

**COVERSHEET
DOCUMENTS POSTED ON BUILDER'S EXCHANGE OF WASHINGTON
(VOLUME 2)**



Project Name

Port Gardner Storage Facility - West Marine View Drive Storm & Combined
Sewer Design - Construction Package 2, City of Everett, WA #UP-3815-02

**Contractor
Name**

KLB Construction, LLC

**Bid Opening
Date**

3/3/2026 @ 2:00 pm PST

**City Clerk's
Digital
Certification
Stamp**

**City of
Everett** Digitally signed
by City of Everett
Date: 2026.04.21
11:35:41 -07'00'

CITY OF EVERETT

PUBLIC WORKS DEPARTMENT

PORT GARDNER STORAGE FACILITY – WEST MARINE VIEW DRIVE STORM AND COMBINED SEWER DESIGN

WORK ORDER: UP-3815-02

Funded in part by the Washington State Department of Ecology

December 2025

CONSTRUCTION PACKAGE 2

SPECIFICATIONS

Divisions 02 – 40

VOLUME 2



CITY OF EVERETT

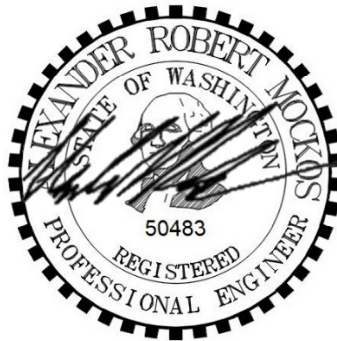
PUBLIC WORKS DEPARTMENT

PORT GARDNER STORAGE FACILITY –
WEST MARINE VIEW DRIVE
STORM AND COMBINED SEWER DESIGN

CONSTRUCTION PACKAGE 2

WORK ORDER: UP-3815-02

Divisions 00 and 01: ALEXANDER MOCKOS



APPROVED
Signer Name: Alexander Mockos
Signing Reason: I approved
this document.
Signing Time: 2025-12-15
17:52:30(EST)

Divisions 01 and 31: ELLIOTT MECHAM



APPROVED
Signer Name: Elliott Mecham
Signing Reason: I approved
this document.
Signing Time: 2025-12-09
13:08:34(EST)



Divisions 02, 09, 31, 32, 33, and 40: DAVID BERGDOLT



Signer Name: David Bergdolt
Signing Reason: I approved
this document.
Signing Time: 2025-12-15
16:01:31 (EST)

Divisions 03, 05, 07, and 31: GINO MAZZOTTI



Signer Name: Gino Mazzotti
Signing Reason: I approved
this document.
Signing Time: 2025-12-09
17:57:06 (EST)

Division 33: JENNIFER FU



Signer Name: Jennifer Fu
Signing Reason: I approved
this document.
Signing Time: 2025-12-12
17:59:59 (EST)



CITY OF EVERETT

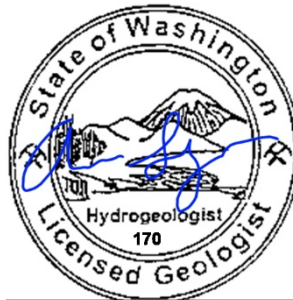
PUBLIC WORKS DEPARTMENT

PORT GARDNER STORAGE FACILITY –
WEST MARINE VIEW DRIVE
STORM AND COMBINED SEWER DESIGN

CONSTRUCTION PACKAGE 2

WORK ORDER: UP-3815-02

Divisions 02: ARNON SUGAR



Arnon Sugar

Signer Name: Arnon Sugar
Signing Reason: I approved
this document.
Signing Time: 2025-12-08
18:52:50 (EST)



CITY OF EVERETT

PUBLIC WORKS DEPARTMENT

PORT GARDNER STORAGE FACILITY –
WEST MARINE VIEW DRIVE
STORM AND COMBINED SEWER DESIGN

CONSTRUCTION PACKAGE 2

WORK ORDER: UP-3815-02

Division 01: RONALD LEIMKUHLER



Signer Name: Ronald Leimkuhler
Signing Reason: I approve
This document
Signing Time: 2025-12-08
20:05:41 (EST)



CITY OF EVERETT

PUBLIC WORKS DEPARTMENT

PORT GARDNER STORAGE FACILITY –
WEST MARINE VIEW DRIVE
STORM AND COMBINED SEWER DESIGN

CONSTRUCTION PACKAGE 2

WORK ORDER: UP-3815-02

Division 33: KIMBERLIE STAHELI



Kimberlie Staheli
Stamp: Kimberlie Staheli
Professional Engineer - E.C.E.
No. 36520
Expires: 12/31/2025



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D. Bergdolt
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SECTION 02 01 10
EXISTING UTILITIES COORDINATION AND LOCATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies requirements to locate existing utilities and coordinate with Utility Owners.
 - 1. Utilities, both known and not known (not shown) shall be located and protected during performance of the Work.
 - a. Known utilities are shown on Drawings based on the best available record information and visible surface expression of utilities (i.e., covers, valve boxes, etc.)
 - 2. Existing utilities include but are not limited to potable water, combined sewer, sanitary sewer, storm water, gas, electric, telephone, communication, traffic control, and other utility lines or service lines, both underground and overhead.
- B. Numerous parallel and crossing utilities are in close proximity to the Work which may or may not lie within the Contractor's excavation/trench zone.
 - 1. The cost of utility coordination (811 Call before you dig), coordination with Utility Owner, subsurface investigations and excavations, location, verification and protection of utilities must be included in the bid item to which the Work is appurtenant.
- C. The Contractor must locate existing utilities sufficiently in advance of construction to identify conflicts and allow for their timely resolution to prevent schedule delays.
 - 1. Work around, crossing, or adjacent to existing utilities must be performed in accordance with the Utility Owner's requirements for methods (e.g., hand-digging), protection, notification and stand-by.
 - 2. Utilities shall be maintained in service at all times unless otherwise specified. Any disruption of service must be coordinated with and approved by the Utility Owner in writing.
 - 3. Where necessary, provide and maintain bypass facilities necessary to maintain existing utilities in service.
 - 4. Provide the Construction Manager with the name and contact information for Contractor's Responsible Person who can be contacted regarding problems during construction on a 24 Hour Basis.
- D. The Contractor's attention is called to the following utilities, in particular. This list shall not be taken as a complete list of parallel and/or crossing utilities and additional potholing is required.
 - 1. 16" W (C-2060-C2069)
 - a. Field verify connection locations, access pit crossing, and depth of cover
 - 2. UG Power Crossing STA 32+14.37 (C-2106)
 - a. See paragraph 3.02.
 - 3. 18" SD STA 70+83.76 (C-2114)
 - 4. 18" SD Sta 76+55.07 (C-2115)

5. SSMH100 Sta 10+00 (C-2206)
 - a. Field verify depth of inverts prior to demolition. Cover is bolted and bolts are stripped. Coordinate work with City. .
 6. COE 24" SS (C-1104)
 7. PSE 12" HP Gas, WMVD (C-2060, C-2106, C-2206, C-2306,)
 8. PSE 6" HP Gas Lower Norton Ave (C-2060 – C-2069)
 9. SnoPUD electric, Lower Norton Ave, Port of Everett, Norton Terminal
 10. COE 18" SD, WMVD (C-2114, STA 70+83.76; C-2115, STA 76+55.07; C-2215, STA 25+01.31)
 11. COE 12" SS HPDE FM. WMVD (C-2215, STA 24+90.23)
 12. Telecom, WMVD and 19th St (C-2312, STA 33.54.76)
- E. See Section 01 12 16 WORK SEQUENCE for additional requirements for utilities with the Port of Everett, Norton Terminal property.
1. Contractor shall be responsible to coordinate completion of the Work with the City and Port to protect, maintain and restore Port utilities.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 02 01 20, Protecting Existing Utilities
 2. Section 31 50 00, Excavation Support and Protection

1.03 REFERENCES

- A. 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.
- B. 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
ASCE 38-22	ASCE/UESI/CI 38-22: Standard Guideline for Investigating and Documenting Existing Utilities
ASCE 75-22	ASCE/UESI/CI 75-22: Standard Guideline for Recording and Exchanging Utility Infrastructure Data
COE	City of Everett Design and Construction Standards & Specifications for

Reference	Title
	Development. Current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures.
- B. Action Submittals
 - 1. Contractor's Responsible person.
 - 2. Submit potholing plan with methods to be provided, name and contact information if third party subcontractors are performing the Work.
 - 3. Submit Schedule for potholing to be completed for the pipeline corridor.
- C. Construction Submittals
 - 1. Submit summarized utility data including but not limited to:
 - a. Surveyed location including Northings and Eastings in the project coordinate system, invert elevation, diameter, material, and location of appurtenances, fittings, and connections where exposed either by potholing or exposed within the excavation. Survey data shall include survey shots on any utility relocated and each utility exposed in the pipe trench (one top of utility survey point on utility at each side of the trench). See Section 01 32 23 SURVEY AND LAYOUT DATA.
 - b. Asphalt thickness where applicable.
- D. Informational Submittals
 - 1. Submit record copies of all permits acquired for Utility work.

1.05 IDENTIFICATION OF UTILITIES AND INVESTIGATIONS

- A. Provide 811 (Call Before You Dig) prior to any excavation.
- B. Obtain required permits and permissions prior to subsurface investigations and excavation from the agency with authority over the ROW and the utility Owner.
- C. Surface restoration, backfill and temporary surface restoration shall be in accordance with the agency requirements.
- D. Take all actions required to verify the existence, location, size, material, and condition of utilities. If the Contractor's investigations identify utilities not shown or not located as shown, notify the Construction Manager immediately.
- E. Document locating and exposing each utility; Provide survey information (N, E, Z), material and service for each utility located and record the location on the Record Drawings.

1.06 NOTIFICATION AND COORDINATION

- A. Notify Utility Owner a minimum of 10 days, or as required by the Utility Owner, whichever is greater, prior to potholing or exposing utilities.
- B. Establish crossing requirements, stand-by requirements, limits to means and methods (e.g., hand-digging), for existing utilities prior to the start of any work.
- C. Coordinate with other contractors working within the project limits, and property owners as required to perform the Work.
- D. Allow adequate time in the schedule for completion of the Utility location work and relocation by others where required.
- E. Where work is performed near other existing utilities, provide support and protect utilities. Protect Utilities in accordance with Section 02 01 20.
- F. Where work is performed near existing overhead utilities, coordinate work to meet safety requirements, prevent schedule delays or damage to utilities.
- G. PSE requires a minimum of 5' separation from gas pipes to shoring. For any shoring less than 5', PSE requires a PI inspector to be onsite while shoring is being completed. Coordinate with PSE accordingly.

PART 2 PRODUCTS

2.01 UTILITY INVESTIGATION REPORTS

- A. Provide utility investigation summary reports per Article 1.04, C.

PART 3 EXECUTION

3.01 GENERAL

- A. Pothole all utility crossings.
 - 1. Submit pothole data/findings to Construction Manager for review prior procuring pipe, fittings, structures, and appurtenances.
 - 2. Incorporate findings into the construction documents and performance of Work.
- B. Connection Points:
 - 1. Excavate test pits to field verify the locations, depth of bury, diameter, and pipe material of existing underground utilities at crossings and at tie-in points before ordering materials or commencing excavation. Immediately notify the Construction Manager if conflicts are encountered.
 - 2. All connections to existing utilities must be reviewed and accepted by the Utility Owner and connections must meet their current requirements. All connections must be fully restrained.

C. Utility Conflicts

1. If a utility conflict is identified that cannot be resolved by supporting the utility in place, the Contractor shall prepare with utility owner and Construction Manager a utility relocation plan. The relocations plan shall be submitted and accepted by the Utility Owner and meet current utility requirements. Submit Utility relocation plans, acceptance, and correspondence.

D. Shutdown/Service Disruptions

1. A request for shutdown shall be required whenever connections are made to any utility line, including electric power and communication lines, gas, water, and sanitary sewers or storm sewers. Connections to any utility without an approved request will make the contractor liable to the owner for correction of any deficiencies and/or resulting impacts, including (but not limited to) health, safety, and financial burden. The Contractor shall request permission with the required notification period prior to the day planned for any utility shutdown. All utility shut downs are subject to approval by the Owner.

END OF SECTION

SECTION 02 01 20
PROTECTING EXISTING UTILITIES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section includes materials and procedures for protecting existing underground utilities during performance of the Work. Provide all necessary labor, equipment, material, and services to protect existing utilities.
- B. Perform Utility location in accordance with Section 02 01 10, Existing Utilities, Coordination and Location.
- C. Numerous parallel and crossing utilities are in close proximity to the Work which may or may not lie within the Contractor's excavation/trench zone. The cost of protection, supporting, verification of condition (Pre- or Post-construction) and repair or replacement of damaged or disturbed facilities will be at the expense of the Contractor and included in the bid item to which the Work is appurtenant.
 - 1. Utilities shall be maintained in service at all times unless otherwise specified. Any disruption of service must be coordinated with and approved by the Utility Owner in writing.
 - 2. Where necessary, provide temporary service and maintain service with bypass or highlining operations as necessary to maintain service.
 - 3. Any disruption of service shall be the responsibility of the Contractor.
- D. Protecting existing underground utilities.
 - 1. Where required to perform the work, shoring shall be provided to maintain side support as the trench is excavated. The Contractor shall be responsible for the design of support systems and any costs for replacing utilities that are damaged as a result of their activities.
 - 2. Provide necessary designs for sheeting, shoring, and other protection in accordance with Section 31 50 00, Excavation Support and Protection.
- E. Protecting existing overhead utilities
 - 1. Where work is performed near existing overhead utilities, coordinate work to meet safety requirements, prevent schedule delays or damage to utilities.
- F. Utility Relocation
 - 1. Relocate existing utility as required to complete the Work. Cost of relocation shall be included in the associated bid items and included in the submitted construction schedule.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 02 01 10, Existing Utilities, Coordination and Location.
 - 2. Section 31 50 00, Excavation Support and Protection

1.03 REFERENCES

- A. 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.
- B. 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.

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WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures.
- B. Action Submittals
1. Submit Plan for the protection of underground utilities including but not limited to:
 - a. Record drawings.
 - b. Description of utility to be protected.
 - c. Pothing data showing the relationship of the proposed work to the existing utility, including survey coordinates and elevations.
 - d. Work to be completed in the proximity of the utility.
 - e. Method to protect the utility.
 - f. Method to utility is undamaged.
 - g. Duration and schedule of any service disruption required.
 2. Submit plans for utility pole bracing and support meeting the requirements of SnoPUD Provide Record Copies of the bracing plan accepted by SnoPUD.

- C. Construction Submittals
 - 1. Submit record copies of all correspondence with Utility Owners.
 - 2. Utility Relocation Plans:
 - a. For all Utility relocation work, provide As Built or Record Utility plans prepared by the Contractor. Plans are subject to review by the Utility Owner.
 - b. Submit information as a hard copy or electronic file format specified by the Utility Owner. Record drawings shall show the locations of existing utilities, structures, trees, streets, and ROW limits.

PART 2 PRODUCTS

2.01 RELOCATION OR REPLACEMENT IN KIND

- A. Except as indicated below or as specifically authorized by the Construction Manager, replace or repair utilities with new materials of the same size, type, and quality as that removed or damaged.
 - 1. Sewer and Sewer Lateral relocations shall be in accordance with Utility Owner.
 - 2. Water line relocations shall be in accordance with Utility Owner, and
 - 3. Storm Drain relocations shall be in accordance with Utility Owner.
 - 4. Where ACP (Transite Pipe) is removed or damaged, replacement shall be made with Steel or Ductile iron pipe spool and appurtenances. All pipe, fittings, couplings and hardware shall be provided with corrosion protection.

2.02 PROTECT STORM DRAIN SYSTEMS

- A. Protect storm drain systems from construction sediments and debris.
- B. Obtain Utility Owner approval prior to discharging water into existing drainage systems. All discharged storm water must meet Western Ecology requirements.

2.03 PROTECTION OF OVERHEAD UTILITIES

- A. Provide utility pole bracing when excavation is within close proximity to existing towers, utility poles, or guy wires and anchors.
- B. Excavation, particularly along the western boundary of Lower Norton Road will be close to existing SnoPUD overhead high voltage power poles. Excavation will be within the prism requiring pole bracing during excavation through complete backfilling and compaction operations. Excavation, shoring and pole bracing must be performed in accordance with SnoPUD requirements. Protection methods must consider the soil type, offset of edge of excavation, excavation depth, and electrical pole foundation dimensions and depth.
- C. Notify and coordinate with SnoPUD for bracing requirements, inspections, approval of bracing system, and installation.

2.04 PROTECTION OF BURIED UTILITIES

- A. Where utility separations are not meet or where specified, provide Utility supports.

B. Expanded Polystyrene Foam

1. Provide High-performance, closed-cell, lightweight, Type II, Expanded Polystyrene foam with the following minimum properties:
 - a. Physical and Thermal Properties
 - 1) Minimum Density of 1.35 pcf. Test method ASTM C303.
 - 2) Thermal resistance of:
 - a) 4.76 (per inch) at @25 °F. Test method ASTM C518 or ASTM C177.
 - b) 4.55 (per inch) at @40 °F. Test method ASTM C518 or ASTM C177.
 - c) 4.17 (per inch) at @75 °F. Test method ASTM C518 or ASTM C177.
 - 3) Water Vapor Permeability of 3.5 perm. Test method ASTM E96.
 - 4) Water Absorption of 3.0% (% by volume). Test method ASTM C272.
 - 5) Minimum Oxygen Index of 24%. Test method ASTM D 2863
 - 6) BTU content of 16,655. Test method ASTM D2015.
 - b. Strength Properties
 - 1) Minimum compressive strength @10% deformation of 15 psi. Test method ASTM D1621.
 - 2) Minimum flexural strength of 35 psi. Test method ASTM C203.
 - 3) Tensile strength of 18-22 psi. Test method ASTM D1623.
 - 4) Shear strength of 26-32. Test method ASTM D732.
 - 5) Shear modulus of 460-500.
 - 6) Modulus of elasticity of 320-360.
 - 7) Dimensional stability of 2.00%. Test method ASTM D2126.
 - 8) Flame spread of less than 20. Test method ASTM E84.
 - 9) Smoke development less than 400. Test method ASTM E84.
2. Acceptable Manufacturers
 - a. StarRFoam
 - b. Northwest Foam Products

PART 3 EXECUTION

3.01 GENERAL

- A. Before beginning pipeline excavation, determine the true location and depth of utilities and service connections which may be affected by or affect the Work in accordance with Section 02 01 10, Existing Utilities, Coordination and Relocation.
- B. Work locating, crossing or adjacent to any utility must be completed in accordance with the Utility Owner's requirements for protection, notification and stand-by.
 1. Notify Construction Manager at least 72 hours prior to excavation adjacent to crossing utilities.
 2. Where utilities are parallel to or cross work, but do not conflict with work, notify the utility owner at least 48 hours in advance of construction at the crossing. Coordinate the construction schedule with the utility owner.

- C. Comply with the requirements in Section 01 12 16. Refer to General Conditions for additional requirements and definitions.
- D. Construction Manager Procedures
 - 1. PROTECTION IN PLACE: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified on the plans or in the Specifications. Backfill and compact under and around the utility so that no voids are left. Refer to Section 31 23 00, Excavation and Fill for methods of backfill and compaction.
 - a. Backfill and compact under and around utilities.
 - b. Methods and compaction shall conform to Section 31 23 00 or the Utility Owner's requirements.
 - c. Where compaction cannot adequately be performed around utility due to the presence of encroaching existing utilities, flowable fill may be provided on a case-by-case basis with acceptance by the Construction Manager and the Utility Owner.
 - 1) Provide Submittals with product data, test results, and all documentation as required by WSDOT Standards to demonstrate compliance.
- E. Damage to Utilities to Remain: If existing utilities to remain are damaged, immediately notify utility owner, and repair to utility owner's satisfaction.

3.02 REMOVE AND RECONSTRUCT

- A. Where specified, required to complete the Work, or as directed by the Construction Manager, remove utilities and after completion of the Work, reconstruct the utility in kind, with new materials and per the Utility agency requirements. Provide temporary service for the disconnected utilities or as directed by the utility owner.

3.03 PROTECTION OF THRUST BLOCKS:

- A. Protect thrust blocks on existing waterlines or sewer force mains in place.
- B. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the Construction Manager, provide alternative thrust resistance accepted by the Construction Manager or reconstruct blocks to bear against firm unexcavated or backfill material.
- C. Contractor shall provide calculations indicating working pressure, surge pressure, joint restraint lengths required and manufacturer's product data. Calculations shall be provided by a Licensed Professional Engineer in the State of Washington

3.04 SERVICE LATERALS AND CONNECTIONS

- A. Service laterals and connections to the various utilities (potable water, secondary water, irrigation water, sewer, gas, storm drains, land drains, etc.) in the vicinity of the Work. All laterals and service connections are not shown on the plans.
- B. Provide investigations, including exploratory excavations in accordance with Section 02 01 10, Existing Utilities, Coordination and Location, to determine the locations and type of existing service laterals or appurtenances when their presence can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the Work.

- C. If the Contractor discovers utility facilities not identified in the Contract Documents or in a position different from that shown in the Contract Drawings, immediately notify in writing the Engineer.
- D. When it is necessary to remove, relocate, protect, or temporarily maintain a service connection, the Contractor shall bear all expenses incidental to the Work on the utility or damage thereto. The work on the service connection shall be done in a manner satisfactory to the utility owner; it being understood that the owner of the utility has the option of doing such work with his own forces or permitting the work to be done by the Contractor.
- E. Report, and record all required repairs due to construction activity, damage, and or removal to the Engineer and on record documents.
- F. Testing shall be conducted in accordance with the Utility Owner's requirements. Substantial Completion will not be issued, and the project will not be considered complete until all construction created damages have been repaired and the system associated with these construction repairs are considered functional by the Utility Owner(s) and Engineer.

END OF SECTION

SECTION 02 41 00
DEMOLITION AND SALVAGE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of buildings or structures.
 - 2. Demolition and removal of exposed piping and appurtenances.
 - 3. Demolition and removal of buried process piping.
 - 4. Photographs showing details of equipment to be demolished.
 - 5. Removal and salvage of select equipment.
- B. Definitions
 - 1. Remove: Detach items from existing construction and legally dispose of materials off-site.
 - 2. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Construction Manager.
 - 3. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
 - 4. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
 - 5. Abandon-In-Place: Render item permanently nonoperational in its existing location, detach from any existing construction and cease to maintain.
- C. All demolished and removed material becomes the property of the Contractor and shall be removed from the site. All activities that have the potential to contact contaminated soil will be performed under a health and safety plan (HASP) and materials shall be handled, stored and disposed of in accordance with the Project's Soil and Groundwater Management Plan.
- D. Portions of this Project are located within the Port of Everett that include the Kimberly-Clark Worldwide MTCA Site and the ExxonMobil/ADC MTCA site, which are listed on the Washington State Department of Ecology's (ECY) Confirmed and Suspected Contaminated Sites List.
 - 1. Excavation, demolition, handling, transport and disposal of all materials are subject to the Soil and Groundwater Management Plans and requirements.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. 02 83 33 Handling and Disposal of Lead Based Paint
 - 2. 33 05 04.30 Selective Demolition For Utilities – Sanitary Sewers

1.03 REFERENCES

- A. 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.
- B. 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
ASCE 38-22	Standard Guideline for Investigating and Documenting Existing Utilities
ASCE 75-22	Standard Guideline for Recording and Exchanging Utility Infrastructure Data
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
DNR	Washington Department of Natural Resources Derelict Pile Removal Best Management Practices for Pile Removal and Disposal
EPA	EPA Best Management Practices for Piling Removal and Placement in Washington State
SMMWW	Department of Ecology's Stormwater Management Manual for Western Washington
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures
- B. Action Submittals:
1. Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
 2. Pre and post-demolition Photographs or Video: Submit before Work begins and after demolition is completed.
 3. Schedule of Demolition Activities: Schedule the following activities in conjunction with the requirements of Section 01 32 16.
 4. Detailed sequence of demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 5. Interruption of utility services. Indicate how long utility services will be interrupted.

6. Coordination for shutoff, capping, and continuation of utility services.
 7. Working drawings, procedures and materials used for demolition of CIPP Lined SS and sealing of cut liner.
- C. Informational Submittals:
1. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 2. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Constructions Submittals:
1. Daily Records of demolition activities including but not limited to:
 - a. Demolition of Kimberly Clark pipelines
 - b. Demolition of Kimberly Clark buried foundations and piles with daily logs for concrete tonnage and for pile removal, lengths and disposal
 - c. Demolition of Norton Terminal Improvements
- E. Closeout Submittals:
1. Inventory: Submit a list of items that have been removed and salvaged.
 2. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.05 PRE-DEMOLITION MEETINGS

- A. Conference: Conduct conference at Project site.
1. Schedule these meetings for each work Area / MOP as noted in 01 12 16 specification.
 2. Inspect and discuss condition of construction to be demolished.
 3. Review structural load limitations of existing structure.
 4. Review and finalize demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 5. Review requirements of work performed by other trades that rely on substrates exposed by demolition operations.
 6. Review areas where existing construction is to remain and requires protection.

1.06 DEMOLITION OF KIMBERLY-CLARK WATER LINES – RED LEAD PAINT

- A. Work shall include the demolition and modification of existing 30- and 48-inch steel water lines. Based on assessments completed by the City, water lines are coated with Red Lead Paint. Contractor shall comply with Section 02 83 33 for all activities related to the modification, removal, handling and disposal of lead based paint and Section 02 61 00 REMOVAL AND DISPOSAL OF CONTAMINATED SOILS

1.07 KIMBERLY CLARK SITE DEMOLITIONS (NORTON TERMINAL)

- A. Based on review of available record drawings, the Contractor will encounter building foundations remaining below ground from the former Kimberly-Clark site demolition to construct the Norton Terminal facilities, including: reinforced concrete, steel and timber piles; timber walls; and concrete slabs, grade beams and vaults. The approximate footprint of these remnant structural foundations is shown in the Drawings.
- B. In addition to the demolitions and replacement of above grade Port improvements, the Contractor shall be responsible for the removal and disposal of reinforced concrete foundations, steel and timber piles, and other abandoned below grade improvements within the trench and excavation limits as required to complete the Work.
 - 1. Demolish existing reinforced concrete foundations, slabs and grade beams, steel and timber piles as required to complete the Work.
 - a. Demolish and dispose of existing concrete reinforced foundations and grade beams in their entirety. Floor slabs are approximately 2'-6" thick (typ).
 - b. Remove and dispose of existing timber piles in accordance with the Washington Department of Natural Resources Derelict Pile Removal Best Management Practices for Pile Removal and Disposal and EPA Best Management Practices for Piling Removal and Placement in Washington State.
 - c. Remove and dispose of existing H-pile within the limits of the trench and access pit excavations. Piles are anticipated to be 5-foot on center with top elevations between 11' to 14' feet of elevation and lengths greater than 30- to 50-feet within the limits shown.
 - 1) H-piles outside of the trench excavation that impact construction activities will be the responsibility of the contractor to remove as necessary at contractor's expense.
 - 2) Demolition should include pre-digging, characterization and removal of materials as required to demolish foundations and piles, pile removal including removal by vibratory pile driver and crane, transportation and disposal.
 - d. Partial removal or cutting off piles will not be considered complete removal.
- C. See Exhibit A Section 02 41 00 for approximate location of H-pile limits. Limits are based on best information available provided by the COE.
- D. See Attachment F for approximate mapped foundation locations of pipes and foundations
- E. Holes resulting from removal shall be backfilled with suitable materials.

1.08 DEMOLITION OF COMBINED SEWER. SANITARY SEWER AND STRUCTURES

- A. Demolish combined sewer, sanitary sewer, sewer force mains, storm drain and structures in accordance with this section and Section 33 05 04.30.
 - 1. Provide bypass pumping of existing sewers and force mains in accordance with Section 33 01 30.50.
 - 2. Clean the structure and connecting pipe prior to removal in accordance with Section 33 01 30.53.

- B. TRANSITION STRUCTURE -20th Street AND 36" CIPP Lined RCP
1. Remove the existing structure in its entirety in accordance with this section and Section 33 05 04.30.
 - a. Provide bypass pumping of existing sewers and force mains in accordance with Section 33 01 30.50. Coordinate schedule and duration with the Construction manager and Navy facility.
 2. Demolish existing 36" CIPP lined RCP as required to perform sliplining work and provide manhole SSMH300 (See C-2213)
 - a. Demolish RCP and CIPP in accordance with CIPP liner fabricator requirements. Cut liner with tools suitable to provide neat, cuts. Inspect liner prior to demolition and after removal to demonstrate the liner has not been damaged during demolition. Contractor will be required to repair the existing liner if damaged, up to and including installation of a replacement CIPP Liner.
 - b. Seal the termination of the cut CIPP Liner with approved epoxy coating, neopoxy or approved equal. Roughen remaining CIPP liner a minimum of 4" into the pipe prior to application.
 - c. All concrete or exposed cementitious surfaces must be protected from corrosion.
- C. FLOW METER VAULT – Lower Norton Avenue
1. Remove the existing structure in its entirety in accordance with this section and Section 33 05 04.30.
 - a. Provide bypass pumping of existing sewers and force mains in accordance with Section 33 01 30.50. Coordinate schedule and duration with the Construction manager, Navy facility and City.
- D. EXISTING 12" CONCRETE SEWER - Lower Norton Avenue
1. Remove the existing sanitary sewer and structures as specified, in its entirety in accordance with this section and Section 33 05 04.30.
 - a. Where required, provide bypass pumping of existing sewers in accordance with Section 33 01 30.50. Coordinate schedule and duration with the Construction manager and City. Portions of the sewer shall remain in service to facilitate dewatering activities at the Northeast corner of the PGSF Site.
 - b. The location of existing structures in the area of the North-east gate, Norton Terminal is unknown. Locations are shown based on available record drawings. Remove structures and pipe within the excavation limits. Provide surveyed locations of any existing structures or pipe abandoned in place.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide all materials and equipment in suitable and adequate quantity as required to accomplish the demolition work shown, specified herein, and as required to complete the Project.

