
 - c. Chemical system feeds are not operating during recharge.
 - d. Low pressure in the wellhead sensed by PIT-301, or high-high well level sensed by LE-300 will initiate a latched alarm and normal shutdown sequence.
 - e. A High Turbidity condition from AIT-321 during recharge will initiate a latched alarm and a Recharge Operation shutdown sequence.
 - f. High or low conductivity values from AIT-324 will initiate an alarm via SCADA but will not initiate a shutdown sequence.
3. Recharge Shutdown Sequence
 - a. When the auto-call signal is de-activated for Recharge Operation, FCV-308 is called to close first and FV-303 is closed afterward to keep the wellhead piping filled with water.

B. Aquifer Recovery Operation

The ASR 3 Well Pump is controlled by a variable frequency drive motor controller, adjusting the motor RPM as necessary to maintain the required flow rate.

1. Startup preconditions for pump operation.
 - a. No critical alarms can be active (low aquifer level, high reservoir level, motor controller fault, overtemperature, phase/power failure, chemical system shutdown). Critical alarms constitute a “Well System Shutdown” alarm.
 - b. Recharge valve FV-303 must be in the closed position.
 - c. Recovered Water valve FV-304 must be in the closed position to force all startup flows through the pump-to-waste valve, FV-302.
 - d. Minimum time exceeded since last motor operation. Following each time the motor stops, a minimum rest period is required to expire. Time is user adjustable, as recommended by the pump supplier. Typical values are 2.0 to 5.0 minutes.
 - e. Pre-lube flow minimum time: The pump bearings require water lubrication before rotation. The operator may select the desired minimum time for pre-lube valve FV-309 operation in minutes prior to enabling motor shaft rotation. Consult the pump O&M for recommended values.
 - f. Pump-to-Waste valve FV-302 is commanded to open. Startup flow is routed to waste for the initial pump operation. The valve must be open prior to pump startup. Valve position is sensed by a limit switch on the valve stem riser.
2. Pump Operation.
 - a. Upon startup of the well pump, flow is directed to the pump-to-waste pipeline. The waste duration is an operator adjustable value in minutes and motor speed is ramped to the ‘pump to waste speed’ setting. Following completion of a pump-to-waste cycle, the valve controlling flow to the reservoir, FV-304, is opened. When FV-304 is confirmed open, the pump-to-waste valve FV-302 is commanded to close and the automation system monitors completion of that action via the valve limit switch.
 - b. The pump speed is then ramped to the operating parameter (selectable as flow rate or pump speed) and chemical feed systems are enabled to meet dosage setpoints.
 - c. Chemical system feeds are confirmed for proper dosage via feedback from the chemical analyzers. A failure of the chemical system to respond to dose request

will disable the auto-call command and initiate a latched alarm and a normal shutdown sequence.

- d. A change to flow routing, as sensed by the “closed” valve position switch for FV-303, which would remove the flow path to the reservoir will initiate a latched alarm and a normal shutdown sequence.
- e. High pressure in the wellhead sensed by PIT-301 or low aquifer level sensed by LE-300 will initiate a latched alarm and faulting shutdown sequence.
- f. The VFD motor controller will provide faulting shutdown on detection of an internal fault, tripping of TSH-301X motor winding thermostats, and by electrical constraints defined by the NEC including calculated overload conditions of the motor. These VFD centric protections are enabled for both Hand and Auto control modes.

3. Well Shutdown Sequence

- a. When the auto-call signal is de-activated or if the VFD selector is placed in the Off position, the VFD ramps the motor speed down at a 1%/sec rate until reaching the minimum speed of the motor at which time the motor is de-energized and will spin to a stop based on inertia. The pump-to-waste valve remains closed as the VFD provides hydraulic dampening during the stop cycle.
- b. The automation system tracks the time when the motor is stopped and will not allow an automatic restart until the minimum off-time period is exceeded.

C. Chemical Feed Systems

Sodium hypochlorite is generated on site and is used to dose the recovered well water for secondary disinfection. There are two hypochlorite chemical feed pumps, each capable of providing the required dose. The dual feed pump system will operate in a Lead/Lag mode, with the lead pump alternating each day. If the Lead pump is not available, the pump alternator will toggle control to the Lag pump. If no chemical feed pump is available, the chemical shutdown alarm will be initiated.

Chemical concentration is used to close the loop on dosage setpoints.

1. Chlorine Feed

- a. The operator specifies the chlorine concentration required in the water leaving the ASR3 facility, flowing into the reservoir.
- b. The automation software uses the chlorine residual concentration to adjust the chemical feed pump operation to meet the target residual settings.

- c. A High or Low chlorine alarm will stop the flow of hypochlorite to the recovered water and stop the flow of recovered water from the ASR3 well.

Water Quality Analysis and Sampling System

- d. The ASR sample pump, P-320, ensures sufficient pressure to convey the sample water to the water quality panel and solenoid valve FV-307 permits the pressurized sample water to flow to the instruments. The following measurements are made: free chlorine residual; pH; conductivity; turbidity.

2.2 RESERVOIR STORAGE:

The existing reservoir on the site where the ASR3 facility will be constructed provides storage for the 560G zone. Water flows into the reservoir from the 713' zone. The reservoir will also receive the water pumped from the ASR3 well during recovery.

A. Flow into the Reservoir

Existing hydraulically operated valves, with solenoid override, control the flow of water into the reservoir from the 713' zone.

B. Seismic Detection and Response

A new Seismic Monitoring Panel CP-375 will provide detection of seismic events. The seismic monitor provides the following signals to the SCADA system: status of the unit's switch, "local" or "remote;" the unit is armed and ready for seismic detection; the unit has tripped; the unit's battery is low. Remote tripping and resetting (or re-arming) is available via the SCADA system.

2.3 ANCILLARY SYSTEMS

The automation system monitors several independently controlled systems and ancillary devices that indicate out-of-normal operating conditions. Standby power generation and hypochlorite generation are independently controlled systems monitored by SCADA. Seismic detection, building and vault access detection, high water, sample pump operation and air quality (hydrogen gas) are included in the monitored systems.

A. Standby Generator and ATS Operation

A 400kW diesel generator provides power to the site in the event of utility power failure. The automatic transfer switch (ATS) signals for the generator to start and stop based upon loss of utility power, a cyclic test schedule and/or a manual test request.

The automation system monitors three key status points from the ATS: switch position (generator or utility), generator available and utility power available. When the ATS is

in the generator position and utility power is available, the well pump is sequenced offline in anticipation of the power transfer back to utility.

The following signals are monitored on the generator and will generate an alarm: generator switch not in Auto position; generator running; and generator general fault condition.

B. Hypochlorite Generation

An onsite hypochlorite generation (OHG) system generates 0.8% free chlorine solution which is stored in tank TNK-352. The manufacturer's control panel CP-355 controls the process using salt, water and electricity to make the hypochlorite solution. Data associated with the generation process is communicated via analog and discrete signals.

C. Air Quality Alarms

Sensors monitor for smoke in ASR3 building, with one sensor in the electrical room and one in the pump room. Hydrogen gas is generated as a by-product of the OHG system, so a hydrogen sensor is located near the OHG system to monitor the concentration of hydrogen gas in the air within the pump room.

The air quality alarms are not listed as life safety devices and are not connected to emergency dispatch personnel. The City's central SCADA facility is notified when any air quality problem is detected and the condition will automatically initiate responses in the control system to mitigate the condition.

The OHG equipment will be automatically disabled and the ASR3 well pump will be automatically shut down if hydrogen gas is detected. The OHG system can also be remotely disabled through the SCADA system. However, after remote shutdown the OHG equipment cannot be remotely restarted; an operator must restart the equipment locally.

Operation of the ASR3 well pump (P301), the OHG system, the downhole ASR flow control valve (FVC-308) and the sample water pump (P-320) will all be disabled if smoke is detected in the pump room or the electrical room.

D. Intrusion / Unauthorized Access

Mechanically actuated limit switches mounted on exterior doors of the building and on all access hatches of all existing and new vaults provide security for the facility. Switch contact shall close as the hatch or door opens.

E. Flood Sensors

A float switch located in the existing valve vault senses high water condition and provides notification to operations personnel via the SCADA system.

END OF SECTION

SECTION 40 91 02 - IN-LINE FLOW MEASURING SYSTEMS

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40_91_00 SECTION 3.3 for instrument list.

1.2 SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 MAGNETIC FLOW MEASURING SYSTEMS

- A. Magnetic Flowmeter (Tube Type): Measures flow of conductive fluids based on the principle of Faradays Law.
1. Each magnetic flow metering system shall include a metering tube, signal cable, and transmitter.
 2. Metering Tube: polyurethane or hard rubber lined stainless steel with flanged connections
 3. Electrodes: Stainless steel.
 4. Designed for use in water/wastewater application.
 5. Flow tube liner: Polyurethane, hard rubber or other coating recommended by manufacturer for specified fluid and application
 6. Meter Housing: rated for NEMA 6P/IP68 submergence conditions for below grade or vault installation. Nema 4X/IP65 for above grade installation. Coating consisting of epoxy painted finish.
- B. Signal converter/transmitter:
1. Shall convert the DC pulse signal from the tube to a flow signal. The flow signal shall be available via Ethernet/IP connection AND 4-20Ma analog. The signal converter/transmitter shall have a backlit alphanumeric display. It shall have an integral calibration self-test feature to verify proper operation of the electronics.
 2. On board integral Ethernet/IP.
 3. Provide integral transmitter unless specified otherwise.
 4. Integral mount transmitter housing shall be Nema 4X/IP65 for above grade installation and NEMA 6P/IP68 submergence for below grade or vault installation.
 5. Remote mounted transmitter shall be Nema 4X/IP65 for above grade installation and NEMA 6P/IP68 submergence for below grade or vault installation. Remote mounted transmitter shall support up to 200 feet of cable between the flow tube and transmitter.
 6. 120VAC/24VDC universal power
 7. Output: (1) 4-20 mA
 8. Low flow cutoff, adjustable

9. Field Programmable via keypad
 10. Support measurement and totalization of bi-directional flow
 11. Flow range up to 30 feet per second
 12. Pulse output for totalization
 13. Accuracy: $\pm 0.2\%$ of flow rate
 14. Repeatability: $\pm 0.1\%$ of range
 15. Environmental Limits: - 10 to + 60° C
 16. Non-volatile memory for retaining programming
 17. Grounding Rings: include (2) corrosion resistant grounding rings constructed of the same material as the electrodes if unit does not include integral grounding rings.
 18. Installation parameters shall be as follows:
 - a. Minimum 5 pipe diameters of straight pipe upstream
 - b. Minimum 2 pipe diameters of straight pipe downstream
 - c. Horizontal or vertical mounting.
- C. Manufacture:
1. Endress & Hauser - Promag L/W 400 for water applications
 2. Or Engineer-approved equal.
- D. Scope of Supply: The Contractor shall provide the following magnetic flow units:
1. WELL DISCHARGE FLOW
 - a. Equipment Tag # FE/FIT-301
 - b. 12 inch meter size
 - c. Service: clean water
 - d. Integral mount transmitter

PART 3 EXECUTION

3.1 GENERAL

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 91 03 - FLOW DETECTION

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all liquid level measuring systems, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40 91 00 SECTION 3.3 for instrument list.

1.2 SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 FLOW DETECTION SWITCHES

- A. Where point flow detection of liquid is indicated, a paddle style flow switch shall be used.
- B. Paddle flow switch shall have the following attributes:
 - 1. NEMA 4 water tight housing.
 - 2. Brass construction with sealed tube
 - 3. Single Pole double throw switch
 - 4. External sensitivity adjust screw.
 - 5. Adjustable paddle length.
 - 6. 1-inch NPT process connection.
- C. Manufacture:
 - 1. McDonnell & Miller FS254
 - 2. Or Engineer-approved equal.
- D. Scope of Supply: The contractor shall provide the following flow detection sensors.
 - 1. ASR3 pump prelube flow switch
 - a. Equipment Tag # FS-306

PART 3 EXECUTION

3.1 GENERAL:

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 91 06 - LEVEL SENSOR

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all liquid level measuring systems, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section
- C. See 40 91 00 SECTION 3.03 for instrument list.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL:

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 SUBMERSIBLE PRESSURE LEVEL MEASURING SYSTEMS

- A. Where submersible pressure sensor types are indicated, pressure level measuring systems shall consist of an integrated, self-contained pressure sensor and electronics to measure static pressure generated by a fluid column.
- B. Pressure sensor level measuring systems shall have the following attributes:
 - 1. 24 VDC loop power.
 - 2. 4-20mA analog output signal.
 - 3. Diaphragm: 316 SS.
 - 4. Housing: 316SS.
 - 5. Port Material: 316 SS.
 - 6. Cable Jacket: Polyethylene, FEP, Polyurethane, Tefzel or equal.
 - 7. Cable Length: 750 ft or as required.
 - 8. Accessories: Cable suspension hardware and breather terminal box.
- C. Manufacturer:
 - 1. KSPI 335
 - 2. Or Engineer-approved equal.
- D. Scope of Supply: The Contractor shall provide the following ultrasonic non-contact level sensors:
 - 1. ASR3 well level
 - a. Equipment Tag # LIT-300
 - b. Range: 304 psi (702 feet of water).

2.3 NON CONTACT LEVEL MEASURING SYSTEMS

- A. Where non-contact sonic types are indicated, sonic level measuring systems shall consist of an integrated electronic controller-transmitter and non-contact sonic transducer. The controller-transmitter shall generate the sonic signal to drive the transducer, detect the return echo and convert the elapsed time to a level.
- B. Ultrasonic sensor level measuring systems shall have the following attributes:
 - 1. 24 VDC loop power.
 - 2. Minimum of one 4-20mA analog output signals configurable for level.
 - 3. Local display integral to transmitter housing with push button interface.
 - 4. IP66 rated housing enclosure
 - 5. 1.5 inch polypropylene transducer housing.
 - 6. 5 meter transducer range in liquid applications
 - 7. 1.5 inch NPT polypropylene threaded mounting process connection

8. 0.5 inch NPT electrical connection
- C. Manufacturer:
1. Endress Hauser Water Pilot FMU30
 2. Or Engineer-approved equal.
- D. Scope of Supply: The Contractor shall provide the following ultrasonic non-contact level sensors:
1. None

PART 3 EXECUTION

3.1 GENERAL

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 91 07 - LEVEL DETECTION

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all liquid level measuring systems, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40 91 00 SECTION 3.3 for instrument list.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 FLOAT LEVEL SWITCH

- A. Where point level measurement in a liquid is indicated, a float type level switch shall be used.
- B. Water reservoir application float level switch shall have the following attributes:
 - 1. Mercury free, self-counter weighted float switch.
 - 2. Polypropylene body.
 - 3. Cable length minimum 30ft or as required for application. PVC cable.
 - 4. Dry contact outputs, Single Pole Double Throw (SPDT) contact arrangement.
 - 5. IP68 rated housing body.
- C. Vault flood application float level switch shall have the following attributes:
 - 1. Vertical float switch.
 - 2. Buna N and Epoxy float.
 - 3. Minimum 24" wire leads
 - 4. Reversible float for changing contact output action.
- D. Manufacturer
 - 1. Water Reservoir application
 - a. Dwyer FSW2 Series
 - b. Or Engineer approved equal
 - 2. Vault flood applications
 - a. Dwyer F7 Series
 - b. Or Engineer approved equal.
- E. Scope of Supply: The Contractor shall provide the following single-point level sensors:
 - 1. ASR3 Seismic Vault Flood, LSHH-1622
 - 2. Site 4 Valve Vault Flood, LSH-100

PART 3 EXECUTION

3.1 GENERAL

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 91 09 - PRESSURE DETECTION DEVICES

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all pressure detection devices, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40_91_00 SECTION 3.3 for instrument list

1.2 SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 ELECTRONIC GAUGE PRESSURE TRANSMITTERS

- A. The transmitter shall be a 2-wire, high-performance capacitive pressure transmitter.

- B. Measure capacitance changes in the sensor as pressure varies and produces a linear 4-20mA DC output proportional to the pressure. The unit shall have self-diagnostic capability and non-volatile memory.
- C. Display shall be an integrally mounted 4-line LCD scaled with engineering units.
- D. Transmitter shall have a static pressure limit at least 1.5 times the nominal pressure range. Unit shall use DC loop-power supply 10.5 to 45 VDC with self-diagnostic capability and a non-volatile memory.
- E. Sensor shall be a high purity aluminum oxide ceramic element with no oil fill and an elastomer seal.
- F. The unit shall be rated for process temperature of minus 40°F to 266°F (302 °F for 1 hour) and an ambient environment of minus 40 degrees F to 185 degrees F.
- G. Reference accuracy shall be +/- .075% of calibrated span including non-linearity hysteresis and non-reproducibility in accordance with IEC 60770. Total performance accuracy including non-linearity hysteresis and non-reproducibility in addition to thermal change of the zero point shall be +/- .2% URL.H. Unit shall have ATEX, FM, CSA or IECEx approvals as required.
- H. Aluminum or Stainless Steel (316SS) housing, NEMA 4X/6P, ½ inch NPT electrical connections.
- I. ½-inch NPT, 316 Stainless process connection with block and bleed valve.
- J. MANUFACTURER:
 - 1. Endress Hauser Cerabar PMC51
 - 2. Or Engineer-approved equal.
- K. Scope of Supply:
 - 1. PIT-301, Well pump discharge pressure.

2.3 PRESSURE GAUGE

- A. Pressure gauges shall be 4-1/2 inches in diameter, liquid-filled, bottom connected, with white laminated dials and black graduations. Windows shall be shatterproof glass. Gauges shall have a blowout disc and be encased in phenolic, steel or cast iron. Measuring element shall be a stainless steel bourdon tube with welded, stress-relieved joints. Socket shall have wrench flats. Movement shall be rotary geared, all stainless steel material. All pressure gauges shall be provided with a pulsation snubber constructed of 316 stainless steel and a ball isolation valve. Accuracy shall be

plus or minus 0.5 percent range to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected.

B. Manufacturer:

1. Ashcroft 1279
2. Or Engineer-approved equal.

C. Scope of Supply

1. PI-301, Well pump discharge pressure

PART 3 EXECUTION

3.1 GENERAL

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 91 10 - HYDROGEN GAS DETECTOR

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The CONTRACTOR shall furnish and install all hydrogen gas detection devices, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40 91 00 3.3 for instrument list.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL:

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 REQUIERMENTS

A. Sensor Requirements

1. Catalytic Bead Type hydrogen sensor/transmitter:
 - a. Type: catalytic bead type hydrogen 0-4% sensor must have a demonstrated resistance to degradation of silicones and reduced sulfur gases.
 - b. Range: catalytic combustible sensor/transmitter shall detect for an above 100%LEL condition (over-range). This condition must be indicated on the front panel LCD.
 - c. Material: 316 Stainless Steel.
 - d. Hot Swappable under power.
 - e. Mounting: Remote mounted from transmitter with manufacturer provided optional j-box. Mount near ceiling to detect lighter than air gas accumulation.
 - f. Resolution: 1% LEL.
 - g. Repeatability: +/- 3% LEL.
 - h. Accuracy: +3% LEL up to 50% LEL, +5% LEL > 50% LEL.
 - i. Operating Temperature Range: -40 Degrees F to +140 Degrees F.
 - j. Operating Humidity Range: 10% to 95% t.h. non- condensing.
 - k. Sensor shall be factory calibrated.
 - l. Certification: CSA, FM, ATEX, IECEx, INMETRO, Marine, CE.
 - m. Classification:
 - 1) Class 1, Div 1 & 2, Groups A, B, C, D
 - 2) Class 2, Div 1 & 2, Groups E, F, G

B. Transmitter Requirements

1. Compatible with selected sensor.
2. Operating Voltage - 11-30 VDC, 3 Wire.
3. Signal Output: 4-20mA current source.
4. Relay Output: DPDT 5A @ 30 VDC; 5A @ 220VAC.

5. Bluetooth Low Energy.
 6. Display: Organic LED with contrast ration of 2000:1, 160 degree viewing angle.
 7. Fault Monitoring: Low supply voltage, internal errors, invalid sensor configuration, sensor faults, general faults.
 8. Enclosure rating: NEMA Type 4X, IP66.
 9. Operating Temperature Range: -40 degrees C to +60 degrees C.
 10. Operating Humidity Range: 0-95 %
 11. Approvals: CSA, FM, ATEX, IECEx, INMETRO, Marine, CE
 12. Classification: Class 1, 2, 3; Div/Zone 1&2.
 13. Cabling: 3-wire cable for all combustible unit sensors.
 14. Local LED display indicating gas type being monitored and concentration of gas present. Display shall be integral to the transmitter and indicate all diagnostic and fault conditions.
- C. Sensor/Transmitter Remote Sensor Mounting
1. The sensor portion of the sensor/transmitter unit will be capable of being able to be remotely mounted from the electronics and display. The separate sensor enclosure will be able to be mounted up to one hundred (100) feet from the main enclosure.
- D. Installation and mounting hardware
1. A mounting strap shall be used which mounts the sensor/transmitter to a wall or similar structure.
 2. The mounting strap shall attach to the sensor/transmitter via two tapped and threaded holes on the rear of the sensor/transmitter. There shall be no brackets or clamps to secure this strap to the sensor/transmitter.
- E. Non-intrusive Calibration Capability
1. All sensor/transmitters can be calibrated without opening any enclosures.
- F. MANUFACTURER: Combustible Gas Detection Devices shall be manufactured by:
1. MSA ULTIMAX 5000 Series Gas Monitor Transmitter with catalytic bead hydrogen 0-4% sensor, no substitutes

G. SCOPE OF SUPPLY

1. AIT-333, for detecting hydrogen gas near hypochlorite generation system at ASR3, see Instrument List, 40 91 00 3.3.
2. Supply with the follow attributes:
 - a. 316 Stainless Steel Enclosure, Large LCD Display, Power Input 7-30 VDC
 - b. Catalytic Bead Hydrogen Sensor, 0-4% Hydrogen
 - c. CSA, FM or UL Approved, Class I, Div 1 & 2, Groups A, B, C & D. Class II, Div 1, Groups E, F & G. Class III, Four Conduit Entries 3/4" NPT Threads
 - d. Output 4-20 mA
 - e. Output Relays: 3 DPDT, 5A @ 30 VDC; 5A @ 220VAC
 - f. Optional J-Box for Remote Mounting of Sensor from Transmitter as required. See P&ID and instrument list. Maximum separation distance is 100-ft
 - g. Bluetooth enabled for configuration and monitoring via app.
 - h. English Language Software
 - i. No Internal Power Supply
 - j. Diffusion Gas Sampling
 - k. Mounting Bracket
 - l. Standard Manuals
 - m. Calibration Kit for Hydrogen

PART 3 EXECUTION

3.1 GENERAL:

1. Installation and wiring shall be per manufacture's requirements.

END OF SECTION

SECTION 40 91 09 – WATER QUALITY ANALYZER

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all water quality analyzer devices, complete and operable, in accordance with the Contract Documents. This includes sensors/analyzers and transmitters for free chlorine, conductivity, pH and turbidity measurement.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40 91 00 SECTION 3.3 for instrument list.

1.2 SUBMITTALS

- A. **General:** The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 FREE CHLORINE DETECTOR

- A. Where residual chlorine monitoring is indicated an online free chlorine analysis system shall be used.
- B. The online free chlorine analysis system shall have the following attributes:
 - 1. EPA approved colorimetric DPD analysis method sensor.
 - 2. Measurement range: 0-10 mg/L.
 - 3. Accuracy of $\pm 5\%$ or ± 0.04 mg/L (whichever is greater) from 0 - 5 mg/L Cl_2
 - 4. Resolution 0.01 mg/L
 - 5. IP66 Enclosure rating.
 - 6. LED, measurement at 510 nm, 1 cm light pathlength
 - 7. Low limit of detection 0.03 mg/L
 - 8. 2.5 min cycle time
 - 9. Wall Mount
 - 10. Operating Temperature Range 5 - 40 °C (41 - 104 °F)
 - 11. 12 VDC, 400 mA maximum (supplied by the controller)
 - 12. Compatible with HACH SC1000 controller
 - 13. Include one month supply of Reagents.
- C. Manufacturer/Equipment:
 - 1. HACH CL17sc.
 - 2. No substitutes.
- D. Scope of Supply:
 - 1. AIT-322 ASR3 Free Chlorine Analyzer.
 - 2. ASR2 Free Chlorine Analyzer.

2.3 PH DETECTOR

- A. Where pH monitoring is indicated an online pH analysis system shall be used.
- B. The online pH analysis system shall have the following attributes:
 - 1. Sensor that continuously measures pH in aqueous solutions.
 - 2. The method of measuring pH will be with a probe or sensor that uses differential electrode measurement technique using three electrodes.
 - a. Two electrodes compare the process value to a stable internal reference standard buffer solution.
 - b. The internal electrode is non-flowing, foul-resistant characteristics

3. Measurement range: 2 to 14 pH.
 4. Sensitivity: 0.01 pH.
 5. Stability: 0.03 pH per 24 hours, non-cumulative.
 6. Temperature range: 23 to 158 °F (-5 to 70 °C).
 7. Sample flow rate: 3 meters (10 feet) per second, maximum.
 8. Pressure Rating: 100 pounds per square inch at 158 °F (6.9 bar at 70 °C).
 9. Transmission distance: 1000 meters (3240 feet), maximum.
 10. Wetted material: PEEK® or Ryton®.
 11. Convertible sensor mount with 1 inch NPT for mounting in pipe tee.340
 12. Compatible with HACH SC1000 controller
- C. Manufacturer:
1. Hach pHD-SC pH Sensor for high purity water application.
 2. No substitutes.
- D. Scope of Supply:
1. AIT-323 pH Analyzer.
 2. ASR2 pH Analyzer.

2.4 CONDUCTIVITY DETECTOR

- A. Where conductivity monitoring is indicated an online conductivity analysis system shall be used.
- B. The online conductivity analysis system shall have the following attributes:
1. Sensor that continuously measures conductivity in aqueous solutions.
 2. Non-metallic Ryton body material
 3. Graphite electrode
 4. Range: 0-1000 uS/cm
 5. Sensor cell constant of 0.5
 6. 1/2 inch NPT compression fitting connection
 7. Temperature range -20 to 200°C (-4 to 392°F)
 8. Accuracy ±2% of reading
 9. Sensitivity ±0.5% of reading
 10. Response time 90% of reading within 30 seconds of step change

11. Repeatability $\pm 0.5\%$ of reading
 12. Compatible with HACH SC1000 controller
- C. Manufacturer:
1. Hach Model 3400sc-series.
 2. No substitutes.
- D. Scope of Supply:
1. AIT-324 ASR3 Conductivity.
 2. ASR2 Conductivity Analyzer.

2.5 TURBIDITY DETECTOR

- A. Where turbidity monitoring is indicated an online conductivity analysis system shall be used.
- B. The online conductivity analysis system shall have the following attributes:
1. Instrument for continuous, online monitoring of turbidity in water by collecting scattered light at an angle of 90° in a 360° radius around the axis of the incident light beam.
 2. Range: 0-5 NTU
 3. Detection Limit: 0.002 NTU
 4. Accuracy
 - a. $\pm 2\%$ of reading ± 0.01 NTU from 0 to 40 NTU based on formazin primary standard at 25°C
 - b. 10% of reading from 40 to 700 NTU based on formazin primary standard at 25°C
 5. Repeatability: $\pm 1\%$ of reading or 0.002 NTU, whichever is greater based on formazin primary standard at 25°C
 6. Resolution: 0.0001 NTU
 7. Response Time: $T_{90} < 45\text{s}$ at 100 mL/min
 8. Sample Flow: 100 to 1000 mL/min; optimal flow rate 200 to 500mL/min
 9. Sample Pressure: Max. 6 bar (87 psi) compared to air at sample temperature range of 0 to 40°C (32 to 104°F)

10. Max. 3 bar (43 psi) compared to air at temperature range of 40 °C to 60°C (104 °F to 140 °F)
 11. Sample Temperature: 2 to 60 °C (36 to 140 °F)
 12. Electronic compartment IP55; all other functional units IP65 with process head/ACM attached
 13. Compatible with HACH SC1000 controller
- C. Manufacturer:
1. Hach series TU5300sc.
 2. No substitutes.
- D. Scope of Supply:
1. AIT-321 ASR3 Turbidity Analyzer.
 2. ASR2 Turbidity Analyze.

2.6 WATER QUALITY ANALYZER/CONTROLLER

- A. All of the water quality sensors specified in section 2.02 through 2.05 shall use one multichannel controller transmitter.
- B. The water quality controller/transmitter shall have the following attributes:
1. Multichannel capable of controlling up to 4 different water quality sensors.
 2. Display: QVGA, 320 x 240 pixels QVGA, 320 x 240 pixels, 256 colors, touch screen
 3. Enclosure Rating: IP65
 4. Enclosure: Polycarbonate
 5. Wall Mount
 6. Without GSM Module
 7. Operating Temperature:-20 - 55 °C / 0 - 95% relative humidity, non-condensing
 8. INPUTS: Up to 12 analogue 0-20 mA, maximum impedance 500 Ohms per probe module. Additional inputs are available with additional probe modules.
 9. OUTPUTS: Up to 12 analog 0/4-20 mA, maximum impedance 500 Ohms per probe module.

10. POWER: 120 - 230 V AC 50/60HZ

11. RELAYS: Up to four SPDT, user-configurable contacts rated 100 to 230 VAC, 5 Amp resistive maximum per probe module. Additional relays are available with additional probe modules.

12. ALARMS: Low alarm point, low alarm point deadband, high alarm point, high alarm point deadband, off delay, and on delay

13. Analog Output Functional Mode: PID, high/low phasing, setpoint, deadband, overfeed timer, off delay, on delay

C. Manufacturer:

1. Hach Model SC1000.
2. No substitutes.

D. Scope of Supply:

1. ASR3 Water Quality Analyzer System.
2. ASR2 Water Quality Analyzer System.

PART 3 EXECUTION

3.1 GENERAL

A. Installation and wiring shall be per manufacture's requirements.

END OF SECTION

SECTION 40 91 12 - INTRUSION DETECTION DEVICES

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all pressure detection devices, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40 91 00 SECTION 3.03 for instrument list.

1.2 SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 DOOR OR VAULT HATCH INTRUSION DETECTION SWITCH

- A. Door and vault hatch switches are used to detect entry into a room or vault.
- B. Characteristics:
 - 1. Magnetic Type
 - 2. Triple Biased, tamper proof
 - 3. Aluminum housing and mounting bracket for flush mount or door frame mount
- C. MANUFACTURER:
 - 1. Interlogix/Sentrol/Edwards 2500 series
 - 2. Or Engineer-approved equal.
- D. Scope of Supply:
 - 1. ZS-336, ASR 3 electrical room door status
 - 2. ZS-335, ASR3 pump room door status
 - 3. ZS-1621, ASR3 Seismic vault intrusion
 - 4. ZS-100, Site 4 valve vault intrusion

2.3 RESERVOIR HATCH OR VENT INTRUSION DETECTION SWITCH

- A. Hatch or vent switches are used to detect entry into reservoir.
- B. Characteristics:
 - 1. Modular plug in style limit switch
 - 2. Single pole double throw contacts
 - 3. Side rotary momentary head
 - 4. Zinc die cast housing with epoxy coating
 - 5. Adjustable radius lever arm with roller
 - 6. Pre-wired cable, 8 feet cable length
- C. MANUFACTURER:
 - 1. Siemens 3SE03 series
 - 2. Or Engineer-approved equal.
- D. Scope of Supply
 - 1. ZS-101, Site 4 reservoir hatch intrusion

PART 3 EXECUTION

3.1 GENERAL

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 91 13 - ALARM INDICATORS

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. **General:** The CONTRACTOR shall furnish and install all alarm indicator devices, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See section 40 91 00 3.3 for instrument list.

1.2 CONTRACTOR SUBMITTALS

- A. **General:** The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. **General:** The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. **General:** None required for this section

1.5 PRODUCT HANDLING

- A. **General:** Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL:

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 INDOOR/OUTDOOR AUDIBLE INDICATOR

- A. Provides audible indication of alarm conditions.
- B. CHARACTERISTICS:
 - 1. Contact closure activates audible indication.
 - 2. Indoor/outdoor capable, Nema 4X or IP65 rating
 - 3. 103 dB at 10 feet adjustable down to 78 dB
 - 4. Mounting: Wall Mount
 - 5. UL or FM Listed
 - 6. Power: 120VAC, 60Hz
- C. MANUFACTURER: Indicators shall be as manufactured by:
 - 1. Edwards Signal 876-N5
 - 2. ENGINEER approved equal.
- D. SCOPE OF SUPPLY
 - 1. See instrument list located in section 40 91 00 3.3.

PART 3 EXECUTION

3.1 GENERAL:

- 1. Installation and wiring shall be per manufacture's requirements.

END OF SECTION

SECTION 40 91 14 SMOKE DETECTION

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall furnish and install all liquid level measuring systems, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.
- C. See 40 91 00 SECTION 3.03 for instrument list.

1.2 CONTRACTOR SUBMITTALS

- A. General: The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: The accuracy of each instrumentation system or loop shall include the following.
 - 1. Verify proper power and signal wire terminations.
 - 2. Ensure proper power voltage is applied to the device.
 - 3. Check for correct output signal.

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

- A. General: None required for this section.

1.5 PRODUCT HANDLING

- A. General: Product shall be properly crated to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL

- A. All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 SMOKE DETECTOR FOR NON-CLASSIFIED AREAS

- A. For monitoring interior space for the presence of smoke/fire.

B. CHARACTERISTICS:

1. Photoelectric type smoke detection.
2. Self-restoring integral heat sensor, set to 135 degrees Fahrenheit.
3. 90 dBA horn (at 10 feet).
4. Provide provision for reverse polarity protection.
5. 4 wire, 24VDC powered with form C dry contacts for alarm
6. Ceiling mount.
7. UL268 listed
8. NFPA 72 compliant

C. Manufacturer

1. Gentex 8240PT
2. Or Engineer approved equal.

D. Scope of Supply: The Contractor shall provide the following single-point level sensors:

1. ASR3 pump room smoke detector, YA-330
2. ASR3 electrical room smoke detector, YA-331

PART 3 EXECUTION

3.1 GENERAL

- A. Installation and wiring shall be per manufacturer's requirements.

END OF SECTION

SECTION 40 92 00 - CONTROL PANELS AND COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes requirements for:
 - 1. Fabrication and assembly of all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:
 - a. Custom built instrumentation and SCADA Control Panels, including, Remote Telemetry Units (RTU), Master Telemetry Units (MTU), and Local Control Panels (LCP).
 - b. Control components.
- B. Related Sections:
 - 1. The Contract Documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the Contractor and its Subcontractors to review all sections to ensure a complete and coordinated project.

1.2 REFERENCES, SPECIFICATIONS, AND CODES

- A. Control panels shall comply with the requirements of NEC, NEMA, and UL.

1.3 DEFINITIONS

- A. Specific Definitions:
 - 1. The term "panel" in this Section is interchangeable with the term "enclosure."

1.4 SYSTEM DESCRIPTION

- A. Panel Dimensions:
 - 1. Minimum dimensions are scalable from or as indicated on Drawings and are based upon manufacturer's noncertified information. It is the responsibility of the Contractor or manufacturer to design and size all panels:
 - a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.

b. Maximum Panel Depth:

- 1) 24 inches, unless otherwise indicated.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. Provide a control panel submittal, for each control panel and enclosure being provided on this project, including but not limited to:

1. Product Data:

a. Enclosure construction details and NEMA type.

b. Manufacturer's literature and specification data sheets for each type of equipment to be installed within or on the panel or enclosure clearly marked to show model and options for selected component.

2. Shop Drawings:

a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information.

b. Detailed control wiring schematics including control power distribution, IO wiring, networks etc.

c. Complete nameplate engraving schedule.

d. Structural details of fabricated panels.

3. Complete and Detailed Bills of Materials:

a. A bill of material list, including quantity, description, manufacturer, part number, serial number, vendor name and spare part list where required, shall be submitted for each of the PCIS system components. Bills of material shall include all items within an enclosure.

b. Provide the bill of material on CD-ROM in Microsoft Excel format.

4. Calculations:

a. For assembled enclosures, provide calculations for:

1) Expected temperature rise inside enclosure

2) Expected duration of up time for back-up power system (UPS or battery).

3) Approximate wire duct percent fill.

1.6 QUALITY ASSURANCE

- A. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by Underwriters Laboratories to assemble and certify UL-labeled control panels:
 - 1. Provide all components and equipment with UL 508 listing.
 - 2. All control panels shall be labeled as follows, unless the equipment in the panel and the design in the Contract Documents cannot be reasonably modified to meet the requirements for the specified labeling:
 - a. UL 508A for general control panels not in hazardous locations.
 - b. UL 698 for control panels in hazardous locations.
 - c. UL 698A for control panels not in hazardous locations but contain intrinsically safe barriers for devices located in hazardous locations.
- B. Non-listed, complex and unique equipment may be evaluated and approved by a third party testing agency, with prior approval by the Owner. Provide report documenting the testing standard, specification, method of testing and that the equipment and materials meet appropriate designated standards or have been tested and found suitable for use in a specified manner.
 - 1. Provide fuses for all equipment that is not UL listed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Crate all panels for shipment using a heavy framework and skids:
 - 1. Provide wrapped waterproof flexible material for covering materials, where applicable, to protect against physical damage in transit.
 - 2. Provide suitable shipping stops and cushioning material for all instruments shipped with the panel to prevent damage due to mechanical shock during shipment.
 - 3. For large panels, provide removable lifting lugs to facilitate handling.

1.8 PROJECT SITE CONDITIONS

- A. Provide enclosures suitable for the location and environmental conditions in which they are located, and in the NEMA types in accordance with project Specifications and Drawings.

1.9 WARRANTY

- A. One-Year Warranty from time of Delivery and Acceptance.

PART 2 PRODUCTS

2.1 GENERAL

- A. The contractor/vendor shall provide the stations to satisfy the functional requirements in the relevant mechanical equipment and instrumentation and control specifications. Each station shall be fabricated with UL labeled components.
- B. The controls shall be 120 V maximum. Where the electrical power supply is 240 V, single phase or 480 V, 3 phase, the system shall be provided with a fused control power transformer.
- C. Each panel shall be provided with identified terminal strips for the connection of external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.
- D. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
- E. Enclosures
 - 1. Enclosures shall be NEMA 4 painted steel for outdoor or wet areas.
 - 2. Enclosures shall be NEMA 4X stainless steel for outdoor corrosive areas.
 - 3. Enclosures, shall be NEMA 12 for dry indoor, non-corrosive areas.
 - 4. Outdoor mounted panels shall be provided with thermostatically controlled heaters.
 - 5. Provide screened weep holes for draining condensation.

2.2 MANUFACTURERS

- A. As listed below in the individual component paragraphs.
- B. Provide instruments and other components performing similar functions of the same type, model, or class, and from one manufacturer.

2.3 MATERIALS

A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:

1. Enclosures shall be NEMA 250 type as indicated in Panel Drawings.
2. Enclosures shall have the following properties:
 - a. NEMA 1:
 - 1) Steel.
 - b. NEMA 4:
 - 1) Steel with gasketed door, rain tight.
 - c. NEMA 4X:
 - 1) Stainless steel Type 316 (unless indicated Type 304 on Drawings).
 - d. NEMA 12:
 - 1) Steel with gasketed door, dust-tight.
 - e. NEMA 7:
 - 1) Cast aluminum.

B. Bolting Material:

1. Commercial quality 1/2-inch diameter, stainless steel hex-head grade five bolts, nuts and washers, with unified coarse (UNC) threads.
2. Carriage bolts for attaching end plates.
3. All other bolted joints shall have S.A.E. standard lock washers.

2.4 MANUFACTURED UNITS

A. Panels/Enclosures:

1. Manufacturers:
 - a. Hoffman/nVent Engineering or equal.

2. Panel Assembly:

a. General guidelines for panel fabrication include:

- 1) Continuous welds ground smooth.
- 2) Exposed surfaces free of burrs and sharp edges.
- 3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2-inch holes at 12-inch spacing to accommodate anchoring of freestanding enclosures to floor.

b. Construct enclosure and mounting panel using stretcher level sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

- 1) Use heavier sheet metal to meet seismic requirements at the Project Site or when required due to equipment requirements.

Enclosure Height (inches)	Minimum Enclosure Steel Thickness	Minimum Back Mounting Panel Thickness
Up to 57	12	12
57-69	12	10
69-82	12 except 10 on back	10
82 or more	10	10

c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient torsional rigidity to resist the bending moments applied via the enclosure surface when it is deflected.

d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

e. Door Construction:

- 1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.
 - a) Sufficient width to permit door opening without interference with rear projection of flush mounted instruments.
 - b) Heavy gauge piano type continuous stainless steel hinges.
 - c) For NEMA 12, 4 and 4X, provide oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.

d) Gasket installed to seal against roll lip on the enclosure opening.

2) Latches:

a) For panels each door provided with a three-point latching mechanism and locking handle with rollers on the ends of the latch rods. Latch rods connected to a common door handle, hold doors securely, forming a compressed seal between door and gasket, at the top, side, and bottom.

(1) Provide padlock for each enclosure with padlock provisions.

3) Include an oil-tight key-locking, three-point latching mechanism on each door:

a) Provide two keys per panel.

b) All locks keyed the same.

4) For large type NEMA 4 and NEMA 4X cabinets, not available with three-point latching hardware, provide multiple clips and padlock hasps.

5) Provide quick release latches for all NEMA 4 and 4X enclosures.

6) Panel Cut-Outs:

a) Cut, punch, or drill cutouts for instruments, devices, and windows. Smoothly finish with rounded edges.

b) Allow a minimum of 3-inch envelope around all displays, controllers, and monitors.

c) Reinforce around cut-outs with steel angles or flat bars for the following:

(1) Large panel cutouts; for example, openings for local operator interfaces.

(2) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.

B. Outdoor Panels. Supplementary requirements for panels located outdoors are as follows:

1. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.

2. Bases: Heavy channel, gasketed iron bases, flanges up, for anchoring to pad.

3. Provide exterior drip edge for top of door frame.
 4. Provide thermostatically controlled heater.
- C. Arrangement of Components:
1. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.
 2. Arrange panel instruments and control devices in a logical configuration associating pushbutton and selector switches with related readout devices.
 3. Mount internal control components on an internal back-panel. Devices may be mounted on the side-panel only by special permission from the Engineer.
 4. All control panel mounted operator interface devices shall be mounted between 4 feet and 6 feet above finished floor.
- D. Disconnect Switches
1. See over current protection below.
- E. Over Current Protection:
1. Main over current Device:
 - a. Where the electrical power supply voltage to the control panel is more than 120V ac, provide the panel with a flange mounted disconnect handle operating a molded case circuit breaker, and provide a control power transformer for 120V ac circuits:
 - 1) Mechanically interlocked the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect switch cannot be closed until all doors are closed.
 - 2) Disconnect switch shall be lockable in the OFF position.
 - 3) Provide means to defeat the interlock.
 - 4) Disconnect switches shall be heavy duty, fusible, single throw. Fuses shall be provided.
 - b. Control Panels Supplied with 120V ac:
 - 1) Provide an internal breaker with the line side terminals covered by a barrier.