PART 3 EXECUTION

3.01 GENERAL

- A. Major obstructions encountered that are not shown or indicated on the Drawings, or could not have been foreseen by visual inspection of the site prior to bidding, should immediately be brought to the attention of the Construction Manager. Construction Manager will make a determination for proceeding with the work.
- B. Blasting is not allowed within the City limits of Everett.

3.02 SAFETY REQUIREMENTS

- A. All debris, materials, piping, and miscellaneous waste products from the demolition process shall be removed safely from the project site as soon as possible. Dispose of in accordance with applicable federal, state and local regulations. Contractor is responsible for determining these regulations and shall bear all costs associated with disposal of these items.

3.03 UTILITIES

- A. Determine whether there are utilities in demolition areas that are needed for continued service to other facilities. Relocate such utilities before demolition work begins.
- B. Provide temporary services during interruptions to existing utilities as acceptable to Construction Manager and Owner of utilities.
- C. Utilities serving facilities to be demolished shall be isolated. Isolation shall occur at a point closest to the remaining active portion of the utility.
- D. Remove utility lines that are exposed by demolition excavation. Likewise, remove all manholes, catch basins, and vault type structures no longer in use.
- E. Cut and plug ends of abandoned pipe with concrete to prevent groundwater infiltration. Interior of pipe shall be cleaned and then completely filled with concrete. Install plug using cement-based dry-pack grout conforming to ASTM C1107, Grade B or C with a minimum plug depth of 24 inches.
- F. Where specified, pressure grout pipe in accordance with Section 03 64 00 Injection Grouting and Section 33 05 04.30 Selective Demolition Sewers.
- G. Some existing pipe is to be re-purposed under this contract, as specified. Special care shall be taken to protect from damage the pipe to be repurposed.

3.04 DEMOLITION

- A. The demolition drawings are based on available information, but the existing conditions may differ from what is presented. The Contractor shall be responsible for determining the scope and extent of the required work by inspecting the site prior to submittal of bid. Additional record drawings are available from the Construction Manager.

- B. Equipment and materials, including piping within the limits of demolition, unless otherwise specified, will become the property of the Contractor.
- C. Drawings define minimum portion of facilities and structures to be removed. Unless otherwise shown, clean saw cuts shall be made to limits of demolition shown. If cuts or breaks are made exceeding limits shown, repair the cuts or breaks back to the dimensions shown on Drawings at the Contractor's expense. Submit repair procedures for Construction Manager's review. Provide saw cut at all pavement surface and curb removal limits and where neat connection lines are required.
- D. Protect structures and equipment from damage during demolition work. No equipment shall be removed without the written approval of the Construction Manager.
- E. Remove piping and duct bank from areas indicated on the drawings and as necessary to install new facilities. Piping to be abandoned in place shall be capped with a watertight plug at demolished end in a manner that will prevent entrance of soil, groundwater or moisture. Restrained caps or plugs shall be installed at demolished ends for pressurized services and where shown on the Drawings.
- F. Only equipment specified herein, shown on the Drawings, designated by the Construction Manager in the field for removal, or approved by the Construction Manager during construction shall be removed. Contractor shall be responsible for the sequence of equipment removal and shall remove it with minimal damage. The limits of removal of equipment shall be as specified on the Drawings or as directed by the Construction Manager. Equipment removal shall include removal of such items as equipment, piping and accessories, supports, piping and tubing supports, fasteners, anchor bolts, and other items. Removal of equipment shall include removal of conduits and wiring from equipment back to nearest junction box. Removal of equipment shall include removal of concrete pads that support equipment, piping and other accessories.
- G. All other areas of the plant not within the limits of demolition work shown on the Demolition Photograph, Drawings or as specified herein shall be left undisturbed. Any damage to these areas during the demolition process shall be repaired or replaced to original pre-contract conditions at the Contractor's expense.
- H. In areas where concrete portions are to be removed from a structure, the edge of removal shall be cut with a concrete saw to leave a perpendicular edge or core drilled when required removal is circular in shape. All reinforcing shall be cut and removed unless otherwise shown or instructed. Cracked or damaged concrete shall be removed to solid concrete. Spalled edges may be required to be re-sawn at the discretion of the Construction Manager.
- I. Cut off concealed or embedded conduit, boxes, anchor bolts, or other materials flush with final finished surface. Where necessary, empty conduits shall be plugged with fireproof sealant to maintain fire rating for wall. For existing circuits no longer needed, remove conductors from the conduit. Remove all surface-mounted conduit that is no longer needed. For conduit below grade or concealed within wall, cap and abandon conduit in place. For existing circuits to remain operational, intercept existing conduit at the most convenient location or as shown and splice and extend conduit to new location. Install new conductors where required to accomplish indicated results. New conductors shall be continuous without splices between J-boxes.

3.05 PARTIAL DEMOLITION

- A. Remove all items that are scheduled for demolition to their full extent, unless otherwise shown or specified for partial demolition.
- B. Partial demolition includes those facilities where a portion of a structure is to remain. Limits of partial demolition are shown on the Drawings.
- C. Partial demolition procedures shall not impair the integrity of the existing structure that is to remain. Where necessary, and where shown, the Contractor shall saw cut or line core drill the existing structure to prevent rupturing or cracking facilities that remain in use. Those structures damaged by the Contractor that are to remain in service shall be repaired to the satisfaction of the Construction Manager at the Contractor's expense.
- D. Cut off all pipes, structural attachments, and embedded metal supports that project into the demolition area flush with the wall, floor or ceiling.
- E. Remove all pipe hangers, mechanical equipment, mechanical attachments, and supports. Where necessary, empty pipes shall be plugged with fireproof sealant to maintain fire rating for wall.
- F. Unless otherwise noted on the drawings where concrete removal occurs, existing reinforcing that is exposed shall be cut flush and grind smooth with surrounding surface. All holes shall be patched with epoxy concrete to form a smooth wall or floor finish.
- G. Remove buried pipe in accordance with this Section. Backfill in the vicinity of the pipe removal shall be in accordance with the requirements of Section 31 23 00, and meeting a minimum 95% compaction, in accordance with the ASTM D1557.

3.06 MISCELLANEOUS DEMOLITION

- A. All existing pavement, landscaping, and other surface features demolished because of the Contractor's activities shall be replaced back to its original condition unless other restoration work is called for on the Drawings.

3.07 PROTECTION

- A. The Contractor shall provide protection devices including barricades, fencing, warning signs, lights, and whatever else is necessary to ensure the security of, and within, the facility during all phases of demolition. Requirements of federal, state and local statutes and regulations dealing with demolition or public safety shall be strictly adhered to by the Contractor.

3.08 DISPOSAL OF DEMOLITION DEBRIS

- A. Remove demolition debris from the work site and dispose in accordance with all local laws, codes and ordinances at the Contractor's expense.
- B. Decant materials prior to disposal.

3.09 EQUIPMENT TO BE SALVAGED OR RELOCATED

- A. Do not remove equipment and materials without approval of the Construction Manager.
- B. Existing equipment shall not be damaged during removal. Any damaged equipment shall be repaired by the Contractor to the satisfaction of the Construction Manager or replaced at the Contractor's expense.
- C. Properly store and maintain equipment and materials in same condition as when removed.
- D. Construction Manager will determine condition of equipment and materials prior to removal.
- E. The Contractor may extract conductors from duct banks and conduit to be abandoned or removed and retain them for salvage value.

3.10 PHOTOGRAPHS AND VIDEOS

- A. Prior to the removal of existing construction, create digital photographs or videos of the existing construction to be removed to provide documentation of this facility and its surroundings. Photographs and/or videos shall be submitted to the Construction Manager during the pre-demolition meetings prior to removal.
 - 1. Each photograph must be labeled with a date, name of work, and the location where the photograph was taken.

END OF SECTION

SECTION 02 60 00
UST REMOVAL AND CLOSURE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. It is not known whether any Underground Storage Tanks (UST) and/or associated piping will be encountered at the site. The work covered by this section consists of furnishing all labor, equipment, and materials necessary for the proper removal of any USTs encountered during soil excavation procedures.

1.02 SECTION INCLUDES

- A. Licensing and permit requirements for firms conducting UST removals
- B. Health and safety requirements related to UST removals and excavation of petroleum-contaminated soil
- C. Excavation and removal of fuel oil and diesel USTs
- D. Evaluating potential soil contamination during UST removals
- E. Excavation and stockpiling of contaminated soil
- F. Treatment/disposal of petroleum-contaminated soil

1.03 RELATED SECTIONS

- A. Section 02 61 00 Removal and Disposal of Contaminated Soils
- B. Section 31 23 19 Dewatering

1.04 LICENSES AND PERMITS

- A. Contractor and appropriate site personnel responsible for removing USTs under this contract shall be fully licensed and registered with the Washington State Department of Ecology and International Fire Code Institute to perform regulated UST services in accordance with Washington State Administrative Code (WAC) 173-360-600 through 173-360-690. Contractor shall be a Washington State licensed UST services provider, and provide a licensed UST decommissioning supervisor on-site during all UST removal activities.
- B. Contractor shall be responsible for making any necessary notifications and obtaining any permits required by state or local regulatory agencies or fire departments, including but not limited to permanent closure notification for removal of USTs in accordance with Underground Storage Tank Regulations, Chapter 173-360-385 WAC.

- C. The Contractor shall submit copies of all notifications made and permits obtained to the Engineer prior to start of work.
- D. The Contractor shall submit to Washington State Department of Ecology required UST checklists within 14 days of UST removal. Contractor shall submit copies of the UST checklist to Engineer at the same time.

1.05 REFERENCES

- A. HWA GeoSciences Inc., Hazardous Materials Analysis Report, Port Gardner Storage Facility – West Marine View Drive Storm and Combined Sewer Design, Everett, Washington, August 18, 2025
- B. American Petroleum Institute (API) Recommended Practice 1604 – Removal and Disposal of Used Underground Petroleum Storage Tank(s).
- C. API Publication 2015 – Cleaning Petroleum Storage Tank(s).
- D. Washington State Department of Ecology Regulations: Chapter 173-303 WAC - Treatment, Transportation, and Disposal of Dangerous Waste; Chapter 173-360 WAC - Underground Storage Tank(s); and Chapter 173-340-WAC – Model Toxics Control Act Cleanup Regulation.
- E. Washington State Department of Ecology Guidance for Remediation of Petroleum Contaminated Soils, Publication 91-30.

1.06 NOTIFICATION

- A. Notify the Engineer immediately upon encountering previously unknown USTs.

PART 2 NOT USED

PART 3 EXECUTION

3.01 UST CLEANING

- A. USTs shall be cleaned prior to removal. Tank(s) cleaning operations shall be in accordance with API Publications 2015, “Cleaning Petroleum Storage Tank(s)”. The tank(s) shall be cleaned by removing liquid and sludge and then rinsing them three times.
- B. The Contractor shall be responsible for the transport to, and disposal of UST contents at a permitted waste oil recycling facility. The Contractor shall provide documentation to the Engineer within 14 days of disposal stating the name and address of the facility where the contents were disposed. The documentation shall also indicate date and volume of material received, and any analytical results of tank contents required by the receiving facility.

3.02 UST REMOVAL

- A. The Contractor shall conduct UST removals in accordance with WAC 173-360 and API Recommended Practice 1604, "Removal and Disposal of Used Underground Petroleum Storage Tank(s)." Contractor shall inert and remove the tank(s) from the site in its entirety without any cutting performed on-site, unless prior approval is obtained from the Engineer.
- B. The Contractor shall remove soil from the sides of the tank(s) to facilitate tank(s) removal. Contractor shall provide suitable equipment to safely and efficiently lift the tanks and place on a truck for transport to an appropriate disposal or recycling facility.
- C. The Contractor shall dispose of cleaned tanks at an appropriate scrap metal yard or landfill permitted to accept such materials. The Contractor shall provide documentation to the Engineer within 14 days of removal from site stating the name and address of the facility where the tank was disposed, including bills of lading. The documentation shall indicate the date received and a description (including size and dimensions given) of the tank received. The documentation shall indicate the receiver's intended final disposal method for the tank (e.g., crushed for scrap metal, etc.). The Contractor shall obtain certificates of destruction from the receiving facility for each tank removed.
- D. If ground water is encountered, the Contractor shall dewater the excavation as necessary to access the UST and provide a safe excavation. Treat and disposal of contaminated groundwater and/or free product per Section 31 23 19 Dewatering.

3.03 UST SOIL SAMPLING AND PETROLEUM-CONTAMINATED SOIL EXCAVATION

- A. The Contractor shall assist the Engineer in collecting soil samples from the excavation using a backhoe or excavator as directed by the Engineer, per Soil Sampling and Testing Coordination bid item.
- B. The Contractor shall excavate, segregate, and stockpile soils at the direction of Engineer per Section 02 61 00 Removal and Disposal of Contaminated Soils.
- C. The Contractor shall dispose or reuse soils at the direction of Engineer per Section 02 61 00 Removal and Disposal of Contaminated Soils.
- D. The Contractor shall secure and leave UST excavations open for up to three days (excluding weekends and pending analytical results) before receiving additional direction from the Engineer to backfill the excavation or excavate additional soils.
- E. The Contractor shall provide suitable barricades, fencing, signing and other warning and safety devices to protect the public and other site workers from open excavations, heavy equipment, and other construction activities. Contractor shall provide earthen or other berms to prevent surface or storm water from entering open excavations.
- F. The Contractor shall backfill and compact the excavation to grade as directed by the Engineer.

END OF SECTION

SECTION 02 61 00
REMOVAL AND DISPOSAL OF CONTAMINATED SOILS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies screening, excavation, handling, stockpiling, temporarily storing, and disposing of contaminated soils that may be encountered during the Work that are known or that may be encountered during the Work.
- B. Contaminated materials in soils and groundwater may be encountered during the Work. Previous studies indicate the presence of petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and metals. Available documents regarding this contamination are provided in the HWA's Geotechnical Report, and Draft Hazardous Materials Analysis Report (August 18, 2025), Port Gardner Storage Facility – West Marine View Drive Storm and Combined Sewer Design, Everett, Washington.
- C. A portion of the work is located on the Port of Everett property west of the existing BNSF Railroad (BNSF) right-of-way (ROW) between 23rd Street and 24th Street. The area of work that is on the Port of Everett property is within the boundaries of a Model Toxics Control Act (MTCA) site known as the Kimberly-Clark Worldwide Site (Norton Terminal Site)(Cleanup Site ID 2569). Due to the known contamination on the Port Site, a Soil and Groundwater Management Plan (SGMP) has been developed for the Project by Brown and Caldwell (Volume 4 Attachment M) . The Plan developed for this project has been prepared for consistency with the existing Soil Groundwater Management Plan (SGMP), (Landau Associates, 2021) developed for the Port of Everett and as requested by the Washington State Department of Ecology (Ecology). The Port's SGMP (2021) is included as a reference within the project specific SGMP (Brown and Caldwell, 2025)
- D. These conditions will require the screening, excavation, handling, stockpiling, temporary storing, and disposal of contaminated materials.
- E. The Contractor's personnel involved in excavation of soils shall utilize appropriate personal protective equipment (PPE), air monitoring instruments, and decontamination procedures to prevent exposure to contaminants and to minimize offsite transportation of contaminants. Specifications for contractor Health and Safety are contained in Section 01 35 29
- F. Contractor shall excavate, stockpile, and treat or dispose all contaminated soil in accordance with the Plans and Specifications and all applicable regulations. The work covered by this section consists of furnishing all labor, equipment, and materials necessary for the proper identification, removal, treatment, and disposal of contaminated soils if encountered.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revision of the following documents:
 - 1. American Society for Testing and Materials International (ASTM)
 - a. ASTM D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock

2. Code of Federal Regulations (CFR)
 - a. 29 CFR 1910 Occupational Safety and Health Standards
 - b. 40 CFR 262 Standards Applicable to Generators of Hazardous Waste
 - c. 40 CFR 264 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
 - d. 40 CFR 268 Land Disposal Restrictions
 - e. 40 CFR 280 Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)
3. Revised Code of Washington (RCW)
 - a. RCW Chapter 70.105D Hazardous Waste Cleanup – Model Toxics Control Act (MTCA)
4. Washington Administrative Code (WAC)
 - a. WAC 173-303 Dangerous Waste Regulations
 - b. WAC 173-340 Model Toxics Control Act – Cleanup
 - c. WAC 296-62 General Occupational Health Standards
 - d. WAC 296-843 Hazardous Waste Operations
 - e. WAC 173-360A Underground Storage Tank Regulations
5. Washington State Department of Ecology
 - a. Publication 94-49 Guidance on Sampling and Data Analysis Methods
 - b. Publication 97-602 Analytical Methods for Petroleum Hydrocarbons
 - c. Publication 10-09-057 Guidance for Remediation of Petroleum Contaminated Sites

1.03 DEFINITIONS

- A. Dewatering: Refer to Section 31 23 19, Dewatering.

1.04 SUBMITTALS

- A. HEALTH AND SAFETY PLAN (HASP)
 1. The Contractor is required to prepare and maintain for the duration of this Contract, a site-specific HASP to promote the health and protection of all onsite personnel and the environment per Section 01 35 29. The Contractor is responsible for ensuring the HASP is approved by a Certified Industrial Hygienist and any required Ecology approvals prior to submittal to the City for review.
 2. Assess the potential risks to onsite personnel and the environment and develop site-specific health and safety plan to safely execute the work under this Contract with respect to removal and disposal of contaminated soils.
- B. CONTAMINATED MATERIAL HANDLING (CMH) PLAN: 21 days after Notice to Proceed
 1. At a minimum, include the following in the CMH Plan, also referred to in Port's SGMP: The plan shall be consistent with the Project and Port's SGMPs.
 - a. Schedule of activities
 - b. Instructing workers in observing and reporting questionable materials and odors, such as refuse, oily sheen or color on soils or water, and oily or chemical odors.

- c. Methods and procedures of excavation and equipment to be used. Include methods to prevent the spread of Contaminated Substances.
 - d. Staging and storage methods, procedures, and locations for liquid and solid contaminated material. Include methods to prevent noncontaminated soil excavated during sloping sidewalls from mixing with contaminated soil.
 - e. Backfill material sources including chemical analytical data or plan to obtain chemical analytical data prior to use of material for backfill.
 - f. Methods and procedures for the transportation, disposal, and off-site treatment of contaminated materials, in compliance with applicable federal, state, and local laws and regulations, including the identification of disposal and treatment facilities, and the use of certified, licensed transporters.
 - g. Equipment decontamination procedures to prevent cross contamination.
 - h. Sampling and analysis plans and responsibilities, including the characterization of materials for disposal, and releases of hazardous and contaminated substances.
 - i. Relevant additions to project-wide Spill Prevention, Control, Contingency, and Countermeasures (SPCCC) plan
 - j. Methods for water management including groundwater, stormwater runoff, and surface water.
 - k. The name, address, and state and federal identification number (if applicable) of all off-site soil treatment or disposal facilities
 - l. Procedures for documenting and reporting encounters with and/or releases of hazardous or contaminated substances
 - m. Coordinate with requirements of Section 01 35 29 Health and Safety.
 - n. Coordinate with requirements of the Erosion and Settlement Control 31 25 00.
 - o. Coordinate with requirements of Section 31 23 19, Dewatering.
 - p. Obtain all required permits and notifications for removal, excavation, dewatering, storage, transportation, and disposal of contaminated material.
- C. EXCAVATION DOCUMENTATION. The contractor shall document intrusive activities, all environmental test data, post intrusive activity environmental conditions, and identify any changes proposed to any applicable restrictive covenant as required by the SGMP.
- D. Closeout Documents at the completion of the task, including:
- 1. Chains-of-custody, Analytical laboratory test results
 - 2. Waste manifests, truck weight tickets
 - 3. Disposal facility certificates of disposal

1.05 QUALITY ASSURANCE

- A. Qualifications
 - 1. Site supervisor:
 - a. Trained and experienced in hazardous and contaminated material handling
 - b. Completed OSHA training requirements for working with hazardous substances including the 8-hour supervisory course
 - c. Minimum of three (3) years of experience in managing hazardous materials projects

2. Site personnel working with contaminated material:
 - a. Received site specific training
 - b. Minimum three (3) years of experience with similar work
 3. For above Level D protection:
 - a. Have received appropriate safety training in compliance with 29 CFR 1910.120, 29 CFR 1910.134, and WAC 296-843-100
 - b. Minimum of 40 hours health and safety training
 - c. Minimum 24 hours of “on the job” training
 - d. Eight (8) hours annual refresher training
 - e. Annual medical monitoring by an occupational physician
- B. Perform contamination excavation and disposal work in compliance with applicable statutes and regulations, including the Washington State Model Toxics Control Act, chapter 70.305 RCW (“MTCA”) and associated regulations and Washington State Department of Ecology Guidance.
- C. Independent Testing Firm: Use an Independent consulting or testing firm with qualifications and experience in contaminated soil and water sampling, analysis, cleanup, and regulatory compliance, with the appropriate Washington State licensed professionals supervising and conducting the work.
- D. Perform contamination excavation and disposal work in compliance with applicable statutes and regulations, including the Washington State Model Toxics Control Act, chapter 70.105D RCW (“MTCA”).

PART 2 NOT USED

PART 3 EXECUTION

3.01 CONTAMINATED MATERIAL SAMPLING

- A. Soil removed from the Port of Everett shall require sampling and testing for potential contamination prior to removal and shall be tested by the contractor. Typical number of samples for chemical analysis is one sample per 1,000 Cubic Yards for compliance with the project SGMP. For compliance with the SGMP the following tests shall be performed.

Table 1. Excavated Soil Waste Characterization Testing Constituents and Methods	
Analyte	Testing Method
TPH, gasoline	NWTPH-Gx
TPH, diesel, oil	NWTPH-Dx
Metals (arsenic, copper, lead, mercury, nickel and zinc)	EPA 6000/7000
PAHs with low level SIM	EPA 8270E/SIM

PCBs	EPA 8082A

NWTPH – DX – Northwest TPH - Diesel

RCRA – Resource Conservation and Recovery Act

EPA – United States Environmental Protection Agency

SIM – Selected Ion Monitoring

TCLP Analysis may be needed based on total analyte results

The contractor will coordinate with the disposal facility to determine if additional sampling beyond what is listed below will be required for waste determination. More frequent testing may be required by the receiving facility.

- B. Locations outside the Port of Everett may also require sampling and testing for potential contamination and shall be tested by the engineer if contamination is suspected. The Contractor shall be responsible for allowing the Owner and the Owner's representative full access and for providing the labor and equipment necessary to remove, isolate, or stockpile potentially contaminated soils, as directed by the Engineer. Such assistance may also include collecting soil samples with a backhoe at the direction of the Engineer. The Contractor may be required to re-order their work, if required by the Engineer to allow for testing and to monitor hazardous materials and conditions and determining when work involves hazardous materials and when conditions are present that require conformance with specified regulatory requirements.
- C. In the event the Contractor's monitoring program detects the presence of suspicious material, the Contractor shall immediately notify the Engineer. Engineer shall test suspected contaminated soils within 2 business days of notification, or as otherwise coordinated with Contractor. Contractor shall provide access and assistance as needed to collect samples from the excavation. Contractor may elect to continue work in that area and stockpile suspected contaminated soil, or move to other work areas of the project. Engineer shall provide analytical results to the Contractor within 3 business days of sampling. Secure and maintain excavation areas during that time.
- D. Following completion of testing to determine the nature of the material, the Engineer will provide analytical results to the Contractor and decide how the material shall be handled and disposed of, per section 3.04. Contractor will be responsible for any additional profiling or analysis that may be required by the treatment/disposal facility.
- E. Monitoring, notification, testing, and the time delays specified herein are included in the base bid, no additional compensation will be made for resulting work delays, moving soil twice, or ancillary costs. In areas of the project on Port of Everett Property, sampling, analysis, excavation and disposal of contaminated soils outside of the neat lines required for installation of project improvements may be required. Based on test results, Contractor will proceed with additional excavation that may be required to remove material that is contaminated above action levels, as directed by the Engineer. Several rounds of testing and excavation may be required by the Washington State Department of Ecology. No excavation outside or beneath already installed shoring, or impacting existing utilities or improvements will be required.

3.02 CONTAMINATED MATERIAL REMOVAL

- A. Give notification at least seven (7) days prior to the start of excavation of known contaminated material.

- B. Implement environmental controls in accordance with Contract Documents prior to the start of excavation.
- C. Strip and stockpile noncontaminated soil separately from contaminated material, for areas that are considered to be below action levels based on field screening as specified herein. Be responsible for protecting this material from becoming contaminated. This may include covering the soil with plastic sheeting. Dispose of such soil that becomes contaminated as a result of work activities at own expense.
- D. Excavate areas of contamination in compliance with the Contaminated Material Handling Plan. Limit the potential for contaminated material to be mixed with uncontaminated material during excavation. Dispose of such mixed soil that becomes contaminated as a result of work activities at Contractor's own expense.
- E. Maintain a log of the materials and visible signs of contamination encountered during excavation for each area of excavation.
- F. Divert surface water to prevent entry into the excavation. Minimize infiltration of water that enters excavation. Dispose of such water that enters excavation as a result of work activities at Contractor's own expense. Limit dewatering to that necessary to ensure adequate access, a safe excavation, and to ensure that compaction requirements can be met.
- G. Contain water generated during dewatering until collection and analysis of samples.
- H. Contain contaminated water and store on Site in accordance with applicable federal, state, and local disposal regulations until analytical results are obtained.
- I. Provide approved containers, vehicles, equipment, labor, signs, labels, placards and manifests, and associated disposal notices and notifications, necessary for accomplishment of the Work.

3.03 CONTAMINATED MATERIAL STAGING

- A. For suspected contaminated material, place material in a staging unit immediately after excavation while awaiting test results. Use staging units that are in good condition and constructed of materials that are compatible with the material or liquid to be staged. If multiple staging units are required, clearly label each unit with an identification number and keep a written log to track the source of contaminated material in each staging unit.
- B. Isolate known and/or suspected contaminated soil from the environment.
- C. Water-tight roll-off units lined with 6 mils thick plastic sheeting may be used to stage the contaminated material. Place an impermeable cover over the units to prevent precipitation from contacting the stored material. Remove and store liquid that collects inside the units.
- D. Staging units with known and suspected contaminated materials must be clearly labeled with the source, date generated, and type of material. Keep a written log to track the source of contaminated materials in each staging unit.

3.04 OFF-SITE DISPOSAL

- A. Load contaminated material for offsite disposal.
- B. Provide transportation in accordance with Department of Transportation (DOT) Hazardous Material Regulations and federal, state, and local requirements, including obtaining necessary permits, licenses, and approvals.
 - 1. Cover each load with tarpaulin prior to leaving the Site.
- C. Treatment, Disposal, and Recycling
 - 1. Perform the treatment, disposal, and recycling of contaminated materials in accordance with all applicable laws and regulations, and conditions specified herein. Include all necessary personnel, labor, transportation, packaging, equipment, and reports for this work.
 - 2. Based on analytical testing of suspected contaminated soils during construction, excavated soils will be disposed of as follows:
 - a. Unrestricted Disposal. Soil containing 1) metals concentrations below Department of Ecology published natural background concentrations; 2) petroleum hydrocarbon constituents below Category 1 criteria per the Ecology Reuse Guidelines in the Guidance for Remediation of Petroleum Contaminated Sites, Publication No. 10-09-057, and 3) no other contaminants or debris; may be disposed of at any contractor-selected fill site.
 - b. Inert Waste Soil. Soil containing 1) metals concentrations below Department of Ecology Method A cleanup levels or facility-specific criteria defined in a County or State-issued Solid Waste permit; 2) petroleum hydrocarbon constituents below facility-specific criteria defined in a County or State-issued Solid Waste permit; and 3) no other contaminants not listed in the County or State-issued Solid Waste permit; may be disposed of at a County or State licensed and permitted Inert Waste Landfill, Limited Purpose Landfill, or mine reclamation site, provided the measured chemical concentrations meet all permit criteria for the facility. Contractor shall obtain and provide to Engineer weight tickets and certificates of disposal from the receiving facility within 14 days of disposal. Certificate of Disposal should include a release of liability from the disposal facility to the Owner for all soils accepted.
 - c. Contaminated Soil. Contaminated soils for off-site treatment and/or disposal include: a) structurally suitable soil with contaminant concentrations exceeding cleanup levels that is not Dangerous Waste, b) all other soils requiring off-site disposal containing contaminants exceeding criteria for unrestricted use OR Inert Waste Soil disposal but are below criteria for Dangerous Waste, c) soil containing coal, cinders, creosote-treated or other treated wood, or garbage/refuse. Contractor shall transport the soil to a licensed facility for landfill disposal or remediation using an approved thermal remediation process, including thermal desorption, incineration, or asphalt or cement incorporation. Contractor shall obtain and provide to Engineer weight tickets and certificates of disposal from the receiving facility within 14 days of disposal.
 - d. All other soils that require off-site disposal, that are not suspected of being contaminated, and not tested, will be disposed of as Inert Waste unless testing indicates otherwise.