- 2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.
2. Selection and Ratings of Protective Devices:
 - a. Interrupting Ratings: Not less than the system maximum available fault current at the point of application.
 - b. Voltage Rating: Not less than the voltage of the application.
 - c. Select current rating and trip characteristics to be suitable for:
 - 1) Maximum normal operating current.
 - 2) Inrush characteristics.
 - 3) Coordination of the protective devices to each other and to the source breaker feeding the panel.
3. Provide a separate protective device for each powered electrical device:
 - a. An individual circuit breaker for each 120V ac instrument installed within its respective control panel and clearly identified for function.
 - b. An individual fuse for each PLC discrete input or related group of inputs. Provide with individual fuse with blown fuse indication external of the I/O card:
 - 1) Size external fuse to open before any I/O card mounted fuses.
 - 2) An individual 1/2-ampere max fuse for each 4 to 20 mA analog loop powered from the control panel.
 - 3) Install protective devices on the back mounting panel and identify by a service nameplate in accordance with the wiring diagrams.
4. Control Circuit Breakers
 - a. DIN Rail Mounting on 35mm rail
 - b. Manual OPEN-CLOSE toggle switch
 - c. Rated 250 VAC

- d. Interrupting Rating:
 - 1) 10kA or available fault current at the line terminal, whichever is higher
 - e. Current ratings:
 - 1) As required for the application.
5. Fuse Holders:
- a. Fused Terminal Blocks
 - b. DIN Rail mounting on 35 mm rail
 - c. Suitable for specified AWG wire
 - d. Rated for 10 amperes at 600 volts
 - e. Screw terminal type
 - f. 8 mm
 - g. Finger safe protection for all terminals for conductors
 - h. Terminals:
 - 1) Plainly identified to correspond with markings on the diagrams. Permanent machine printed terminal identification.
 - i. Wire size 22-12 AWG
 - j. Color:
 - 1) Grey
 - k. Indication:
 - 1) 120VAC NEON
 - l. Indication:
 - 1) 24VDC LED.

F. Conductors and Cables:

1. Power and Control Wiring:

a. Materials:

1) Stranded, soft annealed copper.

b. Insulation:

1) 600-volt Type MTW.

c. Minimum Sizes:

1) Primary Power Distribution:

a) 12 AWG.

2) Secondary Power Distribution:

a) 14 AWG.

3) Control:

a) 16 AWG.

d. Color:

1) ac Power (Line and Load):

a) Black.

2) ac Power (Neutral):

a) White.

3) ac Control:

a) Red.

4) dc Power and Control:

a) Blue.

5) dc Power common white with blue stripe

6) Ground:

a) Green.

G. Signal Cables:

1. Materials:

a. Stranded, soft annealed copper.

2. Insulation:

a. 600-volt, PVC outer jacket.

3. Minimum Size:

a. 18 AWG paired.

4. Overall aluminum shield (tape).

5. Copper drain wire.

6. Color:

a. Two Conductors:

1) Positive (+): White, red.

2) Negative (-): Black.

b. Three Conductors:

1) Positive (+): White.

2) Negative (-): Black.

3) Signal: Red.

c. Insulate the foil shielding and exposed drain wire for each signal cable with heat shrink tubing.

H. Conductor Identification:

1. Identify all conductors and cables with wire markers.

2. Readily identified without twisting the conductor.

I. General Wiring Requirements:

1. Wiring Methods:

- a. Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.
2. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.
3. Where the electrical power supply voltage to the control panel is more than 120V ac, provide the panel with a flange mounted disconnect and control power transformer. Mechanically interlock the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect cannot be closed until all doors are closed.
4. Provide means to defeat this interlock.
5. Control panels supplied with 120V ac:
 - a. Provide an internal breaker with the line side terminals covered by a barrier.
 - b. Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.
6. Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.
7. Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.
8. Provide surge protection device on input supply power.
9. Provide nonmetallic ducts for routing and organization of conductors and cables:
 - a. Size ducts for ultimate build-out of the panel, or for 25 percent spare, whichever is greater.
 - b. Provide separate ducts for signal and low voltage wiring from power and 120V ac control wiring:
 - 1) 120V ac:
 - a) Grey colored ducts.

- 2) 24V dc:
 - a) White colored ducts.
- 10. Cables shall be fastened with cable mounting clamps or with cable ties supported by any of the following methods:
 - a. Screw-on cable tie mounts.
 - b. Hammer-on cable tie mounting clips.
 - c. Fingers of the nonmetallic duct.
- 11. The free ends of cable ties shall be cut flush after final adjustment and fastening.
- 12. Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.
- 13. Support panel conductors where necessary to keep them in place.
- 14. Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.
- 15. Conductors and cables shall be run from terminal to terminal without splice or joints.
 - a. Exceptions:
 - 1) Factory applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.
- 16. The control panel shall be the source of power for all 120V ac devices interconnected with the control panel including, but not limited to:
 - a. Instruments and both mounted in the control panel and remotely connected to the control panel.
 - b. Solenoid Valves.

2.5 PANEL COMPONENTS

A. Pilot Devices:

1. General:

- a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.
- b. Size:

- c. 30.5 mm.
- d. Heavy duty oil tight.
- e. Pushbuttons:
 - 1) Contacts Rated: NEMA A600.
 - 2) Furnish one spare normally open and normally closed contact with each switch.
- f. Selector Switches:
 - 1) Contacts Rated:
 - a) NEMA A600.
 - 2) Knob type.
 - 3) Furnish one spare normally open contact and normally closed contact with each switch.
 - 4) Provisions for locking in the OFF position where lockout provisions are indicated.
- g. E-Stop Pushbuttons
 - 1) Maintained position
 - 2) Mushroom head
 - 3) Red color.
- h. Pilot Lights:
 - 1) Type:
 - a) LED
 - 2) Push to Test.
 - 3) Lamp Color:
 - a) On/Running/Start:
 - (1) Red.
 - b) On Forward:
 - (1) Red.

- c) On Reverse:
 - (1) Red.
- d) Off/Stop:
 - (1) Green.
- e) Power:
 - (1) White.
- f) Ready:
 - (1) White.
- g) Alarm/Failure:
 - (1) Amber.
- h) Opened:
 - (1) Red.
- i) Closed:
 - (1) Green.
- j) Auto:
 - (1) White.
- k) Manual:
 - (1) Amber.
- l) Local:
 - (1) White.
- m) Remote:
 - (1) Amber.

2. Indoor and Outdoor Areas:

- a. NEMA Type 4/13.

- b. Manufacturers and Products: One of the following:
 - 1) Allen-Bradley; Type 800T or equal.
- 3. Corrosive Areas:
 - a. NEMA 4X.
 - b. Corrosion resistant.
 - c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc.
 - d. Manufacturers and Products: One of the following: Allen-Bradley; Type 800H or equal.
- 4. Hazardous (Classified) Areas/Class 1 Division 2:
 - a. NEMA 4X.
 - b. Corrosion resistant.
 - c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc:
 - 1) All contacts contained within a hermetically sealed chamber:
 - a) Pushbuttons.
 - b) Selector switches.
 - c) Push-to-test contacts on pilot lights.
 - 2) UL listed and labeled for Class I Division 2 areas.
 - a) Manufacturers and Products: One of the following:
 - 3) Allen-Bradley; Type 8001-1 or equal.
- B. Signal Isolators and Converters:
 - 1. Furnish signal isolators that provide complete isolation of input, output, and power input:
 - a. Minimum Isolation Level:
 - 1) 1.5 kV ac/50-Hz for at least 1 minute.
 - b. Adjustable span and zero.

- c. Accuracy:
 - 1) Plus or minus 1 percent of span.
 - d. Ambient Temperature Range:
 - 1) Minus 20 degrees C to plus 65 degrees C.
 - 2. Manufacturers and Products:
 - a. One of the following: Phoenix Contact; MCR Series or equal.
- C. Relays:
- 1. General:
 - a. For all types of 120V ac relays, provide transient surge protection across the coil of each relay.
 - b. For all types of 24V dc relays, provide a free-wheeling diode across the coil of each relay.
 - 2. General Purpose:
 - a. Magnetic control relays.
 - b. NEMA A300 Rated:
 - 1) 300 volts.
 - 2) 10 amps continuous.
 - 3) 7,200 VA make.
 - 4) 720 VA break.
 - c. Plug-in type.
 - d. LED indication for relay energized.
 - e. Coil Voltages:
 - 1) As required for the application.
 - f. Minimum Poles:
 - 1) 3PDT.
 - g. Touch Safe Design:
 - 1) All connection terminals to be protected against accidental touch.

- h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.
 - i. Quantity and type of contact shall be as shown on Drawings or as needed for system compatibility.
 - j. Relays with screw-type socket terminals.
 - k. Provide additional (slave/interposing) relays when the following occurs:
 - 1) The number or type of contacts shown exceeds the contact capacity of the specified relays.
 - 2) Higher contact rating is required in order to interface with starter circuits or other equipment.
 - l. DIN rail mounting on 35-mm rail.
 - m. Ice cube type relays shall be provided with retainer clips to secure relay in socket.
 - n. Integrated label holder for device labeling.
 - o. Manufacturers and Products:
 - 1) One of the following:
 - a) Phoenix Contact; PLC series.
 - b) Potter and Brumfield; Type KRP or KUP.
 - c) IDEC; R* Series (* = H, J, R, S, U).
 - d) Allen-Bradley; Type 700 H Series.
 - e) Square D; Type K.
3. Terminal Block Relays
- a. DIN Rail Mounting on 35mm rail
 - b. Magnetic control relays
 - c. NEMA Rated:
 - 1) B300/R300
 - d. Electromechanical relay interchangeable with solid state relays
 - e. Plug-in type
 - f. LED coil indication

- g. Coil voltages:
 - 1) as required by application
 - h. Screw type socket terminals
 - i. Poles:
 - 1) single pole, double throw
 - j. Integrated label holder for device labeling
 - k. Touch safe design. All connection terminals to be protected against accidental touch
 - l. Quantity and type of contact shall be as shown on Drawings or as needed for system compatibility
 - m. Manufacturers and Products:
 - 1) Allen-Bradley 700 series or equal.
4. Time Delay:
- a. Provide time delay relays to control contact transition time.
 - b. Contact Rating:
 - 1) 240 volts.
 - 2) 10 amps continuous.
 - 3) 3,600 VA make.
 - 4) 360 VA break.
 - c. Coil Voltage:
 - 1) As required for the application.
 - d. Provide pneumatic or electronic type with on-delay, off-delay, and on/off delay:
 - 1) For off delay use the power off time delay relays. Where the required timing range exceeds capability of the off delay relay use signal off delay where power loss will not cause undesirable operation or pneumatic time delay relays.
 - e. Minimum Poles:
 - 1) 2PDT.

- f. Units include adjustable dial with graduated scale covering the time range in each case.
 - g. Minimum Timing Range:
 - h. 0.1 second to 10 minutes, or as required for the application.
 - i. Manufacturers and Products:
 - 1) One of the following:
 - a) IDEC; GT3 series.
 - b) Agastat Type; Series 7000 Series (Pneumatic).
 - c) Allen-Bradley; Type 700 HR Series.
 - d) Or equal.
- D. Magnetic starters shall be:
- 1. NEMA, IEC or dual NEMA/IEC rated
 - 2. FVNR type unless indicated otherwise
 - 3. Combination starters with magnetic only instantaneous trip circuit breakers such as Eaton Electrical MCP, G.E. Mag-Break, or equal.
- E. Terminal Blocks:
- 1. Din rail mounting on 35-mm rail.
 - 2. Suitable for specified AWG wire.
 - 3. Rated for 30 amperes at 600 volts.
 - 4. Screw terminal type.
 - 5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
 - 6. Finger safe protection for all terminals for conductors.
 - 7. Construction:
 - a. Polyamide insulation material capable of withstanding temperature extremes from minus 40 degrees C to 105 degrees C.

8. Terminals:

a. Plainly identified to correspond with markings on the diagrams:

- 1) Permanent machine printed terminal identification.
- 2) Disconnect type field signal conductor terminals with socket/screw for testing.
- 3) Identify terminals suitable for use with more than one conductor.
- 4) Position:
 - a) So that the internal and external wiring does not cross. To provide unobstructed access to the terminals and their conductors.
- 5) Provide minimum 25 percent spare terminals.
- 6) Manufacturers:
 - a) Entrelec or equal.

9. Fuses (Holders) and Circuit Breakers:

a. Fuse Holders:

- 1) Modular Type:
 - a) DIN rail mounting on 35-mm rail.
 - b) Touch Safe Design:
 - (1) All connection terminals to be protected against accidental touch.
 - c) Incorporates blown fuse indicator.
- 2) Provide Nameplate Identifying each Fuse.
- 3) Manufacturers:
 - a) Entrelec or equal.

F. Power Supplies:

1. Design power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.

2. Convert 120V ac to 24V dc or other dc voltages as required for the application.
 3. If indicated on project plans, provide redundant 24V dc power supply units to automatically supply the load upon failure of the primary supply.
 4. Provide power supply arrangement that is configured with several modules to supply adequate power in the event of a single module failure:
 5. Provide Automatic switchover upon module failure.
 6. Alarm contacts monitored by the PLC.
 7. Sized to provide 40 percent excess rated capacity.
 8. UL 508C listed to allow full rated output without de-rating.
 9. Provide fuse or short-circuit protection.
 10. Provide a minimum of one set of dry contacts configured to change state on failure for monitoring and signaling purposes.
 11. Output Regulation:
 - a. Plus or minus 0.05 percent for a 10 percent line change or a 50 percent load change: With remote voltage sensing.
 12. Operating Temperature Range:
 - a. 0 to 50 degrees C.
 13. DIN rail mounting on 35-mm rail.
 14. Provide self-protecting power supplies with a means of limiting de current in case of short circuit.
 15. Manufacturer:
 - a. Sola or equal.
- G. Industrial Ethernet Switches:
1. IP Ethernet switch
 2. Four 100/100BaseTX RJ-45 Ports or more as needed
 3. -40C to 70C Operating temperature range
 4. Auto sensing 10/100BaseTX

5. DIN rail mountable enclosure
 6. 24VDC Input voltage
 7. Include minimum of one 1000BaseSX Multimode GB Fiber Optic Port (ST Connector) only as needed or required by project drawings.
 8. Manufacturer N-Tron or equal.
- H. Wire Duct:
1. Provide flame retardant plastic wiring duct, slotted with dust cover.
 2. Type:
 - a. Wide slot.
 - b. Narrow slot.
 - c. Round hole.
 3. Manufacturer: Panduit or equal.

2.6 ACCESSORIES

- A. Provide panels with an inside protective pocket to hold the panel drawings. Ship panels with one copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.
1. Provide 15-inch floor stands or legs where needed or as indicated in Specifications.
 2. Provide nameplate to each panel as indicated on Drawings.
- B. Provide a nameplate with the following markings that is plainly visible after installation:
1. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.
 2. Supply voltage, phase, frequency, and full-load current.
 3. Short-circuit current rating of the panel based on one of the following:
 - a. Short-circuit current rating of a listed and labeled assembly.
 - b. Short-circuit current rating established utilizing an approved method.

C. Lighting:

1. Provide one luminaire for each section, on the interior of the panel, spaced evenly along the top-front of the enclosure door opening(s):
 - a. Covered or guarded.
2. Provide on-off door-activated switches where indicated on Drawings.
3. Provide 18-watt fluorescent lamp for indoor enclosures less than 30 inches wide.
4. Provide 40-watt fluorescent lamp for enclosures larger than 30 inches wide:
 - a. Provide additional fixtures for every 36 inches of width.

D. Receptacles:

1. Provide one duplex receptacle located every 4 feet of enclosure width, spaced evenly along the back mounting panels.
2. GFCI, 125-volt, single-phase, 15-ampere.

E. Grounding: Provide the following:

1. Grounding strap between enclosure doors and the enclosure.
2. Equipment grounding conductor terminals.
3. Provide equipment ground bus with lugs for connection of all equipment grounding wires.
4. Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus.
5. Identify equipment grounding conductor terminals with the word "GROUND", the letters "GND" or the letter "G," or the color green.
6. Signal (24V dc) Grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the loop drawings.
7. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.
8. Design so that removing a device does not interrupt the continuity of the equipment grounding circuit.

9. Provide an equipment-grounding terminal for each incoming power circuit, near the phase conductor terminal.
10. Size ground wires in accordance with NEC and UL standards, unless noted otherwise.
11. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment to the equipment grounding circuit.

2.7 SPARE PARTS

- A. Provide a minimum of 10 percent spare lamps (minimum 2) and one spare lens for each color pilot lamp in each panel.

PART 3 EXECUTION

3.1 CALIBRATION AND TESTING

A. General:

1. Calibration and testing shall be performed in accordance with Section 409100
2. Testing:
 - a. Panel fabricator shall conduct the following test prior to panel shipment:
 - 1) Check panel power distribution such that the indicated fuse or circuit breaker in fact provides power to devices indicated on wiring schematics.
 - 2) Check for proper fuse and circuit breaker size.
 - 3) Power up all devices in the control panel to check for proper operation.
 - 4) Test for correct operation and indication of all selector switches, push buttons and indicator lights.
 - 5) Verify proper operation of variable frequency drives as well as correct response to remote speed control signal and speed feedback signal.
 - 6) Verify correct operation and settings of timing relays.
 - 7) Test all PLC digital inputs for proper operation from the field IO terminal block all the way to the PLC.
 - 8) Test all PLC analog inputs for proper operation from the field IO terminal block all the way to the PLC. Analog inputs shall be tested using a 4-20mA

or 0-10VDC signal source to verify input signals at 25, 50, 75 and 100% of full scale.

9) Test all PLC digital outputs for proper operation from the PLC to the field terminals, including any interposing relays in the output circuit.

10) Test all PLC analog output for proper operation from the field IO terminal block all the way to the PLC. Analog outputs shall be verified using a multimeter at 25, 50, 75 and 100% of full scale.

11) Check Ethernet network connections and switch operation.

B. Test Report:

1. The contractor/vendor shall provide a test report detailing the test procedure and results of the testing conducted according to section B above.

END OF SECTION

SECTION 40 92 01 - PLC CONTROL SYSTEM HARDWARE AND SOFTWARE

PART 1 GENERAL

1.1 THE REQUIREMENT

A. General:

1. The Contractor/vendor, through the use of a qualified electrical installer, shall provide the PLC based control system (PLCS) complete and operable in accordance with the Contract Documents.

B. The Contractor/vendor shall be singularly responsible for selecting, configuring, and verifying correct operation of compatible hardware.

C. Whenever possible, the PLC/controller hardware shall be standardized so as to utilize off-the-shelf, commercially available configurations of hardware. The Contractor/vendor shall be responsible for the following, as a minimum:

1. Procurement of all hardware.
2. Design and submit PLC/Control hardware and all spare parts submittals for Engineer approval.
3. Perform all PLCS test adjustments and calibrations.
4. Provide qualified labor to supervise the installation of PLCS system by electrical contractor.
5. Perform PLCS startup and commissioning activities.
6. Provide tools, test equipment, spare parts, supplies, operation and maintenance manual, and control system record drawings.

D. PLCS Configuration:

1. The PLCS shall consist of PLCs/controller, Operator Interface Terminals, PC-based operator workstations, servers, communication modules, and all required equipment and peripherals as shown on the contract Drawings, and as described in these Specifications, and as required to meet the functional intent of the Specifications.

1.2 SUBMITTALS

A. Shop Drawings:

1. Shop drawings for PLC control panels showing panel layout, dimensions and wiring details.
2. Bill of materials for control panels.

B. Hardware submittals:

1. Components data sheets with part numbers for the following clearly indicating intended components:
 - a. PLC CPU and IO modules.
 - b. PLC accessories, memory cards, power supplies
 - c. Network switches
 - d. Power supplies
 - e. Relays
 - f. Terminal blocks
 - g. HMI panels.
 - h. Surge suppressors
 - i. Uninterruptable power supplies (UPS)
 - j. Panel light
 - k. Indicator lights, buttons and selector switches
 - l. Panel enclosure and back panel
 - m. Circuit breakers
 - n. Miscellaneous electrical components.

C. Owner's O&M Manual:

1. Detailed owners O&M manual shall be provided in accordance with Section 40 91 00. The following items shall be included in the O&M manual:
 - a. Record drawings for PLCS control system wiring and networks.
 - b. PLCS component list with part numbers and manufacturer information.
 - c. PLCS component user manuals.
 - d. Instrument data sheets with part number, manufacturer, setup/calibration information.
 - e. Component cut sheets and user manuals.
 - f. Recommended spare parts list.

D. System Test Procedures

1. System test procedures shall be developed by the Contractor in accordance with the requirements for system testing indicated below in paragraph 3.02 below, and shall be submitted to the Engineer for review. An approved submittal shall be required prior to the commencement of system testing.
2. The procedures shall be in narrative form, and shall sequentially describe the operational steps to be followed in verifying the correct operation of each control component.

1.3 STORAGE AND HANDLING

- A. All equipment and materials delivered to the Site shall be stored in a location which shall not interfere with the operations of the Owner's personnel or interfere with construction. Storage and handling shall be performed in a manner which shall afford maximum protection to the equipment and materials. It is the Contractor's responsibility to assure proper handling and on-site storage.

1.4 WARRANTY REQUIREMENTS

- A. Equipment, software, and materials which do not achieve design requirements after installation shall be replaced or modified by the Contractor to attain compliance. The cost for doing so shall be the Contractor's responsibility. Following replacement or modification, the Contractor shall retest the system and perform any additional procedures needed to place the complete PLCS in satisfactory operation and attain design compliance approval from the Engineer.
- B. The Contractor warrants the materials and workmanship used for the PLCS equipment and materials and further guarantees the materials and workmanship used for any equipment and materials produced and furnished hereunder as a part of the Work to be as required and agreed upon, free from injurious defects, and in all respects satisfactory for the service required.
- C. The Contractor warrants/guarantees the satisfactory performance of the equipment and materials under operating conditions for a period of 1 year after the date of final acceptance of the entire system.

PART 2 PRODUCTS

2.1 GENERAL

- A. The requirements of Section 40 91 00 apply to this Section.

- B. All material and all PLCS equipment furnished under this Contract shall be new, free from defects, of first quality and produced by manufacturers regularly engaged in the manufacture of these products.
- C. Hardware Commonality: Where there is more than one item of similar equipment being furnished, all such similar equipment shall be the product of a singular manufacturer.
- D. If applicable, the Contractor/Vendor shall furnish PLCS hardware that matches the existing facility SCADA system standard as called out in paragraph 2.04.F of this Specification. This applies to PLCS hardware such as CPUs, I/O modules, communication modules, power supplies and chassis. This requirement is in place to ensure communication compatibility between existing PLCs and new vendor supplied PLCs.

2.2 PLCS ENCLOSURES

- A. Each PLC and its corresponding I/O modules, power supply module(s), communication interface devices, peripheral equipment, and UPS shall be mounted inside suitable enclosures. All I/O wiring from the field to the I/O modules shall be routed within wire ways and terminated on terminal blocks in the enclosure.
- B. PLCS enclosures shall be provided in accordance with Section 40 92 00 - Control Panels.

2.3 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. Provide and install line interactive UPSs or DC UPS in all panels that contain PLC/control equipment as shown on design drawings.
- B. Each UPS shall maintain power of all its loads for 15 minutes.

2.4 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. Construction:
 - 1. Each PLC central processing unit (CPU) shall be of solid state design and rated for operation in an industrial environment subject to heat, vibration, RFI, electrical transients and dust. The PLC equipment shall be capable of operating in a temperature of 0 to 60 degrees C at 95 percent humidity, non-condensing without air conditioning or fans.
- B. Components-General:
 - 1. Each PLC shall have the necessary memory and computing capabilities necessary to carry out the control objectives. It is the responsibility of the Contractor/Vendor to select the appropriate PLC equipment for the control application.

C. CPU:

1. The PLC CPU shall contain all relays, timers, counters, memory registers, arithmetic capability, PID loop control, and comparators necessary for the control application. The CPU shall be programmable in Ladder Logic, using PLC manufacturer programming software.

D. Memory:

1. The PLC CPU shall contain sufficient memory for proper program loading and execution. The PLC CPU shall contain an internal battery or non-volatile memory to ensure proper storage of the control logic application when the CPU is without power.

E. Data Communication:

1. Each PLC shall have the following communication ports built in or provided as an add-on module in the PLC chassis:
 - a. One or more industrial standard, IEEE 802.3 100BaseT Ethernet communication port (RJ45).
 - b. One RS-232C serial port if required for programming or other communication as indicated in Specifications and design Drawings.

F. Manufacturer:

1. The PLC shall be manufactured by Allen-Bradley. The PLC CPU shall be Allen-Bradley Compactlogix 5380 series as shown on project Drawings.

2.5 PLC POWER SUPPLY

- A. PLC power supplies shall accept incoming 120 VAC 60 Hz single phase or 24 VDC and convert this to the necessary voltages required to operate the PLC CPU and IO modules.
- B. The PLC power supply shall be mounted in the PLC housing or chassis and provide sufficient power for operating all CPU's and IO modules. The PLC/control power supply shall be sized to provide 25% extra capacity.

2.6 PLC INPUT/OUTPUT (I/O) MODULES

A. General:

1. All PLC I/O modules shall be suitable for use in hostile industrial environments as described in section 2.04.A above. In general, I/O signal types shall be determined

by the Contractor/Vendor for the appropriate control application. Analog input and output signals shall be either 4-20mA or 0-10VDC. Digital input signals shall be 120VAC or 24VDC. Discrete output modules shall be 120VAC, 24VDC or relay contact and needed for the control application. Each location shall contain the I/O modules necessary for the control application plus 20% spare. All unused and spare IO points shall be wired to field terminals for easy utilization in the future.

B. Discrete Input Modules:

1. Discrete input modules shall be Allen-Bradley model compatible with selected PLC CPU as shown on project drawings, selected by the Contractor/Vendor for the control application.

C. Discrete Output Modules:

1. Discrete output modules shall be Allen-Bradley model compatible with selected PLC CPU as shown on project drawings, selected by the Contractor/Vendor for the control application.

D. Analog Input Modules:

1. Analog Input modules shall be Allen-Bradley model compatible with selected PLC CPU as shown on project drawings, selected by the Contractor/Vendor for the control application.

E. Analog Output Modules:

1. Analog output modules shall be Allen-Bradley model compatible with selected PLC CPU as shown on project drawings, selected by the Contractor/Vendor for the control application.

2.7 OPERATOR INTERFACE TERMINALS

A. General:

1. Operator interface terminal refers to touch screen interface devices mounted in control panel enclosures.
2. All operator interface terminals shall be suitable for use in hostile industrial environments as described in section 2.04.A above.
3. Operator interface terminals shall be Allen-Bradley Panelview Plus 7 or Panelview 5000 series as indicated in project plans.

2.8 PERIPHERAL DEVICES

- A. General:
- B. Peripheral devices shall be furnished and installed by the Contractor/vendor as detailed in this Section.
- C. Network Switches:
 - 1. Network switches shall have a minimum of five 10/100 Mbit/s RJ45 ports.
 - 2. Network switches shall be rated for use in an industrial control environment, DIN rail mounted with wired power connections. See specification Section 40 92 00 2.05.G.
 - 3. Provide sufficient network ports so as to have at least two spare ports.
- D. Telemetry Radios
- E. General:
 - 1. Telemetry radios shall be used to implement communication link between remote sites.
- F. Telemetry Radio Characteristics:
 - 1. Industrial hardened, licensed 406-470 MHz narrowband.
 - 2. 10 watt peak power for max range of 50 miles.
 - 3. Serial and Ethernet connections
 - 4. 24 VDC power
 - 5. Provide antenna lightning arrestor and jumper cable TNC male to N male.
- G. Manufacturer:
 - 1. Match existing client communication radio system.

2.9 SPARE PARTS

- A. Spare parts shall be furnished as specified below:
 - 1. Provide one spare of each unique type of Input/Output module.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor/vendor shall utilize qualified personnel to supervise and accomplish the physical installation of all components which it provides.

3.2 TESTING

- A. Factory Testing:
 - 1. Prior to delivery and installation, the PLC hardware components shall be tested for proper operation as part of the Control Panel factory testing as described in Sections 40 91 00 and 40 92 00.

END OF SECTION

SECTION 43 21 00 - LIQUID PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated.
- B. Where two or more pump systems of the same type or size are required, all pumps shall all be produced by the same manufacturer.
- C. Provide all labor, equipment and materials and perform all operations in connection with the installation and testing of pumps selected by the Owner.
- D. Coordinate and utilize all factory testing, installation, start-up and field testing services supplied in conjunction with the pumping equipment.
- E. All work performed under this Section shall be in accordance with all approved trade practices and manufacturer's recommendations.
- F. Section includes:
 - 1. General design requirements for liquid pumps.
 - 2. Factory testing.
- G. Related Requirements:
 - 1. Section 43 21 53 – Sample Pumps.
 - 2. Section 43 21 52 – Deep Well Vertical Turbine Pumps

1.2 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Provide the following information:
 - 1. Pump name, identification number and applicable Section number from Project specifications.
 - 2. Performance Data Curves:
 - a. Showing head, capacity, horsepower demand, NPSH required and pump efficiency over the entire operating range of the pump.

- b. Pump manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions.
 - c. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable speed drive, and a curve for each speed on two-speed pumps.
- 3. The limits on the performance curves recommended for stable operation without surge, cavitation or excessive vibration.
- 4. Assembly and Installation Drawings: Including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
- C. Complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.
- D. Operation and Maintenance Manual: Containing the required information for each pump section.
- E. Spare Parts List: Containing the required information for each pump section.
- F. Factory Test Data: Signed, dated and certified for each pump system which requires factory testing submitted before shipment of equipment.
- G. Certifications:
 - 1. Manufacturer's certification of proper installation.
 - 2. Contractor's certification of satisfactory field testing.
- H. All pump motor information as required in Division 43.
- I. Provide lateral and torsional analysis as specified under Submittals Article of Section 11 05 00, Common Work Results for Equipment.

PART 2 PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least 2 (two) years and shall be suitable for the service intended.
- B. All materials and equipment shall be new and unused except for the testing specified herein.

- C. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.
- D. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine or encroach on the service factor.
- E. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings and appurtenances.
- F. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a 100-mile radius of the site.
- G. The pumps shall be warranted by the manufacturer for a minimum of one (1) year from the date of installation.
- H. All materials and coatings coming in contact with potable water shall be ANSI/NSF Standard 61 approved.
- I. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, suction cans, baseplates, couplings, guards and other accessories.
- J. The complete pump assembly shall be designed and built for continuous service at any and all points within the specified range of operation, without overheating, without damaging cavitation, and without excessive vibration or noise.

2.2 MATERIALS

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
 - 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Casings, Class 30, or equal.
 - 2. Stainless steel pump shafts shall be Type 416 or 316.
 - 3. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.
 - 4. Anchor bolts, washers, and nuts supplied by the Contractor for non-corrosive applications shall be galvanized steel in accordance with the requirements of

Section 05 50 00, Metal Fabrications. Anchor bolts, washers and nuts in corrosive service applications shall be stainless steel in accordance with that Section.

2.3 PUMP COMPONENTS, GENERAL

- A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.
- B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.4 PUMP APPURTENANCES

- A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed and manufacturer's name and model number.
- B. Gauges: Provide and install pressure gauges as shown on the Drawings.
 - 1. All pumps (except sample pumps, sump pumps, hot water circulating pumps and chemical metering pumps) shall be equipped with pressure gauges on the pump discharge.
 - 2. Pump suction lines shall be provided with compound gauges.
 - 3. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.
 - 4. Isolation diaphragms shall be provided for all gauges except where pumping potable water.
 - 5. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

2.5 FACTORY TESTING

- A. The following tests shall be conducted on each indicated pump system:
 - 1. Tests shall be performed using the complete pump system to be furnished, including the motor.
 - 2. For motors 100 hp and smaller, the manufacturer's certified test motor shall be acceptable. The following minimum test data shall be submitted:
 - a. Hydrostatic test data.

- b. A minimum of five (5) hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.
 - c. Pump curves showing head, flow, bhp, efficiency and NPSH requirements.
 - d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.
 - e. Pump test data curves showing head, flowrate, bhp, and efficiency. Acceptance level shall be Grade 1E as defined by ANSI/HI 14.6.
3. Factory Witnessed Tests: Factory witnessed testing for this project not required.
 4. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor and Pump Manufacturer shall make all necessary modifications, repairs or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the Owner until found satisfactory.
- B. The pump manufacturer shall complete a lateral and torsional analysis where required and as specified in the Submittal Article of Section 11 05 00, Common Work Results for Equipment. This analysis shall identify the dry and wet lateral critical and the torsional critical speeds of the pump system and shall be submitted for review as part of the pump submittal.

PART 3 EXECUTION

3.1 SERVICES OF PUMP MANUFACTURER

- A. As part of this construction contract, the Contractor shall utilize the full value of the Owner- acquired services for start-up and testing services from the Pump Supplier as specified in specification section 01 75 16 Testing, Training and System Startup.
- B. An authorized service representative of the manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted and readied for operation:
 1. Installation of the equipment.
 2. Inspection, checking and adjusting the equipment.
 3. Startup and field testing for proper operation.

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.
 5. Requirements are more specifically detailed herein and in individual pump specifications.
- C. Instruction of the Owner's Personnel:
1. An authorized training representative of the manufacturer shall visit the Site to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.
 2. Instruction shall be specific to the models of equipment provided.
 3. The pump manufacturer's representative shall have at least two years' experience in training.
 4. Training shall be scheduled a minimum of three weeks in advance of the first session.
 5. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.
 6. The training materials shall remain with the trainees.
 7. The Owner may videotape the training for later use with the Owner's personnel.

3.2 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. Alignment:
1. All equipment shall be field tested to verify proper alignment, operation as specified and freedom from binding, scraping, vibration, shaft runout or other defects.
 2. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.
 3. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: Provide the necessary oil and grease for initial operation.

3.3 FIELD TESTS

- A. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or overheating of bearings.
- B. Field testing methods and allowable tolerances shall comply with current version of the Hydraulics Institute standards for the type of pumps installed.
- C. The following field testing shall be conducted:
 - 1. Startup, check and operate the pump system over its entire speed range. Where vibration analysis and measurement is required, it shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.
 - 2. Obtain concurrent readings of motor voltage, amperage, pump suction head and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.
 - 3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test, unless insufficient liquid volume is available.
 - 4. Electrical and instrumentation tests shall conform to the requirements of the Section under which that equipment is specified.
 - 5. Field vibration readings shall be conducted by an Owner-selected certified testing agency, paid for by the Contractor, with readings taken at the following positions with the average not exceeding the current Hydraulic Institutes standards for the type of pump installed.
 - a. Measurements shall be taken at the locations as specified in the current Hydraulic Institute standards for the type of pump installed.
 - 6. Provide written proof of vibration readings and provide test data.
- D. Field testing will be witnessed by the Engineer. The Contractor shall furnish three days advance notice of field testing.
- E. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- F. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests and a listing of all persons present during the tests and the test data.

- G. Contractor shall bear all costs of field tests, including additional services of the manufacturer's representative required beyond those specified.

END OF SECTION

SECTION 43 21 52 - DEEP WELL VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

- A. The contractor shall provide all equipment labor and materials to furnish and install a vertical turbine well pump with 480 volt, 3 Phase, 60 Hz motor, column pipe and accessories as shown on the drawings and required by these specifications. Pump Supplier shall unit responsibility for all equipment listed in this section.
- B. Work also includes installation of the downhole components of the aquifer storage and recovery (ASR) valve specified in Section 40 05 23.60. The ASR valve shall be located within the pump column as shown on the plans. The pump installer shall assume unitary responsibility for installation of the pump and the ASR valve.
- C. Prior to preparing technical submittals for this section, Contractor shall complete the work of Section 33 08 20 – Aquifer Testing, submit the results to the Owner for review by Engineer, and receive confirmation of the final pump specifications from the Engineer. The pump specified herein constitutes the basis of design. Final pump specifications may be modified by Engineer on the basis of the results of the aquifer testing.

1.2 SUBMITTALS DURING CONSTRUCTION

- A. Shop drawing submittals in accordance with sections 01 33 00 and 43 21 00.
- B. Contact information for the nearest supplier of parts from which parts may be obtained in sufficient quantity on a 24 hours basis.
- C. Operation and maintenance manuals.
- D. Manufacturer's warranty.
- E. Factory Performance Test results (not witnessed) in accordance with section 43 21 00. Test must be performed using the motor that shall be supplied with the pump assembly. Results shall be reviewed and approved by Engineer prior to shipping.
- F. Factory Hydrostatic Test results.
- G. A lateral and torsional analysis as specified in section 11 05 00.
- H. Hydraulic thrust calculations for pump assembly demonstrating the impellers have clearance throughout the range of operation that exceeds line shaft stretch.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

Pumps shall meet the requirements of the latest version of ANSI/AWWA E-101, Vertical Turbine Pumps – Line Shaft and Submersible Types and the Hydraulic Institute Standards, as modified herein.

PART 2 PRODUCTS

2.1 IDENTIFICATION

- A. Pump Name ASR3 Well, Pump P-301
- B. Quantity 1
- C. Location Tigard, OR

2.2 CONDITIONS

- A. Duty Continuous
- B. Ambient Temperature (F) 55 to 105
- C. Fluid Service Potable Water
- D. Fluid Temperature (F) 40 to 70
- E. Fluid PH 6 to 8
- F. Project Site Elevation (ft) 544

2.3 PERFORMANCE REQUIREMENTS

- A. Duty Points

The flow at the best efficiency point (BEP) must be within six (6) percent of the primary duty point flow rate. The flow rate for all duty point must be within the range of 75% of flow at BEP and 118% of flow at BEP. The primary and secondary duty points are as listed below:

	Duty Point
Flow rate (gpm)	1,200
Total Dynamic Head, min (ft)	720
Minimum Overall Pump Efficiency (%)	80

- B. Maximum Shut of Head (ft) 1,100
- C. Minimum Design Bowl Efficiency (%) 80.5
- D. Maximum Pump Motor Speed (RPM) 1800
- E. Motor HP Rating, minimum 300

- F. Motor HP Rating, maximum 350
- G. Minimum Number of Bowl Stages per manufacturer

2.4 EQUIPMENT REQUIREMENTS

- A. Discharge head size (inches) 12
- B. Minimum column diameter (inches) 10
- C. Maximum outside diameter of assembly (inches) 13.5
- D. Water or oil lubricated Water
- E. Minimum line shaft diameter (inches) 1.9375
- F. Existing casing inside diameter (inches) 15.25
- G. Pump bowl depth (ft below ground surface) 810
- H. Groundwater elevation (ft below ground surface) 676

2.5 PUMP CONSTRUCTION

- A. The bowls shall be flanged type constructed of close grained cast iron conform to ASTM A48, class 30. They shall be free from sand holes, blowholes, or other faults and must be accurately machined and fitted to close tolerances. They shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shut-off head, whichever is greater. The intermediate bowls shall have enamel or epoxy lined waterways for maximum efficiency and wear protection. All intermediate bowls shall be of identical design for interchangeability. All the bowls shall be fitted with sleeve type bearings of bronze alloy C89835. All wetted parts shall be coated with Tenemic, Pota Pox, or Scotchkote 134 with a total thickness of 12 mills.
- B. The impellers shall be constructed from 316SS and shall be the enclosed type. They shall be free from defects and must be accurately cast, machined and filed for optimum performance and minimum vibration. Impellers shall be statically and dynamically balanced at the factory to grade G6.3 of ISO 1940 as minimum. They shall be securely fastened to the bowl shaft with taper locks 416 SS (or key and split thrust ring of SS).
- C. The suction bowl or suction bell shall be provided with non-soluble grease packed bronze bearing. Bowl Bearings will be constructed of steel back rubber. A bronze sand collar shall be provided to protect this bearing from abrasives in the pumping fluids. The bearing housing shall have sufficient opening at the bottom for easy removal of the bearing. A galvanized strainer will be provided. It shall have a net inlet area equal to at least three times the impeller inlet area. The maximum opening shall not be more than 75% of the maximum opening of the water passage through the bowl or impeller.
- D. The bowl shaft shall be constructed from ASTM 582 type 416 stainless steel. It shall be precision ground and polished with surface finish better than 40 RMS.

- E. The complete pump assembly comprising all stages, the suction bowl or suction bell and the strainer shall be assembled at the pump manufacturer's factory.

2.6 COLUMN ASSEMBLY

- A. The column pipe shall be furnished in sections not exceeding a nominal length of 10 ft. and shall be connected by threaded-sleeve couplings. Pumps that shall operate at speeds between 2200 RPM and 3600 RPM shall have intermediate column length and bearing spacing no greater than 5 feet. The length of the top and bottom sections shall not be more than 5 ft. The pipes shall be of ASTM A53 grade B steel pipe and the weight shall be not less than schedule 40. The end of the pipe shall be with 8 threads per inch with 3/16" taper per foot thread and faced parallel to butt against the centering spiders of ASTM B584 Silicon Bronze to form accurate alignment. The inside diameter of the pipe shall be such that the head losses shall not be more than 5 feet per 100 feet of pipe.
- B. The line shaft shall be C1045 steel ground and polished with surface finish not to exceed 40 RMS. They shall be furnished in interchangeable sections not over ten feet in length and shall be coupled with threaded couplings (up to 2-15/16" diameter) machined from solid steel bar. It shall have left-hand thread to tighten during pump operation. The diameter of the shaft and coupling shall be designed in according with AWWA E101 Standard. Each joint shall be equipped with a 304 SS Sleeve; each sleeve will be placed between the bearing and the shafting bearing shall be fluted rubber retained in the centering spider by a shoulder on each end of the bearing.

2.7 DISCHARGE HEAD ASSEMBLY

- A. It shall be of the high-profile type to allow shaft coupled above stuffing box and provided for mounting the driver and support the column and bowl assemblies. It shall be fabricated steel. The above ground outlet shall be flanged with a diameter per the plans and these specifications. The flange shall be ANSI class 150. It shall have a 1/2" NPT connection for a pressure gauge. The stuffing box shall be cast iron and shall contain 5 rings of packing manufactured by John Crane. Discharge Head will be provided with a soleplate with a minimum thickness of 1.5 inches; soleplate will be hot dipped and galvanized.

2.8 MOTORS

Each pump shall be provided with a vertically mounted electric motor that conforms to the following requirements and Section 26 05 88 – Premium Efficiency Vertical Motors. In the event of conflicts, the more restrictive specification shall apply. The brake horsepower required by the driven equipment anywhere on the pump curve shall not exceed the rated nameplate horsepower of the motor. The ratings indicated are minimums. Motors shall be designed to accept the total, unbalanced thrusts imposed by the pump.

The motor shall be a heavy-duty squirrel cage induction type, NEMA Class F insulation with WP-1 enclosure, Premium Efficient, Inverter Duty, 1800 RPM vertical hollow shaft motor, with a non-reverse ratchet (or self-release coupling) to prevent reverse rotation of the rotating elements. A thrust bearing of ample capacity to carry the weight of all rotating parts plus the maximum hydraulic thrust load under all conditions of operation calculated L10 life shall be no less than 8800 hours. Provision shall be made for momentary up thrust equal to 30% of the rated down thrust. The motor shall be standard (or premium) efficiency, 1.15 service factor, and suitable for use on 480 volt, three phase, 60 Hz electric service. A solid coupling shall be provided at the discharge head for setting the impeller to bowl running clearance.

2.9 WATER LEVEL INDICATING & SOUNDER TUBE

- A. The pump column shall be provided with PCV pipe of sufficient length to extend from the well casing sole plate to the top of the bowl assembly to serve as housing for a well pressure transducer. Conduit size and number shall be as shown on the plans. The conduit shall be securely fastened with Type 316 stainless steel straps to the column pipe and care shall be exercised in lowering the pump assembly so that the conduit is not damaged.
- B. The pump column shall be provided with PVC or HDPE pipe of sufficient length to extend from the well casing sole-plate to the top of the bowl assembly to serve as a water level sounding tube. The conduit shall be securely fastened with Type 316 stainless steel straps to the column pipe and care shall be exercised in lowering the pump assembly so that the conduit is not damaged.

2.10 CONTROL CONDUITS FOR DOWNHOLE ASR VALVE

- A. Two conduits for control of the downhole ASR valve shall be installed with the pump installation. Coordinate with the ASR valve manufacturer to determine the diameter of the conduit and the requirements for securing and supporting the conduits

2.11 SPARE PARTS

- A. The pumps shall be provided with the following spare parts for each pump:
 - 1. Packing gland materials and tools.

2.12 MANUFACTURERS

- A. The Contractor shall use Floway, Goulds, Flowserve, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be provided by a contractor licensed as a water well construction contractor in the state of Oregon. Contractor will be responsible for providing a certified well installer license.
- B. Well will be disinfected after pump installation in accordance with State of Oregon requirements and specification section 33 21 50.
- C. The conduits for control of the downhole ASR valve shall be installed with the pump installation. The conduits shall be secured to the pump column in accordance with the written installation instructions of the ASR valve manufacturer and as approved by the Engineer. The conduits shall be installed in a manner that prevent kinks in and damage to the conduits. Installation and securing of the conduits shall be neat and tidy to ensure that the conduits and the piping for level probes will all pass easily and freely through the entire pipe length.
- D. The piping for level probes in the well shall be installed with the pump installation. The pipe shall be secured to the pump column at intervals not exceeding 10 feet in a manner approved by the Engineer. The pipe shall be installed straight and plumb along the pump column so that the probe with a length and diameter as specified elsewhere in the contract documents will pass easily and freely through the entire pipe length.

3.2 MANUFACTURES SERVICES

- A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as shown, unless otherwise approved by the Engineer. Submittals shall be provided to Engineer for all pump components and approved by Engineer prior to ordering and constructing the equipment.
- B. A factory Certified Representative of the pump manufacture with no less than 5 years experience shall be on site for a minimum of two eight hour days. The representative shall supervise the installation of the pumping equipment
- C. A factory Certified Representative of the pump manufacture with no less than 5 years experience shall be on site for a minimum of one eight hour day. The representative shall provide start-up and training of owner personnel.
- D. Field Vibration: Test for acceptable vibration will be made at no additional cost to the owner in the field on each pump system. All field tests will be running tests with the pump pumping product for which it is intended and each pump system will be tested separately with no other pump running. All tests will be done in the presence of the design engineer. Amplitude as used in this specification will mean peak to peak displacement, the requirements for testing for acceptable vibration will be the

measurement of this peak to peak displacement at 5 separate points on the motor and five separate points on the discharge head. The vibration test will be performed by using a Vibxpert manufactured by prufthechnik no equal.

- E. Field Harmonics: During star-up the pump manufacture will perform a Reed Critical Frequency (RCF) analysis commonly referred to as a “bump test”. The bump test will be done through the full operating range of the pump speed, from min speed to max speed. If there are any reflections of harmonics through the operating range of the pump it will be the pump manufactures responsibility to either correct the problem or inform the owner of the speeds that will need to be avoided through the Variable Frequency Drive Settings. A full report of these findings will be provided to the owner before final acceptance of the equipment.
- F. The Engineer may require that the inspection, startup, and field adjustment services above be furnished in separate trips.

END OF SECTION

SECTION 43 21 53 - SAMPLE PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish and install (1) one end-suction, close-coupled centrifugal pump and motor, P-320, to provide sample water to instruments as shown on the plans..

1.2 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Provide the following information:
 - 1. Pump name, identification number and applicable Section number from Project specifications.
 - 2. Manufacturer and manufacturer's type designation.
 - 3. Manufacturer's catalog and/or other data confirming conformance to specified design, material and equipment requirements.
 - 4. Performance Data Curves: Showing head, capacity, horsepower demand, NPSH required and pump efficiency over the entire operating range of the pump.
 - 5. Drawings providing dimensional data.
 - 6. Motor nameplate data.
 - 7. Assembly and Installation Drawings: Including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
- C. Complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.
- D. Operation and Maintenance Manual: Containing the required information for each pump section.
- E. Spare Parts List: Containing the required information for each pump section.
- F. Installation requirements.

PART 2 PRODUCTS

2.1 GENERAL

- A. The pump shall be installed as shown on the drawings and shall be designed and constructed to operate in an unheated, high humidity environment.
- B. The pump shall be designed for pumping water with up to 1.5 ppm of free residual chlorine. The pump will be controlled by the main controller specified elsewhere.
- C. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.
- D. The complete pumping unit shall be designed to operate without overload and continuously at any point within the entire range encompassed by the operating conditions below. Overload protection is required.
- E. Operating requirements:
 - 1. 5 gpm at 30 ft TDH; 3 gpm at 31 ft TDH
 - 2. Maximum 33 ft TDH shut off head.
- F. Maximum motor speed shall be 3,450 rpm. The motor shall be no more than 1/3 hp and non-overloading, exclusive of service factor, at any point on the pump curve. Motor shall be 115V, single-phase.
- G. Pumping unit shall be designed to operate without cavitation or damaging vibration over the entire specified range of speed, flow and head conditions. Pumping units shall not be subject to or a source of undue noise, vibration, or undesirable conditions during reductions in flow from the specified operating capacity range to zero flow. The pump head-capacity curve shall slope in one continuous curve with no points of reverse slope inflection capable of causing hunting at any pump operating condition.
- H. Acceptable Products:
 - 1. Price Pump Co., Model LT25 end-suction close-coupled centrifugal pump with 2.75 inch impeller, complete with 3500 rpm motor and base. Pump shall have a maximum 1/3- hp TEFC motor. The pump shall have a 1/2-inch inlet and 1/4-inch outlet, with 316 SS stub shaft, mechanical seals and bronze volute.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. The equipment shall be installed and tested under the direction of qualified personnel. In addition, the equipment shall be operationally tested in conjunction with the entire aquifer storage and recovery system:

END OF SECTION

SECTION 43 22 56 - STATIC MIXER FOR LIQUID PROCESS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work under this Section applies to the furnishing and installation of static mixers, sized per the Drawings.
- B. Injection and sampling ports are not integral to the static mixer. Refer to the Drawings for details of the injection quill(s) and the location of sampling quill(s).

1.2 SUBMITTALS

Submit the following information in accordance with Section 01 33 00.

- A. Exceptions to these specifications along with justification for each exception.
- B. Manufacturer and manufacturer's type designation.
- C. Manufacturer's catalog and/or other data confirming conformance to the specified design, material and equipment requirements.
- D. Calculations confirming conformance to specified design and operating requirements by showing flow characteristics, flow velocity and head loss as applicable for the specific application.
- E. Drawings providing dimensional data.
- F. Installation requirements.
- G. Operation and maintenance information.

PART 2 PRODUCTS

2.1 STATIC MIXER

- A. The static mixer shall be of an inline design for installation in a pipeline. The mixer housing shall be formed from Schedule 10 316 stainless steel. All mixer materials shall be suitable for exposure to 25% sodium hydroxide and 12.5% sodium hypochlorite.
- B. The mixer shall have three stages of mixing elements, flow straightening vanes on one end only and a threaded injection side port for chemical injection between the flow straightening vanes and the mixing elements.

- C. The static mixer shall accommodate bidirectional flow.
- D. The mixing elements shall be designed to provide thorough and efficient mixing of the fluid with minimal head loss. Mixing elements shall be set at right angles to adjacent elements such that each element divides the flow arriving from the previous element. The mixing elements shall incorporate direct stream impingement into their design to randomize flow distribution. The elements shall generate elliptical vortices that rotate in opposite directions to prevent streaming within the mixer.
- E. The average coefficient of variation (CoV) in the process stream of the injected fluid shall be no more than 5% of the mean value at 1 pipe diameter downstream of the mixer for following range of flows:
 - 1. 12-inch diameter:
 - a. Minimum flow of 900 gpm
 - b. Maximum flow of 1,400 gpm
- F. The mixer shall have the following pressure drop performance:
 - 1. 12-inch diameter: No more than 1 psig at 1,400 gpm
- G. Static mixer shall have flanged end connections conforming to ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Mixer size shall be as shown on the plans.

2.2 MANUFACTURERS

The mixer shall be an inline, triple-action, static mixer, model AS-76743 as manufactured by Komax Systems Inc., or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

The equipment shall be installed as shown on the Drawings and in accordance with the Manufacturer's recommendations for installation. The equipment shall be operationally tested in conjunction with the corrosion control facility.

END OF SECTION

SECTION 43 33 20 - LIQUID CHEMICAL DIAPHRAGM-TYPE METERING PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Positive displacement, diaphragm metering pumps and accessories, for pumping chemical solutions.
- B. Tag numbers:
 - 1. As specified in Pump Schedule.

1.2 REFERENCES

- A. International Society of Automation (ISA):
 - 1. ISA 5.4 - Instrument Loop Diagrams.
- B. National Electrical Code (NEC).
- C. National Electrical Manufacturer's Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- D. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.

1.3 DEFINITIONS

- A. NEMA: Type 4X enclosure in accordance with NEMA 250.

1.4 SYSTEM DESCRIPTION

- A. General: Provide mechanically actuated, positive displacement, diaphragm type chemical metering pumps, accessories, and other items required for a complete and operational system. Each chemical metering pump system shall include, but not be limited to, the following items.
 - 1. Pumps.
 - 2. Control panels.
 - 3. Calibration columns.
 - 4. Pulsation dampeners.
 - 5. External pressure relief valves.
 - 6. Diaphragm back pressure valves.
 - 7. High pressure switches.

8. Pump skids.
 9. Pipe and isolation valves.
- B. Fluid characteristics:
1. Sodium Hypochlorite:
 - a. Dry chemical formula: NaOCl.
 - b. Solution concentration: 0.8 percent by weight.
 - c. Solution pH: Approximately 9.
 - d. Solution specific gravity: 1.1.
- C. Design requirements:
1. Pump:
 - a. Dry self-priming, capable of being run dry without damaging effects to pump.
 2. Motor characteristics: As specified in this Section.
 3. Supports:
 - a. Provide pump and driver supported on a common base.
 - b. Design anchor bolts to withstand a minimum of 1.5 times the maximum imposed operating loads or 1.0 times the imposed seismic loads, whichever is greater.
 4. Pump skid:
 - a. Mount pumps, valves, calibration columns, and appurtenances on a skid as specified in this Section and indicated on the Drawings.
- D. Performance requirements:
1. Systems shall deliver the pressures and volumes listed for their respective services in the Pump Skid Schedule.

1.5 SUBMITTALS

- A. Submit as specified in Section 01 33 00 - Submittal Procedures.
- B. Product data:
1. Design data, test reports, certificates, manufacturer's instructions, manufacturer's field reports:

a. Chemical feed pumps:

1) Submit calculations for each pumping system.

a) Confirm scheduled values or recommend new pressure setpoints for the backpressure valves and pressure relief valves listed in the Pump Skid Schedule.

2) Submit calculations for each metering pump showing the suitability of each pump for the suction and discharge conditions of each application point.

a) Pump manufacturer shall recommend and size an accumulator to be piped to the suction side of each metering pump, when required based on calculations.

3) Submit calculations recommending dimensions of pulsation dampener indicated on the Drawings.

C. Shop drawings:

1. Provide a list of parameters, ratings, or other characteristics where the proposed chemical feed systems deviate from the requirements.

2. Dimensions, including anchor bolt layout, materials of construction, size, weight, and performance data.

3. Drawings: Provide electrical and instrumentation drawings showing coordination with electrical control devices operating in conjunction with the associated feed system.

4. Dimensioned inlet and outlet connections.

5. Current NSF 61 Certification for components to be in contact with associated chemical or potable water.

6. Provide data showing chemical compatibility and history of service with the associated chemical for materials in the system.

7. Control panel views showing equipment arrangement, doors, equipment layout inside the panel and dimensional information.

8. Internal interconnecting wiring diagrams showing terminal strips and external devices connected to the panel as specified in Section 40 61 00 - Common Work Results for Process Control and Instrumentation Systems.

9. Loop drawings for analog and discrete signals in accordance with ISA 5.4.

10. Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.
 11. Panel bill of material with detailed description of components and equipment data sheets.
 12. Field cable numbers and terminations.
 13. Manufacturer's Representative's qualifications.
 14. Manufacturer's certificate stating that the materials of construction are compatible with the pumped fluid.
 15. Manufacturer's Certificate of Source Testing.
 16. Manufacturer's Certificate of Installation and Functionality Compliance.
 17. Capacity control shall be 0 to 100 percent with delivery repeatable within plus or minus 1 percent accuracy over at least a 800 to 1 range.
- D. Calculations: Provide anchorage calculations for each pump skid per 13 05 41 Seismic Requirements for Non-Structural Components and Systems.
- E. Vendor operation and maintenance manuals: As specified in Section 01 33 00 - Submittal Procedures.
1. Provide information on each piece of equipment, including instrumentation.
 2. Provide all safety considerations relating to operations and handling of the associated chemical.
 3. Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life.
 4. Lubrication charts and tables of alternate lubricants.
 5. Name, address, and phone number of manufacturer and manufacturer's local service representative.
- F. Commissioning submittals:
1. Provide Certificate of Source Testing.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

1.6 WARRANTY

- A. Provide warranty as specified in the Contract Documents.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Packing, shipping, handling and unloading:
 - 1. Pack for shipping and outdoor storage at the project site for up to 6 months.
 - a. Apply temporary corrosion protective coatings to unpainted components and pack components to protect from the elements.
 - 2. Ship pump and drive completely assembled.

PART 2 PRODUCTS

2.1 GENERAL

- A. A single pump manufacturer shall furnish the pump components specified in this Section, including motors, couplings, supports, and other specified accessories and appurtenances to ensure compatibility and integrity of the individual components.
- B. The manufacturer of the pumps shall have sole-source responsibility for furnishing the complete assemblies and meeting the specified performance requirements.

2.2 PUMPS

- A. Equipment:
 - 1. Pump Manufacturers: Liquid Metronics (LMI) or approved equal.
 - 2. Type: Simplex chemical proportioning pumps of the positive displacement diaphragm type with solenoid actuation.
 - 3. Materials: The metering pumps and their components and accessories shall be suitable for contact with 0.8 percent Sodium Hypochlorite solution.
 - a. Diaphragm materials:
 - 1) Flat, composite, mechanically actuated diaphragms shall be PTFE faced as pump manufacturer deems suitable for the pumped liquid.
 - b. Other parts in contact with pumped liquid: Suitable for the liquid being pumped.

4. Characteristics:
 - a. Diaphragm simplex chemical proportioning pumps of the positive displacement, flat disc diaphragm type.
 - b. The diaphragm shall be solenoid actuated.
 - c. Pump shall have automatic degassing function.
 - d. Liquid end: Liquid end shall be sealed by means of an o-ring of material compatible with the pumped liquid.
5. Components:
 - a. Suction and discharge double check valves.
 - b. Built-in internal or external, adjustable pressure relief valve to relieve pressure in the event of discharge line stoppage.
6. Accessories: As indicated on the Drawings, pumps shall be equipped with:
 - a. Calibration column in suction piping.
 - b. Diaphragm backpressure, pulsation dampener, pressure gauges and pressure relief valve in discharge piping.
 - c. Isolation valves.

2.3 CONTROL

- A. Pumps shall receive a discrete, remote start/stop signal.
- B. Pumps shall respond automatically to a remote setpoint signal, 4-20 mA.

2.4 ACCESSORIES

- A. Provide the following materials, or other material as approved by the Engineer:
 1. Sodium Hypochlorite:
 - a. Piping: PVC or CPVC.
 - b. Tubing: PFA.
 - c. Valve and Ancillary Equipment: PVC, CPVC.
 - d. Seals: Viton or Teflon (PTFE).

B. Pulsation dampeners:

1. Manufacturers: One of the following or equal:
 - a. Kemlon Products.
 - b. Blacoh Fluid Controls, Inc.
 - c. Pulsafeeder.
 - d. Primary Fluid Systems, Inc.
 - e. Grifco.
2. Pulsation dampeners shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section.
3. Materials:
 - a. Pulsation dampeners materials shall be compatible with the pumped liquid at the specified concentration, and suitable for outdoor use and exposure (if located outdoors).
4. Characteristics:
 - a. Pulsation dampeners shall be gas or air charged, single diaphragm type complete with valved gas/air charge valve connection and pressure gage graduated from 0 to 200 pounds per square inch.
 - b. Pulsation dampeners shall allow no more than 6 percent discharge pressure fluctuation.
5. Dampeners shall be provided with a true-union ball valve for shutoff.

C. Calibration columns:

1. Materials:
 - a. Materials shall be compatible with the pumped liquid and concentration specified in this Section, and suitable for outdoor use and exposure (if located outdoors).
2. Characteristics:
 - a. Furnish and install calibration columns, 1 for each skid, on each chemical pump's inlet line as indicated on the Drawings and specified in this Section.
 - 1) Columns shall be translucent.
 - b. Provide top cap threaded connection with vent piped to common vent piping to prevent entry of foreign materials and to direct spillage or overflow.

- c. End connections shall be flanged.
 - d. Capacities and graduations shall be as recommended by column manufacturer and large enough to accommodate the autocalibration feature of the pump.
- D. Diaphragm backpressure and pressure relief valves:
- 1. Manufacturers: One of the following or equal:
 - a. Pulsafeeder.
 - b. Griffco.
 - c. Milton Roy Co.
 - d. Primary Fluid Systems, Inc.
 - 2. Materials:
 - a. Valves shall be of suitable materials for the pumped liquid.
 - 3. Characteristics:
 - a. Ported to serve as either a backpressure valve or a pressure relief valve.
 - b. Relief valve shall be plumbed to the nearest chemical drain, or back to the pump suction on the non-pump side of the pump suction isolation valve, to avoid spillage, as indicated on the Drawings.
 - c. Valves shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section.
 - d. Valves shall have an adjustable spring range of 15-100 pounds per square inch. Valves shall be factory adjusted for the backpressure recommended by the pump manufacturer.
 - e. Valves shall produce a back pressure no greater than 10 pounds per square inch above valve set pressure when metering pumps are operating at full capacity, pulsating flow.
- E. Diaphragm seals:
- 1. One of the following or equal:
 - a. Primary Fluids Systems
 - 2. Materials:
 - a. Body: See section 2.05.A.
 - b. Diaphragm: PTFE

- c. Pressure: Rated to 200 psi
- F. Pressure gauges:
 - 1. One of the following or equal:
 - a. Primary Fluids Systems
 - 2. Materials:
 - a. Premium Series, 2.5" diameter, liquid filled.
 - b. Connection Size: ¼".
 - c. Housing: Stainless steel.
 - d. Internals: 316 stainless steel.
 - e. Accuracy: +/- 1.6% or less.
 - f. Pressure Range: See drawings.
- G. Additional accessories:
 - 1. Additional accessories required for the system but not required to be supplied by the pump manufacturer include:
 - a. Pump and equipment mounting skid.
 - 1) Pump skid shall house 2 pumps with valves, a calibration column and appurtenances needed for operating the chemical pumps as indicated on the Drawings.
 - 2) Pump skid shall be constructed of polyethylene, polypropylene, or ABS whichever is most compatible with the chemical being pumped.
 - 3) See drawings for maximum skid dimensions.
 - 4) A drip pan and drain shall be integrated into the skid with 1 inch bulkhead fitting.
 - 5) Skid shall be plumbed with pipe and fittings type as scheduled in this Section and as shown on the Drawings.
 - a) Pipe and appurtenances shall be mounted to the skid using click-in type non-metallic pipe supports.
 - 6) All skids shall be fully assembled and tested prior to delivery.
 - a) The piping, ancillary equipment, and appurtenances for the existing pumps' skid shall be tested prior to delivery.

- b. Isolation valves for suction and discharge piping as indicated on the Drawings.
- c. Check valves for discharge piping as indicated on the Drawings.
- d. Piping as specified in Section 40 05 13.

2.5 NAMEPLATES

- A. Each pump and motor shall have, securely affixed in a conspicuous location, a stainless steel nameplate with raised letters providing the manufacturer’s model, serial number, rating, range, speed and other pertinent data.

2.6 SPARE PARTS AND SPECIAL TOOLS

- A. Spare parts: Furnish the following spare parts packed and labeled for warehouse storage:
 - 1. Complete set of inlet and outlet ball check valves (balls, seats and gaskets) and a diaphragm for each pump.
 - 2. 1 complete spare parts kit for each pump provided.
 - 3. 1 spare parts kit for each size and type of backpressure and pressure relief valve.
 - 4. An initial supply of all oils, greases, and lubricants required to start operations. Supply an amount of these materials equivalent to 1 year of continuous operation for each system.
- B. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

PART 3 EXECUTION

3.1 COMMISSIONING

- A. Training:
 - 1. Maintenance: 4 hours per session, 1 session.
 - 2. Operation: 2 hours per session, 1 session.

3.2 PUMP SKID SCHEDULE

- A. Pump Characteristic:

Maximum Flow, (gallons per hour)	19
Minimum Flow, (gallons per hour)	3.3

Normal Flow, (gallons per hour)	10
Pump Stroke Range (strokes per minute)	Per Manufacturer
Maximum Discharge Pressure (psig)	15
Minimum Suction Lift (feet)	5
Backpressure Valve Setting (psig)	25
Relief Valve Setting (psig)	35
<u>Materials</u>	
Pump Housing/Enclosure	PVC (with Kynar head)
Pump Diaphragm	Full PTFE
Pump Connections	Tube Compression Fitting
Elastomers/Seals	FKM (Viton™)
Pipe Material	PVC

END OF SECTION

SECTION 43 40 08 - POLYETHYLENE TANKS

PART 1 GENERAL

1.1 THE SUMMARY

- A. The Contractor shall provide cross-linked polyethylene tanks and accessories, complete and in place, in accordance with the Contract Documents.
- B. Unit Responsibility: The Contractor shall assign responsibility for furnishing the tank system as indicated to the chemical system supplier(s).

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ASTM D 618 Standard Practice for Conditioning Plastics for Testing

ASTM D 638 Tensile Properties of Plastics

ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D 883 Standard Terminology Relating to Plastics

ASTM D 1505 Standard Test Methods for Density of Plastics by the Density-Gradient Technique

ASTM D 1525 Standard Test Method for Vicat Softening Temperature of Plastics

ASTM D 1693 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

ASTM D 1998 Polyethylene Upright Storage Tanks

ASTM D 2765 Standard Test Methods for Determination of Gel Content and Swell Ratio of Cross-linked Ethylene Plastics

ASTM D 2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

ASTM D 3892 Standard Practice for Packaging/Packing of Plastics

- ASTM F 412 Standard Terminology Relating to Plastic Piping Systems
- ANSI B 16.5 Pipe Flanges and Flanged Fittings
- ARM Low Temperature Impact Resistance (Falling Dart Test Procedure)
- NEMA ICS 6 Enclosures for Industrial Control and Systems

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Shop Drawing information
 - 1. Tank Material
 - a. Data sheet
 - b. Information showing compatibility with chemical to be stored under the concentration and temperature conditions expected
 - c. Color sample
 - d. Gasket style and material
 - e. Bolting material
 - 2. Dimensioned tank drawings
 - a. Location and orientation of openings, fittings, accessories, instrumentation, and anchors and supports
 - b. Details of inlet and outlet fittings, manways, flexible connectors, and vents
 - 3. Tank pad requirements
 - 4. Calculations stamped and signed by a registered engineer and certified by the tank manufacturer.
 - a. Wall thickness. Hoop stress shall be indicated.
 - b. Tank restraint system. Design for seismic criteria in accordance with Section 13 05 41 Seismic Restraint Requirements for Non-Structural Components and Systems.
- C. Proposed manufacturer warranty
- D. Manufacturer's unloading procedure

- E. Manufacturer's installation instructions
- F. Manufacturer's written certification signed by a senior company officer stating that the tank design, type, and material is compatible with the indicated chemical to be stored in the tank.
- G. Manufacturer's Qualifications: List of installations documenting manufacturer's qualifications. Include names and telephone numbers for tank installations available for the Engineer to visit.
- H. Technical Manual: Include the following in Part 2 - Operational Procedures:
 - 1. Manufacturer's recommendations for installation.
 - 2. Installation and adjustment procedures to include foundation bolt and piping connections to the tank.
 - 3. Repair procedures for typical situations, including small holes, pinholes, and minor cracks in the tank.
- I. Factory Test Report
 - 1. Tank nominal capacity and diameter, material, hoop stress design
 - 2. Review audit for wall thickness
 - 3. Fitting placement
 - 4. Visual inspection
- J. Certification: After inspecting the installed tank, a representative of the manufacturer shall certify in writing that the tank has been installed in accordance with the manufacturer's recommendations. Certification shall be submitted to the Engineer.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications
 - 1. The tank manufacturer shall have a record of at least 10 installations during the previous 5 years for the tank sizes and for the chemicals indicated in this Contract.

1.5 SPECIAL WARRANTY REQUIREMENT

- A. The tank shall be warranted for 3 years to be free of defects in material and workmanship.

PART 2 PRODUCTS

2.1 GENERAL

- A. Tanks shall be rotationally-molded high density crosslinked (HDXLPE) one piece seamless construction, cylindrical in cross-section, vertical in axis; complete with piping inlets and outlets, drains, and overflows installed by manufacturer; and anchoring system. Floors and tops and/or domes of tanks shall be made of the same material as, and be integral to the cylindrical portion of the tank, and not be bolted or threaded to the tank. Tanks shall be in accordance with ASTM D 1998 unless otherwise indicated. Lined or laminated tanks will not be accepted. Tank outlets shall be either molded on the tank and be the same material or mechanically attached to a chemical compatible insert encapsulated into the tank wall. Covered tanks shall be vented, and where indicated, tanks shall be provided with entrance manways. Tanks shall be marked to identify the manufacturer, date of manufacture, serial number, capacity, and chemical to be stored.
- B. Dimensions and tolerances shall be in accordance with ASTM D 1998. Measurements shall be taken with the tank empty, in the vertical position.

2.2 TANKS

- A. Service: Chemical storage tanks shall be suitable for the following operating conditions:

Equipment number	TNK351	TNK352
Chemical stored	Saturated Brine (NaCl) solution	Sodium Hypochlorite (NaOCl) Solution
Concentration, percent	26%	1.0%
Unit weight, lb/gal	11.3	8.4
Specific gravity	1.35	1.01
pH	6-8	6-8
Viscosity, centipoise at 68 deg. F	2	1
Maximum chemical temperature, deg. F	100	100
Minimum chemical temperature, deg. F	33	33
Minimum ambient air temperature, deg. F	50	50

- B. Materials shall be virgin polyethylene as compounded and certified by the manufacturer, be the type indicated in the tank schedule, and shall meet or exceed the following:

Chemical Stored	Concentration	Resin	Fitting Material	Gasket Material	Bolt Material
Sodium Hypochlorite	less than 16.5 percent	HDLPE	PVC	viton or EPDM	titanium

1. Mechanical Properties of HDXLPE Tank Material

Parameter	ASTM Test Method	Value
Density of resin, gm/cc	D 1505	0.938 to 0.944
Tensile strength, psi (2-inches per min)	D 638	2600
Elongation at break, percent (2-inches per min)	D 638	400
ESCR (100 percent Igepal, Condition A, F50), hours	D 1693	1000
ESCR (10 percent Igepal, Condition A, F50), hours	D 1693	greater than 1000
Vicat softening temperature, deg. F	D 1525	248
Flexural modulus, psi	D 790	100,000

2. Resin shall be used where recommended by the manufacturer and shall be compatible with the chemical to be used in the tank. Resin used in the tank shall be by **Exxon Mobil Chemicals**, or equal, and shall contain ultraviolet stabilizer as recommended by the manufacturer. Where black or white tanks are indicated, the resin shall be compounded black or white.

C. Construction

1. The minimum wall thickness of the cylindrical portion at any chemical depth shall be determined by ASTM D 1998 as modified by the following equation. Wall thickness shall be tapered, and no wall shall be less than 0.187 inch thick at the top.

$$T = (0.433 \times ASG \times OD \times H) / (2 \times SD)$$

Where: T = wall thickness at any depth, in.

ASG = adjusted specific gravity of chemical (See Note A)

H = depth of chemical in tank ft

OD = outside diameter of tank, in.

SD = hydrostatic design stress, 600 psi (See Note B)

- a. Note A: The specific gravity of the fluid shall be multiplied by a service factor of 1.5 to 2.2, depending on the characteristics of the material stored within the tank. The service factor shall allow a design margin for a possible temperature excursion above 100 degrees F.
- b. Note B: The hydrostatic design stress shall be derated for temperatures above 100 deg F in accordance with ASTM D 1998.
- c. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support. Flat areas shall be provided for attachment of large fittings on the cylindrical portion.

2. The top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall equal the thickness of the top of the wall.
3. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be in accordance with ASTM D 1998.
4. Tie-down lugs may be molded into the top head.

D. Tank Schedule

Equipment No.	TNK351	TNK352
Chemical Service Type	Brine Solution (NaCl – 35%)	Sodium Hypochlorite Solution (NaOCl – 1.0%)
Configuration (See note 1)	FLR or FLH	CD
Material Type	HDXLPE	HDXLPE
Insulation	No	No
Nominal diameter, ft	3	4
Nominal height, ft (see Note 2)	4.7	6.1
Nominal capacity, gallons (see Note 5)	200	500
Liquid depth, maximum, ft	4.2	5.5
Manway	None	None
Exposure (UV protection required if tank is mounted outdoors)	indoors	indoors

Note 1: CD = closed, domed top
 CF = closed, flat top
 OIF = open, internal flange
 OEF = open, external flange
 FLR = flat lid, removable
 FLH = flat lid, hinged

Note 2: Nominal height of domed top tanks is the dimension measured along the straight cylindrical portion of the tank and does not include the rounded top.

Note 3: TM = top mount
 TSM = top and side mount

Note 4: Unless otherwise indicated, manways shall be integrally molded with the tank.

Note 5: Nominal volume shall be calculated based on the straight cylindrical side of the tank.

E. Fittings

1. Tank fittings shall be according to the fitting schedule below. Gasket material shall be based on the chemical stored. Fittings shall be compatible with the chemical stored, be bolted double flanged fittings, Schedule 80, or threaded bulkhead type. Threaded fittings shall use American Standard Pipe Threads. No metals shall be exposed to tank contents. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

Item	Fitting Type	
	Equipment No.	TNK351
Fill	TB	TB
Overflow	TB	TB
Tank drain	IMF	IMF
Vent	TB	TB
Outlet to pump	TB	TB
Level indication	Ultrasonic	Ultrasonic

Note 4: Abbreviations for fittings are:

TB: Threaded bulkhead fitting

BF-H: Bolted flange fitting with Hastelloy-C studs and polyethylene encapsulated heads.

BF-SS: Bolted flange fitting with 316 SS studs and polyethylene encapsulated heads.

BF-T Bolted flange fitting with titanium studs and polyethylene encapsulated heads

DB-SD: Double bolt with siphon drain, 316 SS studs, and polyethylene encapsulated heads.

IMF: Integrally molded flanged.

TST: Threaded siphon tube

SWST: Solvent-welded siphon tube

PVC: Double-nut PVC fitting.

- a. Bulkhead fittings shall be constructed of PVC, PP, or other material compatible with the chemical stored. Gaskets shall be a minimum of 1/4-in thickness and be constructed of 40 to 50 durometer EPDM, 60 to 70 durometer Viton, or material compatible with the chemical in the tank. Tank wall thickness must be considered for bulkhead placement. The maximum wall thickness for each fitting size is indicated below.

Fitting Size, in.	Max Wall Thickness, in.
1/2	0.750
3/4	0.875
1	0.875
1-1/4	0.875

1-1/2	0.875
2	1
3	1.125 (flat surface only)

2. Integrally Molded Fittings (IMF). These fittings shall be an integral part of the tank and provide complete drainage of liquid through the sidewall of a flat bottom tank. The attachment shall be constructed from a Schedule 80 PVC, stainless steel, or compatible material and be standard at 2-, 3-, 4- or 6-in with inside diameter depending on the tank size.
3. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 5-ft max intervals with support from standard bulkhead fitting tank attachments or welded PE supports. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.
4. Vents: Each tank must be vented for the material and flow and withdrawal rates expected as shown on the drawings. Tanks containing sodium hypochlorite solutions (NaOCl) shall be vented to the outside as indicated on the drawings. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9) or shall be as large as the filling or withdrawal connection, whichever is larger, but in no case less than 1-in nominal inside diameter.
5. Flange Adapters: Adapters may be used to adapt threaded or socket fitting components to 150 psi flange connections. Adapters shall be of material compatible with the chemical stored.
6. Attachments: Pipe attachments at fittings shall be equipped with flexible couplers or other provisions for movement. Piping attachments shall allow for 3 to 4 percent movement.

2.3 LEVEL INDICATON

- A. Level indication shall conform to the requirements of Section 40 91 07 – Level Detection Devices.
- B. Float Indication: The level indicator shall be completely assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, sunlight and chemical resistant sight tube, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time.
- C. Ultrasonic Level Indicator: The ultrasonic level indicator shall consist of a 2-in 4 - 20 mA output PVC sensor as indicated in Section 40 90 00 – Process Instrumentation and Control.

2.4 TANK STANDS AND SEISMIC RESTRAINT SYSTEM

- A. Tank anchorage shall be designed in accordance with Section 13 05 41 Seismic Restraint Requirements for Non-Structural Components and Systems.

2.5 SAFETY SIGNS

- A. Each tank shall be clearly marked to identify the chemical and specific hazards as described in Section 10 14 10 – Identifying Devices.

2.6 FACTORY TESTING

A. Material Testing

1. Low temperature impact test: Condition samples taken from fitting cutouts frozen for 2 hours at minus 40 degrees F. Perform impact tests in accordance with ASTM D 1998. Specimens less than 1/2-in thick shall be tested at 100 ft.-lb. and specimens equal to or thicker than 1/2 -in shall be tested at 200 ft.-lb.
2. Degree of cross-linking (applicable to cross link material only): Use Method C of ASTM D 2765 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene. Samples from the inside of the tank 1/8-in deep shall test at no less than 65 percent.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be 1/2-in vertical and 2 degrees radial.
2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.
3. Wall Thickness
 - a. Tanks smaller than 2000 gal may be tested during a production run and the results reported as representative of each tank in the run.
4. Hydrostatic test: Following fabrication, the tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the brim for a minimum of 4 hours and inspecting for leaks. Following successful testing, the tank shall be emptied and dried prior to shipment.

- C. An affidavit signed by the tank manufacturer shall be furnished indicating that the factory tests have been performed and the indicated requirements have been met.

2.7 MANUFACTURERS, OR EQUAL

- A. Poly Processing Company
- B. Snyder Industries, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

- A. After installation of tank and connections, the tank shall be water tested by filling the entire tank with water and monitoring the tank and connections for at least 24 hours. Leaks shall be corrected prior to acceptance.

END OF SECTION

SECTION 46 01 00 - EQUIPMENT GENERAL PROVISIONS

PART 1 GENERAL

1.1 THE SUMMARY

- A. The Contractor shall provide equipment and appurtenant WORK, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to equipment throughout the Contract except where otherwise indicated.
- C. All component and support systems of the equipment shall be designed and manufactured to withstand all forces such as internal or external, static, wind, dynamic and seismic loads (seismic in accordance with 13 05 41 Seismic Restraint requirements for Non-Structural Components and Systems) in order for the equipment to last throughout its expected life without premature failure. The manufacturer shall submit a certification signed and stamped by a registered engineer stating that the equipment was designed and manufactured to withstand all the loads specified in this paragraph. Submit a copy of that analysis for review by the Engineer.
- D. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available from manufacturers at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the Drawings are diagrammatic, and some features of the illustrated equipment arrangement may require revision by the Contractor to meet the actual equipment requirements proposed by the Contractor. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered by the Contractor to accommodate the equipment provided. No additional payment will be made to the Contractor for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the fabrication of equipment.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. American National Standards Institute (ANSI).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. American Water Works Association (AWWA).

5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
 6. American Welding Society (AWS).
 7. National Fire Protection Association (NFPA).
 8. Federal Specifications (FS).
 9. National Electrical Manufacturers Association (NEMA).
 10. Manufacturer's published recommendations and specifications.
 11. Occupational Safety and Health Administration (OSHA).
 12. Hydraulic Institute (HI)
 13. General Industry Safety Orders (GISO).
- B. The following standards are referenced in this Section:
- | | |
|--------------|---|
| ASME B16.1 | Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 |
| ASME B16.5 | Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys |
| ASME B46.1 | Surface Texture |
| ANSI S12.6 | Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors |
| ASME B1.20.1 | General Purpose Pipe Threads (Inch) |
| ASME B31.1 | Power Piping |
| ASME B31.3 | Process Piping |
| AWWA C206 | Field Welding of Steel Water Pipe |
| AWWA C207 | Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm) |
| AWWA D100 | Welded Steel Tanks for Water Storage |
| ASTM A 48 | Gray Iron Castings |
| ASTM A 108 | Steel Bars, Carbon, Cold-Finished, Standard Quality |

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the Engineer, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the Contractor.
- C. Spare Parts List: The Contractor shall obtain from the manufacturer and submit as part of Shop Drawings a list of suggested spare parts for each piece of equipment. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

1.4 QUALITY ASSURANCE

- A. Costs: Responsibility shall be the Contractor'S for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The Owner will pay for costs of power, water, and treatment chemicals. If available, the Owner'S operating personnel will provide assistance in the field testing.
- B. Inspection: The Contractor shall inform the local authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, cranes, and related items to obtain required permits and certificates, and shall pay inspection fees.
- C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.
 - 1. Machine WORK shall be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without machined or milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30-feet or less in length, and not greater than 1/8-inch for members over 30-feet in length.
 - 2. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The Engineer shall be notified of larger defects. No repair welding of such defects shall be carried out without the Engineer's written approval. If the removal of metal for repair reduces the stress

resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then the casting may be rejected. Costs of casting new material shall be the Contractor's responsibility as part of the WORK.

3. Materials shall meet the physical and mechanical properties in accordance with the reference standards.
- D. Machine Finish: The type of finish shall be the most suitable for the application as recommended by the equipment manufacturer in micro-inches in accordance with ANSI B46.1. In the absence of manufacturer's recommendations, the following surface finishes shall be used:
1. Surface roughness not greater than 63 micro-inches shall be required for surfaces in sliding contact.
 2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
 3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.
 4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.
- E. Manufacturer's Experience: Equipment manufacturer shall have a record of proven experience of at least 5 years of successful, trouble-free operation in similar applications and size equal or larger than the equipment in this Contract. Where indicated in each individual equipment specifications, the Contractor shall submit this experience record to the Engineer for approval.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque (whichever is the greatest), speed, and horsepower. Applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Blowers		
centrifugal or vane	1.0	Uniform
lobe	1.25	Moderate Shock
Pumps		
centrifugal or rotary	1.0	Uniform
reciprocating	1.8	Moderate Shock
progressing cavity	1.0	Uniform
Mixers		
constant density	1.0	Uniform
flocculator	1.25	Uniform

B. Mechanical Service Factors

Mechanical Service Factors	
Electric Motor	
Uniform	1.25
Moderate Shock	1.50
Heavy Shock	2.00

- C. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.
- D. Where load classifications are not indicated, the equipment manufacturer's recommendations for service factors shall be utilized.
- E. Welding: Unless otherwise indicated, welding shall conform to the following:
1. Latest revision of AWWA D100.
 2. Latest revision of AWWA C206.
 3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent corrosion of hard-to-coat metallic surfaces.
 4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
 5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld

contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

- F. Protective Coating: Equipment shall be painted or coated in accordance with Section 09 90 00 – Painting and Coatings, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- G. Potable Water Contact: Materials immersed in or exposed to potable water shall be made of materials or coated compliant with NSF Standard 61. Bronze alloy materials in contact with potable water shall be constructed of zero-lead materials or materials whose lead content do not exceed the weighted average criteria as required by the Lead Reduction Act. Equipment manufacturer shall submit to the Engineer a certification of compliance with the requirement of NSF Standard 61 and the Lead Reduction Act.
- H. Protection of Equipment: Machined and coated surfaces shall be protected by rust inhibitor material prior to shipment. Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry. Equipment with anti-friction bearings or sleeve bearings shall be protected from being damaged due to jarring motion during shipment. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated per manufacturer's recommendation. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, recoated, or otherwise corrected to restore it to original condition.
- I. Identification of Equipment Items
 - 1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.
 - 2. After installation, each item of equipment shall be given permanent identification.
 - a. Pumps, compressors, and blowers of 150 horsepower or less shall receive acrylic plastic nametags, or as specified in specific equipment specification.

- b. Pumps, compressors, and blowers larger than 150 horsepower shall receive stainless steel plate nametags, or as specified in specific equipment specification.
- J. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.
- K. Equipment Maximum Allowable Vibration Level: Unless otherwise indicated, maximum allowable vibration level shall be in accordance with the acceptance criteria recommended by the reference Standard for that particular type of equipment
- L. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.
- M. Controls: Equipment and system controls shall be in accordance with Division 40 - Instrumentation.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Equipment Supports: Equipment components and supports, anchors, and seismic restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greatest of the following design criteria:
 - 1. Design Criteria noted in 13 05 41 Seismic Restraint requirements for Non-Structural Components and Systems.
- B. Submit design calculations for equipment supports, anchors, and seismic restrainers signed and sealed by an engineer registered in the State or Oregon. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, and normal operation plus wind loadings in accordance with 13 05 41 Seismic Restraint requirements for Non-Structural Components and Systems.
 - 1. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.
 - 2. Seismic requirements: Freestanding and wall-hung equipment shall be anchored in place by methods that satisfy 13 05 41 Seismic Restraint requirements for Non-Structural Components and Systems. Calculations shall be performed and signed and stamped for equipment weighing more than 400 pounds. Calculations shall analyze lateral and overturning forces and shall include a factor of safety against

overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

3. Anchors: Anchor bolts shall be in accordance with Section 05 50 00 - Metal Fabrications. Contractor shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the Shop Drawings.
4. Equipment Foundations: Unless otherwise indicated, mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases. Unless otherwise indicated on the Drawings, pumps, blowers, compressors and engine driven equipment shall be provided with a concrete foundation with a total weight equal to at least five times the weight of the equipment. Concrete foundations shall be isolated from the building floor in order to prevent transfer of vibration from the equipment to the building structure. The Contractor through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.
5. Equipment Grout: Mechanical equipment installed on top of concrete foundations or bases shall be provided with non-shrink concrete or epoxy grout as indicated and as specified in Section 03 60 00 - Grouting. Grout shall be applied between the base plate and the concrete foundation or base in accordance with the grout manufacturer's recommendation. Grout shall be free of void space.