- e. Designated dangerous wastes as defined by Washington State Department of Ecology's "Dangerous Waste Regulations" (Chapter 173 303 WAC) are not expected at this site. If dangerous wastes are encountered, Contractor shall notify Engineer and secure the area to prevent further release to the environment and to prevent exposure to workers and the public.
- 3. Contractor shall verify that the receiving facility receiving each shipment of waste from the site meets the following requirements:
 - a. The facility is fully licensed and permitted to accept the waste by the appropriate County, State and Federal agencies
 - b. The facility will provide the treatment and or disposal services indicated and will accept the quantity and types of waste generated under this Contract within the time period of performance of this contract.
 - c. The facility must not have any significant violations or other environmental conditions that affect the satisfactory operation of the facility.
 - d. The facility will provide a release of liability to the Owner for all soils accepted.
- 4. Contractor shall provide the name, location and applicable state and federal identification number of the off-site facilities used for the treatment/disposal of wastes from this project with the CMH Plan.
- 5. The Engineer reserves the right to contact the treatment/disposal facilities designated by the Contractor and the appropriate regulatory agencies to verify the information provided by the Contractor.
- 6. Contractor will arrange all other profiling requirements, forms, acceptance, and scheduling at the disposal facility. Owner will sign disposal profile forms as "Generator."
- 7. Records
 - a. Records: Maintain records of all waste determinations, including appropriate results of analyses performed, substances and sample location, the time of collection, and other pertinent data as required by 40 CFR 280, Section 74 and 40 CFR 262 Subpart D, and other applicable regulations. Record transportation, treatment, disposal methods and dates, the quantities of waste, the names and addresses of each transporter and the disposal or reclamation facility and make available for inspection, as well as copies of the following documents:
 - 1) Manifests
 - 2) Waste analyses or waste profile sheets
 - 3) Certifications of final treatment/disposal signed by the responsible disposal facility official
 - 4) Land disposal notification records required under 40 CFR 268 for hazardous wastes
 - 5) Provide records in accordance with applicable federal, state, and local regulations.
- 8. Documentation of Treatment or Disposal:
 - a. Transfer the materials to a treatment, storage, disposal facility which has EPA or appropriate state permits and/or hazardous or special waste identification numbers and complies with the provisions of all relevant solid waste disposal regulations.

- b. Furnish the original return copy of the hazardous waste manifest, signed by the owner or operator of a facility legally permitted to treat or dispose of those materials furnished to the Engineer not later than five (5) days following the delivery of those materials to the facility.
 - c. Furnish a statement of agreement from the proposed treatment, storage or disposal facility and certified transporters to accept hazardous or special wastes in the CMH Plan.
 - d. Provide copies of all trucking tickets from the transport of contaminated materials to the Engineer on a weekly basis.
9. Contractor shall remove from the site and dispose all equipment and materials from the site at the conclusion of the job, including visqueen, soil liners, covers, straw bales, personal protective equipment and other materials at Contractor's expense, in accordance with all applicable regulations.

3.05 FIELD QUALITY CONTROL

- A. Sampling, Screening, and Analysis
- 1. Have the independent testing firm employed by the Contractor perform required sampling and chemical analyses relating to generation, use, release, and disposal of contaminated substances in the course of operations, in accordance with the Contaminated Material Handling Plan.
 - 2. Have the independent testing firm employed by the Contractor perform required sampling and chemical analyses relating to existing potentially contaminated substances unless otherwise provided herein or in the Contract Documents. Include characterization sampling and the sampling necessary to determine disposal methods in this sampling. Do not dispose of material until directed to do so by the Engineer.
 - 3. Submit results of all screening testing to the Engineer.
 - 4. The Engineer will inspect the removal of existing contaminated material from each site. Notify the Engineer at least 48 hours prior to when confirmation sampling and analysis will be required. Mark locations of samples in the field and document on the surveys and the as-built drawings.

3.06 DECOMMISSIONING OF MONITORING WELLS

- A. Approximately 8 monitoring well exist on the site. The names and locations of 7 are presented in the Geotechnical report in Volume 4 Attachment B for HWA-7P-24, HWA-7VW-25, HWA-19P-24, HWA-20P-24, HWA-14P-25, HWA-3P-24, HWA-3VW-25. Additionally, one City of Everett Well (ID BIZ-212) located near HWA-7P-24 shall be decommissioned.
- B. Contractor shall decommission selected monitoring wells, as shown in the geotechnical report, or as directed by Engineer, after all dewatering work in that area is completed.
- C. Contractor shall decommission the wells in accordance with Chapter 173-160 WAC Minimum Standards for Construction and Maintenance of Wells.
- D. Work shall be performed by a Drilling Contractor licensed under Chapter 173-162 WAC, Regulation and Licensing of Well Contractors and Operators.

- E. Contactor shall remove well monuments after decommissioning and replace with concrete or other materials consistent with conditions in that location.
- F. Notify Washington State Department of Ecology with Notice of Intent to Decommission a Well Form and pay all fees associated with decommissioning.
- G. Contractor shall protect and preserve all existing ground water monitoring wells not to be decommissioned, from damage or covering during construction. Monitoring wells shall be made accessible for sampling by Engineer during all project work. Contractor shall stake or otherwise mark well locations so they are locatable by visual means, and provide access to Engineer to monitor or sample wells during construction.

END OF SECTION

SECTION 02 83 33
HANDLING AND DISPOSAL OF LEAD-BASED PAINT

PART 1 GENERAL

1.01 SUMMARY

- A. Perform all Work and disposal of lead-based paint in accordance with all applicable laws and regulations.

1.02 REFERENCES

- A. Environmental Protection Agency (EPA), all applicable requirements, most recent edition.
- B. Occupational Safety and Health Administration (OSHA), most recent edition:
 - 1. 29 CFR 1926.62.
- C. Washington Administrative Code (WAC)
 - 1. WAC 296-62-07521 Lead

1.03 DEFINITIONS

- A. LBP: Lead-based paint

1.04 SUBMITTALS

- A. In accordance with Section 01 33 00 – Submittal Procedures
- B. Contractor shall furnish training records, work practices, analytical reports, clean up and disposal records. In complying with this requirement, Contractor shall conform to all requirements of the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and WAC covering the handling and disposal of LBP.
- C. Copy Uniform Hazardous Waste Manifest:
 - 1. Execute manifest form completely and accurately.
 - 2. Identify "Generator" as "City of Everett".

PART 2 PRODUCTS

2.01 DISPOSAL SITES

- A. Materials and debris containing LBP shall be disposed at:

PART 3 EXECUTION

3.01 NOTIFICATION

- A. Contractor shall notify Engineer a minimum of 72 hours in advance of working in areas requiring disturbance of LBP.

3.02 TRAINING

- A. Contractor working with or around Lead containing materials shall be trained as designated in 29CFR1926.62 and WAC 296-62-07521.

3.03 WORK PRACTICES

- A. Any disturbance of lead materials shall be conducted with a focus on the minimization of dust generation. ANY GRINDING ON LEAD CONTAINING MATERIALS IS STRICTLY FORBIDDEN! Any cutting, welding or drilling on equipment that is coated with LBP, must have the paint removed from the surface before work may begin. Where possible, a chemical stripper (non-Methylene Chloride) shall be used. Contractor using a chemical stripper shall follow all precautions set forth on the product MSDS. Contractor shall supply a list of chemicals to be brought on-site. Contractor shall supply an MSDS for the chemical stripper to be used for approval by the Environmental, Health and Safety Department.
- B. Where it is not possible to use a chemical stripper to remove the lead materials, the Contractor shall submit a plan to remove the materials that complies with all applicable requirements per OSHA and EPA.

3.04 DISPOSAL OF WASTE MATERIALS

- A. Any lead waste materials from work performed must be cleaned up upon completion of the job. Work activities shall be employed to minimize the generation of lead paint chips or dust as deemed feasible. All LBP chips must be collected and any areas of potential lead dust generated from work activities must either be removed with a HEPA vacuum or wet-wiped until all contamination is removed. Attention should be given to any dust or paint chips that have migrated away from the immediate work area. All waste shall be accumulated and stored on a daily basis in a secured area.
- B. Contractor must conduct a Toxic Characteristic Leaching Procedure (TCLP) test (EPA Method 200.7) for lead waste materials (e.g., dust, sweepings, paint chips, etc.) by a State of Washington certified laboratory. If the materials pass the TCLP test, it shall be disposed of at an industrial solid waste landfill. If the material fails the TCLP analysis, it shall be disposed of as hazardous waste in accordance with federal or state regulations.
- C. Demolition debris or articles (e.g. steel tank demolition, valves, piping, building materials, etc.) with lead-based paint attached is considered a non-hazardous waste with regard to lead. No sampling/analysis of painted components for lead is required for disposal as non-hazardous waste and shall be disposed of at a permitted demolition debris landfill.
- D. Constituents other than LBP, i.e. PCBs from light ballasts or asbestos containing materials, may require special handling, and these should be removed before demolition
- E. Ensure that all personnel entering regulated work area are equipped with appropriate personal protective equipment.

3.05 FINAL COMPLETION

- A. Final completion will be withheld until Contractor has satisfactorily complied with the requirements for final cleanup of the project site in accordance with Section 01 77 00 Close Out Procedures.

END OF SECTION

SECTION 03 01 00
CONCRETE REPAIR

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes concrete rehabilitation of existing structures.
 - 1. Inspection by Engineer and Contractor to identify areas in need of repair and extent of repair expected.
 - 2. Repair by Contractor, as coordinated with product manufacturers for final product selections, in accordance with this specification and drawings, including preparation, repair, and protective coating.
 - 3. Materials for reinforcement steel modifications below and for cast-in-place concrete construction for new walls shall comply with specification section 03 20 00 Concrete Reinforcing.

1.02 UNIT PRICE

- A. Work includes cost of preparing existing construction to receive Work indicated, installation of repair products, curing, and costs of field quality control.

1.03 RELATED SECTIONS

- A. Section 01 12 16 – Work Sequence
- B. Section 03 20 00 – Concrete Reinforcing
- C. Section 03 30 00 – Cast-In-Place Concrete
- D. Section 09 96 00 – High Performance Coatings for Water and Wastewater

1.04 REFERENCE

- A. The references listed below 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 requirements of this section and those of listed documents, requirements of this section prevail.

- B. References listed below indicate those documents in effect at the time of Advertisement for Bids, Invitation to Bid, or on the effective date of the Agreement if there were no Bids. Where documents are referenced in applicable local, state, or federal codes, use the version referenced by date in the individual code. If referenced documents are not specifically identified in the applicable code(s), reference to those documents shall indicate the latest version of the documents available at the time of Advertisement for Bids, Invitation to Bid, or the effective date of the Agreement if there were no Bids. If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the latest version of 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. For questions, refer to Engineer.
- C. ACI-562 – Assessment, Repair and Rehabilitation of Existing Concrete Structures and Commentary.
- D. ACI-563 – Repair of Concrete in Buildings.

1.05 PRECONSTRUCTION MEETING

- A. Contractor to organize and conduct a preconstruction meeting, at Project site prior to start of work related to this Section. Include representatives from Contractor, Subcontractor, repair product representatives, Coating manufacturer's representative, Engineer, and Owner.
- B. Review methods and procedures related to concrete repairs and protective coating including, but not limited to, the following:
 - 1. Verify Contractor's personnel, equipment, and facilities needed to perform Work and avoid delays.
 - 2. Materials, surface preparation, material application, environmental conditions, curing, sequencing, tolerances, and required clearances.
 - 3. Coordination of Work, including schedule to include provisions for mockup of surface preparation, repair mortar, finish coatings, and testing.
 - 4. Quality-Control program, including required notifications and scheduling of inspections by Contractor, product manufacturers, Engineer, and Owner's testing agency.

1.06 ACTION SUBMITTALS

- A. Concrete Repair Schedule.
 - 1. Include proposed dates for bypass pumping, draining of structures, cleaning, inspection, and completion of Work.
- B. Concrete Repair Plan
 - 1. Include quantities for each type of repair material based on field inspection.
- C. Product Data:
 - 1. Include product data for each product to be used, based on recommendations of product manufacturers.

2. Include construction details, material data sheets, chemical composition, physical properties, test data, and mixing information.
3. Include custom, project specific selections with preparation and application instructions for repair materials per manufacturer's recommendations.
4. Coordinate repair materials with protective coating submittals per Section 09 96 00 and provide written confirmation from coating manufacturer regarding compatibility of coating with selected repair products.
5. Standard submittal documents are required, marked up to indicate selected products and applicable information. Indicate locations of Contractor requested substitutions. Do not submit full catalogs. Do not submit MSD sheets.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Specialty concrete repair Contractor and manufacturers, plus Specialty coating Contractor and manufacturer, based on Quality Assurance requirements below.
- B. Product Test Reports: For each manufacturer and each product, including: bonding agent, cementitious patching mortar, joint-filler, crack-injection adhesive, and structural reinforcement; for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Quality-Control Program: Submit before work begins; to include product manufacturer approval of installation personnel.
- D. Field quality-control tests and observation reports provided by Contractor and product manufacturer representatives. Include pH testing, maximum and minimum surface temperature records, daily maximum and minimum ambient air temperature and humidity readings, and wind speeds prior to and for 48 hours after product installation.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Each product manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and assistance.
 1. Coordinate services of the repair/coating product manufacturer's representative(s) to: attend the preconstruction meeting, provide additional field training, be on-site to monitor mockup, examine surfaces after preparation, mixing of products and application; and be available as-needed thereafter during repair/coating production, provide follow-up observation of curing and finished repair/coating, provide on-site trouble shooting and corrective procedures.
 2. A single source Manufacturer shall provide all products used in the "system" for restoration of concrete surface including protective coatings per Section 09 96 00. Where more than one manufacturer's products are used in the "system", each manufacturer shall provide a complete list of all products in the "system", including the selected products from other manufacturer's and provide a statement regarding acceptance of compatibility.

- B. Specialty Concrete Repair Contractor Qualifications: Engage an experienced specialty concrete-repair firm that employs installers and supervisors who are trained and approved by the manufacturer to perform Work of this Section. The firm shall have completed Work similar in material, design, and extent to that indicated for this Project and shall demonstrate a record of successful in-service performance.
 - 1. Concrete repair Contractor shall have at least 5-years' experience using product(s) being installed (or similar) and demonstrate a history with projects of similar size and complexity as the Work intended for this Project.
 - a. Provide evidence (certificates or letter) of Contractor training by manufacture.
 - 2. Field Supervision: Concrete repair firm shall maintain experienced full-time supervisors on Project site during times that concrete-repair Work is in progress.
- C. Quality Control Program: Prepare a written plan for concrete repair to systematically demonstrate the ability of selected personnel to properly perform the Work. Include each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail, using outline format: materials, methods, equipment to be used; how environmental conditions will be monitored; testing, and sequence of operations to be used for each phase of Work.
- D. Provide pH testing (including written documentation) of prepared concrete surface to determine required depth of removal to obtain a pH neutral surface prior to application of repair materials. Reference ASTM D4262.
- E. A third-party testing agency hired by Contractor shall spot check the pH of prepped surfaces and perform the following test in the mock-up area prior to application of protective coatings.
 - 1. Direct-tension bond testing of prepared surface.
 - 2. Direct-tension bond testing of completed repair.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions, including minimum and maximum temperature requirements and other requirements.
- B. Store materials off ground, under cover, and in a dry location.

1.10 FIELD CONDITIONS

- A. General: Install products according to manufacturer's instructions. Consult product manufacturer for environmental limitations. Plan Work and install products only during permissible temperature range specified by manufacturer's instructions.
- B. Cold-Weather Requirements: Do not apply unless concrete-surface and air temperatures are above 40 deg F and will remain so for at least 48 hours after completion of Work or as directed by manufacturer.
 - 1. If mean daily air temperature falls below 40 deg F, cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 40 deg F within the enclosure for 48 hours after repair.

- C. Hot-Weather Requirements: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade, wet cure methods, wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F and above.

PART 2 PRODUCTS

2.01 GENERAL

- A. Source Limitations: For repair products, where practical, obtain each grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.
- B. All materials shall be free of chlorides and other chemicals causing corrosion.

2.02 REINFORCEMENT PROTECTION

- A. Bonding and Anti-corrosion Agent: Manufactured product that consists of an extended open time, water-insensitive epoxy adhesive/primer solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.
 - 1. BASF Corporation, MasterProtect P 8100AP.
 - 2. Sika Corporation, Armatec 110 EpoCem.
 - 3. Simpson Strong-Tie FX-406.
 - 4. Approved equal.

2.03 SPRAY (OR TROWEL APPLIED) MORTAR SYSTEM (VERTICAL SURFACE REPAIR)

- A. Mortar: One component, cementitious-based, fiber reinforced, shrinkage compensated, gray in color, with a minimum working time of 30-minutes.
 - 1. Sprayable and trowel-able, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of manufacturer's specialty liquid admixture.
- B. Manufacturer and Products:
 - 1. A.W. Cook Cement Products, Inc, Silatec MSM Microsilica Mortar.
 - 2. BASF Corporation, MasterEmaco S 488CI with Concrese liquid (LPL).
 - 3. Euclid Chemical Company, Tamms Structural Mortar.
 - 4. Sauereisen Inc, Restokrete No. F-121.
 - 5. Sika Corporation, SikaRepair 224 with Latex R.
 - 6. Simpson Strong-Tie, CSS-CM or FX-263.
 - 7. Tnemec Company, Mortarcrete series 217.
 - 8. Approved equal.

2.04 POLYMER-MODIFIED REPAIR MORTAR (VERTICAL SURFACE REPAIR)

- A. Mortar: two components, polymer-modified, cementitious based, chloride resistant, gray in color, minimum working time of 20 minutes.
 - 1. Hand applied, extremely low permeability, easy to use and requiring only the addition of water or manufacturer's specialty liquid admixture.

- B. Manufacturers and Products:
 - 1. BASF Corporation, MasterEmaco N 425.
 - 2. Sika Corporation, SikaTop 123 Plus.
 - 3. Simpson Strong-Tie, FX-263.
 - 4. Approved equal.

2.05 POLYMER-MODIFIED REPAIR MORTAR (HORIZONTAL SURFACE REPAIR)

- A. Mortar: two components, polymer-modified, cementitious based, gray in color, minimum working time of 20 minutes.
 - 1. Hand applied, extremely low permeability, easy to use and requiring only the addition of water or manufacturers specialty liquid admixture.
- B. Manufacturers and Products:
 - 1. BASF Corporation, MasterEmaco T 310CI.
 - 2. Sika Corporation, SikaTop 122 Plus.
 - 3. Simpson Strong-Tie, FX-261S (form and pour).
 - 4. Approved equal.

2.06 EPOXY CRACK-INJECTION MATERIALS

- A. Epoxy Crack-Injection Adhesive: ASTM C 881, bonding system, free of VOCs.
 - 1. Type IV at structural locations and where indicated or as directed by Engineer.
 - 2. Type I at other locations.
- B. Manufacturers and Products:
 - 1. BASF Corporation, MasterInject 1380.
 - 2. Sika Corporation, Sikadur 35 Hi-Mod LV LPL.
 - 3. Simpson Strong-Tie, ETI-LV.
 - 4. Capping Adhesive: Product for use with crack-injection adhesive by same manufacturer.
 - 5. Approved equal.

2.07 HYDRO-ACTIVE: CRACK-INJECTION MATERIALS

- A. Manufacturers and Products:
 - 1. 3M Specified Construction Products Department, Scotch-Seal Chemical Grout 5610 (Gel), hydrophilic, urethane.
 - 2. BASF Chemical Company, Concretive 1230 IUG, hydrophobic polyurethane.
 - 3. de neef Construction Chemicals, Inc., Hydro Active Flex, hydrophobic polyurethane.
 - 4. Simpson Strong-Tie, Crack-Pac Flex H20.
 - 5. Approved equal.

2.08 COATING MATERIALS

- A. Specifically designed for use in a wastewater environment to protect concrete from H₂S corrosion, submerged and/or above water surface. Refer to Section 09 96 00.

- B. Two component, high molecular weight, methacrylate resin crack healer/penetrating sealer, non-vapor barrier, specifically designed for broadcast application.
 - 1. Sika corporation, Sika Pronto 19 TF.
 - 2. Approved equal.

2.09 CONCRETE JOINT SEALANT

- A. Use a polyurethane sealant designed for submerged conditions.
- B. Manufacturers and Products:
 - 1. Sika Corporation, Sikaflex-1a or Sikaflex-2c
 - 2. Euclid Chemical Company, Tammsflex NS
 - 3. Approved equal.

PART 3 EXECUTION

3.01 CONCRETE REPAIR

- A. Comply with manufacturers' written instructions for surface preparation, environmental conditions, product application, and product curing/protection requirements.

3.02 EXAMINATION

- A. Notify Engineer seven days in advance of date when mockup areas of deteriorated concrete and deteriorated reinforcing bars will be cleaned for inspection and initial pull-off tensile bond strength test.
 - 1. Use 15-pound chipping and/or bush hammers, abrasive blast, followed by pressure water blasting to remove debris, foreign material, and/or loose concrete from designated areas to be inspected and repaired. Verify depth of surface removal by sounding and pH testing.
 - 2. Follow surface preparation by vacuum and low-pressure water blasting to remove loose debris, foreign material, and/or concrete dust from areas to be inspected and repaired.
 - 3. Upon completion of surface cleaning, Engineer and Contractor shall observe surfaces and test results.
- B. Perform visual surveys of the existing structure as Work progresses to detect hazards resulting from concrete repair Work. Notify Engineer of damage prior to making repairs.

3.03 PREPARATION

- A. Ensure that supervisory personnel are on-site when concrete repair work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of structure being repaired, and surrounding buildings and facilities from harm resulting from concrete repair Work.
 - 1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

2. Use only proven protection methods appropriate to each area and surface being protected.
 3. Provide temporary barricades, barriers, and directional signage to exclude people from areas where concrete repair Work is being performed.
 4. Contain dust and debris generated by concrete repair Work in accordance with OSHA standards and prevent dust and debris from reaching public or adjacent surfaces.
 5. Protect slabs and other surfaces along haul routes from damage, wear, and staining.
 6. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
 7. Neutralize and collect alkaline and acid wastes for legal disposal off property.
 8. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- C. Prevent solids such as aggregate or cementitious material from migrating from the work area. Clean deposited sand or other materials resulting from concrete repair Work prior to reintroducing flow.
- D. Preparation for Concrete Removal: Examine areas to be repaired to determine best methods to safely and effectively perform concrete repair Work. Examine adjacent areas to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed.
1. Verify that affected utilities have been disconnected and capped.
 2. Inventory and record conditions of items to be removed for reinstallation or salvage.
- E. Reinforcing-Bar Preparation: Remove rust from exposed reinforcing bars by abrasive blast cleaning in accordance with SSPC SP-6.
1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, splice in new reinforcing bars and/or notify Engineer to determine appropriate repair method.
- F. Surface Preparation for Concrete Surfaces:
1. Remove delaminated and deteriorated concrete surface material by chipping, bush hammer, and/or pressure water blasting.
 2. Sweep and vacuum roughened surface to remove debris.
 3. Roughen surface of concrete to a minimum ¼-inch amplitude.
 4. Provide final cleaning of concrete to remove dirt, oils, films, and other materials detrimental to patching mortar.

3.04 EXTENT OF CONCRETE REMOVAL

- A. Do not overload structural elements with debris.
- B. Provide ¼-inch deep saw cut at perimeter of repair areas resulting in a defined repair area with a neat, rectangular, area.
- C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.

- D. Remove additional concrete where necessary to provide a depth of removal of at least $\frac{1}{4}$ inch over entire defined repair area.
- E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least $\frac{3}{4}$ -inch clearance around bar.
- F. Test areas where concrete has been removed by tapping with hammer; remove additional concrete until unsound and dis-bonded concrete is completely removed. Provide a pH test of concrete surface to assure enough deteriorated concrete is removed to obtain a pH neutral surface.
- G. Acceptable surface preparation must produce a concrete surface with a minimum pH of 9.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 9.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
- H. Clean removal areas of loose concrete, dust, and debris.
- I. Notify Engineer for observation of surface following cleaning and surface preparation in advance of surface mortar application. Allow at least 48 hours for observation by Engineer and/or inspection by Owner's testing agency for soundness testing, pull-off tensile bond strength testing, and pH testing.
- J. Where required by Contract Documents, coordinate with Engineer and Owner's testing agency to provide up to six (6) smooth test areas for pull-off testing. Test areas are prepared by grinding smooth. The first test area shall be provided at the mockup area with the remaining five (5) areas to be selected after remaining surface preparation is completed.

3.05 REINFORCING PROTECTION APPLICATION

- A. Where reinforcing bar is less than $\frac{1}{2}$ exposed and there are no signs of corrosive products, do not apply anti-corrosion inhibitor.
- B. Where reinforcing bar is $\frac{1}{2}$ or more exposed or there are signs of corrosive products, remove concrete clear all around as specified above. Apply anti-corrosion inhibitor to the entire bar circumference.
- C. Application of anti-corrosion inhibitor shall be made to reinforcing bars by stiff brush and according to manufacturer's instructions. Use care not to spill over or coat concrete and partially exposed reinforcing bar surfaces.
- D. Apply anti-corrosion inhibitor to reinforcing bars in two coats. Allow first coat to dry two to three hours before applying second coat. Allow second coat to completely dry before placing repair mortar.

3.06 REINFORCING REPAIR

- A. After preparation and prior to application of anti-corrosion inhibitor (where applicable), inspect existing reinforcing bars for deterioration. Notify Engineer where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars.
- B. As directed by Engineer, add supplemental and/or replacement reinforcing.
 - 1. Install new reinforcing by tying to existing remaining reinforcing.
 - 2. Provide final touchup protection by re-application of anti-corrosion inhibitor to reinforcing surfaces, scratches, damaged areas, etc.

3.07 SURFACE MORTAR APPLICATION

- A. Apply mortar according to manufacturer's written instructions.
- B. For hand troweled or spray applied applications, work material firmly into the sides and bottom of repair area. Apply a scrub coat prior to full depth application. Build up prepared areas in multiple lifts as required by product manufacturer limitations.
- C. For hand troweled or spray applied applications, follow manufacturer's recommendations for maximum lift thickness, additional surface preparation, and subsequent reapplication time.
- D. Finish surface to match existing adjacent concrete surfaces and/or as required per coating manufacture's recommendations.
- E. Moist cure mortar repair for a minimum of 5-days or in accordance with manufacturer's recommendations.
- F. Notify Engineer for observation after repair mortar has been applied at the initial mockup area and after the repair has cured. Notify Engineer again at intervals specified or as subsequent repair mortar is applied and cured. Once scheduled, allow at least 48 hours for observation by Engineer and/or inspection by Owner's testing agency for pull-off tensile bond strength testing.
- G. Coordinate with Engineer and Owner's testing lab to provide up to six (6) smooth test areas for pull-off testing at the completed mortar repair areas. Test areas shall be prepared by Contractor by grinding smooth. The first completed repair area shall be provided at the mockup area with the remaining five (5) areas to be selected after the mortar repair application is completed.
- H. Contractor to provide follow up repairs to pull-off test areas.

3.08 EPOXY CRACK INJECTION

- A. Expose identified cracks by lightly grinding along length of crack. Clean crack and adjacent areas with oil-free compressed air or low-pressure water to remove loose particles. Do not use acids or corrosives for cleaning. Notify Engineer for observation of crack repair areas prior to epoxy crack injection. Allow at least 48 hours advance notice for observation by Engineer.

- B. Apply surface seal in accordance with Manufacturer's instructions to designated crack face prior to injection to prevent escape of injection epoxy.
- C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive. Seal entire crack length and allow to cure prior to injection.
- D. Injection Procedure: Store epoxy at minimum of 70° F.
 - 1. Start injection into each crack at lowest elevation entry port.
 - 2. Continue injection at first port until adhesive begins to flow out of next higher port.
 - 3. Plug first port and start injection at second port until adhesive flows from next port.
 - 4. Inject entire crack with same sequence.
- E. Finishing Procedure:
 - 1. Cure epoxy adhesive after cracks have been filled to allow surface seal removal without draining or runback of epoxy material from cracks.
 - 2. Remove surface seal from cured injection adhesive.
 - 3. Indentations or protrusions caused by placement of entry ports shall be filled with surface mortar or ground smooth with the adjacent surface.
 - 4. Remove surface seal material and injection adhesive from concrete surfaces.

3.09 HYDRO-ACTIVE CRACK INJECTION

- A. For Cracks, Wet and/or Leaking – repair utilizing a low viscosity, hydrophobic, closed cell polyurethane foam injection system.
- B. Lightly grind crack surface as needed to remove efflorescence and to expose/open up face of the crack.
- C. Starting 6 inches away from crack, drill injection holes at 45 degrees to intersect crack at a minimum of 6 inches deep from the crack surface.
- D. Provide temporary entry ports in these drilled holes spaced 12 to 18 inches or as required to allow movement of fluid between ports. Provide temporary paste-over seal at concrete surface to prevent seepage of injected material.
- E. Inject water into crack to flush out crack and to remove dirt, dust, and contaminants. Inject urethane foam with accelerating catalyst as required after the water flush.
- F. Inject material into prepared ports under pressure using automated equipment that is appropriate for this application.
- G. Start injection at the lowest elevation entry port. Continue injection until repair material appears in adjacent entry port. Repeat this process and continue from port to port until entire crack is filled.
- H. Remove surface paste-over seal and excess adhesive by grinding or other approved method.

3.10 CONCRETE JOINTS (CONSTRUCTION AND EXPANSION)

- A. Remove old sealant by mechanical means. Do not use solvents.
- B. Abrasive blast to clean previously sealed concrete joint surfaces.
- C. Install backer rod or tape to control sealant depth as recommended by manufacturer.
- D. Apply sealant, tool, and cure as recommended by manufacturer.

3.11 COATING

- A. Verify substrate has cured and dried out according to coating manufacturer's requirements for surface preparation.
- B. Verify that all Work in the area to be coated has been completed and installed such that no additional penetrations or holes will be drilled through the final coating, include support framing, gate frames, pipe penetrations, etc.
- C. Apply filler/surfacers, abrasive blast, and clean surface prior to coating application according to Section 09 96 00.
- D. Cracks and adjacent substrate to be sealed must be clean, sound, and free of surface moisture or frost. Remove laitance, curing compounds, and other bond inhibiting materials by abrasive blasting. Prior to application, blow cracks out with oil-free compressed air.
- E. At larger cracks where underside of slab is accessible, seal cracks with an epoxy resin adhesive paste to act as a dam to hold liquid methacrylate until cured, to minimize excessive dripping and loss of product.
- F. Mix and apply liquid methacrylate resin according to manufacturer's instructions. Pour mixed methacrylate resin onto substrate and allow to pond over cracks until cracks are sealed. Spread material out over substrate, before it starts to set, using squeegees and/or rollers.
- G. Continue to apply material until cracks and surface is sealed. The surface should be wet looking with no visible surface film.
- H. After at least 20 minutes, cover the treated area with a broadcast of dry 8/20 sand at a rate of 15 to 20 pounds per 100 square feet. Remove loose sand after drying (at least 4 hours).