2.3 COUPLINGS

- A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Engine driven pumps	Universal joint type or elastomeric flexible type
Single stage centrifugal blowers	Flexible disc pack

- B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

- C. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, 2 sets of universal type couplings shall be provided.
- D. Taper-Lock or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.4 SHAFTING

- A. General: Equipment manufacturer shall be responsible for designing and manufacturing shafting to carry all loads applied to the shaft. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.
- B. Design Criteria: Shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications.
- C. Materials: Shafting materials shall be compatible with the type of service and load transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.
 - 1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.
 - 2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.
 - 3. Other grades of carbon steel alloys shall be suitable for service and load.
 - 4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.
- D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.5 GEARS AND GEAR DRIVES

- A. Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used unless specifically approved by the Engineer.

- B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron, ductile iron, or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.
- C. Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.
- D. Material selections shall be selected by the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.
- E. Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with required appurtenances shall be provided when necessary.
- F. Where gear drive input or output shafts from one manufacturer connect to couplings or sprockets from a different manufacturer, the Contractor shall have the gear drive manufacturer furnish a matching key taped to the shaft for shipment.

2.6 DRIVE CHAINS

- A. Power drive chains shall be commercial type roller chains meeting ASME Standards.
- B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.
- C. A minimum of one connecting or coupler link shall be provided in each length of roller chain.
- D. Chain and attachments shall be of the manufacturer's best standard material and be suitable for the process fluid.

2.7 SPROCKETS

- A. General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.
- B. Materials: Unless otherwise indicated, materials shall be as follows:
 - 1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.
 - 2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.
- C. Sprockets shall be accurately machined to ASME Standards. Sprockets shall have deep hardness penetration in tooth sections.
- D. Finish bored sprockets shall be furnished complete with keyseat and set screws.
- E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with Taper-Lock bushings as required.
- F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.8 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ASME, MPTA, and RMA Standards.
- B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.
- C. Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.
- D. To facilitate installation and disassembly, sheaves shall be provided complete with Taper-Lock or QD bushings as required.
- E. Finish bored sheaves shall be complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.9 DRIVE GUARDS

- A. Power transmission trains, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform to the Division of Industrial Safety General Industrial Safety Orders latest edition and OSHA Safety and Health Standards (29CFR1910), whichever is more stringent requirements. The guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.10 BEARINGS

- A. General: Bearings shall conform to the standards of the American Bearing Manufacturers Association, Inc. (ABMA).
- B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.
- C. Re-lubricatable type bearings shall be equipped with hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.
- E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life, years	L-10 Design Life, hours
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

- F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- G. Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer. In accordance with the Lead Reduction Act, sleeve bearings containing lead material exposed to drinking water shall not be acceptable.
- H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the

manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide heat exchangers, including necessary instrumentation and controls, piping, filters, and valves.

2.11 PIPING CONNECTIONS

- A. Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 40 05 07 – Hangers, Supports and Anchors for Process Piping.
- B. Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to Section 40 05 13 – Common Work Results for Process Piping.
- C. Flexible Connectors: Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 40 05 13 – Common Work Results for Process Piping. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.
- D. Insulating Connections: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the specifications.

2.12 GASKETS AND PACKINGS

- A. Gaskets and packings shall be in accordance with the requirements of the specifications. Gaskets and packings in contact with drinking water shall be NSF 61 approved.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane Everseal, or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the Engineer.

2.13 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.14 TOOLS AND SPARE PARTS

- A. Tools: The Contractor shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.
- B. Spare parts shall be furnished as indicated in the individual equipment sections. Spare parts shall be suitably packaged and labeled with equipment numbers by means of stainless steel or solid plastic nametags attached to the packaging.

2.15 EQUIPMENT LUBRICANTS

- A. The Contractor shall provide lubricants for equipment during shipping, storage, and prior to testing, in accordance with the manufacturer's recommendations. Lubricants that could come in contact with potable water shall be food grade lubricants. After successful initial testing, final testing, and satisfactory completion startup testing per Section 01 75 16 – Testing, Training and System Start-up, the Contractor shall conduct one complete lubricant change on equipment. In addition, the Contractor shall be responsible for the proper disposal of used lubricants. The Owner will then be responsible for subsequent lubricant changes

PART 3 EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Installation Supervision, Inspection, Startup, and Field Adjustment: An authorized, experienced, and competent service representative of the manufacturer shall visit the Site to perform the following:
 - 1. Supervision of the installation of the equipment
 - 2. Inspection, checking, and adjusting the equipment and approving its installation
 - 3. Startup and field testing for proper operation, efficiency, and capacity
 - 4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements
 - 5. Certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

6. A factory representative shall be present at the job site for the number of days as indicated in specific equipment specifications.

B. Owner Staff Training

1. Owner staff training shall be in accordance with Section 01 75 16 – Testing, Training and System Start-up.

3.2 INSTALLATION

A. General: Equipment shall be installed in accordance with the manufacturer's written recommendations.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate space and structural requirements, clearances, utility connections, signals, and outputs with Subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Contractor shall coordinate such features with the Engineer and provide material and labor necessary for a complete installation as required by the manufacturer.

3.4 FIELD ASSEMBLY

A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with Never Seize compound or equal.

3.5 WELDING

A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.6 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable standards.

2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.
 3. Operate equipment indicated in Section 01 75 16 – Testing, Training and System Start-up.
- C. The Engineer shall witness field-testing. The Contractor shall notify the Engineer of the test schedule 3 Days in advance.
- D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

END OF SECTION

SECTION 46 32 00 - SODIUM HYPOCHLORITE GENERATION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes furnishing and installing an on-site sodium hypochlorite generation (OHG) system including appurtenances, complete and operable, in accordance with the Contract Documents and this section of this specifications.
- B. The OHG Equipment Manufacturer System Supplier ("SUPPLIER") shall confirm the size of equipment required to meet the performance specifications. System integration between the OHG system and the Control System shall be completed by the SYSTEM INTEGRATOR with support as needed by the SUPPLIER.
- C. The OHG system and appurtenances shall be furnished by a single SUPPLIER to ensure equipment compatibility.

1.2 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate products that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the Site.

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. Shop Drawings: Include the hypochlorite generation and feed system, with details on materials, controls, wiring diagrams, operation, coating, fabrication, and accessories.

1.4 CODES AND STANDARDS

ANSI Z400.1	Hazardous Industrial Chemicals-Material Safety Data Sheets - Preparation
ASTM D 1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
AWWA B300	Hypochlorites
CE/CSA	Standards for Power Supply
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NFPA 70	National Electrical Code

UL 50 Enclosures for Electrical Equipment

NSF 60/61 Standards for Materials in Contact with Drinking Water

1.5 REFERENCE SPECIFICATIONS

A. The following specifications are referenced in this Section:

1. Section 01 33 00 Submittal Procedures
2. Section 09 90 00 Painting and Coatings
3. Section 43 22 59 Diaphragm Metering Pumps
4. Section 43 40 08 Polyethylene Tanks
5. Section 46 61 40 Water Softeners

1.6 PRODUCT WARRANTY

A. The manufacturer's warranty shall, at minimum, be:

1. System: 1 year
2. Electrolyzer(s): 2 years

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. GENERAL:

1. The Contractor shall provide a complete OHG system for the disinfection of drinking water. To be considered a complete package, the OHG shall include the following:
 - a. Salt saturator (brine) tank,
 - b. Hypochlorite generator assembly, including brine proportioning system, brine pumps and electrolyzers.
 - c. Sodium hypochlorite storage tank.
 - d. Control system.
 - e. Ventilation blower(s) for hydrogen gas dilution.
 - f. Valves, gauges, and intermediate process piping,
 - g. Power supply.

- h. Control panel(s),
 - i. Electrical and instrumentation
 - j. All necessary accessories and appurtenances as required for a complete and operable system.
2. Sodium hypochlorite metering pumps and are not part of the OHG package. They are specified in Section 43 33 20 – Liquid Chemical Diaphragm-Type Metering Pumps.
 3. Performance and Technical Data: The OHG system shall be capable of the indicated capacity of equivalent chlorine (as Cl₂) in the form of 0.7 percent concentration (by weight) of sodium hypochlorite solution. The OHG system and related equipment capacity shall be as follows:

Capacity, (lb. Cl ₂ /day)	20
NaCl salt use, lb per day	17
Brine use, gal per day	2.5 (saturated)
Brine flow rate, gph	1.0
Product Flow, gph	0.2
Product Concentration, %	0.7 (as Cl ₂)
Brine tank minimum volume, gal	200
Sodium Hypochlorite tank volume, gal	500
Water softener, gal/day	Per Section 46 61 40
Ventilation blower, scfm	14.8 scfm (minimum)
Proportioning system (brine pump and softened water mixing)	by supplier

2.2 SUPPLIER

- A. The OHG system shall be manufactured and supplied by one of the following acceptable SUPPLIERS:
 1. Evoqua Water Technologies, distributed by TMG Services
 2. or approved equal

2.3 OHG SYSTEM EQUIPMENT

- A. Water Softening:
 1. Process water exceeding 17 mg/L calcium hardness shall be softened prior to brine saturation or proportioning and sodium hypochlorite generation. Softener shall be dual tank design with automatic change-over for regeneration, suitably sized for the system water requirements.
 2. Additional requirements are included in Section 46 61 40 – Water Softeners.

3. Manufacturers, Or Equal:
 - a. By OHG SUPPLIER
- B. Brine Saturator:
 1. The brine saturator shall consist of a minimum 200-gallon cross-linked HDPE tank as detailed in Section 43 40 08 – Polyethylene Storage Tanks. The saturator shall have a minimum capacity of 430 lbs of dry solar grade sodium chloride (NaCl) granules to ensure full saturation of brine to approximately 26% NaCl. Softened water shall enter the brine saturator via a level-controlled solenoid valve. The saturator shall have automatic level control to maintain constant brine level. Level control shall be connected to the above-mentioned solenoid valve, and the sodium hypochlorite generator process controller. Saturator shall be designed for storage of brine solution at ambient temperature and atmospheric pressure, and shall be suitable for indoor/outdoor installation.
 2. Manufacturers, Or Equal:
 - a. By OHG SUPPLIER
- C. Brine Proportioning System:
 1. The brine proportioning system includes the mixing of softened water and concentrated brine solution to produce a 3% brine solution. The mixing shall be completed with a peristaltic brine solution pump and solenoid valve to supply softened water and be controlled from the process controller as described in the above sections of this Specification.
 2. Additional requirements for the Brine Proportioning System are as follows:
 - a. Brine pump shall be peristaltic type controlled via the supply voltage from the on-site generation system power control system. Brine pump power to be supplied as 100-240 VAC 60Hz.
 - b. The brine pump shall be sized to deliver flows of 1.0 gph (4 L/hr).
 - c. Brine and water shall be combined within the system cabinet piping.
 - d. Water flow shall be established through a solenoid valve and controlled with a flow control purge meter.
 - e. The system shall function to deliver a 3% brine solution to the electrolyzers during periods of operation.
 3. Manufacturers, or Equal

a. The brine pump shall be a Chem-Ad® VPP-DC, by SUPPLIER

D. Onsite Sodium Hypochlorite Generator Assembly:

1. The sodium hypochlorite (NaOCl) generator shall receive the appropriate brine (NaCl) solution as stated in the above section. Each OHG assembly shall have a capacity of producing 20 pounds of equivalent chlorine as a <1.0% NaOCl solution (nominally 0.8%) per day. The generator shall consist of a cathodic-anionic electrolyzer and include the following components and requirements:
2. Cathodes and Anodes shall be manufactured from Titanium. Anodes shall be DSA type with precious metal oxide coating on a titanium substrate. Electrodes shall be manufactured by the manufacturer of the OHG system to ensure the electrodes are suitable quality and meet performance specifications.
3. Electrolyzer shall consist of vertically oriented bi-polar electrodes.
4. The bi-polar electrolyzer assembly shall consist of a minimum of one cell compartment mounted in a horizontal electrolyzer.
5. Each electrolyzer compartment shall allow hydrogen removal to facilitate two-phase flow pattern. Hydrogen gas removal shall be vertical, while the electrolyte solution flow path shall be horizontal.
6. Multiple electrolyzer configurations shall utilize a modular approach. Each electrolyzer shall be added or removed in parallel to expand or reduce the total capacity as desired.
7. Each electrolyzer shall be capable of running independently with a dedicated power supply.
8. Hydrogen gas lift within each electrolyzer shall not exceed 3 inches vertically.
9. Power usage shall not exceed 2.2 to 2.5 KWH AC per pound of equivalent chlorine at a concentration of 0.7%.
10. Electrolyzer shall be able to meet the stated efficiencies operating with an inlet water temperature range of 41-86°F.
11. Electrolyte solution sample and drain valves shall be included.
12. Level switch and temperature switch shall be externally mounted to the hypochlorite outlet manifold to enable maintenance without intrusion to the electrolyzer assembly.

13. Electrolyzer assembly shall be pre-piped and mounted within the system cabinet. The cabinet assembly shall be wall mounted and have a footprint that does not exceed 29" wide x 46" high x 15" deep.
14. All wetted components of the generator/ electrolyzer assembly shall comply with NSF 61 requirements.
15. Manufacturers, or Equal
 - a. By SUPPLIER

E. Power Supply:

1. Input power to the process controller and all components of the OHG system shall be 100-240 VAC \pm 10% single phase, 60 Hz. The power supply shall employ a low voltage sensing circuit whereby either a loss of electrolyte or an overtemperature situation will shutdown the process.
2. DC Power Supply:
3. Power for the electrolysis of brine shall be provided by a high efficiency dual mode constant voltage and constant current output power supply. The on-site generation system shall consist of 4 power supplies running in parallel to a dedicated electrolyzer cartridge. Output to be constant current 32A and 15V DC.
4. Additional power supply requirements are as follows:
 - a. Power supply enclosure shall be rated to meet IP67/IP65 certifications suitable for indoor and outdoor operation.
 - b. Power supply shall have automatic output overload protection
 - c. Power supply shall be built to CE/CSA standards.
 - d. The power supplies shall be mounted in the on-site generation cabinet.
5. Manufacturers, Or Equal
 - a. Mean Well HLG-600H, by SUPPLIER

F. Process Controller:

1. The entire generation process (brine saturator, brine proportioning, electrolyzers, hydrogen dilution blower, and identified appurtenances) shall be controlled by PLC-based control panel. A complete self-contained, skid mounted control panel shall be provided. Additional requirements of the process controller are as follows:

2. The entire generation process shall be controlled by a microprocessor complete with a capacitive-touch, 4.3" colored glass touch screen for easy and intuitive operation.
3. Enclosure shall be NEMA 4X, IP66.
4. Input voltage shall be 100-240 VAC, 1 phase, 60 Hz.
5. Control voltage shall be 24 VDC
6. Controller shall be CE/CSA Listed.
7. The following operational status indicators shall be included:
 - a. Audible alarm contacts
 - b. Power on
 - c. DC Power supply on
 - d. Blower running
 - e. Brine pump on
 - f. Analog storage tank level transmitter
 - g. DC Power supply failed
 - h. Improper voltage
 - i. Improper amps
 - j. High electrolyte solution temperature
 - k. Low electrolyzer solution level
 - l. Overflow of storage tank
 - m. Low storage tank level
 - n. Air flow failed, blower failed
 - o. External interlock for emergency shut down
 - p. External interlock for hydrogen detection
8. The following shall be provided as freely configurable volt-free outputs:
 - a. General Fault
 - b. Dosing pump enable
 - c. Audible Alarm
 - d. Rectifier On/Off
 - e. Hydrogen leak alarm (if used)
9. The Following Panel sourced AC voltage outputs shall be provided
 - a. Brine Pump/Water Valve On/Off
 - b. Blower On/Off
 - 1) Blower to be controlled by panel and powered separately.

10. The process controller shall be programmed and configured for the following discrete inputs:
 - a. Electrolyte Level switch (pre-wired from generator)
 - b. Electrolyte Temperature switch (wired from generator)
 - c. Rectifier Running (wired from power supply)
 - d. Improper voltage (wired from power supply)
 - e. Improper amps (wired from power supply)
 - f. Blower air flow switch (field wired from transmitter)

11. The process controller shall be programmed, and panel configured for the following Analog Inputs:
 - a. Storage Tank Level Transmitter
 - b. Rectifier output voltage
 - c. Rectifier output current
 - d. Electrolyte outlet temperature

12. Intrinsic barriers shall be provided for the following supplied generator equipment.
 - a. Electrolyte Level Switch
 - b. Electrolyzer Outlet temperature switch
 - 1) By SUPPLIER

G. Sodium Hypochlorite Storage Tank

1. The Sodium Hypochlorite (NaOCl) storage tank shall have 500 gallon capacity, totally enclosed, with flanged drain, overflow, inlet and outlet connections, with air dilution inlet and outlet connections and blower suitably sized to dilute hydrogen to at least 25% below LEL. Blower and system operation shall be interlocked to prevent system operation if the blower is not running. Tank construction to comply with all requirements of Section 43 40 08 – Polyethylene Tanks. Compliance with the following additional requirements for the NaOCl storage tank shall be followed:

2. The following controls shall be included:
 - a. Ultrasonic level transmitter control with 4-20 mA output for start-stop operation of the system; FM and CSA Intrinsically Safe; Wetted material shall be suitable for 1.0% hypochlorite solution.

 - b. User-adjustable alarms:
 - 1) Overflow (optional)
 - 2) High storage level

- 3) System stop
- 4) System Start
- 5) Low storage level and metering pump disable

H. Hydrogen Dilution Blower

1. A blower shall be installed and connected to the sodium hypochlorite storage tank to dilute and force hydrogen gas generated as part of the OHG process outside of the chemical building. The blower must be capable of providing sufficient air flow to dilute the hydrogen concentration in the tank to less than 25% of the lower explosive limit (LEL) of hydrogen, which is 1% in air.
2. Power for the blower shall be 115 VAC, independently supplied. The blower shall be controlled by the process controller. The following control conditions apply:
3. Loss of air flow for hydrogen dilution, or blower failure shall automatically shutdown the OHG process controller, and all relevant upstream process components. An alarm shall be installed to notify operators.
4. Fail safe air flow switch contacts shall be incorporated to ensure safe operation.
5. On system shutdown of the OHG equipment, the blower must remain active for a minimum 15-minute duration after shutdown.
6. Manufacturer, Or Equal:
 - a. By SUPPLIER

2.4 PROTECTIVE COATING

- A. Where required, materials and equipment furnished shall be coated in accordance with Section 09 90 00 – Painting and Coatings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The sodium hypochlorite generation system shall be installed in accordance with the manufacturer's instructions.

3.2 EQUIPMENT INSTALLATION AND SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: An authorized service representative of the manufacturer shall visit the Site for a minimum of two (2) days to witness the following and to certify in writing that the equipment and controls have been properly installed, adjusted, and readied for operation.

1. Installation of the equipment.
2. Inspection, checking, and adjusting the equipment.
3. Startup and field testing for proper operation.
4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.

3.3 EQUIPMENT TRAINING AND INSTRUCTION TO OWNER

- A. An authorized training representative of the manufacturer shall visit the Site for minimum of one (1) day to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
- B. Factory trained direct or authorized service contractor shall be available within 24 hours of notification.
- C. The training materials shall remain with the trainees.
- D. The Owner may photograph and/or video record the training for later use with the Owner's personnel.

END OF SECTION

SECTION 46 61 40 - WATER SOFTENERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Water softeners shall provide suitable softened water quality for the sodium hypochlorite generators per Section 46 32 00 – Sodium Hypochlorite Generation Systems, and as indicated in the drawings and described in this Section.
- B. The Contractor shall provide water softeners, and appurtenant work, complete and operable, in accordance with the Contract Documents.
- C. The WORK under this Section shall be furnished by manufacturers having experience in the manufacture of similar products and having a record of successful installations.
- D. The materials of the water softener shall be manufactured of material suitable for potable water or the chemicals they contact and shall be certified for such use on the Shop Drawings. Seismic loads shall be in accordance with Section 01 61 10 Seismic Requirements for Non-Structural Components.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. NSF 60/61
- B. ASTM D859, "Test Method for Silica in Water."
- C. ASTM D1067, "Test Methods for Acidity or Alkalinity of Water."
- D. ASTM D1068, "Test Methods for Iron in Water."
- E. ASTM D1126, "Test Method for Hardness in Water."
- F. ASTM D1129, "Terminology Relating to Water."
- G. ASTM D3370, "Practices for Sampling Water from Closed Conduits."

1.4 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

- B. Shop Drawings: Include detailed and certified design calculations by a registered engineer in Oregon, bill of materials listing all components of the water softeners and appurtenances, including:
 1. Dimensions including anchor bolt layouts to meet the layout requirements as shown in the drawings. Anchorage must conform to Section 01 61 10 Seismic Requirements for Non-Structural Components.
 2. Details of structural support members.
 3. Equipment capacity, gallons.
 4. Maximum design specific gravity.
 5. Equipment weight, empty and filled with water.

1.5 WARRANTY

- A. Manufacturer to provide a suitable warranty for the water softeners and appurtenances as approved by the Owner.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Water softeners effluent shall meet the following water quality requirements:

COMPONENT	SPECIFICATION
pH	6.5 – 8.5
NaCl	25 g/l minimum
Total Silica (as SiO ₂)	2 ppm by wt. maximum
Ba	100 ppb by wt. maximum
Fe	200 ppb by wt. maximum
Mn	10 ppb by wt. maximum
Al	1 ppm by wt. maximum
Ni	20 ppb by wt. maximum
F ⁻	2 ppm by wt. maximum
Cu	5 ppb by wt. maximum
Organics (as grease or oil)	2 ppm by wt. maximum
TOC	1 ppm by wt. maximum

- B. Water softeners, appurtenances and water quality requirements shall conform to NSF 60/61.

- C. Seismic Performance: Water softeners shall meet ASCE & SEI 7 requirements, whichever is more stringent. See Section 01 61 10 Seismic Requirements for Non-Structural Components.
- D. Capacities and Characteristics:
 - 1. Continuous Service Flow Rate: 0.8 – 1.9 gpm @ 25-40 psi
 - 2. Peak Service Flow Rate: 2.0 gpm @ 25-40 psi
 - 3. Resin Type: As needed to meet the above water quality requirements
 - a. High-capacity ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.
 - 4. Resin Volume: As needed to meet the performance requirements of this section.
 - 5. Manifold Pipe Size: as specified on drawings
 - 6. Backwash-to-Drain Pipe Size: as specified on drawings
 - 7. Number of Mineral Tanks: One brine tank
 - 8. Brine types:
 - a. Saturated Sodium Chloride (NaCl) solution, dissolved from crystallized solar salt in the adjacent brine tank.
 - 9. Mineral Exchange Capacity: As needed to meet the above water quality requirements
 - 10. Salt Capacity: As needed to meet the above water quality requirements
 - 11. Minimum Number of Regenerations per Refill: As needed to meet the above water quality requirements
 - 12. Temperature range: 34 to 100 F

2.2 WATER SOFTENERS

- A. Description: Factory-assembled, pressure-type water softener as shown on the drawings.
 - 1. Configuration: As needed to meet the water quality requirements as shown above. The water softeners shall be connected to the brine tank, sodium hypochlorite generation system, and fluoride saturator as shown on the drawings. The brine tank is not to be included as part of this specification and instead shall conform to

Section 43 40 08 – Polyethylene Tanks and Section 46 32 00 – Sodium Hypochlorite Generation System.

2. Water softeners to be mechanically controlled with no electrical components. Controls shall have a mechanical totalizer and associated components to indicate and initiate a backwash regeneration cycle of brine solution from the adjacent brine tank.
- B. Approved Vendors, or equal:
1. Kinetico
 2. Culligan

PART 3 EXECUTION

3.1 WATER SOFTENER INSTALLATION

- A. Equipment Mounting:
1. Install and anchor water softeners on cast-in-place concrete equipment base and/or Unistrut or other rigid metal frame as approved by the Engineer to meet the requirements of Section 03 30 00 – Cast In Place Concrete, and Section 05 50 00 – Metal Fabrications.

3.2 PIPING CONNECTIONS

- A. Piping to and from the water softeners shall conform to 40 05 13 – Common Work Results for Process Piping.
- B. Install valved bypass in water piping around water softeners as shown in the drawings.
- C. Brine waste shall be drained as indicated in the drawings and Division 22 – Plumbing.

3.3 FIELD INSPECTION

- A. The Engineer shall confirm the installation has been completed by the Contractor to meet the requirements of the specifications and drawings.
- B. Water softeners shall conform to the requirements of Section 01 75 16 – Testing, Training and System Startup.

3.4 STARTUP SERVICE AND TESTING

- A. A factory-authorized service representative shall be onsite for a maximum of one day at the completion of construction to startup, inspect and test the water softeners.

B. Tests and Inspections:

1. Leak Test: After installation, Contractor to charge system and test for leaks as required by the manufacturer. Repair leaks and retest until no leaks exist.
2. Water Quality: Manufacturer to sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples) and prepare certified test reports for required water performance characteristics. Water softener sampling and water quality analysis to meet the above requirements and the additional ASTM methods listed in PART 1 above shall comply with NSF 60/61 requirements.

- C. Water softeners will be considered defective if they do not pass tests and inspections and shall be adequately repaired or replaced to pass tests and inspections at the cost of the Manufacturer or Contractor. Factory-authorized representative shall remain onsite during additional product repair, product replacement, testing and/or sampling as need, at the cost of the Manufacturer or Contractor.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months of full maintenance by skilled and manufacturer-approved maintenance personnel.
- B. An operation and preventative maintenance manual shall be delivered to the Owner upon completion of construction. The manual shall include a spare parts list as recommended and authorized by the manufacturer.

END OF SECTION

NOTICE OF TYPE II DECISION
MAJOR MODIFICATION MMD2021-00005
TIGARD ASR No. 3 MECHANICAL BUILDING



120 DAYS = 9/27/2021

SECTION I. APPLICATION SUMMARY

FILE NAME: Tigard ASR No. 3 Mechanical Building
CASE NO.: Major Modification (MMD) MMD2021-00005

PROPOSAL: The applicant is requesting a major modification to Conditional Use Permit (CUP) 2007-00001 for planned improvements to the existing Tigard Aquifer Storage and Recovery (ASR) No. 3 Facility that was constructed in 2007. The modifications include a new small mechanical building, generator, asphalt pad, and relocation of an existing gate at the site's service/maintenance access on SW Bull Mountain Road. These planned modifications will improve the site into a fully operational ASR facility.

APPLICANT: AKS Engineering & Forestry, LLC
 Chris Goodell
 12965 SW Herman Road, Suite 100
 Tualatin, OR 97062

OWNER: City of Tigard
 ATTN: Andy Newbury
 13125 SW Hall Blvd
 Tigard, OR 97223

LOCATION: 13001 SW Bull Mountain Rd.; WCTM 2S109AC Tax Lot 2500

ZONING

DESIGNATION: PR: Parks and Recreation

**APPLICABLE
 REVIEW**

CRITERIA: Community Development Code Chapters 18.140, 18.710, 18.765, 18.910, and 18.920.

SECTION II. DECISION

Notice is hereby given that the City of Tigard Community Development Director's designee has **APPROVED** the above request. The findings and conclusions on which the decision is based are provided in Sections V and VI.

CONDITIONS OF APPROVAL

THE FOLLOWING CONDITIONS MUST BE SATISFIED PRIOR TO PERMIT SUBMITTAL:

1. Prior to permit submittal, the applicant must submit an Autocad file of proposed street names and assignment of addresses and pay the address fee. Contact Oscar Contreras at 503-718-2678 for the submission of the Autocad file. The address fee will be assessed in accordance with the current Master Fee Schedule.

THE FOLLOWING CONDITIONS MUST BE SATISFIED PRIOR TO COMMENCING ANY SITE WORK:

The applicant must prepare a cover letter and submit it, along with any supporting documents or plans that address the following requirements to the ENGINEERING DIVISION, ATTN: Jeremy Tamargo, Principal Engineer at (971) 713-0281 or JeremyT@tigard-or.gov. The cover letter must clearly identify where in the submittal the required information is found:

2. Improvements associated with public infrastructure including street and right-of-way dedication, utilities, grading, water quality and quantity facilities, streetlights, easements, easement locations, and utility connections must be designed in accordance with the following codes and standards:
 - City of Tigard Public Improvement Design Standards
 - Clean Water Services (CWS) Design and Construction Standards
 - Tigard Community Development Codes, Municipal Codes
 - Tualatin Valley Fire and Rescue (TVF&R) Fire Codes
 - Other applicable County, State, and Federal Codes and Standard Guidelines
3. Improvements associated with public infrastructure including street and right-of-way dedication, utilities, grading, water quality and quantity facilities, streetlights, easements, easement locations, and utility connections for future utility extensions are subject to the City Engineer's review, modification, and approval.
4. Prior to commencing any site work, the applicant must submit a Public Facility Improvement (PFI) Permit to cover all infrastructure work including stormwater Water Quality and Quantity Facilities and any other work in the public right-of-way. Four (4) sets of detailed public improvement plans must be submitted for review to the Engineering Department. An Engineering cost estimate of improvements associated with public infrastructures including but not limited to street, street grading, utilities, stormwater quality and water quantity facilities, sanitary sewer, streetlights, and franchise utilities are required at the time of PFI Permit submittal. When the water system is under the City of Tigard jurisdiction, an Engineering cost estimate of water improvement must be listed as a separate line item from the total cost estimate. NOTE: these plans are in addition to any drawings required by the Building Division and should only include sheets relevant to public improvements. Public Facility Improvement Permit plans must conform to City of Tigard Public Improvement Design Standards, which are available at City Hall and the City's web page (www.tigard-or.gov).
5. Prior to commencing any site work, the applicant must submit plans showing the following required street improvements to engineering for review and approval:

SW Bull Mountain Road:

- 8' public utility easement
 - Street lighting
6. Prior to commencing any site work, the applicant must submit the exact legal name, address and telephone number of the individual or corporate entity who will be designated as the "Permittee", and who will provide the financial assurance for the public improvements. Specify if the entity is a corporation, limited partnership, LLC, etc. and the state within which the entity is incorporated and provide the name of the corporate contact person. Failure to provide accurate information will delay processing of project documents.
 7. Prior to commencing any site work, the applicant must provide a construction vehicle access and parking plan for approval by the City Engineer. The purpose of this plan is for parking and traffic control during the public improvement construction phase. All construction vehicle parking must be provided onsite. No construction vehicles or equipment will be permitted to park on the adjoining residential public streets. Construction vehicles include the vehicles of any contractor or subcontractor involved in the construction of site improvements or buildings proposed by this application and must include the vehicles of all suppliers and employees associated with the project.
 8. Prior to commencing site improvements, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B.
 9. Prior to commencing any site work, the applicant must submit site plans and a final storm drainage report as part of the PFI Permit indicating how run-off generated by the development will be collected, conveyed, treated and detained for review and approval. The storm drainage report must be prepared and include a maintenance plan in accordance with CWS Design and Construction Standards and the City of Tigard Standards.
 10. Prior to commencing any site work, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI Permit. Plans must be submitted to the City of Tigard for review. The City will forward plans to CWS after preliminary review.
 11. Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing the proposed sanitary sewer system and associated facilities to be designed and constructed in accordance with the City of Tigard and CWS Design and Construction Standards.
 12. Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing all proposed and/or extensions of public water lines, hydrants and water services to be designed in accordance with the City of Tigard Standards for review and approval.
 13. Prior to commencing any site work, the applicant must provide written approval from TVF&R for fire flow, hydrant placement, and emergency vehicular access and turn around.

14. Prior to commencing any site work, the applicant must submit an erosion control plan as part of the PFI Permit. The plan must conform to the "CWS Erosion Prevention and Sediment Control Design and Planning Manual" (current edition).
15. Prior to commencing any site work, the applicant must submit a final grading plan showing the existing and proposed contours. The plan must detail the provisions for surface drainage of the site and show that it will be graded to ensure that surface drainage is directed to the street or a public storm drainage system approved by the Engineering Division. The design engineer must indicate, on the grading plan, which areas will have natural slopes between 10 percent and 20 percent, as well as area that will have natural slopes in excess of 20 percent. This information will be necessary in determining if special grading inspections or permits will be necessary.
16. Prior to commencing any site work, the applicant must submit a Preliminary Sight Distance Certification for review and approval.
17. Prior to commencing any site work, the applicant must provide a performance bond for all public improvements and private stormwater treatment facilities associated with the development.

**THE FOLLOWING CONDITIONS MUST BE SATISFIED
PRIOR TO FINAL BUILDING INSPECTION:**

The applicant must prepare a cover letter and submit it, along with any supporting documents or plans that address the following requirements to the ENGINEERING DIVISION, ATTN: Jeremy Tamargo, Principal Engineer at (971) 713-0281 or JeremyT@tigard-or.gov. The cover letter must clearly identify where in the submittal the required information is found:

18. Prior to final building inspection schedule a final Planning inspection.
19. Prior to final building inspection, all improvements associated with public infrastructure including but not limited to street improvements under the City of Tigard jurisdiction must be constructed, completed and/or satisfied. The Applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.
20. Prior to final building inspection all public utility facilities including but not limited to storm drainage, water quality and quantity, sanitary sewer, water, gas, electrical, communication, and wireless must be completed.
21. Prior to final building inspection, the applicant must submit the Final Sight Distance Certification for review and approval.
22. Prior to final building inspection, the applicant must place all existing and proposed utilities underground.
23. Prior to final building inspection, the applicant must record all utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

SECTION III. BACKGROUND INFORMATION

The City of Tigard (Owner and Applicant) is submitting this application for a major modification to Conditional Use Permit CUP2007-00001 for planned improvements to the existing Tigard Aquifer Storage and Recovery (ASR) No. 3 Facility that was constructed in 2007. The modifications included in this application will allow previously improved aquifer storage facility to be enhanced to meet City water supply needs.

Proposal:

The Applicant is requesting to permit a new small mechanical building, generator, asphalt pad, and relocation of an existing gate at the site's service/maintenance access on SW Bull Mountain Road. These planned modifications will improve the site into a fully operational ASR facility.

Vicinity Information:

The City of Tigard's ASR No. 3 Facilities are located within the existing Elizabeth Price Park, a ±2.5-acre property located at the intersection of SW Bull Mountain Road and SW 132nd Avenue at 13001 SW Bull Mountain Road. The property generally slopes southeast and has access to SW Bull Mountain Road for service/maintenance purposes and SW 132nd Avenue.

The site is zoned PR and surrounded by single-family residences zoned R-7 to the north, east, and west, and the Alberta Rider Elementary School to the west across Bull Mountain Road.

SECTION IV. PUBLIC COMMENTS

The Tigard Community Development Code requires that property owners within 500 feet of the subject site be notified of the proposal and be given an opportunity for written comments and/or oral testimony prior to a decision being made. Staff mailed a Type II Notice of Application regarding this modification to affected parties on May 26, 2021. The City received no comments.

SECTION V. SUMMARY OF APPLICABLE REVIEW CRITERIA

The following summarizes the review criteria applicable to this decision, in the order in which they are addressed:

Applicable Review Criteria

18.765 Modifications

18.140 Parks and Recreation Zone

18.910 Improvement Standards

18.920 Access, Egress and Circulation

SECTION VI. APPLICABLE REVIEW CRITERIA AND FINDINGS

Findings for only the applicable code sections are found below:

18.765 Modifications

18.765.020 Applicability

B. This chapter applies to all proposals to modify an existing or proposed use, structure, site improvement, or condition of approval – for existing developments or land use approvals – when initially approved through one of the land use applications listed below:

- 1. Conditional uses,**

The Tigard ASR improvements were initially approved through a Conditional Use Permit. This application aims to modify the previously approved Conditional Use Permit (CUP2007-00001). This chapter applies.

18.765.070 Major Modifications

A. Definition. A major modification has the following characteristics:

- 1. It has more than minimal impacts on surrounding properties, sensitive lands, or public facilities but does not qualify as substantial redevelopment as defined in Subsection 18.765.040.C; and**
- 2. It does not cause the development to go out of conformance with any applicable standard or further out of conformance if already nonconforming, except where an adjustment has been approved.**

The proposal includes a mechanical building approximately 1,120 square feet, generator, asphalt pad, and relocation of an existing gate at the site's access on SW Bull Mountain Road. As proposed, the modification does not cause the development to go further out of conformance with any applicable standard. The modification meets the characteristics of a major modification.

D. Approval criteria. The approval authority will approve or approve with conditions a major modification application when all of the following are met:

- 1. The proposed modification qualifies as a major modification as defined in Subsection 18.765.070.A;**

Based on the finding above, the proposal meets the definition of a major modification. This criterion is met.

- 2. The operating and physical characteristics of the modified development are reasonably compatible with surrounding properties, sensitive lands, or public facilities;**

The planned modifications include a new small mechanical building, generator, asphalt pad, and relocation of an existing gate at the site's access on SW Bull Mountain Road. The site does not have sensitive lands, and the planned modifications are not anticipated to generate glare, odor, dust, or affect air quality. The mechanical building and generator are planned to be located over 100 feet from the closest house east of the site. As discussed in the Noise Study (Exhibit J), the new well house is planned to be built with CMU walls with exterior insulation to minimize noise impact. As further discussed in the Noise Study, the sound from the well house and generator are anticipated to be at a sound level that is less than an air conditioner or vacuum cleaner and meet the requirements for noise limits pursuant to Section 6.02 of the Tigard Municipal Code. Additionally, there are existing mature trees along the property line between the planned building and the existing residential homes to the east which will provide both a visual screen and help buffer potential noise. Therefore, the planned modifications are reasonably compatible with surrounding properties. This criterion is met.

- 3. Any impacts from the proposed modification are mitigated to the extent practicable;**

The planned improvements will be mitigated to the extent practicable. The improvements will be adequately screened from both SW Bull Mountain Road and neighboring properties to the east with new landscaping and existing mature landscaping. Additionally, as discussed in the Noise Study (Exhibit J) the mechanical building is planned to include building materials (CMU walls with exterior insulation) that will diminish potential noise impacts. The impacts of these modifications are minimal and mitigated to the extent practicable. There is existing mature landscaping around the site's boundary, providing visual

screening from existing and new improvements. The minimum setback standard for the new mechanical building from the adjacent residential properties to the east is 15 feet (based on the height of the new mechanical building), and as shown on the Preliminary Plans (Exhibit A), the planned setback exceeds this minimum. The mechanical building and generator are planned to be over 100 feet from to the closest house east of the site, and the color palette chosen for the new mechanical building include neutral colors that are intended to blend in with existing landscaping. Additionally, as shown on the Preliminary Plans, the new mechanical building has a variety of materials and has a residential appearance to be compatible with neighboring residential properties and is planned to be constructed with concrete masonry unit (CMU) blocks and will be clad with siding that will help minimize sound.

As shown on the Landscaping Plan included in Exhibit A, this project also includes new landscaping to complement the existing mature landscaping between the new mechanical building and generator and SW Bull Mountain Road and provides screening of the planned improvements.

The new generator is intended for emergency use and will operate during emergencies and for occasional maintenance. A noise study was prepared by Michael Minor & Associates of the well house and generator and is included in this application (Exhibit J). It should be noted, that pursuant to City of Tigard Municipal Code Section 6.02.450, emergency equipment, like the emergency generator included in this application, is exempt from the noise limit provisions.

As detailed in the noise report, during emergency use the generator is anticipated to be less than 55 to 58 dBA at the property line of the closest residences to the east. The study also indicates that the noise level of the well house was calculated at 37 dBA, which is below the thresholds found in Section 6.02.430 of the City of Tigard Municipal Code. As shown in Table 1 of the noise study, a dBA of 55 to 58 has a lower sound level than a large air-conditioning unit or vacuum cleaner and a dBA of 37 has a lower sound level than a bedroom or quiet living room. Therefore, this criterion is met.

- 4. If the proposed modification involves development that has nonconforming structures or site improvements and exceeds the project valuation threshold listed in the city's Master Fees and Charges Schedule, the development will be improved as required by Subsection 18.765.070.E; and**

The modification does not involve development that has nonconforming site improvements and exceeds the project valuation threshold. This criterion is not applicable.

- 5. If the proposal involves the modification of a condition of approval, at least one of the following criteria is met:**
 - a. The condition cannot be implemented for reasons outside the control of the applicant or property owner;**
 - b. The condition is no longer needed or warranted because circumstances have changed; or**
 - c. A new or modified condition better accomplishes the purpose of the original condition.**

The proposal does not involve modifying a condition of approval. This criterion does not apply.

18.140 Parks and Recreation Zone

18.140.040 Land Use Standards

- A. General provisions. A list of allowed, restricted, conditional, and prohibited uses in the PR zone is provided in Table 18.140.1. If a use category is not listed, see Section 18.60.030.**

This application involves modifications to existing water infrastructure improvements to the City of Tigard's ASR No. 3 Facility. Basic utilities are allowed conditionally. These planned modifications are to a facility that was previously approved through a conditional use permit (CUP 2007-00001).

18.420.040 Landscaping Standards

- A. Landscaping standards are provided in Table 18.420.1.**
- B. Landscaping or other areas used to meet the minimum landscape area standard must be provided on the development site and may be met by any combination of the following:**
 - 1. Landscaping, including parking lot landscaping, that meets the L-1 or L-2 landscaping standard;**
 - 2. Landscaping that meets the S-2, S-3, or S-4 screening standard as provided in Table 18.420.2 where required by the applicable development standards chapter;**
 - 3. Any required above-ground vegetated stormwater facility; or**
 - 4. Other areas as specified by the applicable development standards chapter.**
- C. Landscaping in excess of the minimum landscape area standard does not have to meet the L-1 or L-2 landscaping standard.**

The subject site has a Parks and Recreation (PR) zoning designation. Pursuant to Chapter 18.300 of the Tigard Development Code, landscaping and screening standards are not required for properties with this zoning designation. Therefore, these standards are not applicable.