3.12 FIELD QUALITY CONTROL

- A. Manufacturers Field Service: Engage manufacturers' factory-authorized service representatives to provide Project-site training and inspections to observe progress and quality of Work.
- B. Manufacturer's factory-authorized services representatives should also be available for consultation and to provide on-site assistance when requested by Contractor and/or Engineer.

- C. Provide manufacturer's test and inspection reports to Engineer for record.
- D. Coordinate with Engineer and Owner's testing agency for spot verification of substrate soundness, surface pH, and pull-off testing.

END OF SECTION

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Formwork requirements for concrete construction.

1.02 QUALITY ASSURANCE

A. References:

1. The references listed below are part of this section. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict, the requirements of this section shall prevail.

Reference	Title
ACI 117	Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.5	Specifications for Environmental Concrete Structures
National Institute of Standards - PS1	Construction and Industrial Plywood

B. Design – General:

1. Provide design of formwork, shoring and reshoring systems by the Contractor's Professional Engineer currently registered in the State of Washington
2. Design, engineering, and construction of formwork, shoring, and reshoring systems is the responsibility of the Contractor.
3. Develop a procedure and schedule for removal of shores (and installation of reshores).
4. Structural record calculations, signed and sealed by the Contractor's Engineer, are required to prove that all portions of the structure, in combination with the remaining forming and shoring systems, have sufficient strength to safely support their own weight plus the loads placed thereon.
5. When developing procedures, schedules, and structural calculations; consider the structural system that exists, effects of imposed loads, and the strength of concrete at each stage of construction.

C. Design Criteria:

1. Design formwork in accordance with ACI 301 and ACI 318 for building structures and ACI 350 and 350.5 for environmental structures to provide concrete finishes as specified in Section 03 30 00.
2. Design systems for full height of wet concrete pressure.
3. Design formwork to limit maximum deflection of form facing materials, as reflected in concrete surfaces exposed to view, to 1/240 of span.

1.03 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. Manufacturer's product data with installation instructions:
 - a. Form materials.
 - b. Form ties (with waterstops).
 - c. Form release compound.
 - d. Void forms.

B. Informational Submittals:

1. Procedures: Section 01 33 00.
2. Letter of certification:
 - a. Stating that formwork has been designed in accordance with this specification and referenced documents, sealed and stamped by the Contractor's registered design Engineer.

PART 2 PRODUCTS

2.01 FORMS

A. Wood Forms:

1. Provide new and unused exterior grade plywood panels manufactured in accordance with American Plywood Association (APA) and bearing the trademark of that group.
 - a. Forms for concrete surfaces exposed to view: use APA High Density Overlay (HDO) Plyform Class I Exterior 48" X 96" X 3/4".
 - b. Forms for other concrete surfaces: use APA Douglas Fir B-B Plyform Class I Exterior 48" X 96" X 3/4-inch.
2. When approved, plywood may be reused.

B. Metal Forms:

1. Do not use aluminum. Provide forms free of rust and straight without dents to provide members of uniform thickness.

2.02 FORM TIES

- A. Commercially fabricated for use in form construction. Fabricated so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete. Cone on ends shall be 3/4 inch to 1 inch diameter. Provide embedded portion of tie not less than 1 1/2 inch from face of concrete after cone ends have been removed. Provide ties with integral waterstops at water-retaining and below grade structures.
- B. Tapered through-bolts may be used when approved. Use 1-inch minimum diameter at the smallest end. Fill tapered tie holes after cleaning to produce watertight construction. Use a mechanical waterstop plug near the center of the wall and fill each side with non-shrink cement grout. Mechanical waterstop plug shall be Greenstreak Group, Inc. "X-Plug"; or equal.

2.03 FORM RELEASE COMPOUND

- A. Coat form surfaces in contact with concrete using a non-staining, non-residual, water based, bond-breaking form coating. [Use NSF approved form release agents in potable water containment structures.]

PART 3 EXECUTION

3.01 PREPARATION

- A. Cover surface of forms with form release compound prior to form installation in accordance with manufacturer's recommendations.
- B. Do not permit excess form coating material to stand in puddles on forms or hardened concrete surfaces against which fresh concrete is to be placed.
- C. Clean surfaces of forms, reinforcing steel and other embedded items of accumulated mortar, grout, or other foreign materials from previous concreting or construction activities before concrete is placed.

3.02 FORMWORK CONSTRUCTION

- A. Form vertical surfaces of cast-in-place concrete including sides of footings.
- B. Construct and place forms so that the resulting concrete will be of the shape, lines, dimensions, and appearance indicated on the Drawings. Brace or tie forms together to maintain position and shape under the load of freshly-placed concrete.
- C. Tighten forms to prevent leakage.
- D. Provide temporary openings (windows) at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.
- E. Provide temporary openings to limit height of free fall of concrete and to limit the lateral movement of concrete during placement. Openings are required in wall placements greater than 20 feet in height, spaced no more than 8 feet on center measured horizontally and vertically.
- F. Place a 3/4-inch chamfer strip at exposed to view corners of formed surfaces.
- G. At construction joints, overlap hardened concrete surface by at least 1 inch. Brace forms against hardened concrete to prevent movement, offsets, or loss of mortar at construction joint and to maintain a true surface. Where possible, locate juncture of built-in-place forms at architectural lines, control joints, or at other inconspicuous lines.
- H. Where circular sections are formed using flat faced materials, use flat form lengths not exceeding 2 feet wide and the resulting deflection angles at the joints is not greater than 3-1/2 degrees.
- I. Construct wood forms for openings to facilitate loosening. Anchor forms so that movement of any part of the formwork system is prevented during concrete placement.

- J. At platforms constructed to move equipment over in-place reinforcement, provide beams, struts, and/or legs, supported directly on formwork or other structural members without resting on reinforcing steel.
- K. Provide a positive means of adjustment (wedges or jacks) at shores and struts to take up settlement during concrete placement. Brace forms against lateral deflection. Fasten in-place wedges and shims used for final adjustment of forms prior to concrete placement.
- L. Place tapered through-bolt form ties with the larger end on the side of the structure in contact with liquid.

3.03 TOLERANCES

- A. Install formwork with tolerances in accordance with ACI 117 and the following (the more stringent requirement controls):
 - 1. Install formwork in accordance with manufacturer's written instructions.
 - 2. Vertical surface tolerance from plumb; walls, columns, piers, and risers:
 - $\pm 1/2$ inch for entire height
 - $\pm 1/4$ inch in any 10 feet of height
 - 3. Vertical surface tolerance from plumb; exposed wall corners, end columns, control-joint grooves, and other exposed to view vertical lines:
 - $\pm 1/2$ inch for entire height
 - $\pm 1/4$ inch in any 20 feet of height
 - 4. Horizontal variation from level or from grade; top of slabs, slab soffits, ceilings, and beam soffits, measured before removal of supporting shores:
 - $\pm 3/4$ inch for entire length
 - $\pm 3/8$ inch for any bay or 20 foot length
 - $\pm 1/4$ inch in any 10 feet of length
 - 5. Horizontal variation from level or from grade; exposed lintels, sills, parapets, horizontal grooves, and other exposed-to-view horizontal lines:
 - $\pm 1/2$ inch for entire length
 - $\pm 1/4$ inch in any 20 feet of length.
 - 6. Plan position variation; columns, walls, and partitions:
 - $\pm 3/4$ inch for entire length
 - $\pm 3/8$ inch for any bay or 20 foot length
 - 7. Plan location and size; sleeves, floor openings, walls, wall openings, beams, and columns:
 - $\pm 1/2$ inch
 - 8. Cross sectional dimensions; columns and beams and thickness of slabs and walls:
 - $\pm 3/8$ inch
 - 9. Plan dimensions; footings and foundations:
 - minus $1/2$ inch
 - + 2 inches
 - 10. Misplacement or eccentricity; footings and foundations:
 - 2 percent of footing width in direction of misplacement
 - not more than 2 inches

- 11. Thickness; footings and foundations:
 - minus 5 percent
 - no limit on the maximum increase except that which may interfere with other construction.
- 12. Step variance in flight of stairs:
 - Rise $\pm 1/16$ inch
 - Tread from level $\pm 1/8$ inch
- B. Use control points and benchmarks for reference purposes to check tolerances. Establish and maintain reference points in an undisturbed condition until final completion and acceptance of the work.
- C. Regardless of tolerances listed, no portion of a structure shall extend beyond the legal boundary of work site.
- D. Camber formwork to compensate for anticipated deflections in formwork under wet load of concrete. Adjust camber to maintain above specified tolerances in hardened concrete after forms and shoring are removed.

3.04 REMOVAL OF FORMS

- A. Do not impose construction loads or remove shoring from any part of the structure until that portion of the structure in combination with remaining forming and shoring systems has sufficient strength to safely support its weight and loads placed thereon.
- B. If forms are loosened and not removed, proceed same day with wet curing operations to soak surfaces of concrete where forms are loosened. When wet curing is not practical or not planned, loosen, remove, and start approved curing procedures on the same day.
- C. When required for concrete curing in hot weather, required for repair of surface defects, or when required for finishing at an early age; remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- D. Remove top forms on sloping surfaces as soon as concrete has attained sufficient stiffness to prevent sagging. Make repairs or finishing treatment on such sloping surfaces immediately after form removal.
- E. Remove wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- F. Remove formwork from columns, walls, sides of beams, and other parts not supporting weight of concrete as soon as concrete has hardened sufficiently to resist damage from removal.
- G. When shores and supports are so arranged such that non-load-carrying form facing material can be removed without loosening or disturbing other shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

- H. In all cases, proceed with curing same day as form removal.
- I. Where no reshoring is planned, forms and shoring used to support weight of concrete shall be left in place until concrete has attained its specified 28-day compressive strength.

3.05 RESHORING

- A. Do not impose construction loads or remove shoring from any part of the structure until that portion of the structure, in combination with remaining forming and shoring systems, has sufficient strength to safely support its weight and loads placed thereon.
- B. While reshoring is underway, no superimposed dead or live loads are permitted on the new construction.
- C. During reshoring, do not subject concrete in structural members to combined dead and construction loads in excess of loads that the structural members can adequately support.
- D. Place reshores as soon as practicable after stripping operations are complete, but in no case later than the end of working day on which stripping occurs.
- E. Place reshores to carry their required loads without overstressing.
- F. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength specified by the formwork engineer's structural calculations and verified by field cured test cylinders or other approved method.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Reinforcing steel for use in reinforced concrete.

1.02 REFERENCES

- A. The references listed below are a part of this section. 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.

Reference	Title
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements For Structural Concrete
ACI SP-66	ACI Detailing Manual
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A1064	Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
AWS D1.4	Structural Welding Code - Reinforcing Steel
CRSI-PRB	Placing Reinforcing Bars
CRSI-MSP	Manual of Standard Practice

1.03 SUBMITTALS

- A. Action Submittals
1. Procedures: Section 01 33 00.
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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.
 4. Mill certificates of mill analysis, tensile, and bend tests for all reinforcing.
 5. Manufacturer and type of proprietary reinforcing steel splices. Submit a current ICC Report and manufacturer's literature that contains instructions and recommendations for each type of coupler used.

6. Qualifications of welding operators, welding processes and procedures.
7. Reinforcing steel shop drawings showing reinforcing steel bar quantities, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing steel supports. Reinforcing steel shop drawings shall be of sufficient detail to permit installation of reinforcing steel without reference to the contract drawings. Shop drawings shall not be prepared by reproducing the plans and details indicated on the contract drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of reinforcing steel, including large scale drawings at joints detailing bar placement in congested areas. Placement drawings shall be in accordance with ACI 315. Reinforcing details shall be in accordance with ACI SP-66.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Ship reinforcing steel to the jobsite with attached plastic or metal tags having permanent mark numbers which match the shop drawing mark numbers. All reinforcing shall be supported and stored above ground.

PART 2 PRODUCTS

2.01 BAR REINFORCEMENT

- A. Reinforcing steel bars shall be deformed billet steel in conformance with ASTM A615, Grade 60. Bars to be welded shall be deformed billet steel conforming to ASTM A706. Where specified, reinforcing steel shall be epoxy-coated in conformance with ASTM A775.

2.02 WIRE FABRIC

- A. Wire fabric shall be welded steel mesh conforming to ASTM A1064.

2.03 WIRE AND PLAIN BARS

- A. Wire used as reinforcement and bars used as spiral reinforcement in structures shall be cold drawn steel conforming to ASTM A1064.

2.04 TIE WIRE

- A. The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.05 BAR SUPPORTS

- A. Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI-MSP and placed in accordance with CRSI-PRB. Plastic coating on legs shall extend at least 0.5-inch upward from form surface.
- B. Provide precast concrete blocks, four inches square in plan, with embedded tie wires (wire dobies) as specified by CRSI 1 MSP for footing and slabs on grade. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel. Precast concrete blocks shall have same or higher compressive strength as specified for concrete in which they are located.

- C. Provide stainless steel or plastic protected plain steel supports for other work.

2.06 FABRICATION

- A. Fabricate reinforcing steel bars in accordance with ACI 315 and the following tolerances:
 - 1. Sheared lengths: +/-1 inch.
 - 2. Overall dimensions of stirrups, ties, and spirals: +/-1/2 inch.
 - 3. All other bends: +0 inch, -1/2 inch
 - 4. Minimum diameter of bends of reinforcing steel bars: Per ACI 318.

PART 3 EXECUTION

3.01 PLACEMENT TOLERANCE

- A. Reinforcing steel placement tolerance shall conform to the requirements of ACI 117, ACI 318, and the following:
 - 1. Reinforcing steel bar clear distance to formed surfaces shall be within +/-1/4 inch of specified clearance and minimum spacing between bars shall be a maximum of 1/4 inch less than specified.
 - 2. Reinforcing steel top bars in slabs and beams shall be placed +/-1/4 inch of specified depth in members 8 inches deep or less and -1/4", +1/2 inch of specified depth in members greater than 8 inches deep.
 - 3. Reinforcing steel spacing shall be placed within +/- one bar diameter or +/- 1 inch, whichever is greater.
 - 4. The minimum clear distance between reinforcing steel bars shall be equal to the greater of 1 inch or the reinforcing steel bar diameter for beams, walls and slabs, and the greater of 1 1/2 inches or 1.5 times the reinforcing steel bar diameter for columns.
 - 5. Beam and slab reinforcing steel bars shall be threaded through column vertical reinforcing steel bars without displacing the column reinforcing steel bars and still maintain clear distances for beam and slab reinforcing steel bars.

3.02 CONCRETE COVER

- A. Unless specified otherwise on the Drawings, reinforcing steel bar cover shall conform to the following:
 - 1. Reinforcing steel bar cover shall be 3 inches for concrete cast against earth.
 - 2. Reinforcing steel bar cover shall be 2 inches for reinforcing steel bars for formed concrete surfaces exposed to earth and weather.
 - 3. Reinforcing steel bar cover shall be 2 inches for any formed surfaces exposed to or above any liquid.
 - 4. Reinforcing steel bar cover shall be 1 1/2 inches for reinforcing not in the above categories unless noted otherwise on the design drawings.

3.03 SPLICING

- A. Reinforcing steel splicing shall conform to the following:
 - 1. Use Class B splice lengths in accordance with ACI 318 for all reinforcing steel bars unless shown otherwise on the drawings.
 - 2. For welded wire fabric the splice lap length measured between the outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 inches, nor less than 1.5 times the development length nor less than 6 inches.
 - 3. Splices of reinforcement steel bars not specifically indicated or specified shall be subject to the approval of the Owner's Representative. Mechanical proprietary splice connections may be used when approved by the Owner's Representative or as indicated on the drawings.
 - 4. Welding of reinforcing steel bars is not allowed unless approved by the Owner's Representative.

3.04 CLEANING

- A. Reinforcing steel bars at time of concrete placement shall be free of mud, oil, loose rust, or other materials that may affect or reduce bond. Reinforcing steel bars with rust, mill scale or a combination of both may be accepted without cleaning or brushing provided dimensions and weights including heights of deformation on a cleaned sample are not less than required by applicable ASTM standards.

3.05 PLACEMENT

- A. Reinforcing steel bar placement shall conform to the following:
 - 1. Uncoated reinforcing steel bars shall be supported and fastened together to prevent displacement by construction loads or concrete placement. For concrete placed on ground, furnish concrete block supports or metal bar supports with non-metallic bottom plates. For concrete placed against forms furnish plastic or plastic coated metal chairs, runners, bolsters, spacers and hangers for the reinforcing steel bar support. Only tips in contact with the forms require a plastic coating.
 - 2. Fasten coated reinforcing steel bars together to prevent displacement. Use plastic or nylon ties to hold the coated reinforcing steel bars rigidly in place. Support coated reinforcing steel bars with plastic or plastic coated chairs, runners, bolsters, spacers and supports as required.
 - 3. Support reinforcing steel bars over cardboard void forms by means of concrete supports which will not puncture or damage the void forms nor impair the strength of the concrete member.
 - 4. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, reinforcing steel bars in the upper layers shall be placed directly over the reinforcing steel bars in the bottom layer with the clear distance between each layer to be 2 inches unless otherwise noted on the Drawings. Place spacer reinforcing steel bars at a maximum of 3'-0" on center to maintain the minimum clear spacing between layers.
 - 5. Extend reinforcement to within 2 inches of formed edges and 3 inches of the concrete perimeter when concrete is placed against earth.
 - 6. Reinforcing steel bars shall not be bent after embedding in hardened concrete unless approved by the Owner's Representative.

7. Tack welding or bending reinforcing steel bars by means of heat is prohibited.
8. Where required by the contract documents, reinforcing steel bars shall be embedded into the hardened concrete utilizing an adhesive anchoring system specifically manufactured for that application. Installation shall be per the manufacturer's written instructions.
9. Bars with kinks or with bends not shown shall not be used.
10. Heating or welding bars shall be performed in accordance with AWS D1.4 and shall only be permitted where specified or approved by the Owner's Representative. Bars shall not be welded at the bend.

3.06 FIELD QUALITY CONTROL

- A. Field quality control shall include the following:
 1. Notify the Owner's Representative whenever the specified clearances between the reinforcing steel bars cannot be met. The concrete shall not be placed until the Contractor submits a solution to the congestion problem and it has been approved by the Owner's Representative.
 2. The reinforcing steel bars may be moved as necessary to avoid other reinforcing steel bars, conduits or other embedded items provided the tolerance does not exceed that specified in this section. The Engineer's approval of the modified reinforcing steel arrangement is required where the specified tolerance is exceeded. No cutting of the reinforcing steel bars shall be done without written approval of the Owner's Representative.
 3. Coated reinforcing steel bars will be inspected on the jobsite for handling defects, coating abrasion, coating thickness and continuity of coating. The Owner's Representative may defer final inspection of the coated reinforcing steel bars until bar erection and handling is complete. Repair coated areas as directed by the Owner's Representative and completed prior to concrete placement.
 4. An independent laboratory shall be employed to review and approve Contractor welding procedures and qualify welders in accordance with AWS D1.4. The laboratory shall visually inspect each weld for visible defects and conduct non-destructive field testing (radiographic or magnetic particle) on not less than one sample for each 10 welds. If a defective weld is found, the previous 5 welds by the same welder shall also be tested.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Cast-in-place concrete, which consists of providing material, mixing, transporting equipment, and labor for the proportioning, mixing, transporting, placing, consolidating, finishing, curing, and protection of concrete in the structure.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related specification sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 11 00 Concrete Forming
 2. Section 03 20 00 Concrete Reinforcing
 3. Section 03 60 00 Grouting
 4. Section 05 50 00 Metal Fabrications
 5. Section 09 96 00 High Performance Coatings for Water and Wastewater

1.03 REFERENCES

- A. The references listed below are a part of this section. 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.

Reference	Title
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 214R	Guide to Evaluation of Strength Test Results in Concrete
ACI 301	Specifications for Structural Concrete
ACI 305.1	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.1	Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
ACI 503.7	Specification for Crack Repair by Epoxy Injection
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Ready-Mixed Concrete
ASTM C117	Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing

Reference	Title
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Slump of Hydraulic Cement Concrete
ASTM C150	Portland Cement
ASTM C157	Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C172	Sampling Freshly Mixed Concrete
ASTM C192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C511	Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
ASTM C595	Blended Hydraulic Cements
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Slag Cement for use in Concrete and Mortars
ASTM C1059	Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C1077	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1240	Silica Fume Used in Cementitious Mixtures
ASTM C1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1315	Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM C1567	Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Sampling Aggregates
ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
CRD-C572	U.S. Corps of Engineer's Specifications for Polyvinylchloride Waterstop
IBC	International Building Code with local amendments

1.04 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

3. Check-marks (✓) denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined signify compliance with the specification. Include a detailed, written justification for each deviation. Failure to include a copy of this marked-up specification section, along with justification(s) for requested deviations, with the submittal, is cause for rejection of the entire submittal with no further consideration.
4. Each proposed mix design showing:
 - a. Expected strength at 7 and 28-days
 - b. Slump, before and after introduction of high-range water-reducing admixture
 - c. Water/cement ratio
 - d. Weights and test results, certifications, and mill reports of the ingredients
 - e. Chemical analysis report and report of other specified test analyses for supplementary cementitious material
 - f. Aggregate gradation and documentation of test results classifying aggregate as non-potentially reactive
 - g. Test results of mix design prepared by an independent testing laboratory
 - h. Shrinkage test results for liquid containing structures
 - i. Other physical properties necessary to review each mix design for conformance with these specifications
5. Mix designs proposed shall be sealed by a Professional Engineer registered in Washington State
6. Product literature and technical data for aggregates, cement, and pozzolan.
7. Product literature, technical data, and dosage of proposed admixtures including, but not limited to, air entraining, water reducing, retarding, shrinkage reducing, etc.
8. Anticipated average delivery time from batch plant to site. If this time exceeds the limit specified in Part 3, include proposed method to extend set time without deleterious effects on final product. Owner's Representative reserves the right to accept or reject such proposed methods.
9. Lift Drawings: Submit shop drawings for concrete placements on the project before on-site construction begins. The drawings shall be organized by structure and submitted as a complete set for the Engineer's review. The drawings shall be drawn to scale and show dimensions, forming details, and placement volumes. Show location of construction joints, details of surface preparation, scheduled finish, embedments (including conduits, inserts, and anchor bolts), penetrations (including pipe sleeves), openings, keyways, blockouts, bulkheads, etc. The drawings shall clearly show the placement sequence and will be accompanied by a schedule that shows the schedule dates for forming, placement, and stripping for each section of concrete placed within each structure.
10. Curing program description in sufficient detail to demonstrate that the Contractor will provide acceptable strength, finish, and crack control within the completed structure. Detailed plan for curing and protection of concrete in cold and hot weather.
11. Product literature and technical data for waterstops, curing and sealing compounds, bonding compounds, surface hardeners, epoxy and chemical grout for crack injection, retardant, bearing pads, and trench drains.
12. Sample panels at least 12-inches by 12-inches by three inches thick to demonstrate formed wall surface finishes as specified in Part 3.

13. Samples of concrete floor and slab for each finish specified in Part 3 approximately four feet square and a minimum of four inches thick, with one construction joint and one expansion joint, if used.
14. Concrete delivery truck tickets showing the information listed in ASTM C94, section 14.

1.05 QUALITY ASSURANCE

A. Quality Control By Owner:

1. Special Inspection of concrete work shall be performed by the Special Inspector under contract with the Owner and in conformance with the IBC Chapter 17. Special Inspection of concrete is in addition to, not replacing, other inspections and quality control requirements specified herein. Where sampling and testing specified herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.
2. All structural concrete work shall receive Special Inspection in accordance with IBC Chapter 17. Structural concrete includes elements which resist code-defined loads and whose failure would impact life safety. Non-structural site work concrete does not require Special Inspection. Anchor bolts and anchors installed in hardened concrete require Special Inspection.
3. Refer to Section 01 45 23 Testing and Inspection Services for Owner provided testing.

B. Quality Control By Contractor:

1. Where required to demonstrate conformance with the specified requirements for cast-in-place concrete, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329 and ASTM C1077. The testing laboratory shall sample and test concrete materials as specified in this section. Costs of testing laboratory services shall be borne by the Contractor.
2. Concrete testing laboratory personnel shall be certified in accordance with the ACI Concrete Laboratory Testing Technician – Level 1 Certification Program or the ACI Concrete Strength Testing Technician Certification Program, or an equivalent program.
3. Refer to Section 01 45 00 Quality Control.

C. Basis For Quality:

1. Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified herein.

D. Concrete Conference

1. Contractor shall schedule and conduct a meeting to review the specification requirements and the proposed concrete design mixes, including procedures for producing proper concrete construction. Hold the meeting no later than 28 days after the Notice to Proceed.
2. All parties involved in the concrete work shall be included to attend the conference, including the following: Contractor's representative, testing laboratory, concrete subcontractor, concrete supplier, reinforcing steel subcontractor, Owner's Representative, and Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cement:

1. Store cement bags immediately upon receipt in a weatherproof structure as airtight as practicable. Elevate floor above ground to prevent absorption of moisture. Stack bags close together to reduce circulation of air but do not stack against outside walls. Stack to permit easy access for inspection and identification of each shipment.
2. Transfer bulk cement to elevated airtight and weatherproof bins. At the time of use, cement shall be free flowing and free of lumps. Do not use cement which has been in storage longer than 6 months.

B. Aggregates:

1. Store aggregates on areas covered with tightly laid wood planks, sheet metal, or other hard and clean surfaces in a manner that will preclude the inclusion of foreign material. Store aggregates of different sizes in separate piles. Build stock piles of coarse aggregate in horizontal layers exceeding 4 feet in depth to minimize segregation. Remix segregated aggregates to conform to the grading requirements.

C. Admixtures:

1. Store admixtures to prevent damage. Do not use air-entraining admixture which has been in storage for longer than 6 months or has been frozen.

D. Pozzolan:

1. Deliver and store pozzolan in the same manner as cement.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement:

1. Portland cement shall be ASTM C150, Type II, low alkali, containing less than 0.60 percent alkalis. In addition to standard requirements, cement shall satisfy optional chemical and physical requirements of ASTM C150, Tables 2 and 4, respectively.
2. If low alkali portland cement is not available, test results shall be submitted showing aggregates meet the alkali-silica reactivity criteria in 2.01.D.1.b below.
3. Portland-pozzolan cement shall be ASTM C595, Type IP (MS), interground, low alkali.
4. Portland blast-furnace slag cement shall be ASTM C595, Type IS (<70) (MS), interground, low alkali.
5. Portland-limestone cement shall be ASTM C595, Type IL (MS), interground, low alkali. In addition to showing compliance with all testing requirements of ASTM C595 (Tables 1-3), cement certification shall also include chemical testing results showing C₃A content less than 8% to match existing Type I/II characteristics.
6. Hydraulic cements meeting only the Physical Requirements of ASTM C1157 are not permitted.
7. Use cementitious materials that are of the same brand and type and from the same plant of manufacture as the cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures. See Change of Materials paragraph below.

- B. Ground granulated blast-furnace slag (GGBFS), if used in conjunction with portland cement, shall be per ASTM C989, Grade 100 or Grade 120, limited to 50 percent of the weight of cementitious materials. If GGBFS is combined with pozzolans and/or silica fume, the total weight of GGBFS, pozzolans, and silica fume shall not exceed 50 percent of the weight of cementitious materials.
- C. Silica fume, if used in conjunction with portland cement, shall be per ASTM C1240, limited to 10 percent of the weight of cementitious materials. Silica fume shall be used with a high-range water-reducing admixture.
- D. Aggregates:
 - 1. General:
 - a. Except as modified herein, fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates are regarded as separate ingredients. Aggregates shall be non-reactive and washed before use.
 - b. Check aggregates for alkali-silica reactivity to meet the following criteria. Aggregates or combinations of cementitious materials and aggregates shall have less than 0.10% expansion at 16 days when tested in accordance with ASTM C1260 or ASTM C1567. Alternatively, aggregate tested independently in accordance with ASTM C1293 shall have less than 0.04% expansion at one-year, or combinations of aggregate and cementitious materials tested in accordance with ASTM C1293 shall have less than 0.04% expansion at two years. Test results shall be no older than two years.
 - c. Tests for size and grading of fine and coarse aggregates shall be in accordance with ASTM C136. Combined aggregates shall be well and uniformly graded from coarse to fine sizes to produce a concrete that has optimum workability and consolidation characteristics. Establish the final combined aggregate gradation during mix design.
 - d. Aggregates used in the project production concrete shall be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by the submitted historical data or trial mixtures. See Change of Materials paragraph below.
 - 2. Fine Aggregate:
 - a. Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33. For classes of concrete which will be used in liquid retaining structures, fine aggregate shall not exceed 40 percent by weight of combined aggregate total, except for concrete with coarse aggregate of less than maximum size 1/2 inch.
 - b. Variations from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

U.S. standard sieve size	Permissible variation in individual tests, percent
30 and coarser	2
50 and finer	0.5

- c. Other tests shall be in accordance with the following specifications:

Test	Test method	Requirements
Amount of material	ASTM C117	3 percent passing No. 200 sieve maximum by weight
Sand equivalent	ASTM D2419	Minimum 70 percent

3. Coarse Aggregate:

- a. Coarse aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, and organic matter. Other deleterious substances shall not exceed the limits listed in ASTM C33, Table 4 for Class Designation 4S. Gradation of each coarse aggregate size specified shall conform to ASTM C33, Table 3.
- b. Variations from the specified gradations will be acceptable in individual tests if the average of three consecutive tests is within the specified limits.