18.910.030 Streets

- A. Improvements.**
 - 1. No development shall occur unless the development has frontage or approved access to a public street.**
 - 2. No development shall occur unless streets within the development meet the standards of this chapter.**
 - 3. No development shall occur unless the streets adjacent to the development meet the standards of this chapter, provided, however, that a development may be approved if the adjacent street does not meet the standards but half-street improvements meeting the standards of this chapter are constructed adjacent to the development.**
 - 4. Any new street or additional street width planned as a portion of an existing street shall meet the standards of this chapter.**
 - 5. If the city could and would otherwise require the applicant to provide street improvements, the City Engineer may accept a future improvements guarantee in lieu of street improvements if one or more of the following conditions exist**
 - a. A partial improvement is not feasible due to the inability to achieve proper design standards;**
 - b. A partial improvement may create a potential safety hazard to motorists or pedestrians;**
 - c. Due to the nature of existing development on adjacent properties it is unlikely that street improvements would be extended in the foreseeable future and the improvement associated with the project under review does not, by itself, provide a significant improvement to street safety or capacity;**
 - d. The improvement would be in conflict with an adopted capital improvement plan;**
 - e. The improvement is associated with an approved land partition on property zoned residential and the proposed land partition does not create any new streets; or**

- f. **Additional planning work is required to define the appropriate design standards for the street and the application is for a project which would contribute only a minor portion of the anticipated future traffic on the street.**
6. **The standards of this chapter include the standard specifications adopted by the City Engineer in compliance with Subsection 18.910.020.B.**
7. **The approval authority may approve adjustments to the standards of this chapter if compliance with the standards would result in an adverse impact on natural features such as wetlands, bodies of water, significant habitat areas, steep slopes, or existing mature trees. The approval authority may also approve adjustments to the standards of this chapter if compliance with the standards would have a substantial adverse impact on existing development or would preclude development on the property where the development is proposed. In approving an adjustment to the standards, the approval authority shall balance the benefit of the adjustment with the impact on the public interest represented by the standards. In evaluating the impact on the public interest, the approval authority shall consider the criteria listed in Subsection 18.910.030.E. An adjustment to the standards may not be granted if the adjustment would risk public safety.**

As shown in the preliminary site plan, the proposed development has frontage on and has approved access to SW Bull Mountain Road, classified as a collector.

As shown in the preliminary civil plans, the existing street section along SW Bull Mountain Road meets the standards of this section. Half street improvements were previously completed with the Price Park Reservoir project in 2007 (City As-built #1131). Previous improvements in 2007 did not include dedication of the required 8' public utility easement along SW Bull Mountain Road.

Prior to commencing site improvements, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B

Prior to commencing any site work, the applicant must submit plans showing the following required street improvements to engineering for review and approval:

- SW Bull Mountain Road:
 - 8' public utility easement
 - Street lighting

Through the Conditions of Approval, this standard is met.

B. Creation of rights-of-way for streets and related purposes. Rights-of-way shall be created through the approval of a final plat; however, the council may approve the creation of a street by acceptance of a deed, provided that such street is deemed essential by the council for the purpose of general traffic circulation.

1. **The council may approve the creation of a street by deed of dedication without full compliance with the regulations applicable to subdivisions or partitions if any one or more of the following conditions are found by the council to be present:**

- a. Establishment of a street is initiated by the council and is found to be essential for the purpose of general traffic circulation, and partitioning or subdivision of land has an incidental effect rather than being the primary objective in establishing the road or street for public use; or
 - b. The tract in which the road or street is to be dedicated is an isolated ownership of 1 acre or less and such dedication is recommended by the commission to the council based on a finding that the proposal is not an attempt to evade the provisions of this title governing the control of subdivisions or partitions
 - c. The street is located within the mixed use central business district (MU-CBD) zone and has been identified on Figures 5-14A through 5-14I of the City of Tigard 2035 Transportation System Plan as a required connectivity improvement.
2. With each application for approval of a road or street right-of-way not in full compliance with the regulations applicable to the standards, the proposed dedication shall be made a condition of subdivision and partition approval.
 - a. The applicant shall submit such additional information and justification as may be necessary to enable the commission in its review to determine whether or not a recommendation for approval by the council shall be made.
 - b. The recommendation, if any, shall be based upon a finding that the proposal is not in conflict with the purpose of this title.
 - c. The commission in submitting the proposal with a recommendation to the council may attach conditions which are necessary to preserve the standards of this title.
 3. All deeds of dedication shall be in a form prescribed by the city and shall name “the public” as grantee.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A. The standard is met.

- C. Creation of access easements.** The approval authority may approve an access easement established by deed without full compliance with this chapter provided such an easement is the only reasonable method by which a lot large enough to develop can be created.
1. Access easements shall be provided and maintained in compliance with the Oregon Fire Code, Section 503.
 2. Access shall be in compliance with Subsections 18.920.030.H, I, and J.

The proposed development has direct access to SW Bull Mountain Road. Access easements are not proposed or deemed necessary.

- D. Street location, width and grade.** Except as noted below, the location, width and grade of all streets shall conform to an approved street plan and shall be considered in their relation to existing and planned streets, to topographic conditions, to public convenience and safety, and in their appropriate relation to the proposed use of the land to be served by such streets:
1. Street grades shall be approved by the City Engineer in compliance with Subsection 18.910.030.N; and
 2. Where the location of a street is not shown in an approved street plan, the arrangement of streets in a development shall either:
 - a. Provide for the continuation or appropriate projection of existing streets in the surrounding areas, or
 - b. Conform to a plan adopted by the commission, if it is impractical to conform to existing street patterns because of particular topographical or other existing conditions of the land. Such a plan shall be based on the type of land use to be served,

the volume of traffic, the capacity of adjoining streets and the need for public convenience and safety.

The proposed development is adjacent to SW Bull Mountain Road, an existing street. The street grade will remain unchanged.

E. Minimum rights-of-way and street widths. Unless otherwise indicated on an approved street plan, or as needed to continue an existing improved street or within the Tigard Downtown Plan District, street right-of-way and roadway widths shall not be less than the minimum width described below. Where a range is indicated, the width shall be determined by the decision-making authority based upon anticipated average daily traffic (ADT) on the new street segment. (The city council may adopt by resolution, design standards for street construction and other public improvements. The design standards will provide guidance for determining improvement requirements within the specified ranges.) These are provided in Table 18.910.1.

The approval authority shall make its decision about desired right-of-way width and pavement width of the various street types within the subdivision or development after consideration of the following:

1. The type of road as provided in the comprehensive plan transportation chapter - functional street classification.
2. Anticipated traffic generation.
3. On-street parking needs.
4. Sidewalk and bikeway requirements.
5. Requirements for placement of utilities.
6. Street lighting.
7. Drainage and slope impacts.
8. Street tree location.
9. Planting and landscape areas.
10. Safety and comfort for motorists, bicyclists, and pedestrians.
11. Access needs for emergency vehicles.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A.

F. Future street plan and extension of streets.

1. A future street plan shall:
 - a. Be filed by the applicant in conjunction with an application for a subdivision or partition. The plan shall show the pattern of existing and proposed future streets from the boundaries of the proposed land division and shall include other lots within 530 feet surrounding and adjacent to the proposed land division. At the applicant's request, the city may prepare a future streets proposal. Costs of the city preparing a future streets proposal shall be reimbursed for the time involved. A street proposal may be modified when subsequent subdivision proposals are submitted.
 - b. Identify existing or proposed bus routes, pullouts or other transit facilities, bicycle routes and pedestrian facilities on or within 530 feet of the site.
2. Where necessary to give access or permit a satisfactory future division of adjoining land, streets shall be extended to the boundary lines of the tract to be developed, and

- a. These extended streets or street stubs to adjoining properties are not considered to be cul-de-sac since they are intended to continue as through streets at such time as the adjoining property is developed.
- b. A barricade shall be constructed at the end of the street by the property owners which shall not be removed until authorized by the City Engineer, the cost of which shall be included in the street construction cost.
- c. Temporary hammerhead turnouts or temporary cul-de-sac bulbs shall be constructed for stub street in excess of 150 feet in length.

A future street plan is not required, as a subdivision or partition is not proposed as part of the development. New streets are not proposed or deemed necessary as part of the proposed development.

G. Street spacing and access management. Refer to 18.920.030.H.

Street spacing and access management is discussed under Chapter 18.920, Access, Egress, and Circulation.

H. Street alignment and connections.

1. Full street connections with spacing of no more than 530 feet between connections is required except where prevented by barriers such as topography, railroads, freeways, pre-existing developments, lease provisions, easements, covenants or other restrictions existing prior to May 1, 1995 which preclude street connections. A full street connection may also be exempted due to a regulated water feature if regulations would not permit construction.
2. All local, neighborhood routes and collector streets which abut a development site shall be extended within the site to provide through circulation when not precluded by environmental or topographical constraints, existing development patterns or strict adherence to other standards in this code. A street connection or extension is considered precluded when it is not possible to redesign or reconfigure the street pattern to provide required extensions. Land is considered topographically constrained if the slope is greater than 15 percent for a distance of 250 feet or more. In the case of environmental or topographical constraints, the mere presence of a constraint is not sufficient to show that a street connection is not possible. The applicant must show why the constraint precludes some reasonable street connection.
3. Proposed street or street extensions shall be located to provide direct access to existing or planned transit stops, commercial services, and other neighborhood facilities, such as schools, shopping areas and parks.
4. All developments should provide an internal network of connecting streets that provide short, direct travel routes and minimize travel distances within the development.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A. No new streets are proposed or deemed necessary.

I. Intersection angles. Streets shall be laid out so as to intersect at an angle as near to a right angle as practicable, except where topography requires a lesser angle, but in no case shall the angle be less than 75° unless there is special intersection design, and:

1. Streets shall have at least 25 feet of tangent adjacent to the right-of-way intersection unless topography requires a lesser distance;
2. Intersections which are not at right angles shall have a minimum corner radius of 20 feet along the right-of-way lines of the acute angle; and
3. Right-of-way lines at intersection with arterial streets shall have a corner radius of not less than 20 feet.

There are no new proposed streets or street extensions for the proposed development. This standard does not apply.

- J. Existing rights-of-way. Whenever existing rights-of-way adjacent to or within a tract are of less than standard width, additional rights-of-way shall be provided at the time of subdivision or development.**

The existing right-of-way along SW Bull Mountain Road is in accordance with the minimum standards of this chapter. See findings in Section 18.910.030.A.

- K. Partial street improvements. Partial street improvements resulting in a pavement width of less than 20 feet, while generally not acceptable, may be approved where essential to reasonable development when in conformity with the other requirements of these regulations, and when it will be practical to require the improvement of the other half when the adjoining property developed.**

Partial street improvements are not proposed. As provided in the Preliminary Civil Plan, street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131).

- L. Cul-de-sacs. A cul-de-sac shall be no more than 200 feet long, shall not provide access to greater than 20 dwelling units, and shall only be used when environmental or topographical constraints, existing development pattern, or strict adherence to other standards in this code preclude street extension and through circulation:**
- 1. All cul-de-sac shall terminate with a turnaround. Use of turnaround configurations other than circular shall be approved by the City Engineer; and**
 - 2. The length of the cul-de-sac shall be measured from the centerline intersection point of the 2 streets to the radius point of the bulb.**
 - 3. If a cul-de-sac is more than 300 feet long, a lighted direct pathway to an adjacent street may be required to be provided and dedicated to the city.**

A cul-de-sac is not proposed or deemed necessary. This criterion does not apply.

- M. Street names. No street name shall be used which will duplicate or be confused with the names of existing streets in Washington County, except for extensions of existing streets. Street names and numbers shall conform to the established pattern in the surrounding area and as approved by the City Engineer.**

The proposed development does not propose new streets or street names. This criterion does not apply.

- N. Grades and curves.**
- 1. Grades shall not exceed 10 percent on arterials, 12 percent on collector streets, or 12 percent on any other street (except that local or residential access streets may have segments with grades up to 15 percent for distances of no greater than 250 feet); and**
 - 2. Centerline radii of curves shall be as determined by the City Engineer.**

New streets are not proposed. The existing street grade will not be changed with development.

- O. Curbs, curb cuts, ramps, and driveway approaches.** Concrete curbs, curb cuts, wheelchair, bicycle ramps and driveway approaches shall be constructed in compliance with standards specified in this chapter and Chapter 15.04, Work in the Right-of-Way, and:
1. Concrete curbs and driveway approaches are required; except:
 2. Where no sidewalk is planned, an asphalt approach may be constructed with City Engineer approval; and
 3. Asphalt and concrete driveway approaches to the property line shall be built to city configuration standards.

The narrative and preliminary civil plan set show intent to comply with this requirement.

- P. Streets adjacent to railroad right-of-way.** Wherever the proposed development contains or is adjacent to a railroad right-of-way, provision shall be made for a street approximately parallel to and on each side of such right-of-way at a distance suitable for the appropriate use of the land. The distance shall be determined with due consideration at cross streets or the minimum distance required for approach grades and to provide sufficient depth to allow screen planting along the railroad right-of-way in nonindustrial areas.

The proposed development is not adjacent to an existing railroad right-of-way. This standard is not applicable.

- Q. Access to arterials and collectors.** Where a development abuts or is traversed by an existing or proposed arterial or collector street, the development design shall provide adequate protection for residential properties and shall separate residential access and through traffic, or if separation is not feasible, the design shall minimize the traffic conflicts. The design shall include any of the following:
1. A parallel access street along the arterial or collector;
 2. Lots of suitable depth abutting the arterial or collector to provide adequate buffering with frontage along another street;
 3. Screen planting at the rear or side property line to be contained in a nonaccess reservation along the arterial or collector; or
 4. Other treatment suitable to meet the objectives of this subsection;
 5. If a lot has access to 2 streets with different classifications, primary access should be from the lower classification street.

The proposed development is adjacent to SW Bull Mountain Road, which is functionally classified as a collector. The site has an existing access to SW Bull Mountain Road which is utilized only for service and maintenance purposes. No new access is proposed with this development. No residential access is proposed with this development. This standard is not applicable.

- R. Alleys, public or private.**
1. Alleys shall be no less than 20 feet in width. In commercial and industrial zones, alleys shall be provided unless other permanent provisions for access to off-street parking and loading facilities are made.
 2. While alley intersections and sharp changes in alignment shall be avoided, the corners of necessary alley intersections shall have a radius of not less than 12 feet.

New alleys are not proposed or deemed necessary. This standard is not applicable.

- S. Survey monuments.** Upon completion of a street improvement and prior to acceptance by the city, it shall be the responsibility of the developer's registered professional land surveyor

to provide certification to the city that all boundary and interior monuments shall be reestablished and protected.

The proposed development does not include any street improvements. This standard does not apply.

T. Private streets.

1. Design standards for private streets shall be established by the City Engineer; and
2. The city shall require legal assurances for the continued maintenance of private streets, such as a recorded maintenance agreement.
3. Private streets serving more than 6 dwelling units are permitted only within planned developments, mobile home parks, cottage cluster, courtyard units, and apartment developments.

The proposed development does not include any private streets. This standard does not apply.

U. Railroad crossings. Where an adjacent development results in a need to install or improve a railroad crossing, the cost for such improvements may be a condition of development approval, or another equitable means of cost distribution shall be determined by the public works director and approved by the commission.

The development is not adjacent to a railroad crossing. This standard is not applicable.

V. Street signs. The city shall install all street signs, relative to traffic control and street names, as specified by the City Engineer for any development. The cost of signs shall be the responsibility of the developer.

No new street signs are proposed or deemed necessary. This standard is not applicable.

W. Mailboxes. Joint mailbox facilities shall be provided in all residential developments, with each joint mailbox serving at least 2 dwelling units.

1. Joint mailbox structures shall be placed adjacent to roadway curbs;
2. Proposed locations of joint mailboxes shall be designated on the preliminary plat or development plan, and shall be approved by the City Engineer/U.S. Post Office prior to final plan approval; and
3. Plans for the joint mailbox structures to be used shall be submitted for approval by the City Engineer/U.S. Post Office prior to final approval.

No new mailboxes are proposed or deemed necessary. This standard is not applicable.

X. Traffic signals. The location of traffic signals shall be noted on approved street plans. Where a proposed street intersection will result in an immediate need for a traffic signal, a signal meeting approved specifications shall be installed. The cost shall be included as a condition of development.

New traffic signals are not proposed or deemed necessary.

Y. Street light standards. Street lights shall be installed in compliance with regulations adopted by the city's direction.

Prior to commencing any site work, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color

of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B. Through a condition of approval, this standard is met.

Z. Street name signs. Street name signs shall be installed at all street intersections. Stop signs and other signs may be required.

No new street signs are proposed or deemed necessary. This standard is not applicable.

AA. Street cross-sections. The final lift of asphalt concrete pavement shall be placed on all new constructed public roadways prior to final city acceptance of the roadway and within 1 year of the conditional acceptance of the roadway unless otherwise approved by the City Engineer. The final lift shall also be placed no later than when 90 percent of the structures in the new development are completed or 3 years from the commencement of initial construction of the development, whichever is less.

1. Sub-base and leveling course shall be of select crushed rock;
2. Surface material shall be of Class C or B asphaltic concrete;
3. The final lift shall be placed on all new construction roadways prior to city final acceptance of the roadway; however, not before 90 percent of the structures in the new development are completed unless 3 years have elapsed since initiation of construction in the development;
4. The final lift shall be Class C asphaltic concrete as defined by A.P.W.A. standard specifications; and
5. No lift shall be less than 1.5 inches in thickness.

The development will not require frontage improvements along SW Bull Mountain Road; therefore, this section is not applicable.

BB. Traffic calming. When, in the opinion of the City Engineer, the proposed development will create a negative traffic condition on existing neighborhood streets, such as excessive speeding, the developer may be required to provide traffic calming measures. These measures may be required within the development or offsite as deemed appropriate. As an alternative, the developer may be required to deposit funds with the city to help pay for traffic calming measures that become necessary once the development is occupied and the City Engineer determines that the additional traffic from the development has triggered the need for traffic calming measures. The City Engineer will determine the amount of funds required and will collect said funds from the developer prior to the issuance of a certificate of occupancy, or in the case of subdivision, prior to the approval of the final plat. The funds will be held by the city for a period of 5 years from the date of issuance of certificate of occupancy, or in the case of a subdivision, the date of final plat approval. Any funds not used by the city within the 5-year time period will be refunded to the developer.

Traffic calming is not proposed or deemed necessary for the proposed development.

CC. Traffic study.

1. A traffic study shall be required for all new or expanded uses or developments under any of the following circumstances:
 - a. When they generate a 10 percent or greater increase in existing traffic to high collision intersections identified by Washington County.
 - b. Trip generations from development onto the city street at the point of access and the existing ADT fall within the following ranges:

Existing ADT	ADT to be added by development
0—3,000 vpd	2,000 vpd
3,001—6,000 vpd	1,000 vpd
>6,000 vpd	500 vpd or more

- c. If any of the following issues become evident to the City Engineer:
 - i. High traffic volumes on the adjacent roadway that may affect movement into or out of the site.
 - ii. Lack of existing left-turn lanes onto the adjacent roadway at the proposed access drive.
 - iii. Inadequate horizontal or vertical sight distance at access points.
 - iv. The proximity of the proposed access to other existing drives or intersections is a potential hazard.
 - v. The proposal requires a conditional use permit or involves a drive-through operation.
 - vi. The proposed development may result in excessive traffic volumes on adjacent local streets.
2. In addition, a traffic study may be required for all new or expanded uses or developments under any of the following circumstances
 - a. When the site is within 500 feet of an ODOT facility; or
 - b. Trip generation from a development adds 300 or more vehicle trips per day to an ODOT facility; or
 - c. Trip generation from a development adds 50 or more peak hour trips to an ODOT facility.

Based on the estimated trip generation for the proposed development, a traffic study is not required for this proposed development. This standard has been met.

18.910.040 Blocks

- A. **Block design.** The length, width and shape of blocks shall be designed with due regard to providing adequate building sites for the use contemplated, consideration of needs for convenient access, circulation, control and safety of street traffic and recognition of limitations and opportunities of topography.
- B. **Sizes.**
 1. The perimeter of blocks formed by streets shall not exceed 2,000 feet measured along the centerline of the streets except:
 - a. Where street location is precluded by natural topography, wetlands, significant habitat areas or bodies of water, or pre-existing development; or
 - b. For blocks adjacent to arterial streets, limited access highways, collectors or railroads.
 - c. For nonresidential blocks in which internal public circulation provides equivalent access.
 2. Bicycle and pedestrian connections on public easements or rights-of-way shall be provided when full street connection is exempted by Paragraph 18.910.040.B.1. Spacing between connections shall be no more than 330 feet, except where precluded by environmental or topographical constraints, existing development patterns, or strict adherence to other standards in the code.

The development does not propose any new streets and does not warrant a block design or future street plan. Street or pedestrian connections are precluded by preexisting development located to the south, west and east of the proposed development.

18.910.050 Easements

- A. **Easements.** Easements for sewers, drainage, water mains, electric lines or other public utilities shall be either dedicated or provided for in the deed restrictions, and where a development is traversed by a watercourse or drainageway, there shall be provided a stormwater easement or drainage right-of-way conforming substantially with the lines of the watercourse.
- B. **Utility easements.** A property owner proposing a development shall make arrangements with the city, the applicable district, and each utility franchise for the provision and dedication of utility easements necessary to provide full services to the development. The city's standard width for public main line utility easements shall be 15 feet unless otherwise specified by the utility company, applicable district, or City Engineer.

The proposed development is not traversed by a watercourse or drainage way. The development will require an eight-foot public utility easement along the frontage. Prior to final building inspection, the applicant must record all utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

18.910.070 Sidewalks

- A. **Sidewalks.** All public and private streets adjacent to industrially zoned properties shall have sidewalks meeting city standards along at least one side of the street. All other public and private streets shall have sidewalks meeting city standards along both sides of the street. A development may be approved if an adjoining street has sidewalks on the side adjoining the development, even if no sidewalk exists on the other side of the street.

As shown in the preliminary civil plans, the existing street section along SW Bull Mountain Road meets the standards of this section. Half street improvements, including sidewalk, were previously completed with the Price Park Reservoir project in 2007 (City As-built #1131). This standard is met.

B. Requirement of developers.

1. As part of any development proposal or change in use resulting in an additional 1,000 vehicle trips or more per day, an applicant shall be required to identify direct, safe (1.25 x the straight line distance) pedestrian routes within 0.50 miles of their site to all transit facilities and neighborhood activity centers (schools, parks, libraries, etc.). In addition, the developer may be required to participate in the removal of any gaps in the pedestrian system off-site if justified by the development.
2. If there is an existing sidewalk on the same side of the street as the development within 300 feet of a development site in either direction, the sidewalk shall be extended from the site to meet the existing sidewalk, subject to rough proportionality (even if the sidewalk does not serve a neighborhood activity center).

The proposed development does not generate an additional 1,000 vehicle trips or more per day.

As shown in the preliminary civil plans, the applicant's existing sidewalk connects to the existing sidewalk located to the east along SW Bull Mountain Road. There is no existing sidewalk located to the west of the proposed development along SW Bull Mountain Road. This standard is met.

- C. **Planter strip requirements.** A planter strip separation of at least 5 feet between the curb and the sidewalk shall be required in the design of streets, except where the following conditions exist: there is inadequate right-of-way; the curbside sidewalks already exist on predominant portions of the street; it would conflict with the utilities; there are significant natural features

(large trees, water features, significant habitat areas, etc.) that would be destroyed if the sidewalk were located as required; or where there are existing structures in close proximity to the street (15 feet or less) or where the standards in Table 18.910.1 specify otherwise. Additional consideration for exempting the planter strip requirement may be given on a case-by-case basis if a property abuts more than one street frontage.

The preliminary site plan shows the existing planter strip along the proposed development's frontage meets City minimum requirements for SW Bull Mountain Road. This standard is met.

D. Maintenance. Maintenance of sidewalks, curbs, and planter strips is the continuing obligation of the adjacent property owner.

The property owner will take full responsibility for the maintenance of sidewalks, curbs, and planter strips.

E. Application for permit and inspection. Separate street opening permits are required for sidewalk segments that are not part of a current subdivision approval:

1. An occupancy permit shall not be issued for a development until the provisions of this section are satisfied.
2. The City Engineer may issue a permit and certificate allowing temporary noncompliance with the provisions of this section to the owner, builder or contractor when, in his or her opinion, the construction of the sidewalk is impractical for one or more of the following reasons:
 - a. Sidewalk grades have not and cannot be established for the property in question within a reasonable length of time;
 - b. Forthcoming installation of public utilities or street paving would be likely to cause severe damage to the new sidewalk;
 - c. Street right-of-way is insufficient to accommodate a sidewalk on 1 or both sides of the street; or
 - d. Topography or elevation of the sidewalk base area makes construction of a sidewalk impractical or economically infeasible
3. The City Engineer shall inspect the construction of sidewalks for compliance with the provision set forth in the standard specifications manual.

Prior to commencing any site work, the applicant must submit a Public Facility Improvement (PFI) Permit to cover all infrastructure work including stormwater Water Quality and Quantity Facilities and any other work in the public right-of-way. Four (4) sets of detailed public improvement plans must be submitted for review to the Engineering Department. An Engineering cost estimate of improvements associated with public infrastructures including but not limited to street, street grading, utilities, stormwater quality and water quantity facilities, sanitary sewer, streetlights, and franchise utilities are required at the time of PFI Permit submittal. When the water system is under the City of Tigard jurisdiction, an Engineering cost estimate of water improvement must be listed as a separate line item from the total cost estimate. NOTE: these plans are in addition to any drawings required by the Building Division and should only include sheets relevant to public improvements. Public Facility Improvement Permit plans must conform to City of Tigard Public Improvement Design Standards, which are available at City Hall and the City's web page (www.tigard-or.gov).

F. Council initiation of construction. In the event one or more of the following situations are found by the council to exist, the council may adopt a resolution to initiate construction of a sidewalk in accordance with city ordinances:

1. A safety hazard exists for children walking to or from school and sidewalks are necessary to eliminate the hazard;
2. A safety hazard exists for pedestrians walking to or from a public building, commercial area, place of assembly or other general pedestrian traffic, and sidewalks are necessary to eliminate the hazard;
3. Fifty percent or more of the area in a given block has been improved by the construction of dwellings, multiple dwellings, commercial buildings or public buildings or parks; and
4. A criterion which allowed noncompliance under this chapter no longer exists and a sidewalk could be constructed in compliance with city standards.

The above described situations have not been found by the council to exist. This standard does not apply.

18.910.080 Public Use Areas

A. Dedication requirements.

1. Where a proposed park, playground, or other public use shown in a development plan adopted by the city is located in whole or in part in a subdivision, the commission may require the dedication or reservation of such area within the subdivision, provided that the reservation or dedication is roughly proportional to the impact of the subdivision on the park system.
2. Where considered desirable by the commission in compliance with adopted comprehensive plan policies, and where a development plan of the city does not indicate proposed public use areas, the commission may require the dedication or reservation of areas within the subdivision or sites of a character, extent and location suitable for the development of parks or other public use, provided that the reservation or dedication is roughly proportional to the impact of the subdivision on the park system.

- B. Acquisition by public agency.** If the developer is required to reserve land area for a park, playground, or other public use, such land shall be acquired by the appropriate public agency within 18 months following plat approval, at a price agreed upon prior to approval of the plat, or such reservation shall be released to the subdivider.

Public use areas are not proposed or deemed necessary.

18.910.090 Sanitary Sewers

- A. Sewers required.** Sanitary sewers shall be installed to serve each new development and to connect developments to existing mains in compliance with Clean Water Services requirements and the-comprehensive plan.
- B. Sewer plan approval.** The City Engineer shall approve all sanitary sewer plans and proposed systems prior to issuance of development permits involving sewer service.
- C. Over-sizing.** Proposed sewer systems shall include consideration of additional development within the area as projected by the comprehensive plan.
- D. Permits denied.** Development permits may be restricted by the approval authority where a deficiency exists in the existing sewer system or portion thereof which cannot be rectified within the development and which if not rectified will result in a threat to public health or safety, surcharging of existing mains, or violations of state or federal standards pertaining to operation of the sewage treatment system.

The preliminary utility plan provided by the applicant shows connection to an existing eight-inch sanitary sewer main that traverses the northeast portion of the site.

Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing the proposed sanitary sewer system and associated facilities to be designed and constructed in accordance with the City of Tigard and CWS Design and Construction Standards.

Prior to final building inspection, the proposed sanitary sewer system and associated facilities must be constructed, completed, and/or satisfied. The applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.

No oversizing of sanitary sewer is proposed deemed necessary.

18.910.100 Storm Drainage

- A. General provisions. The Director and City Engineer shall issue a development permit only where adequate provisions for stormwater and floodwater runoff have been made, and:**
- 1. The storm water drainage system shall be separate and independent of any sanitary sewerage system;**
 - 2. Where possible, inlets shall be provided so surface water is not carried across any intersection or allowed to flood any street; and**
 - 3. Surface water drainage patterns shall be shown on every development proposal plan.**

The applicant submitted preliminary plans that comply with these general requirements.

- B. Easements. Where a development is traversed by a watercourse, drainageway, channel or stream, there shall be provided a stormwater easement or drainage right-of-way conforming substantially with the lines of such watercourse and such further width as will be adequate for conveyance and maintenance.**

The development is not traversed by a watercourse or drainageway. This standard is not applicable.

- C. Accommodation of upstream drainage. A culvert or other drainage facility shall be large enough to accommodate potential runoff from its entire upstream drainage area, whether inside or outside the development, and the City Engineer shall approve the necessary size of the facility, based on Clean Water Services requirements.**
- D. Effect on downstream drainage. Where it is anticipated by the City Engineer that the additional runoff resulting from the development will overload an existing drainage facility, the director and engineer shall withhold approval of the development until provisions have been made for improvement of the potential condition or until provisions have been made for storage of additional runoff caused by the development in compliance with Clean Water Services requirements.**

A preliminary storm drainage memorandum was submitted as part of the land use submittal. The applicant has proposed to meet CWS standards for water quality and water quantity through the payment of fee-in-lieu.

Prior to commencing any site work, the applicant must submit site plans and a final storm drainage report as part of the PFI Permit indicating how run-off generated by the development will be collected, conveyed, treated and detained for review and approval. The storm drainage report must be prepared and include a maintenance plan in accordance with CWS Design and Construction Standards and the City of Tigard Standards.

Prior to commencing any site work, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI Permit. Plans must be submitted to the City of Tigard for review. The City will forward plans to CWS after preliminary review.

18.910.110 Bikeways and Pedestrian Pathways

A. Bikeway extension.

1. As a standard, bike lanes shall be required along all arterial and collector routes and where identified on the city's adopted bicycle plan in the transportation system plan (TSP). Bike lane requirements along collectors within the downtown urban renewal district shall be determined by the City Engineer unless specified in Table 18.910.1.
2. Developments adjoining proposed bikeways identified on the city's adopted pedestrian/bikeway plan shall include provisions for the future extension of such bikeways through the dedication of easements or rights-of-way, provided such dedication is directly related to and roughly proportional to the impact of the development.
3. Any new street improvement project shall include bicycle lanes as required in this chapter and on the adopted bicycle plan.

B. Cost of construction. Development permits issued for planned developments, conditional use permits, subdivisions and other developments which will principally benefit from such bikeways shall be conditioned to include the cost or construction of bikeway improvements in an amount roughly proportional to the impact of the development.

C. Minimum width.

1. The minimum width for bikeways within the roadway is 5 feet per bicycle travel lane.
2. The minimum width for multi-use paths separated from the road and classified as regional or community trails in the Greenway Trail System Master Plan is 10 feet. The width may be reduced to 8 feet if there are environmental or other constraints.
3. The minimum width for off-street paths classified as neighborhood trails, according to the Greenway Trail System Master Plan, is 3 feet.
4. Design standards for bike and pedestrian-ways shall be determined by the City Engineer.

The City's TSP identifies bike lanes along SW Bull Mountain Road, consistent with the collector street section. The existing street section contains a bike lane. The standard is met.

18.910.120 Utilities

A. Underground utilities. All utility lines including, but not limited to those required for electric, communication, lighting and cable television services and related facilities shall be placed underground, except for surface mounted transformers, surface mounted connection boxes and meter cabinets which may be placed above ground, temporary utility service facilities during construction, high capacity electric lines operating at 50,000 volts or above, and:

1. The developer shall make all necessary arrangements with the serving utility to provide the underground services;
2. The city reserves the right to approve location of all surface mounted facilities;
3. All underground utilities, including sanitary sewers and storm drains installed in streets by the developer, shall be constructed prior to the surfacing of the streets; and
4. Stubs for service connections shall be long enough to avoid disturbing the street improvements when service connections are made.

B. Information on development plans. The applicant for a development shall show on the development plan or in the explanatory information, easements for all underground utility facilities, and

1. Plans showing the location of all underground facilities as described herein shall be submitted to the City Engineer for review and approval; and

2. Care shall be taken in all cases to ensure that above ground equipment does not obstruct vision clearance areas for vehicular traffic.

C. Exception to undergrounding requirement.

1. The developer shall pay a fee in-lieu of undergrounding costs when the development is proposed to take place on a street where existing utilities which are not underground will serve the development and the approval authority determines that the cost and technical difficulty of under-grounding the utilities outweighs the benefit of undergrounding in conjunction with the development. The determination shall be on a case-by-case basis. The most common, but not the only, such situation is a short frontage development for which undergrounding would result in the placement of additional poles, rather than the removal of above-ground utilities facilities.
2. An applicant for a development which is served by utilities which are not underground and which are located across a public right-of-way from the applicant's property shall pay the fee in-lieu of undergrounding.
3. Properties within the MU-CBD zone shall be exempt from the requirements for undergrounding of utility lines and from the fee in-lieu of undergrounding.
4. The exceptions in Paragraphs 18.910.120.C.1 through 3 shall apply only to existing utility lines. All new utility lines shall be placed underground.

D. Fee in-lieu of undergrounding.

1. The City Engineer shall establish utility service areas in the city. All development which occurs within a utility service area shall pay a fee in-lieu of undergrounding for utilities if the development does not provide underground utilities, unless exempted by this chapter.
2. The City Engineer shall establish the fee by utility service area which shall be determined based upon the estimated cost to underground utilities within each service area. The total estimated cost for undergrounding in a service area shall be allocated on a front-foot basis to each party within the service area. The fee due from any developer shall be calculated based on a front-foot basis.
3. A developer shall receive a credit against the fee for costs incurred in the undergrounding of existing overhead utilities. The City Engineer shall determine the amount of the credit, after review of cost information submitted by the applicant with the request for credit.
4. The funds collected in each service area shall be used for undergrounding utilities within the city at large. The City Engineer shall prepare and maintain a list of proposed undergrounding projects which may be funded with the fees collected by the city. The list shall indicate the estimated timing and cost of each project. The list shall be submitted to the city council for their review and approval annually.

Prior to final building inspection, all existing and proposed utilities must be placed underground. A fee-in-lieu of undergrounding is not proposed or required.

18.910.130 Cash or Bond Required

- A. **Guarantee.** All improvements installed by the developer shall be guaranteed as to workmanship and material for a period of 1 year following acceptance by the city council.
- B. **Cash deposit or bond.** Such guarantee shall be secured by cash deposit or bond in the amount of the value of the improvements as set by the City Engineer.
- C. **Compliance requirements.** The cash or bond shall comply with the terms and conditions of Section 18.830.070.

Prior to commencing any site work, the applicant must provide a performance bond for all public improvements and private stormwater treatment facilities associated with the development.

Prior to building inspection, all improvements associated with public infrastructure including but not limited to street improvement under the City of Tigard jurisdiction must be constructed, completed and/or satisfied. The applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.

Prior to final building inspection, all public utility facilities including but not limited to storm drainage, water quality and quantity, sanitary sewer, water, gas, electrical, communication, and wireless must be completed. Private storm water quality and quantity facilities must be provided with two years of maintenance and entered into a stormwater maintenance agreement with the City.

18.910.140 Monuments—Replacement Required

Any monuments that are disturbed before all improvements are completed by the subdivider shall be replaced prior to final acceptance of the improvements.

This standard is met through the PFI permitting process.

18.910.150 Installation Prerequisite

- A. Approval required. No public improvements, including sanitary sewers, storm sewers, streets, sidewalks, curbs, lighting or other requirements shall be undertaken except after the plans have been approved by the city, permit fee paid, and permit issued.**
- B. Permit fee. The permit fee is required to defray the cost and expenses incurred by the city for construction and other services in connection with the improvement. The permit fee shall be set by council resolution.**

This standard is met through the PFI permitting process.

18.910.170 Plan Check

- A. Submittal requirements. Work shall not begin until construction plans and construction estimates have been submitted and checked for adequacy and approved by the City Engineer in writing. The developer can obtain detailed information about submittal requirements from the City Engineer.**
- B. Compliance. All such plans shall be prepared in compliance with requirements of the city.**

This standard is met through the PFI permitting process.

18.910.180 Notice to City

- A. Commencement. Work shall not begin until the city has been notified in advance.**
- B. Resumption. If work is discontinued for any reason, it shall not be resumed until the city is notified.**

This standard is met through the PFI permitting process.

18.910.190 City Inspection of Improvements

Improvements shall be constructed under the inspection and to the satisfaction of the city. The city may require changes in typical sections and details if unusual conditions arising during construction warrant such changes in the public interest.

This standard is met through the PFI permitting process.

18.910.200 Engineer's Written Certification Required

The developer's engineer shall provide written certification of a form provided by the city that all improvements, workmanship, and materials are in accord with current and standard engineering and construction practices, and are of high grade, prior to city acceptance of the subdivision's improvements or any portion thereof for operation and maintenance.

This standard is met through the PFI permitting process.

18.920 Access, Egress, and Circulation

18.920.030 General Provisions

I. Access management.

1. An access report must be submitted with all new development that verifies design of driveways and streets are safe by meeting adequate stacking needs, sight distance, and deceleration standards as set by ODOT, Washington County, the city, and AASHTO (depending on jurisdiction of facility).
2. Driveways must not be placed in the influence area of collector or arterial street intersections. Influence area of intersections is that area where queues of traffic commonly form on approach to an intersection. The minimum driveway setback from a collector or arterial street intersection is 150 feet, measured from the right-of-way line of the intersecting street to the throat of the proposed driveway. The setback may be greater depending upon the influence area, as determined from City Engineer review of a traffic impact report submitted by the applicant's traffic engineer. In a case where a development has less than 150 feet of street frontage, the applicant must explore any option for shared access with the adjacent lot. If shared access is not possible or practicable, the driveway must be placed as far from the intersection as possible.
3. The minimum spacing of driveways and streets along a collector is 200 feet. The minimum spacing of driveways and streets along an arterial is 600 feet.
4. The minimum spacing of local streets along a local street is 125 feet.

Preliminary civil plans have been submitted by the applicant to demonstrate preliminary compliance with the access, egress and circulation requirements of this chapter.

Prior to commencing any site work, the applicant must submit a Preliminary Sight Distance Certification for review and approval.

Prior to final building inspection, the applicant must submit a Final Sight Distance Certification for review and approval. With a condition of approval, this standard is met.

SECTION VII. OTHER STAFF COMMENTS

The City of Tigard Engineering Department comments and conditions are incorporated into this decision and included as Attachment 3.

SECTION VIII. AGENCY COMMENTS

Easements:

Prior to final building inspection, the applicant must record all public access and utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

Fire and Life Safety:

Prior to commencing any site work, the applicant must provide written approval from TVF&R for fire flow, hydrant placement, and emergency vehicular access and turn around.

Public Water System:

The existing public water mains are under the City of Tigard jurisdiction. The site plans indicate that services will be provided to serve the proposed development via the existing public water main located on SW Bull Mountain Road.

Prior to commencing site improvements, the applicant must submit site plans as part of the PFI Permit showing all proposed and/or extensions of public water lines, hydrants and water services to be designed in accordance with the City of Tigard Standards to Engineering for review and approval.

Storm Water Quality:

The City has agreed to enforce Surface Water Management regulations established by CWS Design and Construction which require the construction of on-site water quality facilities. In addition, a maintenance plan must be submitted indicating the frequency and method to be used in keeping the facility maintained through the year.

Prior to commencing site improvements, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI permit. Plans must be submitted to the city for review. The city will forward plans to CWS after preliminary review.

Grading and Erosion Control:

Clean Water Services Design and Construction Standards also regulate erosion control to reduce the amount of sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity which accelerates erosion. Prior to commencing any site work, the applicant must submit an erosion control plan for review and approval. The plan must comply to the "CWS Erosion Prevention and Sediment Control Design and Planning Manual" (current edition).

The Federal Clean Water Act requires that a National Pollutant Discharge Elimination System (NPDES) erosion control permit be issued for any development that will disturb one or more acre of land. The site is greater than one acre.

Prior to commencing any site improvements, the applicant must submit a final grading plan the existing and proposed contours. The plan must detail the provisions for surface drainage of the site and show that it will be graded to ensure that surface drainage is directed to the street or a public storm drainage system approved by the Engineering Department.

The design engineer must also indicate, on the grading plan, areas that will have natural slopes between 10 percent and 20 percent, as well as areas that will have natural slopes in excess of 20 percent. This information will be necessary in determining if special grading inspections and permits will be necessary upon development.

Address Assignments:

The City of Tigard is responsible for the approval of new street names and assigning addresses for parcels within the City of Tigard. Contact Oscar Contreras with Engineering Division at 503-718-2678 to ensure new addresses are assigned. Prior to permit submittal, the applicant must pay the addressing fee. The address fee will be assessed in accordance with the current Master Fee Schedule.

Clean Water Services issued a Service Provider Letter (CWS file 20-002535) stating that project will not significantly impact the existing or potential sensitive lands found near the site. The agency also submitted written comments, dated June 17, 2021, requesting a condition of approval that requires the applicant to obtain Storm Water Connection Permit Authorization. This request has been incorporated into the Conditions of Approval. The City of Tigard and CWS have an intergovernmental agreement stating that the city will ensure implementation of CWS Design and Construction Standards; therefore, this subdivision approval is conditioned to satisfy CWS requirements.

Tualatin Valley Fire and Rescue was sent a copy of the applicant's proposal and response letter dated June 17, 2021 is attached.

Attachments:

Attachment 1: Approved Site Set

Attachment 2: Zoning Map

Attachment 3: Engineering Comments and Conditions Dated June 16, 2021

Attachment 4: Agency Comments

SECTION IX. PROCEDURE AND APPEAL INFORMATION

Notice:

Notice was mailed to:

The applicant and owners

Owners of record within the required distance

Affected government agencies

Final Decision:

**THIS DECISION IS FINAL ON JULY 15, 2021 AND
EFFECTIVE ON JULY 30, 2021 UNLESS AN APPEAL IS FILED.**

Appeal:

The Director's Decision is final on the date that it is mailed. All persons entitled to notice or who are otherwise adversely affected or aggrieved by the decision as provided in Section 18.710.090.A.1 may appeal this decision in accordance with Section 18.710.090.A.2 and .3 of the Tigard Development Code. A written appeal together with the required fee must be filed with the Director within fifteen (15) days of the date the Notice of Decision was mailed. The appeal fee schedule and forms are available from the City of Tigard Planning Division, 13125 SW Hall Boulevard, Tigard, OR 97223.

Appeal hearings are de novo. A de novo hearing allows for the presentation of new evidence, testimony and argument by any party. The appeal authority must consider all relevant evidence, testimony and argument that are provided at the hearing by the appellant or any party. The decision of the appeal authority is the final local decision.

THE DEADLINE FOR FILING AN APPEAL IS 5:00 P.M. ON JULY 29, 2021.

Questions:

If you have any questions, please contact Monica Bilodeau, Associate Planner at (503)718-2427 or MonicaB@tigard-or.gov. You may also mail inquiries to City of Tigard Planning Division, 13125 SW Hall Boulevard, Tigard, OR 97223.



July 15, 2021

PREPARED BY: Monica Bilodeau
Associate Planner



July 15, 2021

APPROVED BY: Tom McGuire
Assistant Community Development Director

CONDITIONS OF APPROVAL

THE FOLLOWING CONDITIONS MUST BE SATISFIED PRIOR TO PERMIT SUBMITTAL:

1. Prior to permit submittal, the applicant must submit an Autocad file of proposed street names and assignment of addresses and pay the address fee. Contact Oscar Contreras at 503-718-2678 for the submission of the Autocad file. The address fee will be assessed in accordance with the current Master Fee Schedule.

THE FOLLOWING CONDITIONS MUST BE SATISFIED PRIOR TO COMMENCING ANY SITE WORK:

The applicant must prepare a cover letter and submit it, along with any supporting documents or plans that address the following requirements to the ENGINEERING DIVISION, ATTN: Jeremy Tamargo, Principal Engineer at (971) 713-0281 or JeremyT@tigard-or.gov. The cover letter must clearly identify where in the submittal the required information is found:

2. Improvements associated with public infrastructure including street and right-of-way dedication, utilities, grading, water quality and quantity facilities, streetlights, easements, easement locations, and utility connections must be designed in accordance with the following codes and standards:
 - City of Tigard Public Improvement Design Standards
 - Clean Water Services (CWS) Design and Construction Standards
 - Tigard Community Development Codes, Municipal Codes
 - Tualatin Valley Fire and Rescue (TVF&R) Fire Codes
 - Other applicable County, State, and Federal Codes and Standard Guidelines
3. Improvements associated with public infrastructure including street and right-of-way dedication, utilities, grading, water quality and quantity facilities, streetlights, easements, easement locations, and utility connections for future utility extensions are subject to the City Engineer's review, modification, and approval.
4. Prior to commencing any site work, the applicant must submit a Public Facility Improvement (PFI) Permit to cover all infrastructure work including stormwater Water Quality and Quantity Facilities and any other work in the public right-of-way. Four (4) sets of detailed public improvement plans must be submitted for review to the Engineering Department. An Engineering cost estimate of improvements associated with public infrastructures including but not limited to street, street grading, utilities, stormwater quality and water quantity facilities, sanitary sewer, streetlights, and franchise utilities are required at the time of PFI Permit submittal. When the water system is under the City of Tigard jurisdiction, an Engineering cost estimate of water improvement must be listed as a separate line item from the total cost estimate. NOTE: these plans are in addition to any drawings required by the Building Division and should only include sheets relevant to public improvements. Public Facility Improvement Permit plans must conform to City of Tigard Public Improvement Design Standards, which are available at City Hall and the City's web page (www.tigard-or.gov).
5. Prior to commencing any site work, the applicant must submit plans showing the following required street improvements to engineering for review and approval:

SW Bull Mountain Road:

- 8' public utility easement
 - Street lighting
6. Prior to commencing any site work, the applicant must submit the exact legal name, address and telephone number of the individual or corporate entity who will be designated as the "Permittee", and who will provide the financial assurance for the public improvements. Specify if the entity is a corporation, limited partnership, LLC, etc. and the state within which the entity is incorporated and provide the name of the corporate contact person. Failure to provide accurate information will delay processing of project documents.
 7. Prior to commencing any site work, the applicant must provide a construction vehicle access and parking plan for approval by the City Engineer. The purpose of this plan is for parking and traffic control during the public improvement construction phase. All construction vehicle parking must be provided onsite. No construction vehicles or equipment will be permitted to park on the adjoining residential public streets. Construction vehicles include the vehicles of any contractor or subcontractor involved in the construction of site improvements or buildings proposed by this application and must include the vehicles of all suppliers and employees associated with the project.
 8. Prior to commencing site improvements, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B.
 9. Prior to commencing any site work, the applicant must submit site plans and a final storm drainage report as part of the PFI Permit indicating how run-off generated by the development will be collected, conveyed, treated and detained for review and approval. The storm drainage report must be prepared and include a maintenance plan in accordance with CWS Design and Construction Standards and the City of Tigard Standards.
 10. Prior to commencing any site work, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI Permit. Plans must be submitted to the City of Tigard for review. The City will forward plans to CWS after preliminary review.
 11. Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing the proposed sanitary sewer system and associated facilities to be designed and constructed in accordance with the City of Tigard and CWS Design and Construction Standards.
 12. Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing all proposed and/or extensions of public water lines, hydrants and water services to be designed in accordance with the City of Tigard Standards for review and approval.
 13. Prior to commencing any site work, the applicant must provide written approval from TVF&R for fire flow, hydrant placement, and emergency vehicular access and turn around.

14. Prior to commencing any site work, the applicant must submit an erosion control plan as part of the PFI Permit. The plan must conform to the "CWS Erosion Prevention and Sediment Control Design and Planning Manual" (current edition).
15. Prior to commencing any site work, the applicant must submit a final grading plan showing the existing and proposed contours. The plan must detail the provisions for surface drainage of the site and show that it will be graded to ensure that surface drainage is directed to the street or a public storm drainage system approved by the Engineering Division. The design engineer must indicate, on the grading plan, which areas will have natural slopes between 10 percent and 20 percent, as well as area that will have natural slopes in excess of 20 percent. This information will be necessary in determining if special grading inspections or permits will be necessary.
16. Prior to commencing any site work, the applicant must submit a Preliminary Sight Distance Certification for review and approval.
17. Prior to commencing any site work, the applicant must provide a performance bond for all public improvements and private stormwater treatment facilities associated with the development.

**THE FOLLOWING CONDITIONS MUST BE SATISFIED
PRIOR TO FINAL BUILDING INSPECTION:**

The applicant must prepare a cover letter and submit it, along with any supporting documents or plans that address the following requirements to the ENGINEERING DIVISION, ATTN: Jeremy Tamargo, Principal Engineer at (971) 713-0281 or JeremyT@tigard-or.gov. The cover letter must clearly identify where in the submittal the required information is found:

18. Prior to final building inspection schedule a final Planning inspection.
19. Prior to final building inspection, all improvements associated with public infrastructure including but not limited to street improvements under the City of Tigard jurisdiction must be constructed, completed and/or satisfied. The Applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.
20. Prior to final building inspection all public utility facilities including but not limited to storm drainage, water quality and quantity, sanitary sewer, water, gas, electrical, communication, and wireless must be completed.
21. Prior to final building inspection, the applicant must submit the Final Sight Distance Certification for review and approval.
22. Prior to final building inspection, the applicant must place all existing and proposed utilities underground.
23. Prior to final building inspection, the applicant must record all utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

SECTION III. BACKGROUND INFORMATION

The City of Tigard (Owner and Applicant) is submitting this application for a major modification to Conditional Use Permit CUP2007-00001 for planned improvements to the existing Tigard Aquifer Storage and Recovery (ASR) No. 3 Facility that was constructed in 2007. The modifications included in this application will allow previously improved aquifer storage facility to be enhanced to meet City water supply needs.

Proposal:

The Applicant is requesting to permit a new small mechanical building, generator, asphalt pad, and relocation of an existing gate at the site's service/maintenance access on SW Bull Mountain Road. These planned modifications will improve the site into a fully operational ASR facility.

Vicinity Information:

The City of Tigard's ASR No. 3 Facilities are located within the existing Elizabeth Price Park, a ±2.5-acre property located at the intersection of SW Bull Mountain Road and SW 132nd Avenue at 13001 SW Bull Mountain Road. The property generally slopes southeast and has access to SW Bull Mountain Road for service/maintenance purposes and SW 132nd Avenue.

The site is zoned PR and surrounded by single-family residences zoned R-7 to the north, east, and west, and the Alberta Rider Elementary School to the west across Bull Mountain Road.

SECTION IV. PUBLIC COMMENTS

The Tigard Community Development Code requires that property owners within 500 feet of the subject site be notified of the proposal and be given an opportunity for written comments and/or oral testimony prior to a decision being made. Staff mailed a Type II Notice of Application regarding this modification to affected parties on May 26, 2021. The City received no comments.

SECTION V. SUMMARY OF APPLICABLE REVIEW CRITERIA

The following summarizes the review criteria applicable to this decision, in the order in which they are addressed:

Applicable Review Criteria

18.765 Modifications

18.140 Parks and Recreation Zone

18.910 Improvement Standards

18.920 Access, Egress and Circulation

SECTION VI. APPLICABLE REVIEW CRITERIA AND FINDINGS

Findings for only the applicable code sections are found below:

18.765 Modifications

18.765.020 Applicability

B. This chapter applies to all proposals to modify an existing or proposed use, structure, site improvement, or condition of approval – for existing developments or land use approvals – when initially approved through one of the land use applications listed below:

1. Conditional uses,

The Tigard ASR improvements were initially approved through a Conditional Use Permit. This application aims to modify the previously approved Conditional Use Permit (CUP2007-00001). This chapter applies.

18.765.070 Major Modifications

A. Definition. A major modification has the following characteristics:

- 1. It has more than minimal impacts on surrounding properties, sensitive lands, or public facilities but does not qualify as substantial redevelopment as defined in Subsection 18.765.040.C; and**
- 2. It does not cause the development to go out of conformance with any applicable standard or further out of conformance if already nonconforming, except where an adjustment has been approved.**

The proposal includes a mechanical building approximately 1,120 square feet, generator, asphalt pad, and relocation of an existing gate at the site's access on SW Bull Mountain Road. As proposed, the modification does not cause the development to go further out of conformance with any applicable standard. The modification meets the characteristics of a major modification.

D. Approval criteria. The approval authority will approve or approve with conditions a major modification application when all of the following are met:

- 1. The proposed modification qualifies as a major modification as defined in Subsection 18.765.070.A;**

Based on the finding above, the proposal meets the definition of a major modification. This criterion is met.

- 2. The operating and physical characteristics of the modified development are reasonably compatible with surrounding properties, sensitive lands, or public facilities;**

The planned modifications include a new small mechanical building, generator, asphalt pad, and relocation of an existing gate at the site's access on SW Bull Mountain Road. The site does not have sensitive lands, and the planned modifications are not anticipated to generate glare, odor, dust, or affect air quality. The mechanical building and generator are planned to be located over 100 feet from the closest house east of the site. As discussed in the Noise Study (Exhibit J), the new well house is planned to be built with CMU walls with exterior insulation to minimize noise impact. As further discussed in the Noise Study, the sound from the well house and generator are anticipated to be at a sound level that is less than an air conditioner or vacuum cleaner and meet the requirements for noise limits pursuant to Section 6.02 of the Tigard Municipal Code. Additionally, there are existing mature trees along the property line between the planned building and the existing residential homes to the east which will provide both a visual screen and help buffer potential noise. Therefore, the planned modifications are reasonably compatible with surrounding properties. This criterion is met.

- 3. Any impacts from the proposed modification are mitigated to the extent practicable;**

The planned improvements will be mitigated to the extent practicable. The improvements will be adequately screened from both SW Bull Mountain Road and neighboring properties to the east with new landscaping and existing mature landscaping. Additionally, as discussed in the Noise Study (Exhibit J) the mechanical building is planned to include building materials (CMU walls with exterior insulation) that will diminish potential noise impacts. The impacts of these modifications are minimal and mitigated to the extent practicable. There is existing mature landscaping around the site's boundary, providing visual

screening from existing and new improvements. The minimum setback standard for the new mechanical building from the adjacent residential properties to the east is 15 feet (based on the height of the new mechanical building), and as shown on the Preliminary Plans (Exhibit A), the planned setback exceeds this minimum. The mechanical building and generator are planned to be over 100 feet from to the closest house east of the site, and the color palette chosen for the new mechanical building include neutral colors that are intended to blend in with existing landscaping. Additionally, as shown on the Preliminary Plans, the new mechanical building has a variety of materials and has a residential appearance to be compatible with neighboring residential properties and is planned to be constructed with concrete masonry unit (CMU) blocks and will be clad with siding that will help minimize sound.

As shown on the Landscaping Plan included in Exhibit A, this project also includes new landscaping to complement the existing mature landscaping between the new mechanical building and generator and SW Bull Mountain Road and provides screening of the planned improvements.

The new generator is intended for emergency use and will operate during emergencies and for occasional maintenance. A noise study was prepared by Michael Minor & Associates of the well house and generator and is included in this application (Exhibit J). It should be noted, that pursuant to City of Tigard Municipal Code Section 6.02.450, emergency equipment, like the emergency generator included in this application, is exempt from the noise limit provisions.

As detailed in the noise report, during emergency use the generator is anticipated to be less than 55 to 58 dBA at the property line of the closest residences to the east. The study also indicates that the noise level of the well house was calculated at 37 dBA, which is below the thresholds found in Section 6.02.430 of the City of Tigard Municipal Code. As shown in Table 1 of the noise study, a dBA of 55 to 58 has a lower sound level than a large air-conditioning unit or vacuum cleaner and a dBA of 37 has a lower sound level than a bedroom or quiet living room. Therefore, this criterion is met.

- 4. If the proposed modification involves development that has nonconforming structures or site improvements and exceeds the project valuation threshold listed in the city's Master Fees and Charges Schedule, the development will be improved as required by Subsection 18.765.070.E; and**

The modification does not involve development that has nonconforming site improvements and exceeds the project valuation threshold. This criterion is not applicable.

- 5. If the proposal involves the modification of a condition of approval, at least one of the following criteria is met:**
 - a. The condition cannot be implemented for reasons outside the control of the applicant or property owner;**
 - b. The condition is no longer needed or warranted because circumstances have changed; or**
 - c. A new or modified condition better accomplishes the purpose of the original condition.**

The proposal does not involve modifying a condition of approval. This criterion does not apply.

18.140 Parks and Recreation Zone

18.140.040 Land Use Standards

- A. General provisions. A list of allowed, restricted, conditional, and prohibited uses in the PR zone is provided in Table 18.140.1. If a use category is not listed, see Section 18.60.030.**

This application involves modifications to existing water infrastructure improvements to the City of Tigard's ASR No. 3 Facility. Basic utilities are allowed conditionally. These planned modifications are to a facility that was previously approved through a conditional use permit (CUP 2007-00001).

18.420.040 Landscaping Standards

- A. Landscaping standards are provided in Table 18.420.1.**
- B. Landscaping or other areas used to meet the minimum landscape area standard must be provided on the development site and may be met by any combination of the following:**
 - 1. Landscaping, including parking lot landscaping, that meets the L-1 or L-2 landscaping standard;**
 - 2. Landscaping that meets the S-2, S-3, or S-4 screening standard as provided in Table 18.420.2 where required by the applicable development standards chapter;**
 - 3. Any required above-ground vegetated stormwater facility; or**
 - 4. Other areas as specified by the applicable development standards chapter.**
- C. Landscaping in excess of the minimum landscape area standard does not have to meet the L-1 or L-2 landscaping standard.**

The subject site has a Parks and Recreation (PR) zoning designation. Pursuant to Chapter 18.300 of the Tigard Development Code, landscaping and screening standards are not required for properties with this zoning designation. Therefore, these standards are not applicable.

18.910.030 Streets

- A. Improvements.**
 - 1. No development shall occur unless the development has frontage or approved access to a public street.**
 - 2. No development shall occur unless streets within the development meet the standards of this chapter.**
 - 3. No development shall occur unless the streets adjacent to the development meet the standards of this chapter, provided, however, that a development may be approved if the adjacent street does not meet the standards but half-street improvements meeting the standards of this chapter are constructed adjacent to the development.**
 - 4. Any new street or additional street width planned as a portion of an existing street shall meet the standards of this chapter.**
 - 5. If the city could and would otherwise require the applicant to provide street improvements, the City Engineer may accept a future improvements guarantee in lieu of street improvements if one or more of the following conditions exist**
 - a. A partial improvement is not feasible due to the inability to achieve proper design standards;**
 - b. A partial improvement may create a potential safety hazard to motorists or pedestrians;**
 - c. Due to the nature of existing development on adjacent properties it is unlikely that street improvements would be extended in the foreseeable future and the improvement associated with the project under review does not, by itself, provide a significant improvement to street safety or capacity;**
 - d. The improvement would be in conflict with an adopted capital improvement plan;**
 - e. The improvement is associated with an approved land partition on property zoned residential and the proposed land partition does not create any new streets; or**

- f. **Additional planning work is required to define the appropriate design standards for the street and the application is for a project which would contribute only a minor portion of the anticipated future traffic on the street.**
6. **The standards of this chapter include the standard specifications adopted by the City Engineer in compliance with Subsection 18.910.020.B.**
7. **The approval authority may approve adjustments to the standards of this chapter if compliance with the standards would result in an adverse impact on natural features such as wetlands, bodies of water, significant habitat areas, steep slopes, or existing mature trees. The approval authority may also approve adjustments to the standards of this chapter if compliance with the standards would have a substantial adverse impact on existing development or would preclude development on the property where the development is proposed. In approving an adjustment to the standards, the approval authority shall balance the benefit of the adjustment with the impact on the public interest represented by the standards. In evaluating the impact on the public interest, the approval authority shall consider the criteria listed in Subsection 18.910.030.E. An adjustment to the standards may not be granted if the adjustment would risk public safety.**

As shown in the preliminary site plan, the proposed development has frontage on and has approved access to SW Bull Mountain Road, classified as a collector.

As shown in the preliminary civil plans, the existing street section along SW Bull Mountain Road meets the standards of this section. Half street improvements were previously completed with the Price Park Reservoir project in 2007 (City As-built #1131). Previous improvements in 2007 did not include dedication of the required 8' public utility easement along SW Bull Mountain Road.

Prior to commencing site improvements, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B

Prior to commencing any site work, the applicant must submit plans showing the following required street improvements to engineering for review and approval:

- SW Bull Mountain Road:
- 8' public utility easement
 - Street lighting

Through the Conditions of Approval, this standard is met.

B. Creation of rights-of-way for streets and related purposes. Rights-of-way shall be created through the approval of a final plat; however, the council may approve the creation of a street by acceptance of a deed, provided that such street is deemed essential by the council for the purpose of general traffic circulation.

1. **The council may approve the creation of a street by deed of dedication without full compliance with the regulations applicable to subdivisions or partitions if any one or more of the following conditions are found by the council to be present:**

- a. Establishment of a street is initiated by the council and is found to be essential for the purpose of general traffic circulation, and partitioning or subdivision of land has an incidental effect rather than being the primary objective in establishing the road or street for public use; or
 - b. The tract in which the road or street is to be dedicated is an isolated ownership of 1 acre or less and such dedication is recommended by the commission to the council based on a finding that the proposal is not an attempt to evade the provisions of this title governing the control of subdivisions or partitions
 - c. The street is located within the mixed use central business district (MU-CBD) zone and has been identified on Figures 5-14A through 5-14I of the City of Tigard 2035 Transportation System Plan as a required connectivity improvement.
2. With each application for approval of a road or street right-of-way not in full compliance with the regulations applicable to the standards, the proposed dedication shall be made a condition of subdivision and partition approval.
 - a. The applicant shall submit such additional information and justification as may be necessary to enable the commission in its review to determine whether or not a recommendation for approval by the council shall be made.
 - b. The recommendation, if any, shall be based upon a finding that the proposal is not in conflict with the purpose of this title.
 - c. The commission in submitting the proposal with a recommendation to the council may attach conditions which are necessary to preserve the standards of this title.
 3. All deeds of dedication shall be in a form prescribed by the city and shall name “the public” as grantee.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A. The standard is met.

- C. Creation of access easements.** The approval authority may approve an access easement established by deed without full compliance with this chapter provided such an easement is the only reasonable method by which a lot large enough to develop can be created.
1. Access easements shall be provided and maintained in compliance with the Oregon Fire Code, Section 503.
 2. Access shall be in compliance with Subsections 18.920.030.H, I, and J.

The proposed development has direct access to SW Bull Mountain Road. Access easements are not proposed or deemed necessary.

- D. Street location, width and grade.** Except as noted below, the location, width and grade of all streets shall conform to an approved street plan and shall be considered in their relation to existing and planned streets, to topographic conditions, to public convenience and safety, and in their appropriate relation to the proposed use of the land to be served by such streets:
1. Street grades shall be approved by the City Engineer in compliance with Subsection 18.910.030.N; and
 2. Where the location of a street is not shown in an approved street plan, the arrangement of streets in a development shall either:
 - a. Provide for the continuation or appropriate projection of existing streets in the surrounding areas, or
 - b. Conform to a plan adopted by the commission, if it is impractical to conform to existing street patterns because of particular topographical or other existing conditions of the land. Such a plan shall be based on the type of land use to be served,

the volume of traffic, the capacity of adjoining streets and the need for public convenience and safety.

The proposed development is adjacent to SW Bull Mountain Road, an existing street. The street grade will remain unchanged.

E. Minimum rights-of-way and street widths. Unless otherwise indicated on an approved street plan, or as needed to continue an existing improved street or within the Tigard Downtown Plan District, street right-of-way and roadway widths shall not be less than the minimum width described below. Where a range is indicated, the width shall be determined by the decision-making authority based upon anticipated average daily traffic (ADT) on the new street segment. (The city council may adopt by resolution, design standards for street construction and other public improvements. The design standards will provide guidance for determining improvement requirements within the specified ranges.) These are provided in Table 18.910.1.

The approval authority shall make its decision about desired right-of-way width and pavement width of the various street types within the subdivision or development after consideration of the following:

1. The type of road as provided in the comprehensive plan transportation chapter - functional street classification.
2. Anticipated traffic generation.
3. On-street parking needs.
4. Sidewalk and bikeway requirements.
5. Requirements for placement of utilities.
6. Street lighting.
7. Drainage and slope impacts.
8. Street tree location.
9. Planting and landscape areas.
10. Safety and comfort for motorists, bicyclists, and pedestrians.
11. Access needs for emergency vehicles.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A.

F. Future street plan and extension of streets.

1. A future street plan shall:
 - a. Be filed by the applicant in conjunction with an application for a subdivision or partition. The plan shall show the pattern of existing and proposed future streets from the boundaries of the proposed land division and shall include other lots within 530 feet surrounding and adjacent to the proposed land division. At the applicant's request, the city may prepare a future streets proposal. Costs of the city preparing a future streets proposal shall be reimbursed for the time involved. A street proposal may be modified when subsequent subdivision proposals are submitted.
 - b. Identify existing or proposed bus routes, pullouts or other transit facilities, bicycle routes and pedestrian facilities on or within 530 feet of the site.
2. Where necessary to give access or permit a satisfactory future division of adjoining land, streets shall be extended to the boundary lines of the tract to be developed, and

- a. These extended streets or street stubs to adjoining properties are not considered to be cul-de-sac since they are intended to continue as through streets at such time as the adjoining property is developed.
- b. A barricade shall be constructed at the end of the street by the property owners which shall not be removed until authorized by the City Engineer, the cost of which shall be included in the street construction cost.
- c. Temporary hammerhead turnouts or temporary cul-de-sac bulbs shall be constructed for stub street in excess of 150 feet in length.

A future street plan is not required, as a subdivision or partition is not proposed as part of the development. New streets are not proposed or deemed necessary as part of the proposed development.

G. Street spacing and access management. Refer to 18.920.030.H.

Street spacing and access management is discussed under Chapter 18.920, Access, Egress, and Circulation.

H. Street alignment and connections.

1. Full street connections with spacing of no more than 530 feet between connections is required except where prevented by barriers such as topography, railroads, freeways, pre-existing developments, lease provisions, easements, covenants or other restrictions existing prior to May 1, 1995 which preclude street connections. A full street connection may also be exempted due to a regulated water feature if regulations would not permit construction.
2. All local, neighborhood routes and collector streets which abut a development site shall be extended within the site to provide through circulation when not precluded by environmental or topographical constraints, existing development patterns or strict adherence to other standards in this code. A street connection or extension is considered precluded when it is not possible to redesign or reconfigure the street pattern to provide required extensions. Land is considered topographically constrained if the slope is greater than 15 percent for a distance of 250 feet or more. In the case of environmental or topographical constraints, the mere presence of a constraint is not sufficient to show that a street connection is not possible. The applicant must show why the constraint precludes some reasonable street connection.
3. Proposed street or street extensions shall be located to provide direct access to existing or planned transit stops, commercial services, and other neighborhood facilities, such as schools, shopping areas and parks.
4. All developments should provide an internal network of connecting streets that provide short, direct travel routes and minimize travel distances within the development.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A. No new streets are proposed or deemed necessary.

I. Intersection angles. Streets shall be laid out so as to intersect at an angle as near to a right angle as practicable, except where topography requires a lesser angle, but in no case shall the angle be less than 75° unless there is special intersection design, and:

1. Streets shall have at least 25 feet of tangent adjacent to the right-of-way intersection unless topography requires a lesser distance;
2. Intersections which are not at right angles shall have a minimum corner radius of 20 feet along the right-of-way lines of the acute angle; and
3. Right-of-way lines at intersection with arterial streets shall have a corner radius of not less than 20 feet.

There are no new proposed streets or street extensions for the proposed development. This standard does not apply.

- J. Existing rights-of-way. Whenever existing rights-of-way adjacent to or within a tract are of less than standard width, additional rights-of-way shall be provided at the time of subdivision or development.**

The existing right-of-way along SW Bull Mountain Road is in accordance with the minimum standards of this chapter. See findings in Section 18.910.030.A.

- K. Partial street improvements. Partial street improvements resulting in a pavement width of less than 20 feet, while generally not acceptable, may be approved where essential to reasonable development when in conformity with the other requirements of these regulations, and when it will be practical to require the improvement of the other half when the adjoining property developed.**

Partial street improvements are not proposed. As provided in the Preliminary Civil Plan, street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131).

- L. Cul-de-sacs. A cul-de-sac shall be no more than 200 feet long, shall not provide access to greater than 20 dwelling units, and shall only be used when environmental or topographical constraints, existing development pattern, or strict adherence to other standards in this code preclude street extension and through circulation:**
- 1. All cul-de-sac shall terminate with a turnaround. Use of turnaround configurations other than circular shall be approved by the City Engineer; and**
 - 2. The length of the cul-de-sac shall be measured from the centerline intersection point of the 2 streets to the radius point of the bulb.**
 - 3. If a cul-de-sac is more than 300 feet long, a lighted direct pathway to an adjacent street may be required to be provided and dedicated to the city.**

A cul-de-sac is not proposed or deemed necessary. This criterion does not apply.

- M. Street names. No street name shall be used which will duplicate or be confused with the names of existing streets in Washington County, except for extensions of existing streets. Street names and numbers shall conform to the established pattern in the surrounding area and as approved by the City Engineer.**

The proposed development does not propose new streets or street names. This criterion does not apply.

- N. Grades and curves.**

- 1. Grades shall not exceed 10 percent on arterials, 12 percent on collector streets, or 12 percent on any other street (except that local or residential access streets may have segments with grades up to 15 percent for distances of no greater than 250 feet); and**
- 2. Centerline radii of curves shall be as determined by the City Engineer.**

New streets are not proposed. The existing street grade will not be changed with development.

- O. Curbs, curb cuts, ramps, and driveway approaches.** Concrete curbs, curb cuts, wheelchair, bicycle ramps and driveway approaches shall be constructed in compliance with standards specified in this chapter and Chapter 15.04, Work in the Right-of-Way, and:
1. Concrete curbs and driveway approaches are required; except:
 2. Where no sidewalk is planned, an asphalt approach may be constructed with City Engineer approval; and
 3. Asphalt and concrete driveway approaches to the property line shall be built to city configuration standards.

The narrative and preliminary civil plan set show intent to comply with this requirement.

- P. Streets adjacent to railroad right-of-way.** Wherever the proposed development contains or is adjacent to a railroad right-of-way, provision shall be made for a street approximately parallel to and on each side of such right-of-way at a distance suitable for the appropriate use of the land. The distance shall be determined with due consideration at cross streets or the minimum distance required for approach grades and to provide sufficient depth to allow screen planting along the railroad right-of-way in nonindustrial areas.

The proposed development is not adjacent to an existing railroad right-of-way. This standard is not applicable.

- Q. Access to arterials and collectors.** Where a development abuts or is traversed by an existing or proposed arterial or collector street, the development design shall provide adequate protection for residential properties and shall separate residential access and through traffic, or if separation is not feasible, the design shall minimize the traffic conflicts. The design shall include any of the following:
1. A parallel access street along the arterial or collector;
 2. Lots of suitable depth abutting the arterial or collector to provide adequate buffering with frontage along another street;
 3. Screen planting at the rear or side property line to be contained in a nonaccess reservation along the arterial or collector; or
 4. Other treatment suitable to meet the objectives of this subsection;
 5. If a lot has access to 2 streets with different classifications, primary access should be from the lower classification street.

The proposed development is adjacent to SW Bull Mountain Road, which is functionally classified as a collector. The site has an existing access to SW Bull Mountain Road which is utilized only for service and maintenance purposes. No new access is proposed with this development. No residential access is proposed with this development. This standard is not applicable.

- R. Alleys, public or private.**
1. Alleys shall be no less than 20 feet in width. In commercial and industrial zones, alleys shall be provided unless other permanent provisions for access to off-street parking and loading facilities are made.
 2. While alley intersections and sharp changes in alignment shall be avoided, the corners of necessary alley intersections shall have a radius of not less than 12 feet.

New alleys are not proposed or deemed necessary. This standard is not applicable.

- S. Survey monuments.** Upon completion of a street improvement and prior to acceptance by the city, it shall be the responsibility of the developer's registered professional land surveyor

to provide certification to the city that all boundary and interior monuments shall be reestablished and protected.

The proposed development does not include any street improvements. This standard does not apply.

T. Private streets.

1. Design standards for private streets shall be established by the City Engineer; and
2. The city shall require legal assurances for the continued maintenance of private streets, such as a recorded maintenance agreement.
3. Private streets serving more than 6 dwelling units are permitted only within planned developments, mobile home parks, cottage cluster, courtyard units, and apartment developments.

The proposed development does not include any private streets. This standard does not apply.

U. Railroad crossings. Where an adjacent development results in a need to install or improve a railroad crossing, the cost for such improvements may be a condition of development approval, or another equitable means of cost distribution shall be determined by the public works director and approved by the commission.

The development is not adjacent to a railroad crossing. This standard is not applicable.

V. Street signs. The city shall install all street signs, relative to traffic control and street names, as specified by the City Engineer for any development. The cost of signs shall be the responsibility of the developer.

No new street signs are proposed or deemed necessary. This standard is not applicable.

W. Mailboxes. Joint mailbox facilities shall be provided in all residential developments, with each joint mailbox serving at least 2 dwelling units.

1. Joint mailbox structures shall be placed adjacent to roadway curbs;
2. Proposed locations of joint mailboxes shall be designated on the preliminary plat or development plan, and shall be approved by the City Engineer/U.S. Post Office prior to final plan approval; and
3. Plans for the joint mailbox structures to be used shall be submitted for approval by the City Engineer/U.S. Post Office prior to final approval.

No new mailboxes are proposed or deemed necessary. This standard is not applicable.

X. Traffic signals. The location of traffic signals shall be noted on approved street plans. Where a proposed street intersection will result in an immediate need for a traffic signal, a signal meeting approved specifications shall be installed. The cost shall be included as a condition of development.

New traffic signals are not proposed or deemed necessary.

Y. Street light standards. Street lights shall be installed in compliance with regulations adopted by the city's direction.

Prior to commencing any site work, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color

of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B. Through a condition of approval, this standard is met.

Z. Street name signs. Street name signs shall be installed at all street intersections. Stop signs and other signs may be required.

No new street signs are proposed or deemed necessary. This standard is not applicable.

AA. Street cross-sections. The final lift of asphalt concrete pavement shall be placed on all new constructed public roadways prior to final city acceptance of the roadway and within 1 year of the conditional acceptance of the roadway unless otherwise approved by the City Engineer. The final lift shall also be placed no later than when 90 percent of the structures in the new development are completed or 3 years from the commencement of initial construction of the development, whichever is less.

1. Sub-base and leveling course shall be of select crushed rock;
2. Surface material shall be of Class C or B asphaltic concrete;
3. The final lift shall be placed on all new construction roadways prior to city final acceptance of the roadway; however, not before 90 percent of the structures in the new development are completed unless 3 years have elapsed since initiation of construction in the development;
4. The final lift shall be Class C asphaltic concrete as defined by A.P.W.A. standard specifications; and
5. No lift shall be less than 1.5 inches in thickness.

The development will not require frontage improvements along SW Bull Mountain Road; therefore, this section is not applicable.

BB. Traffic calming. When, in the opinion of the City Engineer, the proposed development will create a negative traffic condition on existing neighborhood streets, such as excessive speeding, the developer may be required to provide traffic calming measures. These measures may be required within the development or offsite as deemed appropriate. As an alternative, the developer may be required to deposit funds with the city to help pay for traffic calming measures that become necessary once the development is occupied and the City Engineer determines that the additional traffic from the development has triggered the need for traffic calming measures. The City Engineer will determine the amount of funds required and will collect said funds from the developer prior to the issuance of a certificate of occupancy, or in the case of subdivision, prior to the approval of the final plat. The funds will be held by the city for a period of 5 years from the date of issuance of certificate of occupancy, or in the case of a subdivision, the date of final plat approval. Any funds not used by the city within the 5-year time period will be refunded to the developer.

Traffic calming is not proposed or deemed necessary for the proposed development.

CC. Traffic study.

1. A traffic study shall be required for all new or expanded uses or developments under any of the following circumstances:
 - a. When they generate a 10 percent or greater increase in existing traffic to high collision intersections identified by Washington County.
 - b. Trip generations from development onto the city street at the point of access and the existing ADT fall within the following ranges:

Existing ADT	ADT to be added by development
0—3,000 vpd	2,000 vpd
3,001—6,000 vpd	1,000 vpd
>6,000 vpd	500 vpd or more

- c. If any of the following issues become evident to the City Engineer:
 - i. High traffic volumes on the adjacent roadway that may affect movement into or out of the site.
 - ii. Lack of existing left-turn lanes onto the adjacent roadway at the proposed access drive.
 - iii. Inadequate horizontal or vertical sight distance at access points.
 - iv. The proximity of the proposed access to other existing drives or intersections is a potential hazard.
 - v. The proposal requires a conditional use permit or involves a drive-through operation.
 - vi. The proposed development may result in excessive traffic volumes on adjacent local streets.
2. In addition, a traffic study may be required for all new or expanded uses or developments under any of the following circumstances
 - a. When the site is within 500 feet of an ODOT facility; or
 - b. Trip generation from a development adds 300 or more vehicle trips per day to an ODOT facility; or
 - c. Trip generation from a development adds 50 or more peak hour trips to an ODOT facility.

Based on the estimated trip generation for the proposed development, a traffic study is not required for this proposed development. This standard has been met.

18.910.040 Blocks

- A. **Block design.** The length, width and shape of blocks shall be designed with due regard to providing adequate building sites for the use contemplated, consideration of needs for convenient access, circulation, control and safety of street traffic and recognition of limitations and opportunities of topography.
- B. **Sizes.**
 1. The perimeter of blocks formed by streets shall not exceed 2,000 feet measured along the centerline of the streets except:
 - a. Where street location is precluded by natural topography, wetlands, significant habitat areas or bodies of water, or pre-existing development; or
 - b. For blocks adjacent to arterial streets, limited access highways, collectors or railroads.
 - c. For nonresidential blocks in which internal public circulation provides equivalent access.
 2. Bicycle and pedestrian connections on public easements or rights-of-way shall be provided when full street connection is exempted by Paragraph 18.910.040.B.1. Spacing between connections shall be no more than 330 feet, except where precluded by environmental or topographical constraints, existing development patterns, or strict adherence to other standards in the code.

The development does not propose any new streets and does not warrant a block design or future street plan. Street or pedestrian connections are precluded by preexisting development located to the south, west and east of the proposed development.

18.910.050 Easements

- A. **Easements.** Easements for sewers, drainage, water mains, electric lines or other public utilities shall be either dedicated or provided for in the deed restrictions, and where a development is traversed by a watercourse or drainageway, there shall be provided a stormwater easement or drainage right-of-way conforming substantially with the lines of the watercourse.
- B. **Utility easements.** A property owner proposing a development shall make arrangements with the city, the applicable district, and each utility franchise for the provision and dedication of utility easements necessary to provide full services to the development. The city's standard width for public main line utility easements shall be 15 feet unless otherwise specified by the utility company, applicable district, or City Engineer.

The proposed development is not traversed by a watercourse or drainage way. The development will require an eight-foot public utility easement along the frontage. Prior to final building inspection, the applicant must record all utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

18.910.070 Sidewalks

- A. **Sidewalks.** All public and private streets adjacent to industrially zoned properties shall have sidewalks meeting city standards along at least one side of the street. All other public and private streets shall have sidewalks meeting city standards along both sides of the street. A development may be approved if an adjoining street has sidewalks on the side adjoining the development, even if no sidewalk exists on the other side of the street.

As shown in the preliminary civil plans, the existing street section along SW Bull Mountain Road meets the standards of this section. Half street improvements, including sidewalk, were previously completed with the Price Park Reservoir project in 2007 (City As-built #1131). This standard is met.

B. **Requirement of developers.**

1. As part of any development proposal or change in use resulting in an additional 1,000 vehicle trips or more per day, an applicant shall be required to identify direct, safe (1.25 x the straight line distance) pedestrian routes within 0.50 miles of their site to all transit facilities and neighborhood activity centers (schools, parks, libraries, etc.). In addition, the developer may be required to participate in the removal of any gaps in the pedestrian system off-site if justified by the development.
2. If there is an existing sidewalk on the same side of the street as the development within 300 feet of a development site in either direction, the sidewalk shall be extended from the site to meet the existing sidewalk, subject to rough proportionality (even if the sidewalk does not serve a neighborhood activity center).

The proposed development does not generate an additional 1,000 vehicle trips or more per day.

As shown in the preliminary civil plans, the applicant's existing sidewalk connects to the existing sidewalk located to the east along SW Bull Mountain Road. There is no existing sidewalk located to the west of the proposed development along SW Bull Mountain Road. This standard is met.

- C. **Planter strip requirements.** A planter strip separation of at least 5 feet between the curb and the sidewalk shall be required in the design of streets, except where the following conditions exist: there is inadequate right-of-way; the curbside sidewalks already exist on predominant portions of the street; it would conflict with the utilities; there are significant natural features

(large trees, water features, significant habitat areas, etc.) that would be destroyed if the sidewalk were located as required; or where there are existing structures in close proximity to the street (15 feet or less) or where the standards in Table 18.910.1 specify otherwise. Additional consideration for exempting the planter strip requirement may be given on a case-by-case basis if a property abuts more than one street frontage.

The preliminary site plan shows the existing planter strip along the proposed development's frontage meets City minimum requirements for SW Bull Mountain Road. This standard is met.

D. Maintenance. Maintenance of sidewalks, curbs, and planter strips is the continuing obligation of the adjacent property owner.

The property owner will take full responsibility for the maintenance of sidewalks, curbs, and planter strips.

E. Application for permit and inspection. Separate street opening permits are required for sidewalk segments that are not part of a current subdivision approval:

1. An occupancy permit shall not be issued for a development until the provisions of this section are satisfied.
2. The City Engineer may issue a permit and certificate allowing temporary noncompliance with the provisions of this section to the owner, builder or contractor when, in his or her opinion, the construction of the sidewalk is impractical for one or more of the following reasons:
 - a. Sidewalk grades have not and cannot be established for the property in question within a reasonable length of time;
 - b. Forthcoming installation of public utilities or street paving would be likely to cause severe damage to the new sidewalk;
 - c. Street right-of-way is insufficient to accommodate a sidewalk on 1 or both sides of the street; or
 - d. Topography or elevation of the sidewalk base area makes construction of a sidewalk impractical or economically infeasible
3. The City Engineer shall inspect the construction of sidewalks for compliance with the provision set forth in the standard specifications manual.

Prior to commencing any site work, the applicant must submit a Public Facility Improvement (PFI) Permit to cover all infrastructure work including stormwater Water Quality and Quantity Facilities and any other work in the public right-of-way. Four (4) sets of detailed public improvement plans must be submitted for review to the Engineering Department. An Engineering cost estimate of improvements associated with public infrastructures including but not limited to street, street grading, utilities, stormwater quality and water quantity facilities, sanitary sewer, streetlights, and franchise utilities are required at the time of PFI Permit submittal. When the water system is under the City of Tigard jurisdiction, an Engineering cost estimate of water improvement must be listed as a separate line item from the total cost estimate. NOTE: these plans are in addition to any drawings required by the Building Division and should only include sheets relevant to public improvements. Public Facility Improvement Permit plans must conform to City of Tigard Public Improvement Design Standards, which are available at City Hall and the City's web page (www.tigard-or.gov).

F. Council initiation of construction. In the event one or more of the following situations are found by the council to exist, the council may adopt a resolution to initiate construction of a sidewalk in accordance with city ordinances:

1. A safety hazard exists for children walking to or from school and sidewalks are necessary to eliminate the hazard;
2. A safety hazard exists for pedestrians walking to or from a public building, commercial area, place of assembly or other general pedestrian traffic, and sidewalks are necessary to eliminate the hazard;
3. Fifty percent or more of the area in a given block has been improved by the construction of dwellings, multiple dwellings, commercial buildings or public buildings or parks; and
4. A criterion which allowed noncompliance under this chapter no longer exists and a sidewalk could be constructed in compliance with city standards.

The above described situations have not been found by the council to exist. This standard does not apply.

18.910.080 Public Use Areas

A. Dedication requirements.

1. Where a proposed park, playground, or other public use shown in a development plan adopted by the city is located in whole or in part in a subdivision, the commission may require the dedication or reservation of such area within the subdivision, provided that the reservation or dedication is roughly proportional to the impact of the subdivision on the park system.
2. Where considered desirable by the commission in compliance with adopted comprehensive plan policies, and where a development plan of the city does not indicate proposed public use areas, the commission may require the dedication or reservation of areas within the subdivision or sites of a character, extent and location suitable for the development of parks or other public use, provided that the reservation or dedication is roughly proportional to the impact of the subdivision on the park system.

- B. Acquisition by public agency.** If the developer is required to reserve land area for a park, playground, or other public use, such land shall be acquired by the appropriate public agency within 18 months following plat approval, at a price agreed upon prior to approval of the plat, or such reservation shall be released to the subdivider.

Public use areas are not proposed or deemed necessary.

18.910.090 Sanitary Sewers

- A. Sewers required.** Sanitary sewers shall be installed to serve each new development and to connect developments to existing mains in compliance with Clean Water Services requirements and the-comprehensive plan.
- B. Sewer plan approval.** The City Engineer shall approve all sanitary sewer plans and proposed systems prior to issuance of development permits involving sewer service.
- C. Over-sizing.** Proposed sewer systems shall include consideration of additional development within the area as projected by the comprehensive plan.
- D. Permits denied.** Development permits may be restricted by the approval authority where a deficiency exists in the existing sewer system or portion thereof which cannot be rectified within the development and which if not rectified will result in a threat to public health or safety, surcharging of existing mains, or violations of state or federal standards pertaining to operation of the sewage treatment system.