E. Pozzolan:

1. Pozzolan shall be Class F fly ash conforming to ASTM C618. Class C fly ash is not allowed. Pozzolan supplied during the life of the project shall have been formed at the same single source. See Change of Materials paragraph below.
2. The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.
3. Use pozzolan materials that are of the same brand and type and from the same plant of manufacture as the materials used in the concrete represented by the submitted field test records or used in the trial mixtures.
4. The loss on ignition shall be a maximum of four percent.
5. The maximum percent of sulfur trioxide (SO₃) shall be 4.0

F. Admixtures:

1. General:
 - a. Admixtures shall be compatible with the concrete and with each other. Calcium chloride or admixtures containing calcium chloride are not acceptable. Use admixtures in accordance with the manufacturer's recommendations and add separately to the concrete mix. Water reducing retarders and admixtures shall reduce the water required by at least 11 percent for a given concrete consistency and shall comply with the water/cement ratio standards of ACI 211.1. Retarder dosage shall result in set time consistent with requirements specified in Part 3.
2. Water Reducing Admixtures:
 - a. Conform to ASTM C494, Type A. Acceptable products include: BASF Corporation "MasterPozzolith Series"; Sika Chemical Corp. "Plastocrete 161"; Euclid Chemical Co. "Eucon WR 91"; or approved equal.
3. Water Reducing and Retarding Admixtures:
 - a. Conform to ASTM C494, Type D. Acceptable products include: BASF Corporation "MasterSet R Series"; Sika Chemical Corp. "Plastiment"; Euclid Chemical Co. "Eucon Retarder 75"; or approved equal.

4. High Range Water Reducing (Superplasticizing) Admixtures:
 - a. Conform to ASTM C494, Type F. Acceptable products include: BASF Corporation "MasterGlenium" Series; Sika Chemical Corp. "Viscocrete 2100" or "Viscocrete 2110" (Hot Weather) or "Viscocrete 6100" (Cold Weather); Euclid Chemical Co. "Eucon 37"; GCP Applied Technologies "ADVA 195"; or approved equal.
 5. High Range Water Reducing And Retarding Admixtures:
 - a. Conform to ASTM C494, Type G. Acceptable products include: GCP Applied Technologies "Daracem 100"; Sika Chemical Corp. "Sikaplast 200"; Euclid Chemical Co. "Eucon 537"; or approved equal.
 6. Air Entraining Agent:
 - a. Conform to ASTM C260 and produce air entrained concrete as specified in the Mix Proportioning table below. Acceptable products include: BASF Corporation "MasterAir Series"; Sika Chemical Corp. "Sika AEA-14" or "Sika AIR"; Euclid Chemical Co. "Eucon AEA-92"; or approved equal.
 7. Shrinkage Reducing Admixture:
 - a. Select admixture for compatibility with air entrainment admixture and other ingredients in the concrete mix. Acceptable products include: BASF Corporation "MasterLife SRA Series"; GCP Applied Technologies "Eclipse 4500"; or approved equal.
 8. Corrosion Inhibiting Admixture:
 - a. Select admixture for compatibility with other ingredients in the concrete mix. Acceptable products include: BASF "MasterLife CI 222", GCP Applied Technologies "DCI S", or approved equal.
- G. Water:
1. For washing aggregate, mixing, and for curing shall be free from oil and deleterious amounts of acids, alkalis, and organic materials; comply with the requirements of ASTM C1602. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the concrete.
- H. Change of Materials:
1. After each concrete mix design is approved, no changes of any sort or source will be allowed without prior written approval from the Engineer. When brand, type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are proposed to be changed, new field data, data from new trial mixtures, or evidence that indicates that the change will not affect adversely the relevant properties of the concrete shall be submitted for approval by the Engineer before use in concrete.

2.02 CONCRETE CHARACTERISTICS

- A. Mix Proportioning:
1. Concrete shall be normal weight concrete composed of cement, pozzolan, admixtures, aggregates, and water; proportioned and mixed to produce a workable, strong, dense, and impermeable concrete. It is acceptable to substitute interground Portland-pozzolan cement conforming to ASTM C595, containing the specified amount of pozzolan in lieu of Portland cement and pozzolan. Water-cementitious material (w/cm) ratio is based on the combined contents of cement and pozzolan.
 2. Add corrosion inhibiting admixture to Class A, C-1, and C-2 mixes.

3. Provide concrete mix designs in accordance with the following guidelines:

Concrete class	Minimum ^a 28-day compressive strength, psi	ASTM coarse aggregate size	Maximum water- cementitious materials (w/cm) ratio	Minimum cementitious materials content (pounds/CY)	Pozzolan, percent by weight of cementitious materials	Air content (percent)	Slump range ^f (inches)	Max Density (pcf)
B ^c	3000	57 or 67	0.45	560	15-25 ^d	4-6	3-5	-
C-1	4500	57 or 67	0.40	560	15-25	4-6	3-5	-
C-2	5000	57 or 67	0.42	560	15-25 ^d	4-6	3-5]	-
E	2000	57	--	-	15-25 ^d	Not Required	4-8	-
G	5000	67	0.45	660	15-40	Not Required	6-9 ^g	-

^a Determine compressive strength at the end of 28 days based on test cylinders made and tested in accordance with ASTM C39.

^b Compressive strength of Class A concrete may be determined at 56 days.

^c Concrete encasement for electrical conduit shall contain 3 pounds of red oxide per sack of cement.

^d Pozzolan use is optional for this class of concrete.

^e Minimum 28-day compressive strength shall be 500 psi and maximum 28-day compressive strength shall be 1,000 psi.

^f Slump before addition of high range water reducing admixture (superplasticizer). Maximum slump after addition of high range water reducing admixture shall be 8".

^g Do not use high-range water reducing admixtures for Class G concrete.

B. Use:

1. Provide concrete by class for the uses listed below.

Concrete class	Type of use
B	Non-structural concrete (sidewalks, curbs, pavers, etc.), electrical conduit encasement (duct banks).
C-1	Typical cast-in-place structural concrete
C-2	Precast concrete
E ^a	Pipe bedding and encasement and concrete fill
G	Tremie slab concrete

^a Contractor's option to use the same concrete mix for pipe encasement as the concrete slab above.

C. Control Tests:

1. General:

- a. Select and adjust proportions of ingredients in accordance with ACI 211.1. Verification of mix characteristics for submittal may be achieved using either the Trial Mix Design method or Field Experience Data method. Do not place concrete prior to submittal and acceptance of proposed mix.

2. Trial Mix Design:

- a. Mixes verified by this method shall have the samples produced for testing, manufactured at the batch plant which will supply concrete to the project, using materials proposed for the Work and material combinations listed above. Testing, data, and reporting shall conform to ACI 318 and the following:
 - 1) Required compressive strength used as the basis for selecting concrete proportions (f'_{cr}) shall be the specified concrete strength (f'_c) + 1000 psi for specified concrete strengths less than 3,000 psi and f'_c + 1200 psi for specified concrete strengths between 3000 psi and 5000 psi.
 - 2) Make at least three different trial mixtures for each class of concrete qualified by the Trial Mix Design. Each trial mixture shall have a different w/cm ratio or different cementitious materials content that will produce a range of compressive strengths encompassing f'_{cr} .
 - 3) Design trial mixtures to produce a slump within $\frac{3}{4}$ inch of the maximum specified and an air content within 0.5 percent of the maximum specified.
 - 4) For each w/cm ratio or cementitious materials content, cast and cure at least twelve standard test cylinders in accordance with ASTM C192. Four cylinders from each batch tested at age 7-days, 14-days, and 28-days or as required to comply with ACI 318.
 - 5) From results of the cylinder tests, plot a curve showing the relationship between w/cm ratio and compressive strength.
 - 6) From the curve of w/cm ratio versus compressive strength, select the w/cm ratio that will produce f'_{cr} . This is the maximum w/cm ratio to be used unless a lower w/cm ratio is specified above.

3. Field Experience Data:

- a. When sufficient test data for a particular mix design is available which is identical or substantially similar to that proposed for use, Contractor may substitute use of this data in lieu of a trial mix design. Field data, reports, and analysis shall conform to ACI 318, except as modified herein.
 - 1) Historical mix design proportions for which data are submitted may vary from the specified mix within the following limits:
 - a) f'_c as specified or up to 500 psi above
 - b) w/cm ratio as specified or lower
 - c) pozzolan content within 5 percent of that specified
 - d) maximum coarse aggregate size may not vary smaller, but gradation of coarse aggregate may vary
 - e) slump after introduction of admixtures +0/-1 inch.
- b. Use of historical Field Experience Data does not allow modification of the project mix specifications herein without review and acceptance by the Engineer.

4. Shrinkage:
 - a. Liquid containing structures using Class C-1 concrete mix are intended to be watertight. Provide test results for Class C-1 concrete mix meeting the following requirement: drying shrinkage limit of 0.038 percent in the laboratory at 35-days (7-days moist cure and 28-days drying) as tested in accordance with ASTM C157 and the following modifications:
 - 1) Wet cure specimens for a period of 7-days (including the period of time the specimens are in the mold). Wet cure may be achieved either through storage in a moist cabinet or room in accordance with ASTM C 511, or through storage in lime saturated water.
 - 2) Slump of concrete for testing shall match job requirements and need not be limited to restrictions as stated in ASTM C 157 section 8.4.
 - 3) Report results in accordance with ASTM C 157 at 0, 7, 14 & 28-days of drying.
 - b. Concrete shall not be placed in the field prior to acceptance of the concrete mix. To meet the drying shrinkage limit, it is recommended that a shrinkage reducing admixture be considered for use in concrete for liquid containing structures.

2.03 WATERSTOPS

A. Polyvinyl Chloride (PVC):

1. Manufacture PVC waterstops from virgin polyvinyl chloride conforming to the Corps of Engineers Specification No. CRD-C572.
2. Use 6-inch by 3/8-inch ribbed flat ribbed with center bulb waterstop in construction joints. Acceptable products include: Greenstreak Group, Inc. "Model 679" "Model 705"; Vinylex Waterstops and Accessories "Model R638", "Model RB6-38; or approved equal.
3. Use 9 inch by 3/8-inch ribbed with center bulb waterstop in expansion joints. Acceptable products include: Greenstreak Group, Inc. "Model 696"; Vinylex Waterstops and Accessories Model "RLB9-38"; or approved equal.
4. Use molded crosses, tees, and other shapes for changes of direction, intersections, and transitions or cut and splice as recommended by manufacturer.

B. Retro-Fit:

1. Use "Tee" or "L" shape as indicated with epoxy adhesive, stainless steel batten strips, and stainless steel adhesive anchors. Acceptable products include: Greenstreak Group, Inc Model "667" or approved equal.

C. Expanding (Hydrophilic) Waterstops:

1. Bentonite-free, made from unvulcanized rubber. Acceptable products include: Adeka Corporation "Ultra Seal MC-2010MN with P-201 adhesive/sealant"; Greenstreak Group, Inc. "Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive/sealant"; or approved equal. These are allowable for use only where indicated on the drawings or accepted in writing by Engineer. Provide adhesive/sealant approved by manufacturer plus concrete nails and fender washers to secure waterstop material in-place during concrete placement. The waterstop MUST be placed between two mats or curtains of steel reinforcement with minimum 3-inches concrete cover.
2. For limited cover applications or where only one mat or curtain of reinforcement is present, use Adeka Corporation "Ultra Seal KBA-1510FP" or approved equal.

2.04 BONDING COMPOUNDS

- A. Epoxy resin bonding compounds for use in wet areas shall conform to ASTM C881 Types IV or V, Class A, B, or C depending on temperature at use. Acceptable products include: BASF Corporation "MasterEmaco ADH 327RS"; Sika Chemical Corporation "Sikadur 32"; or approved equal.
- B. Non-epoxy bonding compounds for use in dry areas for non-structural bonding or as noted on the drawings shall conform to ASTM C1059 Type II. Acceptable products include: Penetron Specialty Products "Acrylic Bondcrete"; ChemMasters "Cretelox"; or approved equal.
- C. Apply bonding compounds in accordance with the manufacturer's instructions.

2.05 EPOXY FOR CRACK INJECTION

- A. Use a two-component, moisture insensitive, high modulus, injection grade, 100 percent solids, epoxy-resin blend. Consistency as required to achieve complete penetration into cracks. Material shall conform to ASTM C881 Type 1 Grade 1. Acceptable products include: Sika Corporation "Sikadur 52"; Adhesives Technology Corporation "Crackbond SLV302"; or approved equal.
- B. Use epoxy injection for structural crack repairs except as noted below for non-structural cracks in liquid-containing concrete structures. The Engineer shall determine whether a crack is classified as structural or non-structural.

2.06 CHEMICAL GROUT FOR CRACK INJECTION

- A. Use hydrophobic polyurethane grout at the Engineer's discretion as an alternative for sealing non-structural cracks in concrete structures intended to be watertight. Acceptable products for sealing hairline cracks include: GCP Applied Technologies "DE NEEF Flex SLV PURE" (must be used with DE NEEF Flex Cat PURE); or Sika Corporation "SikaFix HH LV" as appropriate for crack width; or approved equal. Coordinate with product supplier to verify and select appropriate product for crack widths to be injected.

2.07 SURFACE RETARDANT

- A. Retardant for exposing aggregate for unformed surfaces in construction joints shall be Sika Corporation "Rugasol-S"; GCP Applied Technologies "Top-Cast"; or approved equal.
- B. Apply retardant in accordance with manufacturer's instructions sufficient to assure a minimum penetration of 1/4 inch.

2.08 CURING AND SEALING COMPOUNDS

- A. Acceptable products include: BASF Corporation "MasterKure CC 250SB"; Dayton Superior "Cure & Seal 25% J22UV"; or approved equal, conforming to ASTM C1315.
- B. Compound shall be clear and applied in accordance with the manufacturer's instructions.

- C. Curing and sealing compound shall be certified compliant with final finish system if applicable, including compatibility with floor hardeners in areas where floor hardeners are specified to be used.

PART 3 EXECUTION

3.01 GENERAL

- A. Use only truck-mixed, ready-mixed concrete conforming to ASTM C94. Proportion materials by weighing.
- B. Introduce pozzolan into the mixer with cement and other components of the concrete mix; do not introduce pozzolan into a wet mixer ahead of other materials or with mixing water.
- C. Introduce water at the time of charging the mixer; additional water may be introduced within 45 minutes from charging the mixer, provided the specified w/c ration and slump is not exceeded and the maximum total water per the approved mix design is not exceeded.
- D. Arrange with the testing laboratory for inspection as required to comply with these specifications.
- E. Deliver concrete to the site and complete discharge within 90 minutes after introduction of water to the mixture. Extension of allowable time beyond this limit requires a Contractor proposed remedial action plan to be reviewed and accepted by the Owner's Representative.

3.02 CONVEYING AND PLACING CONCRETE

- A. Convey concrete from the mixer to the forms in accordance with ACI 301. Remove concrete that has segregated in conveying from the site of the work.
- B. Placing Concrete:
 - 1. General:
 - a. Place concrete in accordance with ACI 301. Do not permit concrete to drop freely more than 4-ft (6-ft when superplasticizer is used).
 - 2. Placing Concrete By Pumping:
 - a. Concrete placed by pumping is at Contractor's discretion and shall not be the cause to change or relax specified mix design characteristics. Concrete shall possess the specified characteristics at the point of placement.
 - b. Measure slump at the hose discharge, except as follows: Initial slump testing in each placement shall occur at both the pumping unit inlet hopper and hose discharge. Slump loss in pumping, measured between the inlet hopper and the hose discharge, shall not exceed 1 inch. After these criteria have been satisfied, slump may be measured at the inlet hopper with allowable slump increased by the earlier measured difference, not to exceed 1 inch.

- c. Before starting each pumping operation, prime the pump and line with a cement slurry to lubricate the system. Waste cement slurry outside the forms. Equip hose tip with a safety chain for recovery in case of hose blowout during pumping. Hose or accessories shall not remain in the freshly placed concrete.
 - d. Use tremie placing techniques and equipment for pump placed concrete. Pump discharge system shall remain full of concrete from pump to discharge point at all times. Concrete pumping shall not occur until Owner's Representative has verified equipment including the tremie plug. Should the discharge line become open, with zones empty of concrete, cease pumping and re-primed with tremie plug installed before continuing.
3. Placing Concrete In Hot Weather:
- a. In temperatures above 80 degrees F, place concrete in accordance with ACI 305.1.
4. Placing Concrete In Cold Weather:
- a. In temperatures below 40 degrees F, place concrete in accordance with ACI 306.1.
5. Tremie Concrete:
- a. To place concrete under water, use tremie placing techniques with equipment and procedures for pump placed concrete as stated above.
 - 1) Tremie/Seal Slab:
 - a) Place concrete in the slab by tremie tube (minimum 10 inch heavy gauge steel pipes) pumping to avoid separation and segregation of the concrete mix components. Separate the first concrete placed from the fluid in the excavation using a plug in the tube, or other approved device.
 - b) Continuously place concrete until the tremie tube or pumping pipe is removed from concrete at completion of the placement. If the area to be placed exceeds 15 feet in any dimension, provide multiple, pre-positioned tubes spaced at no more than 15 feet apart. Pump from one tube to the next until the subsequent tube is sufficiently embedded into the fresh concrete. Continue the placement by pumping into the next tube, and so on until the entire slab is placed.
 - 2) Maintain a minimum 12 inches of tremie pipe embedment in the concrete during concrete placement. If at any time during the pour, the tremie pipe orifice is removed from the concrete and concrete is discharged above the rising concrete level, the placement will be considered to be defective and corrective measures taken at Contractor's expense.
 - 3) If the tremie slab thickness exceeds 36 inches, it will be considered mass concrete where precautions shall be taken to minimize thermal cracking. Tremie slab concrete mix shall be pre-cooled such that the temperature of the concrete delivered to the site does not exceed 70 degrees F. Methods of pre-cooling the concrete mix include cooled batch water, shaded aggregates and cement, and coarse aggregate stockpiles sprayed with water for an evaporative cooling effect.

- 4) Inspection of Tremie Slab Concrete:
 - a) Develop and submit an inspection plan covering locations and methods of taking soundings during the tremie concrete placement. Soundings shall be taken each hour during placement or every 200 cy, whichever results in the most frequency of soundings. Soundings shall be spaced to cover the area at each tremie pipe discharge location. Data obtained from soundings shall be plotted immediately to monitor progress in placement.
- 5) Note that the tremie slab is to be placed 6 inches higher than shown on the drawings followed by removal of the 6 inch excess to ensure quality concrete at the top surface.

3.03 CONSOLIDATING CONCRETE

- A. Consolidate concrete in accordance with ACI 301. If evidence of inadequate consolidation is observed, concrete placement will be suspended until Contractor provides a revised plan to achieve proper consolidation.

3.04 CURING AND SEALING

- A. General:
 1. Cure concrete using water (including form curing and use of moisture retaining covers), a clear membrane curing compound, or by a combination of both methods. Coordinate repairs or treatment of concrete surfaces so that interruption of curing will not be necessary.
 2. Maintain concrete surface temperature between 50 degrees F and 80 degrees F for at least 5 days. Cure concrete in hot weather (above 80 degrees F) in accordance with ACI 305.1. Cure concrete in cold weather (below 45 degrees F) in accordance with ACI 306.1.
- B. Water Curing:
 1. Keep concrete continuously wet for a minimum of 10-days after placement (14 days after placement for sections over 3-feet thick). Absorptive mats or fabric may be used to retain moisture during the curing period. Absorptive covers shall comply with AASHTO M182, Class 3, and moisture retaining covers shall comply with ASTM C171.
 2. Use water curing in hot weather for liquid containment structures. Cover forms and keep moist. Loosen forms as soon as possible without damage to the concrete, and make provisions for curing water to run down inside them. During form removal, take care to provide continuously wet cover to newly exposed surfaces.
- C. Curing Compound:
 1. When curing compound is allowed, apply it as soon as the concrete has set sufficiently so as not to be marred by the application or apply it immediately following form removal for vertical and other formed surfaces. Preparation of surfaces, application procedures, and installation precautions shall follow manufacturer's instructions. For liquid containing structures, apply curing compound at twice the manufacturer's recommended dosage rate, applied in two coats perpendicular to each other.

2. Do not use curing compound on concrete surfaces to be coated, waterproofed, moisture-proofed, tiled, roofed, or where other coverings are to be bonded. In these cases, use water curing unless the curing compound is first removed or is compatible with the final finish covering.

3.05 PROTECTION

- A. Protect concrete from injurious action by sun, rain, wind, flowing water, frost, excessive vibration and mechanical means.
- B. Loading green concrete is not permitted. Green concrete is defined as concrete with less than 100 percent of the specified strength.
- C. Backfill shall not be placed against concrete walls until the concrete has reached the specified strength, connecting slabs and beams have been cast and have also reached the specified strength, and watertightness testing and repairs have been completed for liquid containing structures to the satisfaction of the Owner's Representative.
- D. Arrangements for covering, insulating, heating, and protecting concrete in cold weather shall be in accordance with ACI 306.1.

3.06 CONSTRUCTION JOINTS

- A. General:
 1. Place concrete in each unit of construction continuously. Before new concrete is placed on or against concrete which has set, retighten forms and clean foreign matter from the surface of the set concrete. Provide waterstops as specified.
- B. Construction:
 1. Form construction joints by producing a rough surface of exposed aggregates using a surface retardant; include joints between the slab and topping concrete. The limit of the treated surfaces shall be 1 inch away from the joint edges. Within 24 hours after placing, remove retarded surface mortar either by high pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregate. A rough surface of exposed aggregate may also be produced by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/4 inch of laitance film and expose coarse aggregate to ensure adequate bond and watertightness at the construction joints.
- C. Locations:
 1. Provide construction joint locations as follows:
 - a. Cast walls exceeding 50 feet in length in panels not to exceed 30 feet in length. Cast adjoining panels only after 5-days have elapsed. Joints are not allowed within the lesser of 10 feet or 25 percent of the wall length from a corner unless specifically detailed thus on the drawings.
 - b. Locate joints in beams or girders at or near the quarter point between supports.
 - c. Make joints in the members of a floor system at or near the quarterpoint of the span.

- d. Make joints in walls and columns at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs.
 - e. Cast slab panels in checkerboard patterns not to exceed 40 feet in length and not to exceed 900 square feet in area, with maximum 1 ½ to 1 ratio of side lengths. Minimum lapsed time between placing adjacent panels shall be 3-days. The requirements for size of slab panel is waived if joints are located on the Drawings.
2. Vertical construction joints shall have edges grooved or beveled at faces exposed to view including interior faces of basins and tanks. Seal grooves subjected to wetting or weather with joint sealant.
 3. Continue reinforcing steel and welded wire reinforcement through construction joints. Beams, girders, and floor slabs shall not be constructed over columns or walls until at least one day has elapsed to allow for initial shrinkage in the column or wall. No joint will be allowed between a slab and a beam or girder unless otherwise shown. Joints shall be perpendicular to the main reinforcement. Provide waterstops in construction joints as specified.

3.07 INSERTS AND EMBEDMENTS

A. Inserts:

1. Where pipes, castings, or conduits are to pass through structures, position in forms before placing concrete; or where shown on Drawings or approved by the Owner's Representative, provide openings in the concrete for subsequent insertion of such pipes, castings, or conduits. Provide waterstops and a slight flare in the form to facilitate grouting and permit the escape of entrained air during grouting.
2. Provide additional reinforcement around openings. Use non-shrink grout to infill around inserts.
3. Place horizontal conduits and pipes, in slabs and beams, between the top and bottom layers of reinforcement. Spacing and size limitations shall conform to ACI 318.
4. Conduits and pipes shall not run directly beneath a column or base plate.
5. Position conduit, pipe, and other ferrous items such that there will be a minimum of 2-inches clearance between said item and concrete reinforcement. Welding inserts to reinforcement is not permitted.
6. The outside diameter of conduit or pipe shall not exceed one-fourth the slab or beam thickness.

B. Embedments:

1. Gate frames, gate thimbles, special castings, channels, grating frames, or other miscellaneous metal parts to be embedded in concrete shall be secured in the forms prior to concrete placement.
2. Embed anchor bolts and inserts in concrete as shown. Provide inserts, anchors, or other bolts necessary for the attachment of piping, valves, metal parts, and equipment.

3. Provide nailing blocks, plugs, strips, and the like necessary for the attachment of trim, finish, and similar work. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent entry of concrete. Do not use continuous anchor slots or strips in concrete intended to be watertight.
4. Position operators or sleeves for gate or valve stems to clear reinforcing steel, conduit, and other embedments, and to align accurately with equipment.

3.08 EXPANSION JOINTS

- A. Expansion joints shall be as shown. Do not extend reinforcement or other embedded metal items through expansion joints. Provide waterstops where indicated.

3.09 WATERSTOPS

- A. Waterstops shall conform to ACI 301. Tie waterstops in position prior to placement of concrete to prevent movement and deformation.
- B. Provide waterstops in construction and expansion joints as follows:
 1. Joints in parts of structures exposed to ground or water on one side and occupied by non-submerged equipment or by personnel on the other.
 2. Wall and slab joints of tanks and channels subject to water pressure.
 3. Waterstops shall be provided for the full height of the walls.
 4. Provide at other locations shown on the Drawings.
- C. Field splices shall be at straight sections using heat fused welded, butt splices only. Lapping of splices or joining by means other than heat fused welding is not allowed.
- D. Install hydrophilic waterstops according to manufacturer's recommendations. Surfaces of concrete shall be prepared level/plumb and to the smoothness required by manufacturer. Grind surface as necessary. Provide bonding adhesive and concrete nails with fender washers to hold waterstop in position during concrete placement.

3.10 MODIFICATION OF EXISTING CONCRETE

- A. General:
 1. Verify structural dimensions related to or controlled by previously constructed or existing structures prior to concrete work.
- B. Cutting or Coring Concrete:
 1. Saw cut concrete to a depth of 3/4 inch to form straight outlines of concrete areas to be removed. Where reinforcement is exposed due to saw cutting or core drilling and no new material is to be placed on the cut surface, provide a protective epoxy coating to the entire cut surface.
 2. Coat surfaces of oversized openings with an epoxy bonding compound prior to re-finishing with profiling mortar to the required opening size.
 3. Grind existing joint edges to create a chamfer matching those used on adjacent construction.

4. Investigate concrete to be drilled, cored, or sawcut to determine location of reinforcing steel. Locate penetrations to clear existing reinforcing steel. Where not possible to avoid reinforcing steel, consult the Engineer as to acceptability of cutting reinforcing steel and provide new reinforcing systems as directed.
 5. Locating methods include chipping to expose reinforcing steel, ground penetrating radar, X-ray, or magnetic flux devices. Locates of existing reinforcing shall be by the Contractor.
- C. Joining New Concrete To Existing:
1. Existing concrete surfaces to be joined with new concrete shall be cleaned and roughened by abrasive blasting, bush hammering, or other method to achieve 1/4-inch amplitude surface. Remove existing metalwork, embeds, or other interfering items. Coat existing surface with epoxy bonding compound prior to placement of new concrete.
- D. Post-Installed Anchors and Dowels:
1. Use non-destructive methods for locating reinforcement prior to drilling operations. For anchor and dowel locations that interfere with reinforcement, attempt to relocate to avoid drilling through the reinforcement if possible.
 2. For situations that do not allow relocation, cutting of reinforcement for installation is subject to the following:
 - a. Prior to drilling through reinforcement, the Contractor shall consult the Owner's Representative or Engineer.
 - b. Drill holes with a hammer drill and carbide bit (core drilled holes are not allowed), followed by brushing and air-cleaning with oil-free compressed air.
 - c. Holes drilled through reinforcement must be in compliance with adhesive anchor assumptions for roughened hole surface typical of a hammer drill and carbide bit. No smooth hole surfaces are allowed.
 - d. Do not cut slab rebar within 24 inches of a supporting wall, column, or an opening in the slab.
 - e. No cutting of rebar is allowed in the middle third of slab spans for anchors with diameters equal to or greater than 3/4 inch.
 - f. Maximum of two rebar may be cut in any 10 foot width of slab.
 - g. Maximum of two rebar may be cut within any 10 foot width of concrete wall.
 - h. Maximum of one rebar may be cut within any 8 foot width of CMU wall.
 3. For anchors that cannot be moved and that conflict with the above requirements, consult Engineer for direction. It is not acceptable to cut reinforcement in beams, columns, precast members, or stairs.
 4. Use a pre-manufactured, self-mixing, injectable, two-component, epoxy adhesive, as per Section 03 60 00. Follow manufacturer's recommendations and ICC Evaluation Report for installation.
- E. Waterstops:
1. Where a waterstop between new and existing concrete is required, install a hydrophilic waterstop, or a retrofit waterstop where indicated on the design drawings for the specific location.

3.11 FORMED SURFACE FINISHES

A. Repair Of Surface Defects:

1. Repair surface defects, including tie holes, minor honeycombing, or otherwise defective concrete in accordance with ACI 301. Clean areas to be repaired. Cut and chip out honeycombed or otherwise defective areas to solid concrete, to a depth of at least 1-inch. If defective area includes exposed reinforcing steel, correct by removing concrete a minimum of 1-inch beyond the reinforcing. Make edges of the cut perpendicular to the surface of the concrete in a neat rectangular pattern.
2. Joints shall be grooved to a radius or bevel of $\frac{3}{4}$ -inch depth.
3. Finish patches on exposed surfaces to match and blend with adjoining work. Cure patches as specified for the concrete. Protect finished surfaces from stains and abrasions.

B. Formed Surface Finishes:

1. Finish A - Grout Rubbed Finish
 - a. After repair of surface defects, apply a grout rubbed finish in accordance with ACI 301 except that all form fins and other protrusions shall be completely removed. Lightly sandblast surfaces prior to sacking. Sandblasting shall occur after the specified curing period.
 - b. Add a PVA bonding compound to the mix water used in sacking mortar; as recommended by the manufacturer.
 - c. Provide Finish A at uncoated surfaces of stair wells, at interior surfaces of equipment rooms, galleries, tunnels, operations areas, exposed channels and tanks from 1 foot below minimum water surfaces and up, at exposed exterior surfaces to 1 foot below grade, and at permanently exposed vertical and sloped surfaces such as pipe chases.
 - d. Do not provide Finish A at concrete surfaces receiving a coating.
2. Finish B - Smooth Surface Finish
 - a. Initial surface preparation is the same as Finish A; repair surface defects and remove all form fins.
 - b. Provide Finish B at surfaces to be coated, at interior surfaces of exposed channels and tanks from 1 foot below minimum water surfaces and down (Finish A applied above this level), and full height at surfaces of wet wells, tanks, and channels not exposed to view. See Section 09 96 00 for additional concrete surface preparation, including filling of bug holes, and coating requirements.
3. Finish C - Rough Form Finish
 - a. Repair surface defects and imperfections greater than $\frac{3}{8}$ inch in any dimension. Remove form fins and protrusions down to less than $\frac{3}{8}$ inch projection.
 - b. Provide Finish C or smoother at exterior surfaces from 1 foot below grade and down, at other vertical surfaces not exposed to view and not specified above to receive Finish A or B.
 - c. Also apply Finish C to unoccupied interior areas not otherwise specified.

4. Finish D – Unfinished Surface
 - a. Repair surface defects and otherwise leave the surfaces as they come from the forms, except plug tie holes and repair or remove defects greater than 1/2 inch in any dimension.
- C. Sample Of Formed Surface Finish A:
 1. Provide a sample concrete panel, minimum 4 feet by 4 feet; representative of formed surface Finish A. The panel shall be representative of the workmanship and finish required, including repair of defects, filling of tie holes, sandblasting, and rubbing.
 2. The sample shall be approved by the Owner's Representative prior to the start of production work. The sample shall be on display at the job site, and finished surfaces shall match sample.

3.12 SLAB FINISHES

- A. General:
 1. The finishes specified herein include surface finishes, treatments and toppings for floors and slabs. Do not use dry cement on new concrete surfaces to absorb excess moisture. Round edges to a radius of 1/2 inch.
 2. Slope floors to drain uniformly within a room or space. Unless otherwise specified, slope shall be a minimum of 1/8 inch per foot toward nearest drain. Restrict use of floor drains with only locally depressed slabs to locations specifically noted.
 3. Immediately after final finish is applied, the surface shall be cured and protected as specified in Curing, Sealing, and Protection paragraphs above.
 4. Where finish is not specified, floor slabs shall receive a Steel Trowel Finish.
- B. Float Finish:
 1. Perform floating with a hand or power-driven float in accordance with ACI 301. Begin floating when the bleed water sheen has disappeared and the surface has stiffened sufficiently. Float as required to meet tolerance requirements of ACI 117 for a conventional surface.
 2. Floating shall close cracks and checks plus compact and smooth the surface. Refloat the slab to a uniform texture.
 3. Apply float finish to surfaces of channels, tank bottom slabs, exterior below grade horizontal surfaces, including tops of footings, and surfaces to receive insulation or roofing.
- C. Steel Trowel Finish:
 1. Float the concrete surface as indicated above and then trowel in accordance with ACI 301.
 2. Provide Steel Trowel Finish on interior exposed floors and slabs that will receive resilient flooring, carpet or ceramic tile, unless specified otherwise.

D. Broom Finish:

1. Float the concrete surface as indicated above, then immediately give the concrete a coarse transverse scored texture by drawing a broom or burlap belt across the surface in accordance with ACI 301.
2. Provide a Broom Finish for steps and ramps, exterior exposed horizontal surfaces, and where otherwise indicated.

E. Samples Of Concrete Slab Finishes:

1. Provide a sample concrete slab, minimum 4 feet by 4 feet, representative of workmanship and each specified finish.
2. Samples shall be approved by the Owner's Representative prior to the start of production work. The samples shall be on display at the job site, and finished surfaces shall match samples.

3.13 RELATED SURFACES

A. Finishing of Unformed Surfaces:

1. Adjacent Unformed Surfaces:
 - a. Tops of walls, buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be Float Finished to a texture reasonably consistent with that of the adjacent formed surface.
 - b. Continue final treatment of formed surface uniformly across the top of the unformed surface.
2. Pavements and Sidewalks:
 - a. The surface of the concrete shall be screeded to grade and sloped to drain. After screeding, the surface shall be Float Finished followed by a Broom Finish.
 - b. Round edges and expansion joints to a radius of 1/2 inch. Control joints shall be grooved or sawcut to a minimum depth of 1/4 the slab thickness.

3.14 FIELD SAMPLING AND TESTS

A. General:

1. Field sampling and tests shall be performed by an independent testing laboratory. Samples of aggregates and concrete will be obtained at such times to represent the quality of the materials and work throughout the project.
2. The laboratory shall provide necessary labor, materials and facilities for sampling aggregate and for casting, handling, and initially storing the concrete samples at the work site.
3. The minimum number of samples and tests are specified in Testing paragraph below.

B. Sampling:

1. Aggregates:
 - a. General:
 - 1) Sample fine and coarse aggregates in accordance with ASTM D75 not less than 30 days prior to the use of such aggregates in the work.

- 2) Take samples at the discharge gates of the bins feeding the weigh hopper. Repeat sampling when the source of material is changed or when unacceptable deficiencies or variations from the specified requirements of materials are found.
 - 3) Aggregate samples shall be tagged and their sources identified.
 - b. Coarse Aggregate:
 - 1) Take a sample weighing between 50 and 60 pounds after the batch plant is brought up to full operation.
 - 2) Take samples to obtain a uniform cross section, accurately representing the materials on the belt or in the bins for sieve analysis.
 - c. Fine Aggregate:
 - 1) Take samples as specified for coarse aggregate.
 - 2) Take samples of sand when the sand is moist for sieve analysis and specific gravity tests.
 2. Concrete:
 - a. Take samples of plastic concrete in accordance with ASTM C172.
 - b. Take samples at the hopper of mixing equipment or transit mix truck, except as noted in the Placing Concrete by Pumping subparagraph of the Conveying and Placing article above.
- C. Testing:
1. Aggregate:
 - a. A minimum of one test of coarse aggregate per 400 cubic yards of concrete used and a minimum of one test of fine aggregate per 200 cubic yards of concrete used shall be made to confirm continuing conformance with specifications for gradation, cleanliness and sand equivalent.
 - b. A maximum of one test per day of each aggregate is required.
 - c. Repeat of the entire concrete mix design test program is required before source changes will be accepted.
 2. Concrete:
 - a. Strength Tests:
 - 1) The strengths specified for the design mix shall be verified by the independent testing laboratory during placement of the concrete. Verification shall be accomplished by testing standard cylinders of concrete samples taken at the job site. Cylinders shall be 4 by 8 inch or 6 x 12 inch.
 - 2) Concrete samples shall represent the concrete placed in the forms. One set of six standard 6 x 12 inch (or nine 4 x 8 inch) cylinders shall be cast of each class of concrete for each 100 cubic yards or less, or for each 5,000 square feet of slab or wall surface area placed per day. Provide additional cylinders when an error in batching is suspected. Each set of cylinders are cast from material taken from a single load of concrete.
 - 3) Casting, handling and curing of cylinders shall be in accordance with ASTM C31. For the first 24 hours after casting, keep cylinders moist in a storage box constructed and located so that its interior air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the testing laboratory will transport the cylinders to their laboratory.

- 4) Testing of specimens for compressive strength shall be in accordance with ASTM C39. Each test shall consist of two 6 x 12 inch (or three 4 x 8 inch) test cylinders from each group of six (or nine) specimens. Test at the end of 7 days and at the end of 28 days. The remaining cylinders shall be tested at the end of 56 days if the 28-day strength reports below specification.
 - 5) A strength test shall consist of the average strength of two 6 x 12 inch (or three 4 x 8). If one cylinder shows evidence of low strength due to improper sampling, casting, handling, or curing, the result of the remaining cylinders may be used if approved by the Owner's Representative.
 - 6) The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete for each structure shall be equal to or greater than the specified strength. Not more than 10 percent of the individual strength test results shall have values less than the specified 28-day strength for the total job concrete. No individual strength test result shall be less than the specified strength by more than 500 pounds per square inch.
 - 7) Provide certified reports of the test results directly to the Owner's Representative and the Engineer. Test reports shall include sufficient information to identify the mix used, the stationing or location of the concrete placement, and the quantity placed. Slump, water/cement ratio, air content, temperature of concrete, and ambient temperature shall be noted.
 - 8) The 28-day strength test results shall be evaluated in accordance with ACI 214R. Quality control charts showing field test results shall be included with the test results for each class of concrete in each major structure. Charts shall be prepared in accordance with ACI 214R. Quality control charts shall be maintained throughout the entire project and shall be available for the Owner's Representative's inspection at any time.
 - 9) If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Report changes and adjustments in writing to the Owner's Representative.
 - 10) If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the Engineer. Costs of such tests and/or analysis shall be borne by the Contractor.
- b. Tests for Consistency of Concrete:
- 1) Measure slump in accordance with ASTM C143. Take samples for slump determination from concrete during placement. Tests shall be made at the beginning of concrete placement operation, whenever test cylinders are cast, and at subsequent intervals to ensure that the specification requirements are met.
 - 2) For pumped concrete, measure slump in accordance with the Placing Concrete by Pumping subparagraph of the Conveying and Placing article above.
 - 3) When high range water reducer is added at the site, slump tests shall be taken before and after addition of the admixture.

c. Tests for Temperature and Air Content:

- 1) Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Perform temperature tests whenever test cylinders are cast.
- 2) Measure air content in accordance with ASTM C231 whenever test cylinders are cast. For pumped concrete, measure air content in accordance with the Placing Concrete by Pumping subparagraph of the Conveying and Placing article above.

D. Final Laboratory Report:

1. The testing laboratory shall provide a final report at the completion of all concreting. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure.
2. Include final quality control charts for compressive strength tests for classes of concrete specified in each major structure. Also include the concrete batch plant's coefficient of variation and standard deviation results for each class of concrete.

3.15 REPAIR OF DAMAGED AND CRACKED CONCRETE:

A. Acceptance Of Concrete:

1. Completed cast-in-place concrete work shall conform to the applicable requirements of ACI 301 and the Contract Documents. Concrete work that fails to meet these requirements shall be repaired, as approved by the Engineer, to bring the concrete into compliance. Repair methods shall be in accordance with ACI standards, including ACI 503.7, and are subject to the approval of the Engineer.
2. Concrete that cannot be brought into compliance by approved repair methods will be rejected. Remove and replace rejected concrete work.
3. The cost of repairs and replacement of defective concrete shall be borne by the Contractor.

B. Repair Methods:

1. Damaged/defective concrete or concrete with crack widths exceeding 0.004 inches at liquid-containing and conveying structures or crack widths exceeding 0.006 inches for other structures shall be repaired by one of the following methods (only the Engineer may determine that a defect or crack does not require repair):
 - a. Perform watertightness testing and repair as needed to meet leakage criteria in this specification even when liquid-containing and conveying structures meet the crack width criteria defined above.
 - b. Damaged or defective concrete includes surface defects, honeycomb, rock pockets, indentations greater than 3/16 inch, spalls, chips, air bubbles greater than 1/2 inch diameter, pinholes, bugholes, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins, projections, form popouts, texture irregularities, and stains or other color variation that cannot be removed by cleaning.
 - 1) Damaged or defective concrete is repaired according to procedures outlined above under finish requirements, Repair of Surface Defects.

2. Crack Repair Method 1:
 - a. Fill the joint or crack by drilling holes to the affected area (following the product manufacturer's details), install injection ports, and force epoxy or chemical grout (expanding urethane) into the joint under pressure.
 - b. Material type and repair procedures shall be approved by Engineer.
 - c. After injection and curing; ports, sealing mix, and surface shall be cleaned and worked to match the adjacent specified finish.
 3. Crack Repair Method 2:
 - a. Fill cracks with low viscosity epoxy, applied by pouring/flooding crack zone until cracks are filled. Prepare surface, install, and cure according to manufacturer's recommendations.
 - b. At a minimum, prepare surface to be clean and dry with no visible detrimental material in cracks to be filled. Conform to temperature limitations of epoxy. Clean and refinish to match adjacent surfaces.
 4. Crack Repair Method 3:
 - a. Cut a bevel groove 3/8 to 1/2 inch in width and depth, use backer rod or tape, and fill with sealant in accordance with manufacturer's instructions.
 - b. This repair method is only used where approved by Engineer.
 - c. Groove and sealant shall be applied on wet or hydrostatic pressure side of surface.
- C. Repair Method Use:
1. Repair Method 1: For cracks in walls, surfaces sloped 1:1 or greater, beams, columns, structural slabs, overhead surfaces, and liquid retaining surfaces. Need for repair depends upon crack width, location, and leakage.
 2. Epoxy grout is used for repair of structural cracks and chemical grout (expanding urethane) for repair of non-structural cracks at liquid-containing structures. The Engineer shall determine whether a crack is classified as structural or non-structural.
 3. Repair Method 2: Utilized in lieu of Method 1 for slabs when approved by Owner's Representative. Final finish shall match adjacent surfaces.
 4. Repair Method 3: Limited to dry-surface slabs, walls subject to less than three feet of liquid pressure, or as approved by Engineer. Repair Method 3 is not an equivalent repair method to Repair Methods 1 or 2, which shall be considered the standards.

3.16 WATERTIGHTNESS TESTING AND REPAIR

- A. Liquid Containing Concrete Tanks And Channels:
1. Watertightness testing shall comply with ACI 350.1 and the following requirements.
 2. Concrete tanks, basins, reservoirs and channels which have walls or slabs subjected to hydrostatic pressure shall be tested for watertightness. The tests shall be made after the structure is complete and the concrete has achieved its specified 28-day strength, but prior to application of waterproof coating or backfill.
 3. Filling of the tank for watertightness testing shall not exceed a rate of 4 feet/hour. Fill with water to the maximum operating water surface. Keep water at this level for at least 72 hours prior to start of test.

4. Testing includes visual inspection of the dry sides of all walls, wall base construction joint at top of the slab, and the soffit of elevated slabs for evidence of leakage. Damp spots, leakage, or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by Repair Method 1 (see Repair Methods paragraph in the Repair of Damaged Concrete and Cracking article above).
5. Damp spots are defined as areas from which water that can be picked up on dry hand and smeared across the dry concrete surface.
6. Re-test tanks or channels which have been repaired to check the suitability of repairs.
7. Provide water required for testing and re-testing and dispose of in an approved manner.
8. After repair of visual leakage, liquid containing or conveying concrete structures supported on soil must also meet maximum leakage criteria into the soil through their base slab or mat foundation as follows:

Structure Type	Tightness Criterion
Containment structures fully lined prior to hydrostatic test	No measurable loss
Rectangular basins and tanks	0.050 percent per day

Note: All damp spots and/or leakage through walls, wall-to-slab joints, and elevated slabs shall first be repaired as described above.

9. Record volume loss by measuring the vertical distance from the water surface to a fixed point on the tank above the water surface. Account for evaporation from open surfaces.
10. If the drop in water surface during the test period exceeds the values given in the table above, exclusive of evaporation, the leakage is considered excessive and shall be remedied. The test period shall be per ACI 350.1.

3.17 CLEANUP

- A. Upon completion of the work and prior to final inspection, clean all concrete surfaces as follows: Sweep with a broom to remove loose dirt, then mop and/or flush with clean water. Scrub by hand or machine as required to remove and blend stains or discolored areas .
- B. Clean floors that have curing and sealing compound as stated above, followed by the final application of curing and sealing compound.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Grout for column base plates, other structural supports, equipment bases, reinforcing bar dowels, surface repair, grout toppings, patching of fresh concrete, and uses other than masonry. Adhesive anchor bolt grouting is specified in Section 05 05 20. Topping concrete over precast elements and clarifier topping concrete is specified in Section 03 30 00.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 30 00 Cast-In-Place Concrete
 2. Section 05 05 20 Anchor Bolts

1.03 REFERENCES

- A. The references listed below are a part of this section. 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.

Reference	Title
ASTM C109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
ASTM C230	Flow Table for Use in Tests of Hydraulic Cement
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
ASTM C939	Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1107	Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
COE CRD-C611	Flow of Grout for Preplaced Aggregate Concrete

Reference	Title
COE CRD-C621	Non-shrink Grout
IBC	International Building Code

1.04 SUBMITTALS

A. Action Submittals

1. Procedure: Section 01 33 00:
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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.
4. Complete product literature, including mixing, handling and placement instructions for the following: Cementitious non-shrink grout, epoxy grout, adhesive for reinforcing bar dowel grouting, concrete repair mortar, and prepackaged cement grout products to be used on the project.
5. Mix design for cement grout that is not prepackaged, including product data for aggregates and cement in accordance with Section 03 30 00.
6. Current ICC Evaluation Service reports for adhesives used for reinforcing dowels.
7. Installer certification in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined reinforcing bar dowels grouted using adhesive.
8. Certified test results verifying the compressive strength, shrinkage and expansion requirements specified herein.

1.05 QUALITY ASSURANCE

A. Quality Control by Owner

1. The Owner will provide the services of a qualified Special Inspector in accordance with Section 01 45 23.
2. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
 - a. The Special Inspector shall furnish a report to the Engineer, Owner's Representative and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).

B. Quality Control by Contractor

1. Provide the services of an independent testing laboratory which complies with the requirements of ASTM E329 if a product other than those listed below is proposed and test data is not available from the supplier to demonstrate equivalence to the specified grout. The testing laboratory shall sample and test the proposed grout materials. Costs of testing laboratory services shall be borne by the Contractor.

C. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined reinforcing bar dowels grouted using adhesive.

D. 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 insure continued compliance with these Specifications.

1. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.

E. Manufacturer Qualifications

1. Manufacturer shall have a minimum of five years' experience of producing products substantially similar to that required and shall be able to submit documentation of at least five satisfactory installations that have been in successful operation for at least five years each.
2. When required, provide services of manufacturer's full-time employee, factory-trained in handling, use, and installing the products required, with at least five years of experience in field applications of the products required.

PART 2 PRODUCTS

2.01 CEMENTITIOUS NON-SHRINK GROUT

- A. The grout material shall be an approved ready to use mixture requiring only water for use at the job site. The 2-inch cubes shall have a minimum compressive strength of 3,000 psi at 7 days and 7,000 psi at 28 days.
- B. Cementitious non-shrink non-metallic aggregate grout shall be:
1. BASF, Masterflow 928
 2. Euclid Chemical Company, Hi-Flow Grout
 3. Five Star Products, Inc., Five Star Grout
 4. Sika Corporation, SikaGrout 212
 5. Approved Equal

- C. Non-shrink grout shall conform to CRD-C 621 and ASTM C1107, Grade B or C when tested at a maximum fluid consistency of 30 seconds per ASTM C939 at temperature extremes of 45 degrees Fahrenheit and 90 degrees Fahrenheit and an extended working time of 15 minutes.
- D. Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.

2.02 EPOXY GROUT FOR EQUIPMENT MOUNTING:

- A. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system.
- B. Epoxy grout for equipment mounting shall be a non-cementitious, resin based, multi-component formulation. Epoxy grout shall be flowable, with shrinkage minimized to achieve minimum 98% effective bearing area. Epoxy grout shall be:
 - 1. BASF, Masterflow 648
 - 2. Euclid Chemical Company, E3-G
 - 3. Sika Corporation, Sikadur 42
 - 4. Approved Equal.
- C. The following properties shall be attained with the minimum quantity of aggregate allowed by epoxy grout manufacturer.
 - 1. Length change after hardening shall be less than 0.0006-inch per inch and coefficient of thermal expansion shall be less than 0.00003-inch per inch per degree F when tested in accordance with ASTM C531.
 - 2. Compressive creep at one year shall be less than 0.001-inch per inch when tested under a 400-psi constant load at 140 degrees F in accordance with ASTM C1181.
 - 3. Minimum seven-day compressive strength shall be 14,000 psi when tested in accordance with ASTM C579
 - 4. Grout shall be capable of maintaining at least a flowable consistency for minimum of 30 minutes at 70 degrees F.
 - 5. Shear bond strength to portland cement concrete shall be greater than shear strength of concrete when tested in accordance with ASTM C882/C882M.

2.03 ADHESIVE FOR GROUTING REINFORCING BAR DOWELS

- A. Adhesive for setting dowels in concrete shall be an injectable two-component epoxy adhesive. Adhesive shall be approved for the intended use per the product ICC Report. Adhesive shall be:
 - 1. Hilti, HIT-RE 500v3
 - 2. Simpson Strong Tie, SET XP
 - 3. Approved Equal (equivalent product must have ICC approval for use in cracked concrete in areas with high seismic risk).

2.04 CONCRETE REPAIR MORTAR

- A. Horizontal Applications: Repair mortars shall be:
 - 1. BASF, MasterEmaco S 466CI

2. Sika Corporation, SikaTop 111 Plus
 3. Approved Equal
- B. Vertical and Overhead Applications: Repair mortars shall be:
1. BASF, MasterEmaco 1500HCR Vertical Overhead
 2. Sika Corporation, SikaTop 123 Plus
 3. Approved Equal

2.05 CEMENT GROUT

- A. Cement grout shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed in accordance with this Section.
1. Minimum Compressive Strength: 4,500 psi at 28 days.
 2. Maximum Water Cement Ratio: 0.42 by weight.
 3. Coarse Aggregate: ASTM C33/C33M, No. 8 size.
 4. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.
 5. Air Content: Five percent (plus or minus one percent).
 6. Minimum Cement Content: 564 pounds per cubic yard.
 7. Slump for grout fill shall be adjusted to match placing and finishing conditions, and shall not exceed four inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine and accept existing conditions before beginning work.

3.02 CEMENTITIOUS NONSHRINK GROUT

- A. Non-shrink, cementitious, nonmetallic aggregate grout shall be used for column base plates, structural bearing plates, and all locations where the general term "non-shrink grout" is indicated on the Drawings. Use of this grout to support the bearing surfaces of machinery shall be as detailed on the Drawings for specific locations or pieces of equipment. If guidance is not provided in locations noted above, use of non-shrink grout for equipment mounting shall be limited to equipment less than 25 horsepower or 750 pounds. Grout shall be placed and cured in accordance with the manufacturer's instructions.
- B. Non-shrink cementitious grout shall not be used as a surface patch or topping. Non-shrink cementitious grout must be used in confined applications only.

3.03 EPOXY GROUT FOR EQUIPMENT MOUNTING

- A. Prepare concrete surfaces of equipment pads as indicated in details on the Drawings and as required by the epoxy grout manufacturer. Epoxy grout for equipment mounting shall be placed and cured in accordance with the requirements and in conformance with manufacturer's recommendations.

3.04 ADHESIVE FOR GROUTING REINFORCING BAR DOWELS

- A. Follow manufacturer's instructions.

3.05 CONCRETE REPAIR MORTAR

- A. Concrete repair materials and procedures shall be submitted for review to the Owner's Representative and shall be accepted prior to commencement of the repair work.
- B. Follow all manufacturer's instructions, including those for minimum and maximum application thickness, surface preparation and curing. Add aggregate as required per manufacturer's recommendations. Any deviations from the manufacturer's instructions shall be submitted for review to the Owner's Representative and shall be accepted prior to commencement of the work.

3.06 CEMENT GROUT

- A. Cement grout shall be used for grout toppings less than four inches thick and for patching of fresh concrete.
- B. Grouting shall comply with temperature and weather limitations in Section 03 30 00, Cast-In-Place Concrete.
- C. Cure grout in accordance with grout manufacturer's instructions for prepackaged grout and Section 03 30 00, Cast-In-Place Concrete, for non-prepackaged cement grout.

END OF SECTION

SECTION 03 64 00
INJECTION GROUTING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the requirements for injection grouting to seal pipe or structures including but not limited to pipe walls and joints, manhole or structures, and annular spaces.
- B. For infiltration, grout may be injected into the soil surrounding the pipe or structure or from within the pipe or structure to stabilize the soil and form an impermeable seal, or soil ring, which prevents infiltration and migration of material into the host pipe. Adequate volumes of grout must be injected to form an effective seal.
 - 1. If infiltration is observed in the pipe to be rehabilitated, the Contractor shall inject grout to stop the infiltration prior to installation of the CIPP. Grouting shall be incidental to the CIPP work.
- C. Provide pre-grouting inspections to identify all I/I locations and post inspection to document I/I has been mitigated/stopped.

1.02 QUALITY ASSURANCE

- A. References:
 - 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 stricter requirements as determined by the Construction Manager, shall apply.

Reference	Title
ASTM C138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C150	Portland Cement
ASTM C869	Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete
ASTM C939	Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM F2304	Rehabilitation of Sewers Using Chemical Grouting
ASTM F2454	Sealing Lateral Connections and Lines from the Mainline Sewer Systems by the Lateral Packer Method Using Chemical Grouting

B. QUALIFICATIONS

- 1. The Chemical Grout Installer shall have a history of at least three years of pressure testing and grouting sewers.

C. Manufacturer's Representative

1. The Manufacturer's Representative is authorized to act on behalf of the manufacturer regarding technical issues. They shall provide technical support to resolve field issues throughout the duration of the work.
2. The Manufacturer's Representative shall be available to the Owner and Construction Manager and spend at least 8 hours on-site providing field inspections of grouting activities.
3. The Manufacturer's Representative shall verify in writing that the proper procedures and equipment are used by the Contractor and installer and that the grout is being applied per the manufacturer's recommendations.

1.03 SUBMITTALS

A. In accordance with Section 01 33 000, SUBMITTAL PROCEDURES.

B. Action Submittals:

1. A copy of this specification section, with addendum updates included, and 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. A check mark 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 Construction Manager 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. Grouting plan(s) including but not limited to:
 - a. Grouting Contractor's name, contact information, list of key personnel and experience for Company and installers performing the work.
 - b. Chemical grout, grout mixture ratio (including additives), and gel times.
 - c. LDCC mix design including foaming agent and admixtures.
 - d. Equipment operating procedures and systems to be used, including manufacturer's literature on grout pumps, packers, and lateral blockage clearing equipment.
3. Upon completion of grouting each reach, submit to Owner and Construction Manager a report showing the following data for each joint tested and/or grouted or attempted to be grouted.
 - a. Stationing.
 - b. Time and date.
 - c. Grout mixture formation, including additives and catalyst mixture formulation and proportion of each. Include procedure for adjusting grout mixture for variations in ambient temperatures and changes of temperature of grout through hoses exposed to the atmosphere.

- d. Pumping pressure.
 - e. Gel time.
 - f. Quantity of grout (if applicable) used to seal the joint.
 - g. Post-grout pressure test results.
 - h. Regrouting and retesting giving above data as required.
 - 4. Calculation of the annular space between the lateral tap connection packer and host pipe.
 - 5. Manufacturer's Representative's Certification per Paragraph 1.02 C.
- C. Informational Submittals:
- 1. Manufacturer's product data including handling and storage requirements, application requirements and SDS Sheets
 - 2. Manufacturer's Representative name, contact information, and resume.
- D. Closeout Submittals:
- 1. Locations of injection grouting, by station and clock position where applicable.

1.04 HANDLING AND STORAGE

- A. Products are to be kept dry, protected from weather, and stored under cover. Products are to be stored and handled according to the MSDS and Manufacturer's recommendations taking into account actual site conditions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Grout must have the following minimum characteristics:
- 1. While being injected, the grout must be able to react/perform in the presence of water (groundwater) and pumpable over the distance required to install and stage. Minimum of 500 feet.
 - 2. The cured grout must withstand submergence in water without degradation and not be biodegradable.
 - 3. Catalyzation shall take place at the point of injection/repair.
 - 4. Resultant grout formation must prevent the passage of water (infiltration) through the pipe joint or defect.
 - 5. After curing, grout must be flexible, under both dry and wet conditions and be chemically stable, resistant to acids, alkalis, and organics found in sewage.
 - 6. Residual grout shall be easily removable from the sewer line to prevent blockage of the sewage flow.

2.02 PIPE SEALING GROUT

- A. Pipe Sealing Grout shall be acrylamide, acrylic, or acrylate based and shall have the following characteristics:
- 1. A minimum of 12% base material by weight in the total grout mix. A higher concentration of base material may be used to increase strength or offset dilution during injection.

2. The ability to tolerate some dilution and react in moving water during injection.
3. A viscosity of approximately 2 centipoises, which can be increased with additives.
4. A constant viscosity during the reaction period.
5. A controllable reaction time from 10 seconds to 1 hour.
6. A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, firm, flexible gel.
7. The ability to increase mix viscosity, density, and gel strength using additives.
8. Accepted Product Manufacturers:
 - a. Avanti AV-100.
 - b. Avanti AV-118,
 - c. DeNeef AC-400,
 - d. or Approved Equal.

2.03 ADDITIVES

- A. Latex additive (or equal) to strengthen the grout, provide protection against shrinkage, and improve the strength of the gel. The quantity of latex additive will be according to the manufacturer recommendation. Adjust the grout admixture to meet specified viscosity and reaction time. Follow manufacturer's recommendations for product handling and storing. Latex additive shall not contain organic solvents and shall have the following characteristics.

Solids Content	49% minimum	ASTM D-1010
pH	7.5-8.5	8.0 Average
Viscosity	130 cps @ 77 °F	ASTM D-1638
Density	8.52 lbs./gal.	ASTM D-1564W
Solvent	Water	

- B. A root deterrent chemical such as dichlobenil to the grout in proportions as recommended by the manufacturer.
- C. A shrink control agent that is a water-based emulsion with the grout. The shrink control agent shall reduce shrinkage and improve strength of the grout providing the resultant cured material with both improved hydrostatic pressure resistance and flexibility. The agent shall be added in proportions as recommended by the manufacturer. The use of anti-freeze or other agent that is not specifically recommended by the manufacturer is prohibited. Product shall be Avanti AV-257 or approved equal.
- D. Add gel time extending agent in accordance with the Manufacturer's recommendations to extend gel time, as necessary. Product shall be potassium ferricyanide (KFe), or equal.