The preliminary utility plan provided by the applicant shows connection to an existing eight-inch sanitary sewer main that traverses the northeast portion of the site.

Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing the proposed sanitary sewer system and associated facilities to be designed and constructed in accordance with the City of Tigard and CWS Design and Construction Standards.

Prior to final building inspection, the proposed sanitary sewer system and associated facilities must be constructed, completed, and/or satisfied. The applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.

No oversizing of sanitary sewer is proposed deemed necessary.

18.910.100 Storm Drainage

- A. General provisions. The Director and City Engineer shall issue a development permit only where adequate provisions for stormwater and floodwater runoff have been made, and:**
- 1. The storm water drainage system shall be separate and independent of any sanitary sewerage system;**
 - 2. Where possible, inlets shall be provided so surface water is not carried across any intersection or allowed to flood any street; and**
 - 3. Surface water drainage patterns shall be shown on every development proposal plan.**

The applicant submitted preliminary plans that comply with these general requirements.

- B. Easements. Where a development is traversed by a watercourse, drainageway, channel or stream, there shall be provided a stormwater easement or drainage right-of-way conforming substantially with the lines of such watercourse and such further width as will be adequate for conveyance and maintenance.**

The development is not traversed by a watercourse or drainageway. This standard is not applicable.

- C. Accommodation of upstream drainage. A culvert or other drainage facility shall be large enough to accommodate potential runoff from its entire upstream drainage area, whether inside or outside the development, and the City Engineer shall approve the necessary size of the facility, based on Clean Water Services requirements.**
- D. Effect on downstream drainage. Where it is anticipated by the City Engineer that the additional runoff resulting from the development will overload an existing drainage facility, the director and engineer shall withhold approval of the development until provisions have been made for improvement of the potential condition or until provisions have been made for storage of additional runoff caused by the development in compliance with Clean Water Services requirements.**

A preliminary storm drainage memorandum was submitted as part of the land use submittal. The applicant has proposed to meet CWS standards for water quality and water quantity through the payment of fee-in-lieu.

Prior to commencing any site work, the applicant must submit site plans and a final storm drainage report as part of the PFI Permit indicating how run-off generated by the development will be collected, conveyed, treated and detained for review and approval. The storm drainage report must be prepared and include a maintenance plan in accordance with CWS Design and Construction Standards and the City of Tigard Standards.

Prior to commencing any site work, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI Permit. Plans must be submitted to the City of Tigard for review. The City will forward plans to CWS after preliminary review.

18.910.110 Bikeways and Pedestrian Pathways

A. Bikeway extension.

1. As a standard, bike lanes shall be required along all arterial and collector routes and where identified on the city's adopted bicycle plan in the transportation system plan (TSP). Bike lane requirements along collectors within the downtown urban renewal district shall be determined by the City Engineer unless specified in Table 18.910.1.
2. Developments adjoining proposed bikeways identified on the city's adopted pedestrian/bikeway plan shall include provisions for the future extension of such bikeways through the dedication of easements or rights-of-way, provided such dedication is directly related to and roughly proportional to the impact of the development.
3. Any new street improvement project shall include bicycle lanes as required in this chapter and on the adopted bicycle plan.

B. Cost of construction. Development permits issued for planned developments, conditional use permits, subdivisions and other developments which will principally benefit from such bikeways shall be conditioned to include the cost or construction of bikeway improvements in an amount roughly proportional to the impact of the development.

C. Minimum width.

1. The minimum width for bikeways within the roadway is 5 feet per bicycle travel lane.
2. The minimum width for multi-use paths separated from the road and classified as regional or community trails in the Greenway Trail System Master Plan is 10 feet. The width may be reduced to 8 feet if there are environmental or other constraints.
3. The minimum width for off-street paths classified as neighborhood trails, according to the Greenway Trail System Master Plan, is 3 feet.
4. Design standards for bike and pedestrian-ways shall be determined by the City Engineer.

The City's TSP identifies bike lanes along SW Bull Mountain Road, consistent with the collector street section. The existing street section contains a bike lane. The standard is met.

18.910.120 Utilities

A. Underground utilities. All utility lines including, but not limited to those required for electric, communication, lighting and cable television services and related facilities shall be placed underground, except for surface mounted transformers, surface mounted connection boxes and meter cabinets which may be placed above ground, temporary utility service facilities during construction, high capacity electric lines operating at 50,000 volts or above, and:

1. The developer shall make all necessary arrangements with the serving utility to provide the underground services;
2. The city reserves the right to approve location of all surface mounted facilities;
3. All underground utilities, including sanitary sewers and storm drains installed in streets by the developer, shall be constructed prior to the surfacing of the streets; and
4. Stubs for service connections shall be long enough to avoid disturbing the street improvements when service connections are made.

B. Information on development plans. The applicant for a development shall show on the development plan or in the explanatory information, easements for all underground utility facilities, and

1. Plans showing the location of all underground facilities as described herein shall be submitted to the City Engineer for review and approval; and

2. Care shall be taken in all cases to ensure that above ground equipment does not obstruct vision clearance areas for vehicular traffic.

C. Exception to undergrounding requirement.

1. The developer shall pay a fee in-lieu of undergrounding costs when the development is proposed to take place on a street where existing utilities which are not underground will serve the development and the approval authority determines that the cost and technical difficulty of under-grounding the utilities outweighs the benefit of undergrounding in conjunction with the development. The determination shall be on a case-by-case basis. The most common, but not the only, such situation is a short frontage development for which undergrounding would result in the placement of additional poles, rather than the removal of above-ground utilities facilities.
2. An applicant for a development which is served by utilities which are not underground and which are located across a public right-of-way from the applicant's property shall pay the fee in-lieu of undergrounding.
3. Properties within the MU-CBD zone shall be exempt from the requirements for undergrounding of utility lines and from the fee in-lieu of undergrounding.
4. The exceptions in Paragraphs 18.910.120.C.1 through 3 shall apply only to existing utility lines. All new utility lines shall be placed underground.

D. Fee in-lieu of undergrounding.

1. The City Engineer shall establish utility service areas in the city. All development which occurs within a utility service area shall pay a fee in-lieu of undergrounding for utilities if the development does not provide underground utilities, unless exempted by this chapter.
2. The City Engineer shall establish the fee by utility service area which shall be determined based upon the estimated cost to underground utilities within each service area. The total estimated cost for undergrounding in a service area shall be allocated on a front-foot basis to each party within the service area. The fee due from any developer shall be calculated based on a front-foot basis.
3. A developer shall receive a credit against the fee for costs incurred in the undergrounding of existing overhead utilities. The City Engineer shall determine the amount of the credit, after review of cost information submitted by the applicant with the request for credit.
4. The funds collected in each service area shall be used for undergrounding utilities within the city at large. The City Engineer shall prepare and maintain a list of proposed undergrounding projects which may be funded with the fees collected by the city. The list shall indicate the estimated timing and cost of each project. The list shall be submitted to the city council for their review and approval annually.

Prior to final building inspection, all existing and proposed utilities must be placed underground. A fee-in-lieu of undergrounding is not proposed or required.

18.910.130 Cash or Bond Required

- A. Guarantee. All improvements installed by the developer shall be guaranteed as to workmanship and material for a period of 1 year following acceptance by the city council.
- B. Cash deposit or bond. Such guarantee shall be secured by cash deposit or bond in the amount of the value of the improvements as set by the City Engineer.
- C. Compliance requirements. The cash or bond shall comply with the terms and conditions of Section 18.830.070.

Prior to commencing any site work, the applicant must provide a performance bond for all public improvements and private stormwater treatment facilities associated with the development.

Prior to building inspection, all improvements associated with public infrastructure including but not limited to street improvement under the City of Tigard jurisdiction must be constructed, completed and/or satisfied. The applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.

Prior to final building inspection, all public utility facilities including but not limited to storm drainage, water quality and quantity, sanitary sewer, water, gas, electrical, communication, and wireless must be completed. Private storm water quality and quantity facilities must be provided with two years of maintenance and entered into a stormwater maintenance agreement with the City.

18.910.140 Monuments—Replacement Required

Any monuments that are disturbed before all improvements are completed by the subdivider shall be replaced prior to final acceptance of the improvements.

This standard is met through the PFI permitting process.

18.910.150 Installation Prerequisite

- A. Approval required. No public improvements, including sanitary sewers, storm sewers, streets, sidewalks, curbs, lighting or other requirements shall be undertaken except after the plans have been approved by the city, permit fee paid, and permit issued.**
- B. Permit fee. The permit fee is required to defray the cost and expenses incurred by the city for construction and other services in connection with the improvement. The permit fee shall be set by council resolution.**

This standard is met through the PFI permitting process.

18.910.170 Plan Check

- A. Submittal requirements. Work shall not begin until construction plans and construction estimates have been submitted and checked for adequacy and approved by the City Engineer in writing. The developer can obtain detailed information about submittal requirements from the City Engineer.**
- B. Compliance. All such plans shall be prepared in compliance with requirements of the city.**

This standard is met through the PFI permitting process.

18.910.180 Notice to City

- A. Commencement. Work shall not begin until the city has been notified in advance.**
- B. Resumption. If work is discontinued for any reason, it shall not be resumed until the city is notified.**

This standard is met through the PFI permitting process.

18.910.190 City Inspection of Improvements

Improvements shall be constructed under the inspection and to the satisfaction of the city. The city may require changes in typical sections and details if unusual conditions arising during construction warrant such changes in the public interest.

This standard is met through the PFI permitting process.

18.910.200 Engineer's Written Certification Required

The developer's engineer shall provide written certification of a form provided by the city that all improvements, workmanship, and materials are in accord with current and standard engineering and construction practices, and are of high grade, prior to city acceptance of the subdivision's improvements or any portion thereof for operation and maintenance.

This standard is met through the PFI permitting process.

18.920 Access, Egress, and Circulation

18.920.030 General Provisions

I. Access management.

1. An access report must be submitted with all new development that verifies design of driveways and streets are safe by meeting adequate stacking needs, sight distance, and deceleration standards as set by ODOT, Washington County, the city, and AASHTO (depending on jurisdiction of facility).
2. Driveways must not be placed in the influence area of collector or arterial street intersections. Influence area of intersections is that area where queues of traffic commonly form on approach to an intersection. The minimum driveway setback from a collector or arterial street intersection is 150 feet, measured from the right-of-way line of the intersecting street to the throat of the proposed driveway. The setback may be greater depending upon the influence area, as determined from City Engineer review of a traffic impact report submitted by the applicant's traffic engineer. In a case where a development has less than 150 feet of street frontage, the applicant must explore any option for shared access with the adjacent lot. If shared access is not possible or practicable, the driveway must be placed as far from the intersection as possible.
3. The minimum spacing of driveways and streets along a collector is 200 feet. The minimum spacing of driveways and streets along an arterial is 600 feet.
4. The minimum spacing of local streets along a local street is 125 feet.

Preliminary civil plans have been submitted by the applicant to demonstrate preliminary compliance with the access, egress and circulation requirements of this chapter.

Prior to commencing any site work, the applicant must submit a Preliminary Sight Distance Certification for review and approval.

Prior to final building inspection, the applicant must submit a Final Sight Distance Certification for review and approval. With a condition of approval, this standard is met.

SECTION VII. OTHER STAFF COMMENTS

The City of Tigard Engineering Department comments and conditions are incorporated into this decision and included as Attachment 3.

SECTION VIII. AGENCY COMMENTS

Easements:

Prior to final building inspection, the applicant must record all public access and utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

Fire and Life Safety:

Prior to commencing any site work, the applicant must provide written approval from TVF&R for fire flow, hydrant placement, and emergency vehicular access and turn around.

Public Water System:

The existing public water mains are under the City of Tigard jurisdiction. The site plans indicate that services will be provided to serve the proposed development via the existing public water main located on SW Bull Mountain Road.

Prior to commencing site improvements, the applicant must submit site plans as part of the PFI Permit showing all proposed and/or extensions of public water lines, hydrants and water services to be designed in accordance with the City of Tigard Standards to Engineering for review and approval.

Storm Water Quality:

The City has agreed to enforce Surface Water Management regulations established by CWS Design and Construction which require the construction of on-site water quality facilities. In addition, a maintenance plan must be submitted indicating the frequency and method to be used in keeping the facility maintained through the year.

Prior to commencing site improvements, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI permit. Plans must be submitted to the city for review. The city will forward plans to CWS after preliminary review.

Grading and Erosion Control:

Clean Water Services Design and Construction Standards also regulate erosion control to reduce the amount of sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity which accelerates erosion. Prior to commencing any site work, the applicant must submit an erosion control plan for review and approval. The plan must comply to the "CWS Erosion Prevention and Sediment Control Design and Planning Manual" (current edition).

The Federal Clean Water Act requires that a National Pollutant Discharge Elimination System (NPDES) erosion control permit be issued for any development that will disturb one or more acre of land. The site is greater than one acre.

Prior to commencing any site improvements, the applicant must submit a final grading plan the existing and proposed contours. The plan must detail the provisions for surface drainage of the site and show that it will be graded to ensure that surface drainage is directed to the street or a public storm drainage system approved by the Engineering Department.

The design engineer must also indicate, on the grading plan, areas that will have natural slopes between 10 percent and 20 percent, as well as areas that will have natural slopes in excess of 20 percent. This information will be necessary in determining if special grading inspections and permits will be necessary upon development.

Address Assignments:

The City of Tigard is responsible for the approval of new street names and assigning addresses for parcels within the City of Tigard. Contact Oscar Contreras with Engineering Division at 503-718-2678 to ensure new addresses are assigned. Prior to permit submittal, the applicant must pay the addressing fee. The address fee will be assessed in accordance with the current Master Fee Schedule.

Clean Water Services issued a Service Provider Letter (CWS file 20-002535) stating that project will not significantly impact the existing or potential sensitive lands found near the site. The agency also submitted written comments, dated June 17, 2021, requesting a condition of approval that requires the applicant to obtain Storm Water Connection Permit Authorization. This request has been incorporated into the Conditions of Approval. The City of Tigard and CWS have an intergovernmental agreement stating that the city will ensure implementation of CWS Design and Construction Standards; therefore, this subdivision approval is conditioned to satisfy CWS requirements.

Tualatin Valley Fire and Rescue was sent a copy of the applicant's proposal and response letter dated June 17, 2021 is attached.

Attachments:

Attachment 1: Approved Site Set

Attachment 2: Zoning Map

Attachment 3: Engineering Comments and Conditions Dated June 16, 2021

Attachment 4: Agency Comments

SECTION IX. PROCEDURE AND APPEAL INFORMATION

Notice:

Notice was mailed to:

- The applicant and owners
- Owners of record within the required distance
- Affected government agencies

Final Decision:

**THIS DECISION IS FINAL ON JULY 15, 2021 AND
EFFECTIVE ON JULY 30, 2021 UNLESS AN APPEAL IS FILED.**

Appeal:

The Director's Decision is final on the date that it is mailed. All persons entitled to notice or who are otherwise adversely affected or aggrieved by the decision as provided in Section 18.710.090.A.1 may appeal this decision in accordance with Section 18.710.090.A.2 and .3 of the Tigard Development Code. A written appeal together with the required fee must be filed with the Director within fifteen (15) days of the date the Notice of Decision was mailed. The appeal fee schedule and forms are available from the City of Tigard Planning Division, 13125 SW Hall Boulevard, Tigard, OR 97223.

Appeal hearings are de novo. A de novo hearing allows for the presentation of new evidence, testimony and argument by any party. The appeal authority must consider all relevant evidence, testimony and argument that are provided at the hearing by the appellant or any party. The decision of the appeal authority is the final local decision.

THE DEADLINE FOR FILING AN APPEAL IS 5:00 P.M. ON JULY 29, 2021.

Questions:

If you have any questions, please contact Monica Bilodeau, Associate Planner at (503)718-2427 or MonicaB@tigard-or.gov. You may also mail inquiries to City of Tigard Planning Division, 13125 SW Hall Boulevard, Tigard, OR 97223.



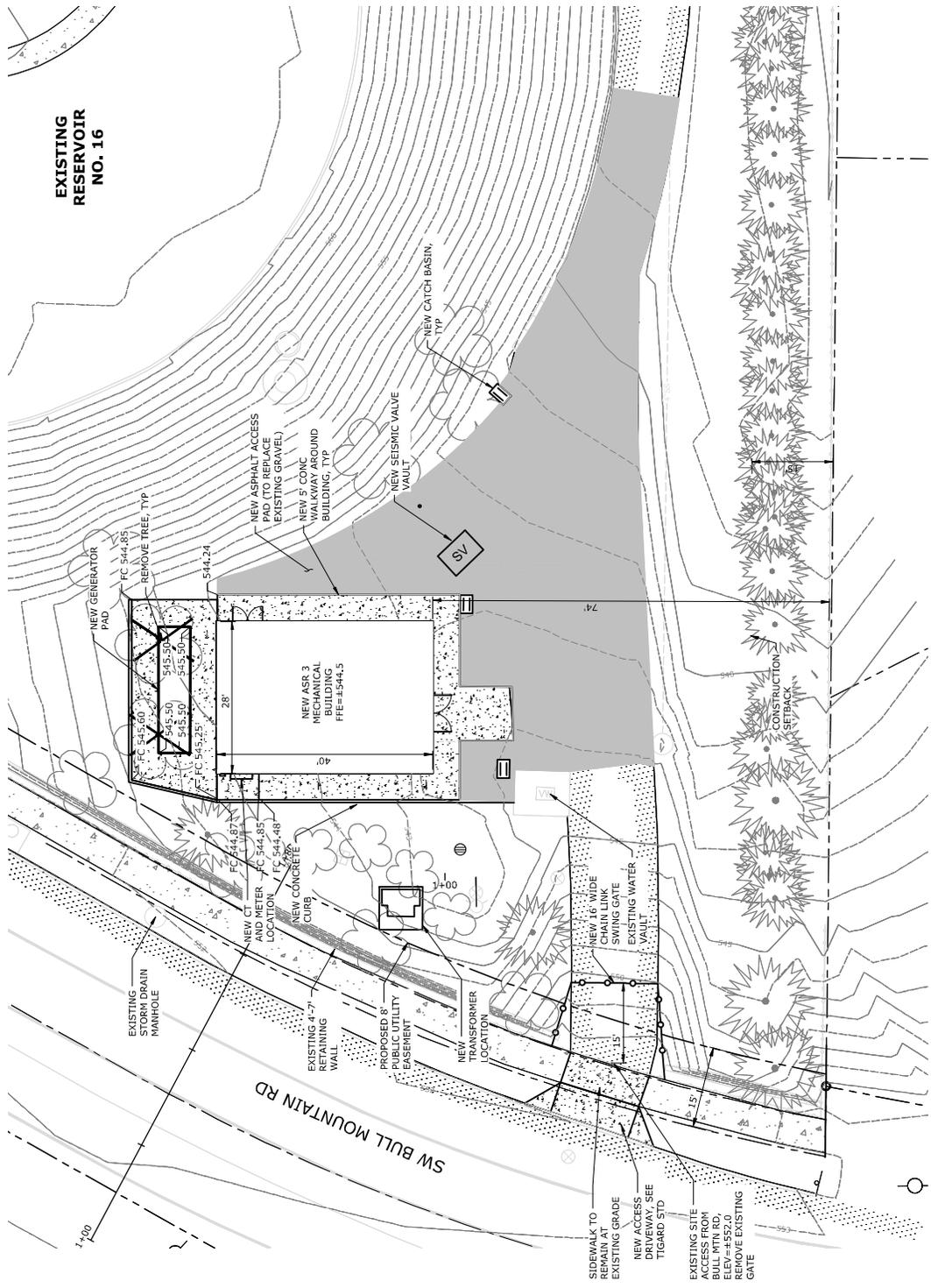
July 15, 2021

PREPARED BY: Monica Bilodeau
Associate Planner



July 15, 2021

APPROVED BY: Tom McGuire
Assistant Community Development Director



PLAN
SCALE: 1"=10'

				ASR 3 SITE PLAN		SHEET C-3	
PRELIMINARY ONLY DO NOT USE FOR CONSTRUCTION DECEMBER 2020 		CITY OF TIGARD ASR WELLS REHABILITATION DESIGN AND CONSTRUCTION		AS SHOWN		DATE: FEBRUARY 2021	
NOTICE  IF THIS BAR DOES APPEAR IN THE DRAWING IS NOT TO SCALE		LRC DESIGNED LRC DRAWN ANB CHECKED		PROJECT NO.: 20-2729		SCALE:	
NO.	DATE	BY	REVISION				

Zoning Map

City of Tigard, Oregon

Generalized Zoning Categories

 Subject Site

 Unimproved Right of Way

Zoning -General

-  Residential
-  Mixed Use Residential
-  Commercial
-  Mixed Use
-  Triangle Mixed Use
-  Mixed Use Employment
-  Industrial
-  Parks and Recreation
-  WA-CNTY

Data is derived from multiple sources. The City of Tigard makes no warranty, representation, or guarantee as to the content, accuracy, timeliness or completeness of any of the data provided herein. The City of Tigard shall assume no liability for any errors, omissions, or inaccuracies in the information provided regardless of how caused.



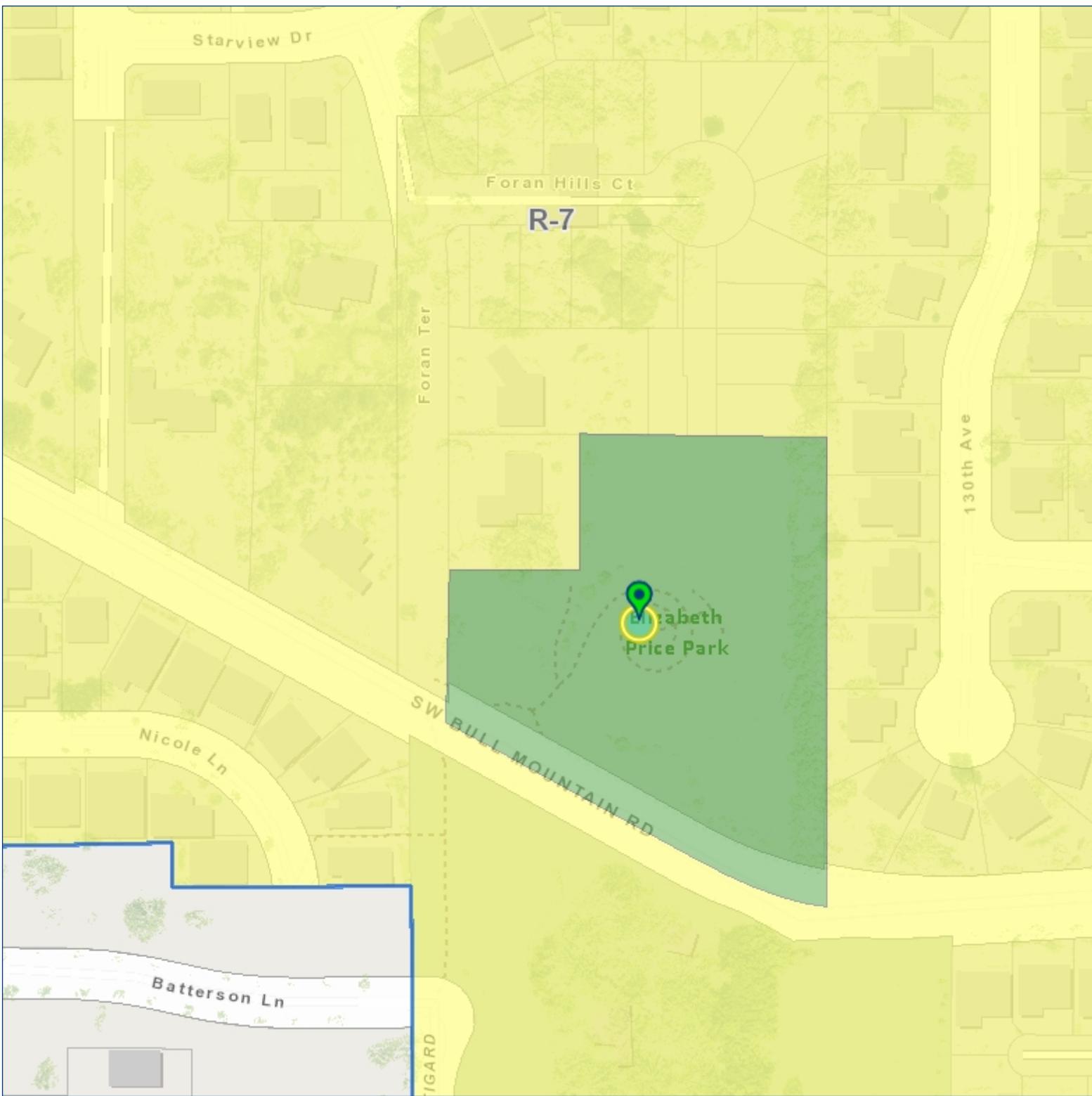
Scale:  0.04 Miles

COMMUNITY DEVELOPMENT DEPARTMENT

City of Tigard
13125 SW Hall Blvd
Tigard, OR 97223
(503) 639-4171
www.tigard-or.gov



Map Created:
05/25/2021





City of Tigard

MEMORANDUM

DATE: June 16, 2021
TO: Monica Bilodeau, Associate Planner
FROM: Jeremy Tamargo, Principal Engineer
PROJECT: MMD2021-00005: Tigard ASR #3

FINDINGS OF FACT:

CHAPTER 18.910 IMPROVEMENT STANDARDS

18.910.030 Streets

A. Improvements.

1. No development shall occur unless the development has frontage or approved access to a public street.
2. No development shall occur unless streets within the development meet the standards of this chapter.
3. No development shall occur unless the streets adjacent to the development meet the standards of this chapter, provided, however, that a development may be approved if the adjacent street does not meet the standards but half-street improvements meeting the standards of this chapter are constructed adjacent to the development.
4. Any new street or additional street width planned as a portion of an existing street shall meet the standards of this chapter.
5. If the city could and would otherwise require the applicant to provide street improvements, the City Engineer may accept a future improvements guarantee in lieu of street improvements if one or more of the following conditions exist
 - a. A partial improvement is not feasible due to the inability to achieve proper design standards;
 - b. A partial improvement may create a potential safety hazard to motorists or pedestrians;
 - c. Due to the nature of existing development on adjacent properties it is unlikely that street improvements would be extended in the foreseeable future and the improvement associated with the project under review does not, by itself, provide a significant improvement to street safety or capacity;
 - d. The improvement would be in conflict with an adopted capital improvement plan;
 - e. The improvement is associated with an approved land partition on property zoned residential and the proposed land partition does not create any new streets; or

- f. Additional planning work is required to define the appropriate design standards for the street and the application is for a project which would contribute only a minor portion of the anticipated future traffic on the street.
6. The standards of this chapter include the standard specifications adopted by the City Engineer in compliance with Subsection 18.910.020.B.
7. The approval authority may approve adjustments to the standards of this chapter if compliance with the standards would result in an adverse impact on natural features such as wetlands, bodies of water, significant habitat areas, steep slopes, or existing mature trees. The approval authority may also approve adjustments to the standards of this chapter if compliance with the standards would have a substantial adverse impact on existing development or would preclude development on the property where the development is proposed. In approving an adjustment to the standards, the approval authority shall balance the benefit of the adjustment with the impact on the public interest represented by the standards. In evaluating the impact on the public interest, the approval authority shall consider the criteria listed in Subsection 18.910.030.E. An adjustment to the standards may not be granted if the adjustment would risk public safety.

As shown in the preliminary site plan, the proposed development has frontage on and has approved access to SW Bull Mountain Road, classified as a collector.

As shown in the preliminary civil plans, the existing street section along SW Bull Mountain Road meets the standards of this section. Half street improvements were previously completed with the Price Park Reservoir project in 2007 (City As-built #1131). Previous improvements in 2007 did not include dedication of the required 8' public utility easement along SW Bull Mountain Road.

Prior to commencing site improvements, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B

Prior to commencing any site work, the applicant must submit plans showing the following required street improvements to engineering for review and approval:

- SW Bull Mountain Road:
 - 8' public utility easement
 - Street lighting

Through the Conditions of Approval, this standard is met.

B. Creation of rights-of-way for streets and related purposes. Rights-of-way shall be created through the approval of a final plat; however, the council may approve the creation of a street by acceptance of a deed, provided that such street is deemed essential by the council for the purpose of general traffic circulation.

1. The council may approve the creation of a street by deed of dedication without full compliance with the regulations applicable to subdivisions or partitions if any one or more of the following conditions are found by the council to be present:
 - a. Establishment of a street is initiated by the council and is found to be essential for the purpose of general traffic circulation, and partitioning or subdivision of land has an incidental effect rather than being the primary objective in establishing the road or street for public use; or
 - b. The tract in which the road or street is to be dedicated is an isolated ownership of 1 acre or less and such dedication is recommended by the commission to the council based on a finding that the proposal is not an attempt to evade the provisions of this title governing the control of subdivisions or partitions
 - c. The street is located within the mixed use central business district (MU-CBD) zone and has been identified on Figures 5-14A through 5-14I of the City of Tigard 2035 Transportation System Plan as a required connectivity improvement.
2. With each application for approval of a road or street right-of-way not in full compliance with the regulations applicable to the standards, the proposed dedication shall be made a condition of subdivision and partition approval.
 - a. The applicant shall submit such additional information and justification as may be necessary to enable the commission in its review to determine whether or not a recommendation for approval by the council shall be made.
 - b. The recommendation, if any, shall be based upon a finding that the proposal is not in conflict with the purpose of this title.
 - c. The commission in submitting the proposal with a recommendation to the council may attach conditions which are necessary to preserve the standards of this title.
3. All deeds of dedication shall be in a form prescribed by the city and shall name “the public” as grantee.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A. The standard is met.

- C. Creation of access easements.** The approval authority may approve an access easement established by deed without full compliance with this chapter provided such an easement is the only reasonable method by which a lot large enough to develop can be created.
1. Access easements shall be provided and maintained in compliance with the Oregon Fire Code, Section 503.
 2. Access shall be in compliance with Subsections 18.920.030.H, I, and J.

The proposed development has direct access to SW Bull Mountain Road. Access easements are not proposed or deemed necessary.

- D. Street location, width and grade.** Except as noted below, the location, width and grade of all streets shall conform to an approved street plan and shall be considered in their relation to existing and planned streets, to topographic conditions, to public convenience and safety, and in their appropriate relation to the proposed use of the land to be served by such streets:
1. Street grades shall be approved by the City Engineer in compliance with Subsection 18.910.030.N; and

2. Where the location of a street is not shown in an approved street plan, the arrangement of streets in a development shall either:
 - a. Provide for the continuation or appropriate projection of existing streets in the surrounding areas, or
 - b. Conform to a plan adopted by the commission, if it is impractical to conform to existing street patterns because of particular topographical or other existing conditions of the land. Such a plan shall be based on the type of land use to be served, the volume of traffic, the capacity of adjoining streets and the need for public convenience and safety.

The proposed development is adjacent to SW Bull Mountain Road, an existing street. The street grade will remain unchanged.

E. Minimum rights-of-way and street widths. Unless otherwise indicated on an approved street plan, or as needed to continue an existing improved street or within the Tigard Downtown Plan District, street right-of-way and roadway widths shall not be less than the minimum width described below. Where a range is indicated, the width shall be determined by the decision-making authority based upon anticipated average daily traffic (ADT) on the new street segment. (The city council may adopt by resolution, design standards for street construction and other public improvements. The design standards will provide guidance for determining improvement requirements within the specified ranges.) These are provided in Table 18.910.1.

The approval authority shall make its decision about desired right-of-way width and pavement width of the various street types within the subdivision or development after consideration of the following:

1. The type of road as provided in the comprehensive plan transportation chapter - functional street classification.
2. Anticipated traffic generation.
3. On-street parking needs.
4. Sidewalk and bikeway requirements.
5. Requirements for placement of utilities.
6. Street lighting.
7. Drainage and slope impacts.
8. Street tree location.
9. Planting and landscape areas.
10. Safety and comfort for motorists, bicyclists, and pedestrians.
11. Access needs for emergency vehicles.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A.

F. Future street plan and extension of streets.

1. A future street plan shall:
 - a. Be filed by the applicant in conjunction with an application for a subdivision or partition. The plan shall show the pattern of existing and proposed future streets from the boundaries of the proposed land division and shall include other lots

- within 530 feet surrounding and adjacent to the proposed land division. At the applicant's request, the city may prepare a future streets proposal. Costs of the city preparing a future streets proposal shall be reimbursed for the time involved. A street proposal may be modified when subsequent subdivision proposals are submitted.
- b. Identify existing or proposed bus routes, pullouts or other transit facilities, bicycle routes and pedestrian facilities on or within 530 feet of the site.
2. Where necessary to give access or permit a satisfactory future division of adjoining land, streets shall be extended to the boundary lines of the tract to be developed, and
 - a. These extended streets or street stubs to adjoining properties are not considered to be cul-de-sac since they are intended to continue as through streets at such time as the adjoining property is developed.
 - b. A barricade shall be constructed at the end of the street by the property owners which shall not be removed until authorized by the City Engineer, the cost of which shall be included in the street construction cost.
 - c. Temporary hammerhead turnouts or temporary cul-de-sac bulbs shall be constructed for stub street in excess of 150 feet in length.

A future street plan is not required, as a subdivision or partition is not proposed as part of the development. New streets are not proposed or deemed necessary as part of the proposed development.

G. Street spacing and access management. Refer to 18.920.030.H.

Street spacing and access management is discussed under Chapter 18.920, Access, Egress, and Circulation.

H. Street alignment and connections.

1. Full street connections with spacing of no more than 530 feet between connections is required except where prevented by barriers such as topography, railroads, freeways, pre-existing developments, lease provisions, easements, covenants or other restrictions existing prior to May 1, 1995 which preclude street connections. A full street connection may also be exempted due to a regulated water feature if regulations would not permit construction.
2. All local, neighborhood routes and collector streets which abut a development site shall be extended within the site to provide through circulation when not precluded by environmental or topographical constraints, existing development patterns or strict adherence to other standards in this code. A street connection or extension is considered precluded when it is not possible to redesign or reconfigure the street pattern to provide required extensions. Land is considered topographically constrained if the slope is greater than 15 percent for a distance of 250 feet or more. In the case of environmental or topographical constraints, the mere presence of a constraint is not sufficient to show that a street connection is not possible. The applicant must show why the constraint precludes some reasonable street connection.
3. Proposed street or street extensions shall be located to provide direct access to existing or planned transit stops, commercial services, and other neighborhood facilities, such as schools, shopping areas and parks.
4. All developments should provide an internal network of connecting streets that provide short, direct travel routes and minimize travel distances within the development.

Street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131). See findings in Section 18.910.030.A. No new streets are proposed or deemed necessary.

- I. **Intersection angles.** Streets shall be laid out so as to intersect at an angle as near to a right angle as practicable, except where topography requires a lesser angle, but in no case shall the angle be less than 75° unless there is special intersection design, and:
1. Streets shall have at least 25 feet of tangent adjacent to the right-of-way intersection unless topography requires a lesser distance;
 2. Intersections which are not at right angles shall have a minimum corner radius of 20 feet along the right-of-way lines of the acute angle; and
 3. Right-of-way lines at intersection with arterial streets shall have a corner radius of not less than 20 feet.

There are no new proposed streets or street extensions for the proposed development. This standard does not apply.

- J. **Existing rights-of-way.** Whenever existing rights-of-way adjacent to or within a tract are of less than standard width, additional rights-of-way shall be provided at the time of subdivision or development.

The existing right-of-way along SW Bull Mountain Road is in accordance with the minimum standards of this chapter. See findings in Section 18.910.030.A.

- K. **Partial street improvements.** Partial street improvements resulting in a pavement width of less than 20 feet, while generally not acceptable, may be approved where essential to reasonable development when in conformity with the other requirements of these regulations, and when it will be practical to require the improvement of the other half when the adjoining property developed.

Partial street improvements are not proposed. As provided in the Preliminary Civil Plan, street improvements along SW Bull Mountain Road were previously constructed in compliance with the regulations applicable to the standards with the Price Park Reservoir project in 2007 (City As-built #1131).

- L. **Cul-de-sacs.** A cul-de-sac shall be no more than 200 feet long, shall not provide access to greater than 20 dwelling units, and shall only be used when environmental or topographical constraints, existing development pattern, or strict adherence to other standards in this code preclude street extension and through circulation:
1. All cul-de-sac shall terminate with a turnaround. Use of turnaround configurations other than circular shall be approved by the City Engineer; and
 2. The length of the cul-de-sac shall be measured from the centerline intersection point of the 2 streets to the radius point of the bulb.
 3. If a cul-de-sac is more than 300 feet long, a lighted direct pathway to an adjacent street may be required to be provided and dedicated to the city.

A cul-de-sac is not proposed or deemed necessary. This criterion does not apply.

M. Street names. No street name shall be used which will duplicate or be confused with the names of existing streets in Washington County, except for extensions of existing streets. Street names and numbers shall conform to the established pattern in the surrounding area and as approved by the City Engineer.

The proposed development does not propose new streets or street names. This criterion does not apply.

N. Grades and curves.

1. Grades shall not exceed 10 percent on arterials, 12 percent on collector streets, or 12 percent on any other street (except that local or residential access streets may have segments with grades up to 15 percent for distances of no greater than 250 feet); and
2. Centerline radii of curves shall be as determined by the City Engineer.

New streets are not proposed. The existing street grade will not be changed with development.

O. Curbs, curb cuts, ramps, and driveway approaches. Concrete curbs, curb cuts, wheelchair, bicycle ramps and driveway approaches shall be constructed in compliance with standards specified in this chapter and Chapter 15.04, Work in the Right-of-Way, and:

1. Concrete curbs and driveway approaches are required; except:
2. Where no sidewalk is planned, an asphalt approach may be constructed with City Engineer approval; and
3. Asphalt and concrete driveway approaches to the property line shall be built to city configuration standards.

The narrative and preliminary civil plan set show intent to comply with this requirement.

P. Streets adjacent to railroad right-of-way. Wherever the proposed development contains or is adjacent to a railroad right-of-way, provision shall be made for a street approximately parallel to and on each side of such right-of-way at a distance suitable for the appropriate use of the land. The distance shall be determined with due consideration at cross streets or the minimum distance required for approach grades and to provide sufficient depth to allow screen planting along the railroad right-of-way in nonindustrial areas.

The proposed development is not adjacent to an existing railroad right-of-way. This standard is not applicable.

Q. Access to arterials and collectors. Where a development abuts or is traversed by an existing or proposed arterial or collector street, the development design shall provide adequate protection for residential properties and shall separate residential access and through traffic, or if separation is not feasible, the design shall minimize the traffic conflicts. The design shall include any of the following:

1. A parallel access street along the arterial or collector;
2. Lots of suitable depth abutting the arterial or collector to provide adequate buffering with frontage along another street;
3. Screen planting at the rear or side property line to be contained in a nonaccess reservation along the arterial or collector; or
4. Other treatment suitable to meet the objectives of this subsection;

5. **If a lot has access to 2 streets with different classifications, primary access should be from the lower classification street.**

The proposed development is adjacent to SW Bull Mountain Road, which is functionally classified as a collector. The site has an existing access to SW Bull Mountain Road which is utilized only for service and maintenance purposes. No new access is proposed with this development. No residential access is proposed with this development. This standard is not applicable.

R. Alleys, public or private.

1. **Alleys shall be no less than 20 feet in width. In commercial and industrial zones, alleys shall be provided unless other permanent provisions for access to off-street parking and loading facilities are made.**
2. **While alley intersections and sharp changes in alignment shall be avoided, the corners of necessary alley intersections shall have a radius of not less than 12 feet.**

New alleys are not proposed or deemed necessary. This standard is not applicable.

- S. Survey monuments. Upon completion of a street improvement and prior to acceptance by the city, it shall be the responsibility of the developer's registered professional land surveyor to provide certification to the city that all boundary and interior monuments shall be reestablished and protected.**

The proposed development does not include any street improvements. This standard does not apply.

T. Private streets.

1. **Design standards for private streets shall be established by the City Engineer; and**
2. **The city shall require legal assurances for the continued maintenance of private streets, such as a recorded maintenance agreement.**
3. **Private streets serving more than 6 dwelling units are permitted only within planned developments, mobile home parks, cottage cluster, courtyard units, and apartment developments.**

The proposed development does not include any private streets. This standard does not apply.

- U. Railroad crossings. Where an adjacent development results in a need to install or improve a railroad crossing, the cost for such improvements may be a condition of development approval, or another equitable means of cost distribution shall be determined by the public works director and approved by the commission.**

The development is not adjacent to a railroad crossing. This standard is not applicable.

- V. Street signs. The city shall install all street signs, relative to traffic control and street names, as specified by the City Engineer for any development. The cost of signs shall be the responsibility of the developer.**

No new street signs are proposed or deemed necessary. This standard is not applicable.

W. Mailboxes. Joint mailbox facilities shall be provided in all residential developments, with each joint mailbox serving at least 2 dwelling units.

1. Joint mailbox structures shall be placed adjacent to roadway curbs;
2. Proposed locations of joint mailboxes shall be designated on the preliminary plat or development plan, and shall be approved by the City Engineer/U.S. Post Office prior to final plan approval; and
3. Plans for the joint mailbox structures to be used shall be submitted for approval by the City Engineer/U.S. Post Office prior to final approval.

No new mailboxes are proposed or deemed necessary. This standard is not applicable.

X. Traffic signals. The location of traffic signals shall be noted on approved street plans. Where a proposed street intersection will result in an immediate need for a traffic signal, a signal meeting approved specifications shall be installed. The cost shall be included as a condition of development.

New traffic signals are not proposed or deemed necessary.

Y. Street light standards. Street lights shall be installed in compliance with regulations adopted by the city's direction.

Prior to commencing any site work, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B. Through a condition of approval, this standard is met.

Z. Street name signs. Street name signs shall be installed at all street intersections. Stop signs and other signs may be required.

No new street signs are proposed or deemed necessary. This standard is not applicable.

AA. Street cross-sections. The final lift of asphalt concrete pavement shall be placed on all new constructed public roadways prior to final city acceptance of the roadway and within 1 year of the conditional acceptance of the roadway unless otherwise approved by the City Engineer. The final lift shall also be placed no later than when 90 percent of the structures in the new development are completed or 3 years from the commencement of initial construction of the development, whichever is less.

1. Sub-base and leveling course shall be of select crushed rock;
2. Surface material shall be of Class C or B asphaltic concrete;
3. The final lift shall be placed on all new construction roadways prior to city final acceptance of the roadway; however, not before 90 percent of the structures in the new development are completed unless 3 years have elapsed since initiation of construction in the development;
4. The final lift shall be Class C asphaltic concrete as defined by A.P.W.A. standard specifications; and
5. No lift shall be less than 1.5 inches in thickness.

The development will not require frontage improvements along SW Bull Mountain Road; therefore, this section is not applicable.