2.04 EQUIPMENT

- A. Grouting equipment shall consist of two separate pumping systems capable of supplying an uninterrupted flow of sealing materials to fill the voids completely. The gel side of the system shall be a closed system to minimize exposure to moisture. Pumps, fittings, and hoses shall be designed to transport a high viscosity material and shall not be affected by acetone or ketone solvents. The sizing of the system shall be such that the water side can transport materials at 1 to 1 or 8 to 10 times the ratio of the gel side. Pumps shall be sized to deliver a minimum of 3 gpm.
- B. Grout shall pass from the pumping system through instant reading, controlled flow meters and then through a dual hose system into the sealing device. The device (referred to hereafter as a packer) shall be a cylindrical case of a size less than pipe size, with the cables at either end used to pull it through the line. The packer device shall be constructed in such a manner as to allow a restricted amount of sewage to flow at all times.
- C. Air impervious inflatable sleeves shall be mounted over the cylinder with the ends of the sleeve sealed to the ends of the casing. The sleeves shall be so constructed that they can be pneumatically expanded from the center to both ends. The center portion of the sleeve shall be sealed to the casing by a broad confining band. When the packer is inflated, two widely spaced annular bladders shall be formed, each having an elongated shape and producing an annular void around the confined portion of the sleeve. The packer (between the ends) shall be expandable in order to reduce the amount of wasted grout in the void area. No sealing device which is expanded mechanically nor where the expansion sleeve is not continuous will be allowed in order to prevent damage to the pipe from excessive amounts of sealing pressures or air leakage in the center area of such sealing device. Only low void packers with annular space less than $\frac{1}{4}$ gallon shall be used.
- D. Tap and lateral service sealing shall be accomplished with a lateral packer. The objective of the lateral service packer is to seal the tap connection to the main sewer and a portion of the lateral service. The lateral sealing tube shall be designed to accommodate 4-inch and 6-inch diameter laterals and laterals with a transition diameter. Sealing of lateral tap connections directly connected to the mainline sewer shall be completed using an 8-foot-long sleeve. Sealing of lateral pipe joints for laterals connected to manholes shall be for the first 20 feet, as measured from the manhole wall to the pipe transition or to the cleanout, whichever comes first.

2.05 MANHOLE/STRUCTURE JOINT SEALING GROUT

- A. Rapid setting cement to eliminate infiltration shall be Quadex Quad-Plug or approved equal.
- B. Fill any large voids with patching mix such as Quadex Hyperform or approved equal.
- C. Pressure chemical grout shall be DeNeef, Inc., Oil-free Oakum and Hydro Active Sealfoam or Hydro Active Flex LV grout, Scotch-Seal Chemical hydrophilic grout 5000, 5610, Avanti AV-333 Injectaflex or other approved gel type chemical grout. Provide Avanti MG-AV-290 hydrophobic polyurethane foam grout or other approved foam grouts for high volume leaks.

- D. The Contractor shall employ an expanded gasket to control in flowing water in larger cracks, joints, or pipe to manhole boots by soaking dry Oil Free Oakum Avanti (AV-219 Fibrotite) or equal with (AV-202) Multigrout or equal and forcing the Oakum/Resin plug into opening until it sets. See: Avanti EGP Manual for details.

2.06 ANNULAR SPACE GROUT

- A. Provide Low Density Cellular Concrete (LDCC) for grouting of annular spaces where specified,
 - 1. ELASTIZELL PS, or approved equal.
 - 2. LDCC shall be Portland cement in accordance with ASTM C150, C595 or C1157, water and preformed foam in accordance with ASTM C869 when tested in accordance with ASTM C796. LDCC shall:
 - a. Include fine aggregate, pozzolans and other cementitious materials and admixtures. Admixtures shall be approved by the foam manufacturer.
 - b. Have a compressive strength of 50 to 300 psi.
 - c. Have a density of 20- to 120 pcf.
 - d. Mix designs as recommended by the Contractor for the installation shall be submitted for reviewed and accepted
 - 3. LDCC shall not be used for pipe zone or trench backfill.
- B. Grouting of the annular space shall be done in such a manner as to prevent damage or collapse of the Liner pipe. Grouting pressures shall not exceed the pipe manufacturer's recommendations.
- C. Control groundwater and wastewater flows during grouting and groundwater or wastewater present shall be removed from the annular space before injecting the grout.

PART 3 EXECUTION

3.01 PREPARATION

- A. All material shall be clearly dated by the manufacturer. Owner or Construction Manager shall be provided the opportunity to inspect the Contractor's storage facilities at any time. Any material found to have exceeded its shelf life or found to be stored under improper temperature and humidity conditions, as determined by manufacturer's recommendation, shall be marked rejected, shall not be used, and shall be removed from the site immediately.
- B. Mix and handle the grout and the constituents producing it, which may be toxic on contact or inhalation, as recommended by the manufacturer and to minimize hazard to personnel. Provide appropriate protective measures to ensure that the grout components and the chemicals produced in mixing are under the control of the Contractor at all times and are not available to unauthorized personnel or others. Dispose of excess grout resulting from sewer grouting operations in a safe manner. All equipment and material shall be subject to the review of Owner and Construction Manager.

3.02 INJECTION

- A. Grouting shall be by the injection method or equal. This shall be accomplished by forcing grout through a system of pumps and hoses into and through the joints of the sewer from the packer within the sewer pipe. Jetting or driving pipes from the surface that could damage or cause undermining of the pipelines, shall not be allowed. Except where specifically shown on the drawings or called for in the specifications, do not uncover the pipe by excavation.

3.03 QUALITY CONTROL AND TESTING

- A. At the beginning of each day, prior to application of grout, perform a pump test to determine if proper ratios are being pumped from the grout component tanks at the proper rates. Use separate containers to capture the discharges from the grout component tanks. Take corrective action if unequal quantities are being pumped. Repeat the pump test until equal quantities are pumped from the grout tanks. Pump one gallon of grout and count the pump strokes to confirm the number of pump strokes required to achieve a delivery rate of 3 to 4 gpm. Repeat the pump test until proper ratios and delivery rates are pumped from the grout tanks.
- B. At the beginning of each day, when new batches of grout are mixed, when grout additives are modified to change gel times, at the beginning of any new pipe segment or manhole, and whenever the temperature in the tanks and hoses have changed by more than 10 degrees F from the previous gel test, perform a grout gel test with quantities of grout in the presence of the Owner or Construction Manager to determine the grout mixture gel time by performing a cup test at the grout component tanks or collecting a sample of grout from the packer discharge. Add gel time extending agent as necessary in the presence of the Owner or Construction Manager to compensate for changes in temperature in grout component tanks or hoses. The addition of dilution water to extend gel times is not acceptable.
- C. During the grouting process, the Contractor and Owner or Construction Manager shall monitor the grout component tanks to make sure that proper ratios are being pumped. If unequal levels are noted in the tanks, repeat the pump test as described above.
- D. For mainline sewer pipe joint sealing and sealing laterals connected to manholes by packer injection grouting, gel times shall be 35 seconds $\pm$ 5 seconds unless otherwise approved by Owner or Construction Manager.
- E. Submit calculations of the expected annular space between the packer and the lateral pipe for approval by the ENGINEER. For lateral tap connection sealing for laterals directly connected to the mainline sewer and for lateral pipe joints sealing for laterals directly connected to manholes, gel times shall be the following unless otherwise approved by Construction Manager:

$$\text{Gel Time} = \left(\frac{\text{Volume of Annular Space (gal)}}{\text{Pumping Rate (gpm)}} \right) \left(\frac{60 \text{ sec}}{1 \text{ min}} \right) + 20 \text{ seconds } (\pm 5 \text{ seconds})$$

3.04 PIPE JOINT SEALING BY PACKER INJECTION GROUTING FOR MAINLINE SEWERS

- A. Position the mainline packer over the joint or defect to be sealed by means of a closed-circuit television camera in the line. Position the lateral packer over the joint or defect to be sealed by a means of visual observation, marked push rod, or where a cleanout is available, through a closed-circuit television camera in the lateral. Make accurate measurement of the location of the defect to be sealed using a portion of the packer as a point of reference for positioning the injection area of packer over the defect. Pneumatically expand the packer sleeves such that they seal against the inside periphery of the pipe to form a void area at the joint now completely isolated from the remainder of the pipeline.
- B. Pump grout materials into this isolated area through the hose system at controlled pressures that are in excess of groundwater pressures. Run the pump continuously until refusal with the goal of applying $\frac{1}{4}$ gallon to $\frac{1}{2}$ gallon of grout per inch-diameter of pipe joint. Refusal shall mean the mixed grout has flowed through any joint failure, through any annular space, and into the surrounding soil; gelled or filled the available void space; and formed a cohesive seal stopping further grout flow. Record the amount of grout pumped on the sealing log. The pumping, metering, and packer shall be integrated so that proportions and quantities of materials and pressures for materials and sealing gel can be instantly monitored and regulated in accordance with the type and size of the leak, percentage of voids being filled, type of soil surrounding the pipe, and the rate of flow of the sealing gel solution in relation to the back pressures. These parameters should follow the manufacturer's specifications and guidelines.
- C. Upon completion of the injection, deflate the packer to break away the ring of gel formed by the packer void and move the packer at least one packer length in either direction. Move the television camera to a position to observe and inspect the results of the injection. If inspection and/or testing shows the seal was not completely effective, repeat the process. The packer should then be repositioned over the joint, re-inflated, and the joint retested at a pressure equal to the initial test pressure. If the lateral tap fails this air test, repeat the grouting procedure at no additional cost to the Owner. Repeat this sequence of air testing, grouting and subsequent air testing until either the lateral tap is sealed, or it is determined that the grout consumption is too high and may result in the blockage of the lateral pipe. The final determination to stop subsequent attempts to seal a lateral tap will be made jointly between the Owner, ENGINEER and the Contractor. If necessary, clear the injection port on the packer with a quick burst of air such that the void pressure meter reads zero $\pm \frac{1}{2}$ psi. Should the void pressure meter not read zero $\pm \frac{1}{2}$ psi, clean the equipment of residual grout or make the necessary equipment repairs/adjustments to produce accurate void pressure readings.
- D. If a joint requires more than 12 gallons of grout, modify grouting procedure to step grouting by pumping additional grout in 4-gallon increments, waiting 1 full minute, retesting, and, if needed, continuing with additional 4-gallon grout steps until successful test or until directed to stop by the Owner or Construction Manager.

- E. After the final post-grout pressure testing of each joint, move the packer forward, wiping away the excess grout that extends into the pipe, reduces the pipe diameter, or restricts the flow. Leave the sealed joints flush with the existing pipe surface. Remove excess grout from pipe and laterals. Excess grout shall be defined as a thickness of grout greater than 3/4-inch at any point or an amount of grout that, in the judgment of the Owner or Construction Manager, could cause a blockage. Flush or push forward to the next downstream manhole, remove from the sewer system, and properly dispose of excess grout. In no case shall excess grout material be allowed to accumulate or flushed down the sewer. Promptly repair any sewer damage resulting from the Contractor's operations at no additional compensation

3.05 JOINT SEALING VERIFICATION

- A. At the completion of the sewer line segment (i.e., manhole to manhole), conduct joint grouting verification testing of grouted joints and laterals for quality control purposes on 5% of the grouted mainline joints (minimum of two repaired joints), 25% of the grouted lateral taps (minimum of one lateral tap), and two joints for one grouted lateral connected to a manhole. Owner or Construction Manager may select the joints and laterals to be re-tested. Within a sewer line segment, if any joints or lateral taps fail the retest after sealing, retest all joints and lateral taps in the sewer line segment. Perform this post repair testing and any additional testing/sealing required beyond the initial retest area at no additional cost to Owner.

3.06 LOW PRESSURE AIR TESTING

- A. Testing shall not be required where the sewer is actively infiltrating, nor for longitudinal cracks longer than the sealing length of the packer. Areas actively infiltrating shall be grouted directly. The Owner or Construction Manager will make a determination on all defects which cannot be grouted and may direct the Contractor to perform a spot repair. Pressure tests shall be performed with air where Hydrostatic testing of joints is prohibited.
- B. Testing shall be accomplished by positioning the packer with the aid of the television camera so that the packer straddles the area to be tested. Once positioned, the packer's end bladders shall be inflated to create a void isolating the joint or defect. The pressure at the void shall be transmitted to, and continuously monitored by, the testing operator. Measurement of the void pressure shall be accurate to 0.1 psi. The void pressure gage shall be rated for 15 psi maximum.
- C. The operator shall add air until the internal pressure in the void is raised to 4 psi plus 0.5 psi for each foot the groundwater table is above the sewer invert elevation. The maximum test pressure shall be 10 psi. The Contractor shall be responsible for determining the groundwater elevations. Operator shall then allow sufficient time for the void pressure and temperature to stabilize. The pressure may be reduced by 0.5 psi before starting the test. When the void pressure has stabilized, the operator shall start the test by disconnecting the air supply and recording the time required for the void pressure to drop 0.5 psi. If the pressure drops more than 0.5 psi in 10 seconds, the section has failed the test and shall be grouted.
- D. All grouted sections shall be air tested. Where a grouted section fails the air test, it shall be repeatedly grouted and retested until it passes the air test requirements. The Contractor shall be responsible for all costs for achieving a successful test.

3.07 MANHOLE LEAKAGE SEALING

- A. Clean manholes in accordance with Section 33 01 30.53. Place approved manhole invert covers over sewer invert before manhole cleaning and preparation. Secure invert covers in place. Provide seal to prevent debris from entering the sewer main.
- B. Manufacturers' recommendations shall be strictly followed where surface preparation, patching, plugging, or grouting is performed. No material applications shall be made when ambient temperatures are less than 40 degrees F and or when freezing is expected within 24 hours or when ambient temperatures exceed 90 degrees F.
- C. Repair is not intended to fully rehabilitate the manhole; however, repairs with hydrophobic chemical grouts alone will not be accepted.
- D. Apply approved rapid setting cement or patching mix to eliminate minor infiltration.
- E. Where severe infiltration or persistent leakage exists, drill weep holes and pressure grout to provide a seal. If repairing a gushing leak, provide an initial injection of hydrophobic chemical grouts to reduce the flow to manageable levels for the use of hydrophilic resin to complete the repair. After injection is complete, the weep holes shall be plugged with quick setting patching material non-shrink grout per Section 03 60 00.

3.08 ANNULAR SPACE GROUTING

- A. During placement of the initial batches, check the density and adjust the mix as required to obtain the specified cast density at the point of placement.
- B. Take four (4) test specimens for each 300 cubic yards or every four (4) hours of placing. Test in accordance with ASTM C495. The specimens shall be 3" diameter x 6" high cylinders covered after casting to prevent damage and loss of moisture. Moist cure the specimens at least up to 3 days prior to a 28-day compressive strength test. Specimens may be tested at any age to monitor the compressive strength.

END OF SECTION

SECTION 05 05 14
HOT-DIP GALVANIZING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Hot-dip galvanizing of steel materials.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.

1.03 REFERENCES

- A. The references listed below are a part of this section. 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.

Reference	Title
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A780	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B6	Zinc
ASTM D6386	Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E536	Test Methods for Chemical Analysis of Zinc and Zinc Alloys
DOD-P-21035A	Paint, High Zinc Dust Content, Galvanizing Repair

1.04 SUBMITTALS

- A. Action Submittals
1. Procedure: Section 01 33 00:
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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.
4. Coating applicator's Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements of ASTM A123 or A153, as applicable.
5. Evidence that the galvanized coating applicator is a member of the American Galvanizing Association.

1.05 QUALITY ASSURANCE

- A. Hot-dip galvanized coating applicator shall be a member of the American Galvanizing Association.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Zinc used for galvanizing shall conform to ASTM B6, and shall be at least equal to the grade designated as Prime Western.
- B. Maximum amount of aluminum added to a galvanizing bath shall not exceed 0.01 percent.
- C. Hot-Dip Galvanized Coating: Conform to ASTM A123 and A153, as applicable.
- D. Repair: Zinc dust-zinc oxide coating conforming to MIL-P-21035B and achieving at least 93 percent zinc in the dry film. Acceptable products:
 1. ZRC Cold Galvanizing Compound by ZRC Worldwide
 2. 7000 System Cold Galvanizing Compound by Rustoleum
 3. Crown Cold Galvanize Coating 93% Zinc Rich by Aervoe Industries
 4. or approved equal.

2.02 FABRICATION REQUIREMENTS

- A. Fabrication practices for products to be galvanized: In accordance with applicable portions of ASTM A143, A384 and A385. Avoid fabrication techniques that could cause steel distortion or embrittlement.
- B. Coordinate with steel detailer to provide vent and drain holes of sufficient size and quantity to achieve specified galvanized coating.

PART 3 EXECUTION

3.01 PREPARATION

- A. Casting surfaces to be galvanized shall be sand blasted or ground smooth. When a smooth cast is required, castings shall be tumbled and all high spots ground flush. Castings shall be normalized to prevent cracking. Malleable iron shall be safeguarded against embrittlement by pre-annealing.
- B. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux or shall be blast cleaned and fluxed to obtain an acceptable surface for quality hot dip galvanizing.

3.02 APPLICATION

- A. Steel Members, Fabrications, and Assemblies: Hot-dip galvanize after fabrication in accordance with ASTM A123.
- B. Steel Bolts, Screws, Nuts, Washers and Hardware Components: Hot-dip galvanize in accordance with ASTM A153.

3.03 COATING REQUIREMENTS

- A. Hot-dip Coating Thickness: Conform to ASTM A123 or ASTM A153, as applicable.

3.04 TESTING

- A. Chemical analysis for impurities in the bath shall be made in conformity with ASTM E536.
- B. Test Requirements and Methods: In accordance with ASTM A123 or ASTM A153, as applicable.

3.05 GALVANIZED SURFACES TO BE PAINTED

- A. Where galvanized surfaces are specified to be painted, conform to ASTM D6386.

3.06 REPAIR OF DEFECTIVE GALVANIZED COATING

- A. Where zinc coating has been damaged after installation, clean substrate surface and repair with zinc dust-zinc oxide coating in accordance with ASTM A780. Apply zinc dust-zinc oxide coating in accordance with manufacturer's recommendation. Apply multiple coats to achieve a minimum film thickness of 8 mils.
- B. Remove items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, from the project site for repair by the hot-dip zinc coating method.

END OF SECTION

SECTION 05 05 20
ANCHOR BOLTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bolts and all-thread rods used to attach structural elements and equipment to concrete and concrete masonry. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.
- B. Cast-in-place and post-installed anchors shall be Type 316 stainless steel unless noted otherwise.

1.01 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 03 30 00 Cast-In-Place Concrete
 - 2. Section 03 60 00 Grouting

1.02 REFERENCES

- A. The references listed below are a part of this section. 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.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments

1.03 SUBMITTALS

- A. Action Submittals
 - 1. Procedures: Section 01 33 00.

2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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.
4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of Washington. Calculations shall comply with the provisions of ACI 318-17, Chapter 17. Base anchor capacity determination on cracked concrete condition and compressive strength of new concrete per Section 03 30 00. Assume compressive strength of existing concrete is 4,000 psi unless otherwise noted.
7. Submit record copy of proof loading test results within five days after test.
8. Product Data:
 - a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).
 - b. Product data indicating load capacity charts/calculations.
 - c. Chemical resistance.
 - d. Temperature limitations.
 - e. Manufacturers written installation instructions.
9. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

1.04 QUALITY ASSURANCE

A. Quality Assurance By Owner

1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
2. A five percent sample of installed post-installed anchors shall be proof-loaded by an independent laboratory contracted by the Contractor. The quantity of samples and locations shall be coordinated with the Owner's Representative.
3. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.

4. The Special Inspector shall furnish a report to the Engineer, Owner's Representative, and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).
- B. Certifications
1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 PRODUCTS

2.01 GENERAL

- A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts for equipment mounting shall be provided as required by manufacturer.
- B. Tapered washers shall be provided where mating surface is not square with the nut.
- C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.02 PERFORMANCE/DESIGN CRITERIA

- A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable. Design criteria provided in Structural General Notes.
- B. Design anchor bolts for support and bracing of non-structural components and non-building structures for loading specified in Structural General Notes.

2.03 MATERIALS

- A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts	ASTM A194 Heavy Hex Nuts, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316 ASTM A194 Heavy Hex Nuts Grade 8S (Nitronic 60)
Stainless Steel Washers	Type 316 to match bolt material
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized

Material	Specification
Concrete Adhesive Anchors	Hilti "HIT-RE 500v3", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3", or approved equal, Type 316 Stainless Steel
Concrete Expansion (wedge) Anchors *	Hilti "KWIK BOLT TZ", or approved equal, Type 316 Stainless Steel

**Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.*

2.04 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

- A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:
 1. Suitable for potable water supply.
 2. Formulated to resist washout.
 3. Acceptable manufacturers are Bostik, Saf-T-Eze, or equal.

2.05 ANCHOR BOLT SLEEVES

- A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
 1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 3. Acceptable manufacturers are Contec, Wilson, or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.
- B. Grouting of anchor bolts using plastic sleeves with non-shrink or epoxy grout, where specified, shall be in accordance with Section 03 60 00.
- C. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.
- B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.03 ADHESIVE ANCHOR BOLTS

- A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive anchors is acceptable for the specific use and location. Use of adhesive anchors shall be subject to the following conditions:
1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
 - a. Acid concentrations higher than 10 percent
 - b. Chlorine gas
 - c. Machine or diesel oils
 2. Limit to applications where exposure to the following is extremely unlikely:
 - a. Fire
 - b. Concrete or rod temperature above 120 degrees F
 3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
 4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
 5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
 6. Embedment depth shall be as specified or as required by the equipment manufacturer.
 7. Follow the anchor system manufacturer's installation instructions.
 8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.
 9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
 10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
 11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

3.04 EXPANSION ANCHORS

- A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 4 through 9 as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

- A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.
- B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.
- C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.
- D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.
- E. Reinforcing steel in masonry shall not be damaged.
- F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.
 - 1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the state of Washington.
 - 2. Calculations and details for redesign shall be submitted.

END OF SECTION

SECTION 05 10 00
STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Structural metals consisting of standard shapes, hollow sections, fasteners, and plates that are used in structural framing and connections.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 33 00 Submittal Procedures
 2. Section 05 05 14 Hot-Dip Galvanizing
 3. Section 05 05 20 Anchor Bolts

1.03 REFERENCES

- A. The references listed below 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.
- B. The references listed below indicate those documents in effect at the time of Advertisement for Bids, Invitation to Bid, or on the effective date of the Agreement if there were no Bids. Where documents are referenced in applicable local, state, or federal codes, use the version reference by date in the individual code. If referenced documents are not specifically identified in the applicable code(s), reference to those documents shall indicate the latest version of the documents available at the time of Advertisement for Bids. If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the latest version of 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.

Reference	Title
Aluminum Association ADM	Aluminum Design Manual
AISC 207	Certification Programs
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 313	Code of Standard Practice for Structural Stainless Steel Buildings
AISC 325	Steel Construction Manual
AISC 341	Seismic Provisions for Structural Steel Buildings
AISC 358	Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications
AISC 360	Specification for Structural Steel Buildings
AISC 370	Specification for Structural Stainless Steel Buildings
AISC DG 10	Erection Bracing of Low-Rise Structural Steel Buildings

Reference	Title
AISC DG 27	Structural Stainless Steel
ASTM A6	General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36	Carbon Structural Steel
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A276	Stainless Steel Bars and Shapes
ASTM A312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low Temperature Service
ASTM A380	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A484	General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A554	Welded Stainless Steel Mechanical Tubing
ASTM A529	High-Strength Carbon Manganese Steel of Structural Quality
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A999	General Requirement for Alloy and Stainless Steel Pipe
ASTM A992	Structural Steel Shapes
ASTM A1069	Laser and Laser Hybrid Welded Stainless Steel Bars, Plates, and Shapes
ASTM A1085	Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM F959	Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series
ASTM F3125	High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
ASTM F436	Hardened Steel Washers Inch and Metric Dimensions
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
AWS-B2.1	Welding Procedure and Performance Qualification
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D1.8	Structural Welding Code – Seismic Supplement
RCSC	Structural Joints Using High Strength Bolts
IBC	International Building Code with local amendments

1.04 SUBMITTALS

A. Procedures: Section 01 33 00.

B. Action Submittals:

1. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
2. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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.
3. Shop drawings for approval prior to fabrication. Shop drawings shall not be reproductions of the Drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, coatings, connection details, blocks, copes, and cuts. Substitutions of details shown on the Drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the Drawings.
4. Certification that steel Fabricator is approved to perform steel fabrication without special inspection.
5. AISC quality certification: Evidence that steel Fabricator has AISC 207 Certification as a AISC Certified Plant, Category BU (Certified Building Fabricator). Certificate to show name and address of certified firm, effective date, and category of certification.
6. Welding procedures, qualifications, and inspection report.
7. Certified mill test reports for structural steel and high-strength bolts and nuts.
8. In accordance with IBC Chapter 17, Fabricator at the completion of fabrication to submit Certification of Compliance stating that the fabrication was performed in accordance with the design documents.
9. Certified copies of all surveys conducted by a registered professional engineer or surveyor showing elevations and locations of base plates and anchor bolts to receive structural steel or aluminum, and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

1.05 QUALITY ASSURANCE

A. Quality Control by Owner:

1. Special Inspection of structural metals work shall be performed by the Special Inspector under contract with the Owner and in conformance with the IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection of structural metals is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

2. All structural steel work shall receive Special Inspection in accordance with IBC, Chapter 17. Structural steel includes all steel elements that resist code-defined loads and whose failure would affect life safety. Items to be inspected include, but are not limited to, mechanical / electrical supports, beams, stringers, columns, access walkways, and stairways.

B. Fabricator Qualifications:

1. A qualified Fabricator must participate in the AISC 207 Certification program and be designated an AISC Certified Plant, Category BU (Certified Building Fabricator).

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel:

1. Materials for structural steel shall be as specified in Table A.

Table A - Steel Materials	
Material	Specification
M-shapes	ASTM A36
S-shapes	ASTM A36
Channels	ASTM A36
Angles	ASTM A36
Plates	ASTM A36
HP-shapes	ASTM A572 Grade 50
Rolled wide-flange sections (W-shapes) and WTs	ASTM A992
Pipe sections	ASTM A53, Type E or S, Grade B (Fy = 35 ksi)
Round Hollow Structural Sections (HSS)	ASTM A500, Grade C (Fy=46 ksi min)
Square and Rectangular Hollow Structural Sections (HSS)	ASTM A500, Grade C (Fy = 50 ksi min)
Stainless steel bolts (used at stainless steel and aluminum framing unless noted otherwise)	ASTM F593, Type 316
Stainless steel nuts and washers (used at stainless steel and aluminum framing unless noted otherwise)	ASTM F594, Type 316
Steel bolts (used at galvanized and painted steel framing)	Galvanized ASTM F3125 Gr. A325
Carbon steel nuts and washers	Galvanized ASTM A563 nuts and galvanized ASTM F436 washers
Anchor bolts	Refer to Section 05 05 20

B. Stainless Steel:

1. Materials for structural stainless steel shall be as specified in Table B. All stainless steel shall be passivated per ASTM A380.

Table B – Stainless Steel Materials

Material	Specification
Hot-rolled and extruded structural shapes	ASTM A276, Type 316, finish per ASTM A484
Hollow structural sections (HSS)	ASTM A554, Type 316, finish per ASTM A554
Welded round pipe	ASTM A312, Type 316, finish per ASTM A999
Built-up I-shape, channel, angle, tee, & box section shapes (laser & laser hybrid)	ASTM A276, Type 316, finish per ASTM A1069
Bolts	Use stainless steel bolts for stainless steel framing (see Table A above)
Plates	ASTM A480, Type 316, finish per ASTM A480
Anchor bolts	Refer to Section 05 05 20

C. Aluminum:

1. Materials for structural aluminum shall be as specified in Table C.

Table C - Aluminum Materials

Material	Specification
Structural shapes	Alloy 6061-T6 per ASTM B308
Bolts	Use stainless steel bolts for aluminum framing (see Table A above)
Guardrail and handrail pipe	Alloy 6061-T6 or 6063-T6 per ASTM B241
Plates	Alloy 6061-T6 per ASTM B209
Anchor bolts	Refer to Section 05 05 20

PART 3 EXECUTION

3.01 GOVERNING DOCUMENTS

- A. The following paragraphs are primarily written to be applicable to structural steel. Where stainless steel or aluminum are utilized the applicable governing document(s) for that material shall be adhered to as necessary.

3.02 EXAMINATION

- A. Examine and accept conditions before beginning work.

3.03 FABRICATION

- A. Fabrication of steel shall be in accordance with the applicable provisions of the AISC Steel Construction Manual and AISC 360. Fabrication of stainless steel shall be in accordance with the applicable provisions of AISC 313 and AISC 370. Fabrication of aluminum shall be in accordance with Aluminum Design Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under AISC 207 for Category BU.

- B. Compression joints depending on contact bearing shall have a surface roughness not more than 500 micro-inches and ends shall be square within the tolerances for milled ends specified in ASTM A6.
- C. Shop splices of members will be permitted only where indicated on the Drawings. Splices not indicated require the approval of the Owner's Representative.
- D. Verify measurements at the job site prior to fabrication. Fabricate to match job site measurements.
- E. Provide bolt holes as indicated for securing other work to structural framing. Conform to AISC 325 and AISC 360 guidelines or contact Owner's Representative for approval for bolt holes not indicated on drawings.
- F. Other work shall be routed around structural steel framing members to the extent possible. Where not indicated on the design drawings, additional cuts, alterations, and holes for the passage of other work through steel framing members require the approval of the Owner's Representative and shall be addressed in accordance with AISC 303.

3.04 INSTALLATION

- A. General:
 - 1. Erection of structural steel shall be in accordance with the applicable provisions of AISC Steel Construction Manual (AISC 325). Erection plan shall conform to AISC 303. For low-rise structural steel buildings, 60 feet tall or less and a maximum of 2 stories, the structure shall be erected in accordance with AISC Design Guide 10.
 - 2. Coordinate installation of anchor bolts and other connectors required for securing structural steel in place. Refer to Section 05 05 20 for additional information regarding anchor bolts.
 - 3. Employ a registered professional engineer or surveyor for accurate erection of the structural framing. Check elevations of concrete and locations of anchor bolts before erection proceeds and report discrepancies to the Owner's Representative.
 - 4. Placement tolerances shall be in accordance with AISC 303 and AISC 360
 - 5. After final positioning of members, provide full bearing under base plates and bearing plates using non-shrink grout. Place non-shrink grout in accordance with the Manufacturer's instructions. Grout shall be cured prior to loading of the structure.
 - 6. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Protect aluminum in contact with concrete or grout with a heavy coat of bituminous paint.
 - 7. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned without damaging any metalwork coatings (if applied).
 - 8. Structural steel completely encased in concrete shall not be galvanized or painted and shall have a clean surface for bonding to concrete.
 - 9. Metalwork which is bent, broken or otherwise damaged shall be repaired or replaced at the Contractor's expense.