BB. Traffic calming. When, in the opinion of the City Engineer, the proposed development will create a negative traffic condition on existing neighborhood streets, such as excessive speeding, the developer may be required to provide traffic calming measures. These measures may be required within the development or offsite as deemed appropriate. As an alternative, the developer may be required to deposit funds with the city to help pay for traffic calming measures that become necessary once the development is occupied and the City Engineer determines that the additional traffic from the development has triggered the need for traffic calming measures. The City Engineer will determine the amount of funds required and will collect said funds from the developer prior to the issuance of a certificate of occupancy, or in the case of subdivision, prior to the approval of the final plat. The funds will be held by the city for a period of 5 years from the date of issuance of certificate of occupancy, or in the case of a subdivision, the date of final plat approval. Any funds not used by the city within the 5-year time period will be refunded to the developer.

Traffic calming is not proposed or deemed necessary for the proposed development.

CC. Traffic study.

1. A traffic study shall be required for all new or expanded uses or developments under any of the following circumstances:
 - a. When they generate a 10 percent or greater increase in existing traffic to high collision intersections identified by Washington County.
 - b. Trip generations from development onto the city street at the point of access and the existing ADT fall within the following ranges:

Existing ADT	ADT to be added by development
0—3,000 vpd	2,000 vpd
3,001—6,000 vpd	1,000 vpd
>6,000 vpd	500 vpd or more

- c. If any of the following issues become evident to the City Engineer:
 - i. High traffic volumes on the adjacent roadway that may affect movement into or out of the site.
 - ii. Lack of existing left-turn lanes onto the adjacent roadway at the proposed access drive.
 - iii. Inadequate horizontal or vertical sight distance at access points.
 - iv. The proximity of the proposed access to other existing drives or intersections is a potential hazard.
 - v. The proposal requires a conditional use permit or involves a drive-through operation.
 - vi. The proposed development may result in excessive traffic volumes on adjacent local streets.
 2. In addition, a traffic study may be required for all new or expanded uses or developments under any of the following circumstances

- a. When the site is within 500 feet of an ODOT facility; or
- b. Trip generation from a development adds 300 or more vehicle trips per day to an ODOT facility; or
- c. Trip generation from a development adds 50 or more peak hour trips to an ODOT facility.

Based on the estimated trip generation for the proposed development, a traffic study is not required for this proposed development.

18.910.040 Blocks

- A. **Block design.** The length, width and shape of blocks shall be designed with due regard to providing adequate building sites for the use contemplated, consideration of needs for convenient access, circulation, control and safety of street traffic and recognition of limitations and opportunities of topography.
- B. **Sizes.**
 1. The perimeter of blocks formed by streets shall not exceed 2,000 feet measured along the centerline of the streets except:
 - a. Where street location is precluded by natural topography, wetlands, significant habitat areas or bodies of water, or pre-existing development; or
 - b. For blocks adjacent to arterial streets, limited access highways, collectors or railroads.
 - c. For nonresidential blocks in which internal public circulation provides equivalent access.
 2. Bicycle and pedestrian connections on public easements or rights-of-way shall be provided when full street connection is exempted by Paragraph 18.910.040.B.1. Spacing between connections shall be no more than 330 feet, except where precluded by environmental or topographical constraints, existing development patterns, or strict adherence to other standards in the code.

The development does not propose any new streets and does not warrant a block design or future street plan. Street or pedestrian connections are precluded by preexisting development located to the south, west and east of the proposed development.

18.910.050 Easements

- A. **Easements.** Easements for sewers, drainage, water mains, electric lines or other public utilities shall be either dedicated or provided for in the deed restrictions, and where a development is traversed by a watercourse or drainageway, there shall be provided a stormwater easement or drainage right-of-way conforming substantially with the lines of the watercourse.
- B. **Utility easements.** A property owner proposing a development shall make arrangements with the city, the applicable district, and each utility franchise for the provision and dedication of utility easements necessary to provide full services to the development. The city's standard width for public main line utility easements shall be 15 feet unless otherwise specified by the utility company, applicable district, or City Engineer.

The proposed development is not traversed by a watercourse or drainage way. The development will require an eight-foot public utility easement along the frontage. Prior to final building inspection, the

applicant must record all utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

18.910.060 Reserved

18.910.070 Sidewalks

A. Sidewalks. All public and private streets adjacent to industrially zoned properties shall have sidewalks meeting city standards along at least one side of the street. All other public and private streets shall have sidewalks meeting city standards along both sides of the street. A development may be approved if an adjoining street has sidewalks on the side adjoining the development, even if no sidewalk exists on the other side of the street.

As shown in the preliminary civil plans, the existing street section along SW Bull Mountain Road meets the standards of this section. Half street improvements, including sidewalk, were previously completed with the Price Park Reservoir project in 2007 (City As-built #1131). This standard is met.

B. Requirement of developers.

- 1. As part of any development proposal or change in use resulting in an additional 1,000 vehicle trips or more per day, an applicant shall be required to identify direct, safe (1.25 x the straight line distance) pedestrian routes within 0.50 miles of their site to all transit facilities and neighborhood activity centers (schools, parks, libraries, etc.). In addition, the developer may be required to participate in the removal of any gaps in the pedestrian system off-site if justified by the development.**
- 2. If there is an existing sidewalk on the same side of the street as the development within 300 feet of a development site in either direction, the sidewalk shall be extended from the site to meet the existing sidewalk, subject to rough proportionality (even if the sidewalk does not serve a neighborhood activity center).**

The proposed development does not generate an additional 1,000 vehicle trips or more per day.

As shown in the preliminary civil plans, the applicant's existing sidewalk connects to the existing sidewalk located to the east along SW Bull Mountain Road. There is no existing sidewalk located to the west of the proposed development along SW Bull Mountain Road. This standard is met.

C. Planter strip requirements. A planter strip separation of at least 5 feet between the curb and the sidewalk shall be required in the design of streets, except where the following conditions exist: there is inadequate right-of-way; the curbside sidewalks already exist on predominant portions of the street; it would conflict with the utilities; there are significant natural features (large trees, water features, significant habitat areas, etc.) that would be destroyed if the sidewalk were located as required; or where there are existing structures in close proximity to the street (15 feet or less) or where the standards in Table 18.910.1 specify otherwise. Additional consideration for exempting the planter strip requirement may be given on a case-by-case basis if a property abuts more than one street frontage.

The preliminary site plan shows the existing planter strip along the proposed development's frontage meets City minimum requirements for SW Bull Mountain Road. This standard is met.

D. Maintenance. Maintenance of sidewalks, curbs, and planter strips is the continuing obligation of the adjacent property owner.

The property owner will take full responsibility for the maintenance of sidewalks, curbs, and planter strips.

E. Application for permit and inspection. Separate street opening permits are required for sidewalk segments that are not part of a current subdivision approval:

1. An occupancy permit shall not be issued for a development until the provisions of this section are satisfied.
2. The City Engineer may issue a permit and certificate allowing temporary noncompliance with the provisions of this section to the owner, builder or contractor when, in his or her opinion, the construction of the sidewalk is impractical for one or more of the following reasons:
 - a. Sidewalk grades have not and cannot be established for the property in question within a reasonable length of time;
 - b. Forthcoming installation of public utilities or street paving would be likely to cause severe damage to the new sidewalk;
 - c. Street right-of-way is insufficient to accommodate a sidewalk on 1 or both sides of the street; or
 - d. Topography or elevation of the sidewalk base area makes construction of a sidewalk impractical or economically infeasible
3. The City Engineer shall inspect the construction of sidewalks for compliance with the provision set forth in the standard specifications manual.

Prior to commencing any site work, the applicant must submit a Public Facility Improvement (PFI) Permit to cover all infrastructure work including stormwater Water Quality and Quantity Facilities and any other work in the public right-of-way. Four (4) sets of detailed public improvement plans must be submitted for review to the Engineering Department. An Engineering cost estimate of improvements associated with public infrastructures including but not limited to street, street grading, utilities, stormwater quality and water quantity facilities, sanitary sewer, streetlights, and franchise utilities are required at the time of PFI Permit submittal. When the water system is under the City of Tigard jurisdiction, an Engineering cost estimate of water improvement must be listed as a separate line item from the total cost estimate. NOTE: these plans are in addition to any drawings required by the Building Division and should only include sheets relevant to public improvements. Public Facility Improvement Permit plans must conform to City of Tigard Public Improvement Design Standards, which are available at City Hall and the City's web page (www.tigard-or.gov).

F. Council initiation of construction. In the event one or more of the following situations are found by the council to exist, the council may adopt a resolution to initiate construction of a sidewalk in accordance with city ordinances:

1. A safety hazard exists for children walking to or from school and sidewalks are necessary to eliminate the hazard;
2. A safety hazard exists for pedestrians walking to or from a public building, commercial area, place of assembly or other general pedestrian traffic, and sidewalks are necessary to eliminate the hazard;

3. Fifty percent or more of the area in a given block has been improved by the construction of dwellings, multiple dwellings, commercial buildings or public buildings or parks; and
4. A criterion which allowed noncompliance under this chapter no longer exists and a sidewalk could be constructed in compliance with city standards.

The above described situations have not been found by the council to exist. This standard does not apply.

18.910.080 Public Use Areas

A. Dedication requirements.

1. Where a proposed park, playground, or other public use shown in a development plan adopted by the city is located in whole or in part in a subdivision, the commission may require the dedication or reservation of such area within the subdivision, provided that the reservation or dedication is roughly proportional to the impact of the subdivision on the park system.
2. Where considered desirable by the commission in compliance with adopted comprehensive plan policies, and where a development plan of the city does not indicate proposed public use areas, the commission may require the dedication or reservation of areas within the subdivision or sites of a character, extent and location suitable for the development of parks or other public use, provided that the reservation or dedication is roughly proportional to the impact of the subdivision on the park system.

- B. Acquisition by public agency.** If the developer is required to reserve land area for a park, playground, or other public use, such land shall be acquired by the appropriate public agency within 18 months following plat approval, at a price agreed upon prior to approval of the plat, or such reservation shall be released to the subdivider.

Public use areas are not proposed or deemed necessary.

18.910.090 Sanitary Sewers

- A. **Sewers required.** Sanitary sewers shall be installed to serve each new development and to connect developments to existing mains in compliance with Clean Water Services requirements and the-comprehensive plan.
- B. **Sewer plan approval.** The City Engineer shall approve all sanitary sewer plans and proposed systems prior to issuance of development permits involving sewer service.
- C. **Over-sizing.** Proposed sewer systems shall include consideration of additional development within the area as projected by the comprehensive plan.
- D. **Permits denied.** Development permits may be restricted by the approval authority where a deficiency exists in the existing sewer system or portion thereof which cannot be rectified within the development and which if not rectified will result in a threat to public health or safety, surcharging of existing mains, or violations of state or federal standards pertaining to operation of the sewage treatment system.

The preliminary utility plan provided by the applicant shows connection to an existing 8-inch sanitary sewer main that traverses the northeast portion of the site.

Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing the proposed sanitary sewer system and associated facilities to be designed and constructed in accordance with the City of Tigard and CWS Design and Construction Standards.

Prior to final building inspection, the proposed sanitary sewer system and associated facilities must be constructed, completed, and/or satisfied. The applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.

No oversizing of sanitary sewer is proposed deemed necessary.

18.910.100 Storm Drainage

- A. General provisions. The Director and City Engineer shall issue a development permit only where adequate provisions for stormwater and floodwater runoff have been made, and:**
- 1. The storm water drainage system shall be separate and independent of any sanitary sewerage system;**
 - 2. Where possible, inlets shall be provided so surface water is not carried across any intersection or allowed to flood any street; and**
 - 3. Surface water drainage patterns shall be shown on every development proposal plan.**

The applicant submitted preliminary plans that comply with these general requirements.

- B. Easements. Where a development is traversed by a watercourse, drainageway, channel or stream, there shall be provided a stormwater easement or drainage right-of-way conforming substantially with the lines of such watercourse and such further width as will be adequate for conveyance and maintenance.**

The development is not traversed by a watercourse or drainageway. This standard is not applicable.

- C. Accommodation of upstream drainage. A culvert or other drainage facility shall be large enough to accommodate potential runoff from its entire upstream drainage area, whether inside or outside the development, and the City Engineer shall approve the necessary size of the facility, based on Clean Water Services requirements.**
- D. Effect on downstream drainage. Where it is anticipated by the City Engineer that the additional runoff resulting from the development will overload an existing drainage facility, the director and engineer shall withhold approval of the development until provisions have been made for improvement of the potential condition or until provisions have been made for storage of additional runoff caused by the development in compliance with Clean Water Services requirements.**

A preliminary storm drainage memorandum was submitted as part of the land use submittal. The applicant has proposed to meet CWS standards for water quality and water quantity through the payment of fee-in-lieu.

Prior to commencing any site work, the applicant must submit site plans and a final storm drainage report as part of the PFI Permit indicating how run-off generated by the development will be collected, conveyed, treated and detained for review and approval. The storm drainage report must be prepared and include a maintenance plan in accordance with CWS Design and Construction Standards and the City of Tigard Standards.

Prior to commencing any site work, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI Permit. Plans must be submitted to the City of Tigard for review. The City will forward plans to CWS after preliminary review.

18.910.110 Bikeways and Pedestrian Pathways

A. Bikeway extension.

1. As a standard, bike lanes shall be required along all arterial and collector routes and where identified on the city's adopted bicycle plan in the transportation system plan (TSP). Bike lane requirements along collectors within the downtown urban renewal district shall be determined by the City Engineer unless specified in Table 18.910.1.
2. Developments adjoining proposed bikeways identified on the city's adopted pedestrian/bikeway plan shall include provisions for the future extension of such bikeways through the dedication of easements or rights-of-way, provided such dedication is directly related to and roughly proportional to the impact of the development.
3. Any new street improvement project shall include bicycle lanes as required in this chapter and on the adopted bicycle plan.

B. Cost of construction. Development permits issued for planned developments, conditional use permits, subdivisions and other developments which will principally benefit from such bikeways shall be conditioned to include the cost or construction of bikeway improvements in an amount roughly proportional to the impact of the development.

C. Minimum width.

1. The minimum width for bikeways within the roadway is 5 feet per bicycle travel lane.
2. The minimum width for multi-use paths separated from the road and classified as regional or community trails in the Greenway Trail System Master Plan is 10 feet. The width may be reduced to 8 feet if there are environmental or other constraints.
3. The minimum width for off-street paths classified as neighborhood trails, according to the Greenway Trail System Master Plan, is 3 feet.
4. Design standards for bike and pedestrian-ways shall be determined by the City Engineer.

The City's TSP identifies bike lanes along SW Bull Mountain Road, consistent with the collector street section. The existing street section contains a bike lane. The standard is met.

18.910.120 Utilities

A. Underground utilities. All utility lines including, but not limited to those required for electric, communication, lighting and cable television services and related facilities shall be placed underground, except for surface mounted transformers, surface mounted connection boxes and meter cabinets which may be placed above ground, temporary utility service facilities during construction, high capacity electric lines operating at 50,000 volts or above, and:

1. The developer shall make all necessary arrangements with the serving utility to provide the underground services;
2. The city reserves the right to approve location of all surface mounted facilities;
3. All underground utilities, including sanitary sewers and storm drains installed in streets by the developer, shall be constructed prior to the surfacing of the streets; and

4. Stubs for service connections shall be long enough to avoid disturbing the street improvements when service connections are made.
- B. Information on development plans.** The applicant for a development shall show on the development plan or in the explanatory information, easements for all underground utility facilities, and
1. Plans showing the location of all underground facilities as described herein shall be submitted to the City Engineer for review and approval; and
 2. Care shall be taken in all cases to ensure that above ground equipment does not obstruct vision clearance areas for vehicular traffic.
- C. Exception to undergrounding requirement.**
1. The developer shall pay a fee in-lieu of undergrounding costs when the development is proposed to take place on a street where existing utilities which are not underground will serve the development and the approval authority determines that the cost and technical difficulty of under-grounding the utilities outweighs the benefit of undergrounding in conjunction with the development. The determination shall be on a case-by-case basis. The most common, but not the only, such situation is a short frontage development for which undergrounding would result in the placement of additional poles, rather than the removal of above-ground utilities facilities.
 2. An applicant for a development which is served by utilities which are not underground and which are located across a public right-of-way from the applicant's property shall pay the fee in-lieu of undergrounding.
 3. Properties within the MU-CBD zone shall be exempt from the requirements for undergrounding of utility lines and from the fee in-lieu of undergrounding.
 4. The exceptions in Paragraphs 18.910.120.C.1 through 3 shall apply only to existing utility lines. All new utility lines shall be placed underground.
- D. Fee in-lieu of undergrounding.**
1. The City Engineer shall establish utility service areas in the city. All development which occurs within a utility service area shall pay a fee in-lieu of undergrounding for utilities if the development does not provide underground utilities, unless exempted by this chapter.
 2. The City Engineer shall establish the fee by utility service area which shall be determined based upon the estimated cost to underground utilities within each service area. The total estimated cost for undergrounding in a service area shall be allocated on a front-foot basis to each party within the service area. The fee due from any developer shall be calculated based on a front-foot basis.
 3. A developer shall receive a credit against the fee for costs incurred in the undergrounding of existing overhead utilities. The City Engineer shall determine the amount of the credit, after review of cost information submitted by the applicant with the request for credit.
 4. The funds collected in each service area shall be used for undergrounding utilities within the city at large. The City Engineer shall prepare and maintain a list of proposed undergrounding projects which may be funded with the fees collected by the city. The list shall indicate the estimated timing and cost of each project. The list shall be submitted to the city council for their review and approval annually.

Prior to final building inspection, all existing and proposed utilities must be placed underground. A fee-in-lieu of undergrounding is not proposed or required.

18.910.130 Cash or Bond Required

- A. **Guarantee.** All improvements installed by the developer shall be guaranteed as to workmanship and material for a period of 1 year following acceptance by the city council.
- B. **Cash deposit or bond.** Such guarantee shall be secured by cash deposit or bond in the amount of the value of the improvements as set by the City Engineer.
- C. **Compliance requirements.** The cash or bond shall comply with the terms and conditions of Section 18.830.070.

Prior to commencing any site work, the applicant must provide a performance bond for all public improvements and private stormwater treatment facilities associated with the development.

Prior to building inspection, all improvements associated with public infrastructure including but not limited to street improvement under the City of Tigard jurisdiction must be constructed, completed and/or satisfied. The applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.

Prior to final building inspection, all public utility facilities including but not limited to storm drainage, water quality and quantity, sanitary sewer, water, gas, electrical, communication, and wireless must be completed. Private storm water quality and quantity facilities must be provided with two years of maintenance and entered into a stormwater maintenance agreement with the City.

18.910.140 Monuments—Replacement Required

Any monuments that are disturbed before all improvements are completed by the subdivider shall be replaced prior to final acceptance of the improvements.

This standard is met through the PFI permitting process.

18.910.150 Installation Prerequisite

- A. **Approval required.** No public improvements, including sanitary sewers, storm sewers, streets, sidewalks, curbs, lighting or other requirements shall be undertaken except after the plans have been approved by the city, permit fee paid, and permit issued.
- B. **Permit fee.** The permit fee is required to defray the cost and expenses incurred by the city for construction and other services in connection with the improvement. The permit fee shall be set by council resolution.

This standard is met through the PFI permitting process.

18.910.160 Reserved

18.910.170 Plan Check

- A. **Submittal requirements.** Work shall not begin until construction plans and construction estimates have been submitted and checked for adequacy and approved by the City Engineer in writing. The developer can obtain detailed information about submittal requirements from the City Engineer.
- B. **Compliance.** All such plans shall be prepared in compliance with requirements of the city.

This standard is met through the PFI permitting process.

18.910.180 Notice to City

- A. **Commencement.** Work shall not begin until the city has been notified in advance.
- B. **Resumption.** If work is discontinued for any reason, it shall not be resumed until the city is notified.

This standard is met through the PFI permitting process.

18.910.190 City Inspection of Improvements

Improvements shall be constructed under the inspection and to the satisfaction of the city. The city may require changes in typical sections and details if unusual conditions arising during construction warrant such changes in the public interest.

This standard is met through the PFI permitting process.

18.910.200 Engineer's Written Certification Required

The developer's engineer shall provide written certification of a form provided by the city that all improvements, workmanship, and materials are in accord with current and standard engineering and construction practices, and are of high grade, prior to city acceptance of the subdivision's improvements or any portion thereof for operation and maintenance.

This standard is met through the PFI permitting process.

CHAPTER 18.920
ACCESS, EGRESS, AND CIRCULATION

18.920.030 General Provisions

I. **Access management.**

1. An access report must be submitted with all new development that verifies design of driveways and streets are safe by meeting adequate stacking needs, sight distance, and deceleration standards as set by ODOT, Washington County, the city, and AASHTO (depending on jurisdiction of facility).
2. Driveways must not be placed in the influence area of collector or arterial street intersections. Influence area of intersections is that area where queues of traffic commonly form on approach to an intersection. The minimum driveway setback from a collector or arterial street intersection is 150 feet, measured from the right-of-way line of the intersecting street to the throat of the proposed driveway. The setback may be greater depending upon the influence area, as determined from City Engineer review of a traffic impact report submitted by the applicant's traffic engineer. In a case where a development has less than 150 feet of street frontage, the applicant must explore any option for shared access with the adjacent lot. If shared access is not possible or practicable, the driveway must be placed as far from the intersection as possible.
3. The minimum spacing of driveways and streets along a collector is 200 feet. The minimum spacing of driveways and streets along an arterial is 600 feet.
4. The minimum spacing of local streets along a local street is 125 feet.

Preliminary civil plans have been submitted by the applicant to demonstrate preliminary compliance with the access, egress and circulation requirements of this chapter.

Prior to commencing any site work, the applicant must submit a Preliminary Sight Distance Certification for review and approval.

Prior to final building inspection, the applicant must submit a Final Sight Distance Certification for review and approval. With a condition of approval, this standard is met.

ADDITIONAL CITY OR AGENCY COMMENTS:

Easements:

Prior to final building inspection, the applicant must record all public access and utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

Fire and Life Safety:

Prior to commencing any site work, the applicant must provide written approval from TVF&R for fire flow, hydrant placement, and emergency vehicular access and turn around.

Public Water System:

The existing public water mains are under the City of Tigard jurisdiction. The site plans indicate that services will be provided to serve the proposed development via the existing public water main located on SW Bull Mountain Road.

Prior to commencing site improvements, the applicant must submit site plans as part of the PFI Permit showing all proposed and/or extensions of public water lines, hydrants and water services to be designed in accordance with the City of Tigard Standards to Engineering for review and approval.

Storm Water Quality:

The City has agreed to enforce Surface Water Management regulations established by CWS Design and Construction which require the construction of on-site water quality facilities. In addition, a maintenance plan must be submitted indicating the frequency and method to be used in keeping the facility maintained through the year.

Prior to commencing site improvements, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI permit. Plans must be submitted to the city for review. The city will forward plans to CWS after preliminary review.

Grading and Erosion Control:

Clean Water Services Design and Construction Standards also regulate erosion control to reduce the amount of sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity which accelerates erosion. Prior to commencing any site work, the applicant must submit an erosion control plan for review and approval. The plan must comply to the "CWS Erosion Prevention and Sediment Control Design and Planning Manual" (current edition).

The Federal Clean Water Act requires that a National Pollutant Discharge Elimination System (NPDES) erosion control permit be issued for any development that will disturb one or more acre of land. The site is greater than one acre.

Prior to commencing any site improvements, the applicant must submit a final grading plan the existing and proposed contours. The plan must detail the provisions for surface drainage of the site and show that it will be graded to ensure that surface drainage is directed to the street or a public storm drainage system approved by the Engineering Department.

The design engineer must also indicate, on the grading plan, areas that will have natural slopes between 10 percent and 20 percent, as well as areas that will have natural slopes in excess of 20 percent. This information will be necessary in determining if special grading inspections and permits will be necessary upon development.

Address Assignments:

The City of Tigard is responsible for the approval of new street names and assigning addresses for parcels within the City of Tigard. Contact Oscar Contreras with Engineering Division at 503-718-2678 to ensure new addresses are assigned. Prior to permit submittal, the applicant must pay the addressing fee. The address fee will be assessed in accordance with the current Master Fee Schedule.

CONDITIONS OF APPROVAL

THE FOLLOWING CONDITIONS MUST BE SATISFIED PRIOR TO PERMIT SUBMITTAL:

1. Prior to permit submittal, the applicant must submit an Autocad file of proposed street names and assignment of addresses and pay the address fee. Contact Oscar Contreras at 503-718-2678 for the submission of the Autocad file. The address fee will be assessed in accordance with the current Master Fee Schedule.

THE FOLLOWING CONDITIONS MUST BE SATISFIED PRIOR TO COMMENCING ANY SITE WORK:

The applicant must prepare a cover letter and submit it, along with any supporting documents or plans that address the following requirements to the ENGINEERING DIVISION, ATTN: Jeremy Tamargo, Principal Engineer at (971) 713-0281 or JeremyT@tigard-or.gov. The cover letter must clearly identify where in the submittal the required information is found:

2. Improvements associated with public infrastructure including street and right-of-way dedication, utilities, grading, water quality and quantity facilities, streetlights, easements, easement locations, and utility connections must be designed in accordance with the following codes and standards:
 - City of Tigard Public Improvement Design Standards

- Clean Water Services (CWS) Design and Construction Standards
 - Tigard Community Development Codes, Municipal Codes
 - Tualatin Valley Fire and Rescue (TVF&R) Fire Codes
 - Other applicable County, State, and Federal Codes and Standard Guidelines
3. Improvements associated with public infrastructure including street and right-of-way dedication, utilities, grading, water quality and quantity facilities, streetlights, easements, easement locations, and utility connections for future utility extensions are subject to the City Engineer's review, modification, and approval.
 4. Prior to commencing any site work, the applicant must submit a Public Facility Improvement (PFI) Permit to cover all infrastructure work including stormwater Water Quality and Quantity Facilities and any other work in the public right-of-way. Four (4) sets of detailed public improvement plans must be submitted for review to the Engineering Department. An Engineering cost estimate of improvements associated with public infrastructures including but not limited to street, street grading, utilities, stormwater quality and water quantity facilities, sanitary sewer, streetlights, and franchise utilities are required at the time of PFI Permit submittal. When the water system is under the City of Tigard jurisdiction, an Engineering cost estimate of water improvement must be listed as a separate line item from the total cost estimate. NOTE: these plans are in addition to any drawings required by the Building Division and should only include sheets relevant to public improvements. Public Facility Improvement Permit plans must conform to City of Tigard Public Improvement Design Standards, which are available at City Hall and the City's web page (www.tigard-or.gov).
 5. Prior to commencing any site work, the applicant must submit plans showing the following required street improvements to engineering for review and approval:

SW Bull Mountain Road:
 - 8' public utility easement
 - Street lighting
 6. Prior to commencing any site work, the applicant must submit the exact legal name, address and telephone number of the individual or corporate entity who will be designated as the "Permittee", and who will provide the financial assurance for the public improvements. Specify if the entity is a corporation, limited partnership, LLC, etc. and the state within which the entity is incorporated and provide the name of the corporate contact person. Failure to provide accurate information will delay processing of project documents.
 7. Prior to commencing any site work, the applicant must provide a construction vehicle access and parking plan for approval by the City Engineer. The purpose of this plan is for parking and traffic control during the public improvement construction phase. All construction vehicle parking must be provided onsite. No construction vehicles or equipment will be permitted to park on the adjoining residential public streets. Construction vehicles include the vehicles of any contractor or subcontractor involved in the construction of site improvements or buildings proposed by this application and must include the vehicles of all suppliers and employees associated with the project.

8. Prior to commencing site improvements, the applicant must provide a photometric analysis for the review and approval. The applicant must submit plans showing the location of streetlights and the type and color of pole and light fixture for review and approval. Photometric analysis will follow the recommended values and requirements described in ANSI/IESNA. All public streetlights must be PGE Option B.
9. Prior to commencing any site work, the applicant must submit site plans and a final storm drainage report as part of the PFI Permit indicating how run-off generated by the development will be collected, conveyed, treated and detained for review and approval. The storm drainage report must be prepared and include a maintenance plan in accordance with CWS Design and Construction Standards and the City of Tigard Standards.
10. Prior to commencing any site work, the applicant must obtain a CWS Stormwater Connection Authorization prior to issuance of the City of Tigard PFI Permit. Plans must be submitted to the City of Tigard for review. The City will forward plans to CWS after preliminary review.
11. Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing the proposed sanitary sewer system and associated facilities to be designed and constructed in accordance with the City of Tigard and CWS Design and Construction Standards.
12. Prior to commencing any site work, the applicant must submit site plans as part of the PFI Permit showing all proposed and/or extensions of public water lines, hydrants and water services to be designed in accordance with the City of Tigard Standards for review and approval.
13. Prior to commencing any site work, the applicant must provide written approval from TVF&R for fire flow, hydrant placement, and emergency vehicular access and turn around.
14. Prior to commencing any site work, the applicant must submit an erosion control plan as part of the PFI Permit. The plan must conform to the "CWS Erosion Prevention and Sediment Control Design and Planning Manual" (current edition).
15. Prior to commencing any site work, the applicant must submit a final grading plan showing the existing and proposed contours. The plan must detail the provisions for surface drainage of the site and show that it will be graded to ensure that surface drainage is directed to the street or a public storm drainage system approved by the Engineering Division. The design engineer must indicate, on the grading plan, which areas will have natural slopes between 10 percent and 20 percent, as well as area that will have natural slopes in excess of 20 percent. This information will be necessary in determining if special grading inspections or permits will be necessary.
16. Prior to commencing any site work, the applicant must submit a Preliminary Sight Distance Certification for review and approval.

17. Prior to commencing any site work, the applicant must provide a performance bond for all public improvements and private stormwater treatment facilities associated with the development.

**THE FOLLOWING CONDITIONS MUST BE SATISFIED
PRIOR TO FINAL BUILDING INSPECTION:**

The applicant must prepare a cover letter and submit it, along with any supporting documents or plans that address the following requirements to the ENGINEERING DIVISION, ATTN: Jeremy Tamargo, Principal Engineer at (971) 713-0281 or JeremyT@tigard-or.gov. The cover letter must clearly identify where in the submittal the required information is found:

18. Prior to final building inspection, all improvements associated with public infrastructure including but not limited to street improvements under the City of Tigard jurisdiction must be constructed, completed and/or satisfied. The Applicant must obtain conditional acceptance from the City and provide a two-year maintenance assurance for said improvements.
19. Prior to final building inspection all public utility facilities including but not limited to storm drainage, water quality and quantity, sanitary sewer, water, gas, electrical, communication, and wireless must be completed.
20. Prior to final building inspection, the applicant must submit the Final Sight Distance Certification for review and approval.
21. Prior to final building inspection, the applicant must place all existing and proposed utilities underground.
22. Prior to final building inspection, the applicant must record all utility easements including for storm drainage, sanitary sewer, and franchise utilities and provide recorded copies to the City.

MEMORANDUM

Date: June 17, 2021
To: Monica Bilodeau, Associate Planner, City of Tigard
From: Jackie Sue Humphreys, Clean Water Services (CWS)
Subject: Tigard ASR No. 3, MMD2021-00005, 2S109AC02500

Please include the following comments when writing your conditions of approval:

PRIOR TO ANY WORK ON THE SITE

A Clean Water Services (CWS) Storm Water Connection Permit Authorization must be obtained. Application for CWS Permit Authorization must be in accordance with the requirements of the Design and Construction Standards, Resolution and Order No. 19-5 as amended by R&O 19-22, or prior standards as meeting the implementation policy of R&O 18-28, and is to include:

- a. Detailed plans prepared in accordance with Chapter 2, Section 2.04.
- b. Detailed grading and erosion control plan. An Erosion Control Permit will be required. Area of Disturbance must be clearly identified on submitted construction plans.
- c. Detailed plans showing each lot within the development having direct access by gravity to public storm and sanitary sewer.
- d. Provisions for water quality in accordance with the requirements of the above named design standards. Water Quality is required for all new development and redevelopment areas per R&O 19-5, Section 4.04. Access shall be provided for maintenance of facility per R&O 19-5, Section 4.07.6.
- e. If use of an existing offsite or regional Water Quality Facility is proposed, it must be clearly identified on plans, showing its location, condition, capacity to treat this site and, any additional improvements and/or upgrades that may be needed to utilize that facility.

- f. If private lot LIDA systems proposed, must comply with the current CWS Design and Construction Standards. A private maintenance agreement, for the proposed private lot LIDA systems, needs to be provided to the City for review and acceptance.
- g. Show all existing and proposed easements on plans. Any required storm sewer, sanitary sewer, and water quality related easements must be granted to the City.
- h. Any proposed offsite construction activities will require an update or amendment to the current Service Provider Letter for this project.

CONCLUSION

This Land Use Review does not constitute CWS approval of storm or sanitary sewer compliance to the NPDES permit held by CWS. CWS, prior to issuance of any connection permits, must approve final construction plans and drainage calculations.



June 17, 2021

Associate Planner
City of Tigard
13125 SW Hall Blvd
Tigard, Oregon 97223

Re: Tigard ASR #3
Tax Lot I.D: 2S109AC TL 2500 / 13001 SW Bull Mt Rd

Thank you for the opportunity to review the proposed site plan surrounding the above named development project. These notes are provided in regards to the plans received **June 2021**. There may be more or less requirements needed based upon the final project design, however, Tualatin Valley Fire & Rescue will endorse this proposal predicated on the following criteria and conditions of approval.

FIRE APPARATUS ACCESS:

1. **FIRE APPARATUS ACCESS ROAD DISTANCE FROM BUILDINGS AND FACILITIES:** Access roads shall be within 150 feet of all portions of the exterior wall of the first story of the building as measured by an approved route around the exterior of the building or facility. An approved turnaround is required if the remaining distance to an approved intersecting roadway, as measured along the fire apparatus access road, is greater than 150 feet. (OFC 503.1.1)
2. **GATES:** Gates securing fire apparatus roads shall comply with all of the following (OFC D103.5, and 503.6):
 1. Minimum unobstructed width shall be not less than 20 feet (or the required roadway surface width).
 2. Gates shall be set back at minimum of 30 feet from the intersecting roadway or as approved.
 3. Electric gates shall be equipped with a means for operation by fire department personnel
 4. Electric automatic gates shall comply with ASTM F 2200 and UL 325.
3. **ACCESS DURING CONSTRUCTION:** Approved fire apparatus access roadways shall be installed and operational prior to any combustible construction or storage of combustible materials on the site. Temporary address signage shall also be provided during construction. (OFC 3309 and 3310.1)

FIREFIGHTING WATER SUPPLIES:

4. **COMMERCIAL BUILDINGS – REQUIRED FIRE FLOW:** The minimum fire flow and flow duration shall be determined in accordance with OFC Table B105.2. The required fire flow for a building shall not exceed the available GPM in the water delivery system at 20 psi residual. (OFC B105.3)

Note: OFC B106, Limiting Fire-Flow is also enforced, except for the following:

- The maximum needed fire flow shall be 3,000 GPM, measured at 20 psi residual pressure.
- Tualatin Valley Fire & Rescue does not adopt Occupancy Hazards Modifiers in section B105.4-B105.4.1

5. **FIRE FLOW WATER AVAILABILITY:** Applicants shall provide documentation of a fire hydrant flow test or flow test modeling of water availability from the local water purveyor if the project includes a new structure or increase in the floor area of an existing structure. Tests shall be conducted from a fire hydrant within 400 feet for commercial projects, or 600 feet for residential development. Flow tests will be accepted if they were performed within 5 years as long as no adverse modifications have been made to the supply system. Water availability information may not be required to be submitted for every project. (OFC Appendix B)
6. **WATER SUPPLY DURING CONSTRUCTION:** Approved firefighting water supplies shall be installed and operational prior to any combustible construction or storage of combustible materials on the site. (OFC 3312.1)

FIRE HYDRANTS:

7. **FIRE HYDRANTS – COMMERCIAL BUILDINGS:** Where a portion of the building is more than 400 feet from a hydrant on a fire apparatus access road, as measured in an approved route around the exterior of the building, on-site fire hydrants and mains shall be provided. (OFC 507.5.1)
 - This distance may be increased to 600 feet for buildings equipped throughout with an approved automatic sprinkler system.
 - The number and distribution of fire hydrants required for commercial structure(s) is based on Table C105.1, following any fire-flow reductions allowed by section B105.3.1. Additional fire hydrants may be required due to spacing and/or section 507.5 of the Oregon Fire Code.
8. **KNOX BOX:** A Knox Box for building access may be required for structures and gates. See Appendix B for further information and detail on required installations. Order via www.knoxbox.com or contact TVF&R for assistance and instructions regarding installation and placement. (OFC 506.1)
9. **FIRE PROTECTION EQUIPMENT IDENTIFICATION:** Rooms containing controls to fire suppression and detection equipment shall be identified as "Fire Control Room." Signage shall have letters with a minimum of 4 inches high with a minimum stroke width of 1/2 inch, and be plainly legible, and contrast with its background. (OFC 509.1)
10. **PREMISES IDENTIFICATION:** New and existing buildings shall have approved address numbers; building numbers or approved building identification placed in a position that is plainly legible and visible from the street or road fronting the property, including monument signs. These numbers shall contrast with their background. Numbers shall be a minimum of 4 inches high with a minimum stroke width of 1/2 inch. (OFC 505.1)

If you have questions or need further clarification, please feel free to contact me at **503-259-1504**.

Sincerely,



John Wolff
Deputy Fire Marshal II

john.wolff@tvfr.com

Cc:

A full copy of the New Construction Fire Code Applications Guide for Commercial and Multi-Family Development is available at <http://www.tvfr.com/DocumentCenter/View/1296>

SENSITIVE AREA PRE-SCREENING SITE ASSESSMENT

 Clean Water Services File Number 20-002535

1. **Jurisdiction:** City of Tigard

2. **Property Information** (example: 1S234AB01400)
 Tax lot ID(s): 2S109AC02500

OR Site Address: 13001 SW Bull Mountain Road
 City, State, Zip: Tigard, OR 97224
 Nearest cross street: SW 132nd Terrace

3. **Owner Information**
 Name: _____
 Company: City of Tigard
 Address: 13125 SW Hall Boulevard
 City, State, Zip: Tigard, OR 97224
 Phone/fax: Please contact AKS Engineering & Forestry, LLC
 Email: Please contact AKS Engineering & Forestry, LLC

4. **Applicant Information**
 Name: Jacki Herb
 Company: AKS Engineering & Forestry, LLC
 Address: 12965 SW Herman Road, Suite 100
 City, State, Zip: Tualatin, OR 97062
 Phone/fax: (503) 563-6151 | (503) 563-6152
 Email: herbj@aks-eng.com

4. **Development Activity** (check **all** that apply)
 Addition to single family residence (rooms, deck, garage)
 Lot line adjustment Minor land partition
 Residential condominium Commercial condominium
 Residential subdivision Commercial subdivision
 Single lot commercial Multi lot commercial
 Other Modifications to existing water facilities/wells

6. **Will the project involve any off-site work?** Yes No Unknown
 Location and description of off-site work: _____

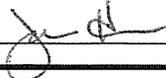
7. **Additional comments or information that may be needed to understand your project:** _____

This application does NOT replace Grading and Erosion Control Permits, Connection Permits, Building Permits, Site Development Permits, DEQ 1200-C Permit or other permits as issued by the Department of Environmental Quality, Department of State Lands and/or Department of the Army COE. All required permits and approvals must be obtained and completed under applicable local, state, and federal law.

By signing this form, the Owner or Owner's authorized agent or representative, acknowledges and agrees that employees of Clean Water Services have authority to enter the project site at all reasonable times for the purpose of inspecting project site conditions and gathering information related to the project site. I certify that I am familiar with the information contained in this document, and to the best of my knowledge and belief, this information is true, complete, and accurate.

 Print/type name Jacki Herb

 Print/type title Planner

 Signature 

 Date 9-17-20

FOR DISTRICT USE ONLY

- Sensitive areas potentially exist on site or within 200' of the site. **THE APPLICANT MUST PERFORM A SITE ASSESSMENT PRIOR TO ISSUANCE OF A SERVICE PROVIDER LETTER.** If Sensitive Areas exist on the site or within 200 feet on adjacent properties, a Natural Resources Assessment Report may also be required.
- Based on review of the submitted materials and best available information sensitive areas do not appear to exist on site or within 200' of the site. This Sensitive Area Pre-Screening Site Assessment does NOT eliminate the need to evaluate and protect water quality sensitive areas if they are subsequently discovered. This document will serve as your Service Provider Letter as required by Resolution and Order 19-5, Section 3.02.1, as amended by Resolution and Order 19-22. All required permits and approvals must be obtained and completed under applicable local, State and federal law.
- Based on review of the submitted materials and best available information the above referenced project will not significantly impact the existing or potentially sensitive area(s) found near the site. This Sensitive Area Pre-Screening Site Assessment does NOT eliminate the need to evaluate and protect additional water quality sensitive areas if they are subsequently discovered. This document will serve as your Service Provider Letter as required by Resolution and Order 19-5, Section 3.02.1, as amended by Resolution and Order 19-22. All required permits and approvals must be obtained and completed under applicable local, state and federal law.
- THIS SERVICE PROVIDER LETTER IS NOT VALID UNLESS _____ CWS APPROVED SITE PLAN(S) ARE ATTACHED.**
- The proposed activity does not meet the definition of development or the lot was platted after 9/9/95 ORS 92.040(2). **NO SITE ASSESSMENT OR SERVICE PROVIDER LETTER IS REQUIRED.**

 Reviewed by 

 Date 9/25/2020

 Once complete, email to: SPLReview@cleanwaterservices.org • Fax: (503) 681-4439

OR mail to: SPL Review, Clean Water Services, 2550 SW Hillsboro Highway, Hillsboro, Oregon 97123

Revised 2/2020

EXHIBIT A
CONTRACTOR COVID-19 VACCINATION ATTESTATION

City of Tigard Personnel Policy 80.0 [COVID-19 Vaccination Requirement](#) requires contractors must be full vaccinated for the COVID-19 virus or have a documented medical or religious exemption if the contractor personnel will (a) physically interact with Tigard staff or members of the public on behalf of the City in the course of performing work under the contract or (b) provide goods or perform services on-site at City buildings.

If you are unsure whether the vaccination requirement applies to you, please contact your Tigard contract administrator/project manager to discuss further.

By signing this form, I certify and attest to the following:

- I am authorized to sign this certification on behalf of contractor and am authorized to legally bind contractor.
- Contractor will not allow any unvaccinated employees, workers, or agents of the organization to perform any services or provide goods pursuant to this City of Tigard contract where such work includes (a) physically interacting with Tigard staff or members of the public on behalf of the City in the course of performing work under this contract or (b) provide goods or perform services on-site at City buildings.
- Contractor will ensure that any employees, workers, or agents of the organization engaged in work pursuant to this contract will adhere to any and all of the City's health and safety guidelines for the location where the work is performed, including wearing face coverings, distancing from others, and isolating or quarantining if exposed to or contracting COVID-19.
- Contractor understands and agrees that failure to comply with these requirements, which are hereby incorporated by reference as part of the terms and conditions in the Agreement, may result in the termination of contract for default.

Print Name

Date

Signature