B. Welding:

1. Welding shall be done by welders, welding operators, and tackers who have been qualified by tests as prescribed by AWS to perform the type of work required. The quality of welding shall conform to AWS Codes.
2. Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures.
3. Provide continuous seal welds for plates or structural shapes that are exposed to or submerged in water or wastewater.

C. Bolted Connections:

1. Bolted connections, unless noted otherwise, shall conform to AISC 360 and the RCSC and shall be bearing type connections with bolts snug-tight. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Finished holes shall be 1/16 inch larger than the nominal size of the bolts for bolts less than one inch diameter, unless otherwise specified. Finished holes shall be 1/8 inch larger than the nominal size of the bolts for bolts one inch diameter and larger, unless otherwise specified. Bolts, nuts, and washers shall be clean of dirt and rust and lubricated immediately prior to installation. No drifting of bolts or enlargement of holes will be allowed to correct misalignment. Holes shall not be cut or enlarged by burning. Mismatched holes shall be corrected with new material. Bolts may not be re-used. Specifics to bolted connection types are as follows:
 - a. Snug-tight: Typical bearing type connections per the requirements of the RCSC specification. Note that thru-bolted HSS connections are only allowed to be snug-tight.

3.05 CORROSION PROTECTION

- A. Unless otherwise specified, carbon structural steel shall be galvanized.. Coating surface preparation shall include the following operations:
1. Grind the exterior and interior edges of all flame-cut plates or members to a smooth surface.
 2. Grind all sharp edges from sheared plates and punched holes.
 3. Grind uneven or rough welds with high beads to a smooth finish.

3.06 CLEANING

- A. After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat. Damaged surfaces of galvanized metals shall be repaired as specified in Section 05 05 14.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be provided under work of other specification sections.
 2. Seat angle frames
 3. Ladders, ladder cages, and safety posts
 4. Ladder Rail Fall Protection System
 5. U-channel concrete inserts
 6. Cover plates and frames
 7. Pipe sleeves
 8. Bollards
 9. Miscellaneous metal fabrications not covered elsewhere

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 05 05 14 Hot-Dip Zinc Coating
 2. Section 05 05 20 Anchor Bolts
 3. Section 05 10 00 Structural Metal Framing
 4. Section 09 96 00 High Performance Coatings For Water And Wastewater

1.03 REFERENCES

- A. The references listed below are a part of this section. 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.

Reference	Title
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 360	Specification for Structural Steel Buildings
AISC Steel Construction Manual	American Institute of Steel Construction, Manual of Steel Construction
ANSI A14.3	Standard for Ladders - Fixed - Safety Requirements
ASTM A36	Carbon Structural Steel
ASTM A48	Gray-Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

Reference	Title
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240	Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	Stainless Steel Bars and Shapes
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength
ASTM A312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A325	Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A489	Carbon Steel Lifting Eyes
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A554	Welded Stainless Steel Mechanical Tubing
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
ASTM A780	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
ASTM A786	Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A793	Rolled Floor Plate, Stainless Steel
ASTM A924	Steel Sheet, Metallic-Coated by Hot-Dip Process
ASTM A992	Structural Steel Shapes
ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM D1056	Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM F436	Hardened Steel Washers
ASTM F468	Nonferrous Bolts, Hex Cap Screws, SocketHead Cap Screws and Studs for General Use
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F3125	Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code - Stainless Steel
OSHA 29 CFR 1910.27	Fixed Ladders
OSHA 29 CFR 1926.502	Fall Protection Systems Criteria and Practices
SSPC SP5	White Metal Blast Cleaning

Reference	Title
IBC	International Building Code

1.04 DEFINITIONS

- A. Galvanize: Hot-dip galvanize per ASTM A123 or ASTM A153, per Section 05 05 14.

1.05 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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
 4. Manufacturer's product data.
 5. Detailed Shop Drawings:
 - a. Fabrication drawings showing layouts, connections to structural system, and anchoring details.
 - b. Erection and installation drawings indicating thickness, type, grade, class of metal, coating system and dimensions.
 - c. Construction details, reinforcement, anchorage, and installation with relation to the building construction.
 6. Welding procedures and welder certificates and qualifications.
 7. U-Channel Concrete Inserts: Manufacturer's product description and allowable load tables.
 8. Passivation method for stainless steel fabrications.
 9. Fall Arrest Anchor Certificate:
 - a. Certify fall arrest system is designed to meet OSHA 29 CFR 1926.502 specified performance requirements.
 - b. Signed and sealed by a Professional Engineer licensed in the state in which the project is located.

1.06 QUALITY ASSURANCE

- A. Qualifications
1. Fabricator shall have a minimum of five years experience in fabrication of metal specified.

B. Certificates

1. Certified welding procedures and welding operators in accordance with AWS. Welding operator certificates shall be no more than one-year old and the welder shall have used the welding process to be performed within the last six months.

C. The use of salvaged, reprocessed or scrap materials will not be permitted.

D. Shop Assembly: Items in the shop shall be preassembled to the greatest extent possible, so as to minimize field splicing and assembly of units. Units shall be disassembled only to the extent necessary for shipping and handling limitations. Units shall be clearly marked for reassembly and coordinated installation.

1.07 DELIVERY, STORAGE AND HANDLING

A. Avoid damage during delivery and handling of fabrications.

B. Store off the ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials for miscellaneous metalwork are specified in the following table.

Material	Specification
Steel	
Sheets, plates and shapes (except W shapes)	ASTM A36
W shapes	ASTM A992
Pipe	ASTM A53, Grade B
Square/rectangular tubing	ASTM A500, Grade B
Headed Anchor Studs	ASTM A108
Carbon steel bolts	ASTM A307, Grade A
High strength bolts	ASTM A325 (Type 1)
Nuts	ASTM A563
Washers	ASTM F436
Stainless Steel	
Sheet and Plates	ASTM A240, Type 316 or 316L
Shapes, bars, and similar items	ASTM A276, Type 316 or 316L
Pipe	ASTM A312, Type 316 or 316L
Headed Anchor Studs	ASTM A276, Type 316L
Bolts	ASTM F593, Type 316
Nuts	ASTM F594, Type 316
Other steel items	
Iron castings	ASTM A48
Eyebolts	ASTM A489

Material	Specification
Threaded rods	ASTM A36

2.02 FABRICATION

A. General

1. Conform to AISC or Aluminum Association standards as applicable. Where Code defined loads apply, also conform to IBC requirements.
2. Shop and field welding shall conform to the requirements of AISC and applicable AWS procedures and specifications as required by the material being welded.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt, tight, flush, and hairline. Remove burrs and weld splatter. Ease exposed edges to small uniform radius.
4. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.
5. Fabrication, including cutting, drilling, punching, threading and tapping required for fabrications or adjacent work, shall be performed prior to galvanizing.

B. Seat Angle Frames

1. Provide recessed seat angle frames for grating and floor plates. Miter corners to ensure accurate fit. Match depth of recess with grating or floor plate thickness. Anchor frames in concrete with headed studs. Steel angle support frames shall be stainless steel, ASTM A276, Type 316, unless indicated otherwise.

C. Ladders

1. Steel Ladders: Provide vertical ladders conforming to 29 CFR 1910.27. As a minimum, provide 2 1/2 inch by 3/8 inch steel flat bars for side rails and 3/4 inch diameter steel rods for rungs unless otherwise indicated on the Drawings. Rungs shall be a minimum clear length of 16 inches, uniformly spaced at a maximum of 12 inches and plug welded into side rails. Install ladders so that the distance from the centerline of rungs to the finished wall surface is not less than 7 inches nor more than 12 inches. Provide clip angle supports bolted to the side rail at the top. Provide intermediate clip angle lateral supports at a maximum of 10 feet on center.
2. Ladder Safety Post:
 - a. Provide a telescoping ladder safety post at ladders below all floor and roof hatches, and other coverings.
 - b. The ladder safety post shall be pre-assembled from the manufacturer.
 - c. Performance characteristics:
 - 1) Post shall lock automatically when fully extended.
 - 2) Post shall have controlled upward and downward movement.
 - 3) Release lever shall disengage the post to allow it to be returned to its lowered position.
 - 4) Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14" on center and clamp brackets to accommodate ladder rungs up to 1-3/4" in diameter.

- 5) Post: Manufactured of high strength square tubing with a pull up loop provided at the upper end of the post to facilitate raising the post.
- 6) Material of construction: Stainless steel Type 316
- 7) Balancing spring: Stainless steel spring balancing mechanism to provide smooth, easy, controlled operation when raising and lowering the safety post.
- d. Acceptable products include:
 - 1) LadderUp Safety Post by Bilco
 - 2) Ladder Safety Post Model SP by Nystrom Inc.
 - 3) Approved equal
3. Ladder Rail Fall Protection System:
 - a. System shall consist of a vertical rigid track carrier rail securely and permanently attached to ladder, over which travels a sleeve to harness belt can be attached.
 - b. Rail:
 - 1) Notched at six-inch intervals and constructed of stainless steel Type 316.
 - 2) Provide ladder attachments/rail mounting brackets of same material as rail, and as required by Supplier.
 - 3) For all ladders, include provisions to secure safety sleeve to carrier rail at top of vertical ladder so that sleeve will not slide down rail when safety belt is unsnapped.
 - 4) Ladders Below Hatches: Rail for ladder shall extend from bottom of ladder to top of ladder. Provide telescopic safety post.
 - 5) Ladders Not Below Hatches: Rail for ladder shall extend from bottom of ladder to above horizontal landing or roof at top of ladder. Provide removable extension section at top of ladder. Arrange rail to allow climber to land on landing or roof without unsnapping climber's safety harness.
 - c. Accessories: Provide with each ladder the following, all furnished by the fall prevention system Supplier:
 - 1) One safety sleeve compatible for use with the rail. Sleeve shall be cast bronze with five zinc plated steel roller bearings. Sleeve shall travel smoothly on straight or curved rail.
 - 2) One safety harness that attaches to sleeve. Harness shall be of woven high-strength nylon, with padded straps and forged steel buckles and rings. Harness shall distribute impact forces of a fall over climber's thighs, buttocks, chest, and shoulders.
 - 3) One shock adsorbing lanyard no longer than six-feet, complying with ANSI Z359.1. Lanyard shall be 5/8-inch diameter nylon rope with double locking hooks at each end.
 - d. Acceptable ladder rail fall protection systems include:
 - 1) Miller Saf-T-Climb as manufactured by Honeywell
 - 2) Vertical Rigid Track Fall Arrest System as manufactured by Diversified Fall Protection
 - 3) Approved equal

D. U-Channel Concrete Inserts

1. U-Channel Concrete Inserts shall be stainless steel conforming to attachment hardware and materials attached. Channels shall be 1 5/8 inch wide by 1 3/8 inch deep with a minimum thickness of 0.105 inches. Channels shall be open-bottom with curved or lipped flange edges to engage standard nuts and connection hardware. Load rating shall meet or exceed a 2,000 pound point load at 12 inch minimum spacing. Provide standard accessories and hardware per manufacturers recommendations.

E. Cover Plates and Frames

1. Fabricate aluminum cover plates weighing not more than 80 pounds per cover with a raised pattern nonslip top surface conforming to ASTM B632. Reinforce to sustain a live load of 100 pounds per square foot (foot traffic only) or as indicated on the Drawings. Frames shall be stainless steel angles and plates, with stainless steel headed anchors welded to frame for anchoring to concrete. Miter and weld corners and butt joint straight runs. Provide flush drop handles for removal. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld connections and grind top surface smooth. Provide 1/8 inch clearance at edges.

F. Pipe Sleeves

1. Unless otherwise indicated on the Drawings, fabricate pipe sleeves from schedule 40 steel pipe with 3/16 inch thick by 3 feet wide seep ring continuously seal welded to the outside of the pipe. Galvanize after fabrication in accordance with ASTM A123.

G. Bollards

1. Provide minimum 6 inch galvanized standard weight steel pipe or as indicated on the Drawings. Pipe to be in accordance with ASTM A53. Anchor posts in concrete and fill solidly with concrete of a minimum compressive strength of 2500 psi. Coat galvanized pipe above grade in accordance with Section 05 05 14. Top coat cover color shall be safety yellow.

H. Other Miscellaneous Steel Metalwork

1. Other miscellaneous steel metalwork including embedded and non-embedded steel metalwork, hangers and inserts shall be as specified or shown on the Drawings, and shall be galvanized after fabrication unless otherwise noted.

2.03 FINISHES

A. Galvanizing

1. Galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing in accordance with ASTM A123, ASTM A153, ASTM A653 or ASTM A924, Z275 G90, as applicable. Galvanize anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.
2. Repair damaged Zinc-Coated surfaces with galvanizing repair method and paint conforming to ASTM A780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Owner's Representative.
3. Safeguard against warpage and distortion during galvanizing of steel in accordance with ASTM A384. Straighten items after galvanizing so that they are straight, free of racking and distortion.

- B. Shop Painting
 - 1. Prepare and coat surfaces.
 - 2. Steel to be embedded in concrete shall be free of dirt and grease.
- C. Stainless Steel Passivation
 - 1. Stainless steel to be cleaned, descaled, and passivated after fabrication in accordance with ASTM A380. Passivate to remove iron compounds from the surface of the stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify measurements at the site. Include field dimensions in shop drawings.
- B. Examine and accept existing conditions before beginning work.

3.02 PREPARATION

- A. Make provisions for erection loads with temporary bracing. Keep work in alignment.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.03 INSTALLATION

- A. Install items plumb, level and square, accurately fitted, and free from distortion or defects. Install rigid, substantial, and neat in appearance.
- B. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Fieldwork shall not be permitted on galvanized items. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
- D. Protect encased or embedded dissimilar metals (both metals must be encased or embedded) from galvanic corrosion by means of pressure tapes, coatings or isolators.
- E. Place metalwork to be embedded in concrete accurately and hold in correct position while the concrete is placed or, if indicated, form recesses or blockouts in the concrete. Thoroughly clean the surfaces of metalwork in contact with or embedded in concrete.
- F. Seat angles, supports and guides: Set seat angles for grating and supports for floor plates so that they maintain the grating and floor plates flush with the floor.
- G. Ladder Safety Post: Comply with manufacturer's installation instructions.

- H. Pipe Sleeves: Provide where pipes pass through concrete or masonry. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls. Provide a center flange for water stoppage on sleeves in exterior or water bearing walls. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves.
- I. U-Channel Concrete Inserts: Provide as indicated for pipe supports and where otherwise specified or shown on Drawings.
- J. Fastening to Construction-In-Place: Provide anchorage devices and fasteners where necessary for fastening fabricated items to construction-in-place. Design anchorage devices in accordance with manufacturer recommendations. Anchor bolts to be in accordance with Section 05 05 20.

3.04 REPAIR/RESTORATION

- A. Galvanized
 - 1. Maximum area to be repaired shall not be more than 1/2 of 1 percent of the surface area or 36 sq. in. per ton of piece weight, whichever is less. Damage in excess of this requirement shall be repaired by stripping and recoating entire piece.
 - 2. Clean damaged areas to SSPC-SP5. Repair with zinc-rich paint in accordance with the manufacturer's instructions and with ASTM A780, Annex A2. Minimum thickness requirements shall be in accordance with ASTM A123.
 - 3. Use zinc-rich repair paint. Acceptable manufacturers:
 - a. LPS, Cold Galvanize
 - b. ZRC Worldwide, ZRC Galvilite
 - c. Approved Equal
- B. Painted
 - 1. After installation, clean and touch up damaged areas with the same materials used for the shop coat.

3.05 FIELD QUALITY CONTROL

- A. Electrolytic Protection
- B. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.
- C. Stainless Steel
 - 1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
 - 2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.

3. Remove contamination in accordance with requirements of ASTM A380.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.

END OF SECTION

SECTION 07 10 00
WATERPROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies waterproofing for below-grade concrete surfaces.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 30 00 Cast-In-Place Concrete.

1.03 DEFINITIONS

- A. SM – Coating System Manufacturer
- B. TR – Coating System Manufacturer's Technical Representative

1.04 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00.
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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.
 4. System Manufacturer's (SM) current printed recommendations and product data sheets for proposed systems including:
 - a. Volatile organic compound (VOC) data.
 - b. Surface preparation recommendations.
 - c. Allowable substrate moisture content.
 - d. Primer type, coverage rate, and drying time; where required.
 - e. Maximum dry and wet-mil thickness per coat.
 - f. Product(s) shelf life.
 - g. Minimum and maximum curing time between coats.
 - h. Atmospheric condition requirements during application and curing.
 - i. Curing time before submergence in liquid.
 - j. Thinner to be used.

- k. Ventilation requirements.
 - l. Allowable application methods.
 - m. Corner, joint, and wall penetration details.
 - n. Backfill procedure recommendations including termination bar if required.
 - 5. Affidavits signed and sealed by an officer of the SM's corporation, attesting to compliance of each system component with federal, state, and local air pollution control regulations and requirements.
 - 6. SM's detailed, written instructions for system installation including graphic details for terminations, pipe penetrations, metal embedments, gate frames, concrete joints, and other terminations as coordinated by Contractor.
 - 7. Schedule of all surfaces where waterproofing coating will be applied.
- B. Informational Submittals:
- 1. Material Safety Data Sheets (MSDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
 - 2. List of cleaning and thinner solutions allowed by the SMs.
 - 3. Storage and handling requirements including temperature, humidity, and ventilation for system materials as recommended by the SMs.
 - 4. The Contractor and SM shall each provide five project references with contact name, address, and telephone number where similar coating work has been performed by their companies in the past five years.

1.05 QUALITY ASSURANCE

- A. General:
- 1. Materials in each system shall be the products of a single SM.
 - 2. Installation of each system shall be by a single installation Contractor, approved by the SM.
- B. Quality Control:
- 1. The Contractor is responsible for the workmanship and quality of the system installation. Inspections by the Construction Manager or the System Manufacturer's Technical Representative (TR) will not relieve or limit the Contractor's responsibilities.
 - 2. Installation methods shall conform to requirements of this specification. Changes in the system installation requirements will be allowed only with the written acceptance of the Construction Manager before work commences.
 - 3. Only personnel who are trained by the TR specifically for the system or who are approved by the SM specifically for the system are allowed to perform the system installation specified in this Section.
 - 4. For repairs, provide the same products, or products recommended by the SM, as used for the original installation.
 - 5. Identify the points of access for inspection by the Construction Manager. Provide ventilation, ingress and egress, and other means necessary for the inspection personnel to safely access the work areas.
 - 6. Conduct and inspect the work so that the system is installed as specified. Work that does not conform to the specifications shall be corrected.

1.06 SPECIAL WARRANTY

- A. Waterproofing coating SM and the installation Contractor agree to repair or replace components of the waterproofing system that fail in materials or workmanship within 5 years from the date of completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Epoxy Waterproofing Coating:
 - 1. Tnemec Series 69.
 - 2. Ameron Amercoat 385.
 - 3. International Protective Coatings Interseal 670HS.

2.02 MATERIALS

- A. Epoxy Waterproofing Coating: Polyamidoamine epoxy resin.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine and accept existing conditions before beginning work.

3.02 EPOXY WATERPROOFING COATING

- A. Location:
 - 1. Apply epoxy waterproofing coating to the earth side of walls as indicated on the Drawings.
- B. Surface Preparation:
 - 1. New concrete shall have cured at least 28 days and allowed to dry to a moisture content recommended by the coating manufacturer. Remove loose concrete and laitance by abrasive blasting. Repair voids and cracks as specified in Section 03 30 00.
- C. Application:
 - 1. Total dry film thickness: minimum 16 mils.
 - 2. Apply two or more coats at the manufacturer's recommended dry film thickness.
 - 3. Drying time between coats: as recommended by the manufacturer.

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE COATINGS FOR WATER AND WASTEWATER

PART 1 GENERAL

1.01 DESCRIPTION

- A. Scope:
1. This Section specifies coating systems, surface preparation, and application requirements for high performance protective coating systems applied to both concrete and metal substrates.
- B. This section includes:
1. High performance coatings to be used for all significantly corrosive environments including headspace environments exposed to biogenic sulfide corrosion or to other corrosive gases or vapors.
 2. Immersion service of concrete and metal substrates in all wastewater treatment process areas, pump stations, and other process areas as specified.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 11 80 Environmental Conditions
 2. Section 01 33 00 Submittal Procedures
 3. Section 01 45 00 Quality Control
 4. Section 01 45 23 Testing and Inspection Services
 5. Section 01 60 00 Materials and Equipment
 6. Section 01 99 90 Reference Forms
 7. Section 03 01 00 Concrete Repair
 8. Section 07 10 00 Waterproofing

1.03 DEFINITIONS

- A. Coating terminology used in this Section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions.
1. Abrasive: Material used for blast cleaning, such as sand, grit or shot.
 2. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
 3. AMPP: Association for Materials Protection and Performance (Merger of NACE and SSPC).
 4. Anchor Pattern: Profile or texture of prepared surface(s).
 5. ANSI: American National Standards Institute.
 6. Bug Holes: Small cavities, usually not exceeding 15 millimeters in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.

7. Biogenic Sulfide Corrosion: Sulfuric acid corrosion of metal and concrete substrates caused by the formation of sulfuric acid by the metabolic process of sulfurs oxidizing bacteria metabolizing hydrogen sulfide.
8. Coating/Paint/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.
9. Coating System Applicator (CSA): A generic reference to the specialty subcontractor or subcontractors retained by the Contractor to install the coating systems specified in this Section.
10. Coating System Manufacturer (CSM): Refers to the acceptable coating system manufacturer, abbreviated as the CSM.
11. Coating System Manufacturer's Technical Representative(s) (CTR): Refers to the technical representative(s) of the acceptable Coating System Manufacturer and is abbreviated as CTR.
12. Continuous film or continuity of film: refers to coating layer/system without holidays, pinholes or other discontinuities.
13. CQC: Coating System Applicator (CSA) Quality Control.
14. Dehumidification: The removal of moisture, humidity or dampness from the air
15. Dew point: Temperature of a given air/water vapor mixture at which condensation starts.
16. Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001 inch).
17. Drying/Cure Time: Time interval between application and curing of material before exposure to service conditions.
18. Dry to Recoat: Time interval between application of material and ability to receive next coat.
19. Dry to Touch: Time interval between application of material and ability to touch lightly without damage.
20. Feather Edging: Reducing the thickness of the edge of paint.
21. Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.
22. Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
23. Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.
24. Holiday: A discontinuity, skip, or void in coating or coating system film that exposes the substrate.
25. Honeycomb: Segregated condition of hardened concrete due to non-consolidation
26. ICRI: International Concrete Repair Institute.
27. Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
28. Laitance: A layer of weak, non-durable concrete containing cement fines that are brought to the surface through bleed water because of concrete finishing and/or over-finishing.
29. Mil: 0.001 inch.
30. NACE: National Association of Corrosion Engineers.
31. NSF International: National Sanitation Foundation.

32. Overspray: Dry spray, particularly such paint that failed to strike the intended surface.
33. Owner's Quality Assurance Representative: Person or persons designated by the Owner to perform QA review of the Contractor's QC reports and inspection and testing work.
34. Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
35. Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
36. QCP: Quality Control Person representing the Contractor and responsible for QC Testing, Inspection and associated documentation.
37. QCTIP: Quality Control Testing and Inspection Plan..
38. QP-1 AMPP: Accredited program that evaluates the practices of field painting.
39. QP-3- AMPP: Accredited program that evaluates the practices of shop painting facilities.
40. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-base material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
41. Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
42. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
43. Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
44. SSPC: The Society for Protective Coatings.
45. Stripe Coat: A separate coat of paint applied to all weld seems, pits, nuts/bolts/washers and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
46. Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
47. Tie Coat: An intermediate coat used to bond different types of paint coats; coatings used to improve the adhesion of a succeeding coat.
48. Touch-Up Coating: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
49. TPC: Technical Practice Committee.
50. Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).
51. Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.
52. Weld Spatter: Beads of metal scattered near seam during welding.
53. Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application; wet film thickness is measured in mils or thousandths of an inch (0.001 inch) and is abbreviated WFT.

1.04 REFERENCES

- A. This section contains references to the following documents listed and described below. 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 and described documents, the requirements of this section shall prevail.
- B. 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.

References	Title
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Material
ASTM C1583	Standard Test Method For Tensile Strength Of Concrete Surfaces and The Bond Strength Or Tensile Strength Of Concrete Repair and Overlay Materials By Direct Tension (Pull-Off Method)
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D2200 (SSPC-VIS1)	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Methods for Pull-Off Strength of Coatings On Metal Substrates Using Portable Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM 5402	Standard Practice for assessing the solvent resistance of organic coatings using solvent rubs
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers.
ASTM E337	Standard Test Method for Measuring Humidity With a Psychrometer
ASTM F22	Standard Test Method for Hydrophobic Surface Films by the Water-Break Test
FS 595b	Federal Standard Colors

References	Title
ICRI 310.2R-2013	Guideline for Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair
NACE Publication 6D-163	A Manual for Painter Safety
NACE Publication 6F-163	Surface Preparation of Steel or Concrete Tank/Interiors
NACE Publication 6G-164 A	Surface Preparation Abrasives for Industrial Maintenance Painting
NACE Standard RP0188	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete
NACE SP0178	Design, Fabrication and Surface Finish Practices for Vessels and Tanks to Be Lined for Immersion
NACE Standard RP0892	Standard Recommended Practice, Linings Over Concrete in Immersion Service
NACE Publication TPC2	Coatings and Linings for Immersion Service
NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
OSHA 1915.35	Standards – 29CFR – Painting
South Coast Air Quality Management District (SCAQMD)	Rule 1113 -Architectural Coatings
SSPC	Paint Application Specification No. 1.
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
SSPC Guide 15	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.
SSPC-PA Guide 3	A Guide to Safety in Paint Application
SSPC-PA Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
SSPC PA-Guide 10	Guide to Safety and Health Requirements for Industrial Painting Projects
SSPC- PA Guide 11	Guide for Stripe Coating
SSPC-PA Guide 12	Guide for Illumination of Industrial Painting Project
SSPC SP1	Solvent Cleaning
SSPC SP2	Hand Tool Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP5/NACE #1	White Metal Blast Cleaning
SSPC SP6/NACE#3	Commercial Blast Cleaning
SSPC SP7/NACE #4	Brush-Off Blast Cleaning
SSPC SP10/NACE#2	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC/NACE WJ 1-4	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating
SSPC SP13/NACE#6	Surface Preparation of Concrete
SSPC SP14/NACE#8	Industrial Blast Cleaning
SSPC SP15	Commercial Power Tool Cleaning

References	Title
SSPC SP16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
SSPC-TR2	Wet Abrasive Blast Cleaning
SSPC-TU-3	Overcoating
SSPC-TU-4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.
SSPC V2	Systems and Specifications: Steel Structures Painting Manual, Volume 2
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
SSPC-VIS 4	Visual Standards (Waterjetting)
SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)

1.05 QUALITY ASSURANCE

A. General Requirements:

1. Materials and supplies provided shall be the standard products of CSMs. Materials in each coating system shall be the products of a single CSM.
2. The standard products of CSMs other than those specified may be acceptable when it is demonstrated to the Construction Manager that they are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for consideration of CSMs other than those specified in this Section will be considered in accordance with the requirements of the General Conditions and provided the following minimum conditions are met. Such requests are not a substitution for submittals after the alternative CSMs have been considered and accepted.
 - a. The proposed coating system shall use an equal or greater number of separate coats to achieve the required total DFT.
 - b. The proposed coating system shall use coatings of the same generic type as that specified including curing agent type.
 - c. Requests for consideration of products from CSMs other than those specified in this Section shall include information listed in paragraph 1.07, demonstrating that the proposed CSM's product is equal to the specified coating system.
 - d. The Contractor and the proposed alternative CSM shall provide a list of references for the proposed product where the coating of the same generic type has been applied. The reference list shall include the project name, city, state, owner, and phone number of owner; coating system reference and number from this Section 09 96 00; type of facility in which it was used, generic type, and year coating was applied.
 - e. At any time when there is a conflict between the CSM's product data and the COAT SPEC requirements regarding surface preparation, material application or any other coating details that provides the more stringent requirements will take precedent.

B. Shop and Field Quality Control Requirements:

1. The Contractor is solely responsible for the workmanship and quality of the coating system installation by the CSA. Inspections by the Owner, Engineer, a Construction Manager, the CTR, or any other party will not relieve or limit the Contractor's responsibilities for the quality of the coating system.

2. The Contractor's CSA's methods shall conform to requirements of this specification and the standards referenced in this Section. Changes in the coating system installation requirements will be allowed only with the written acceptance of the Engineer before work commences.
3. Only personnel who are trained by the CTR specifically for this contract or who are approved by the CSM specifically for this contract shall be allowed to perform the coating system installation specified in this Section.
4. All field surface preparation and coating applications shall be performed by a AMPP QP1 Certified field painting Contractor in good standing.
5. All shop surface preparation and coating applications shall be performed by a AMPP QP3 Certified blast and painting shop in good standing.
6. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
7. For repairs, the CSA shall provide the same products, or products recommended by the CSM, as used for the original coating.
8. The Contractor shall identify the points of access for inspection by the Owner, the Engineer, or the Owner's Representative. The Contractor shall provide ventilation, ingress and egress, and other safe means necessary for the Owner's or Engineer's personnel or designated representative to safely access the work areas.
9. The Contractor and CSA shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected to the as-specified requirements.
10. The CSA shall have full time inspection and shall have trained and certified quality control (QC) inspectors performing all QC procedures. All persons performing QC duties shall be a minimum AMPP Basic Coating Inspector (NACE/SSPC Level 1) with a minimum of 3 years' experience in QC processes is acceptable, providing they are under the direct supervision of a AMPP Certified Coatings Inspector (NACE/SSPC Level 2) or AMPP Senior Coatings Inspector (NACE/SSPC Level 3) in good standing, with at least 10 years of similar coatings work experience. The trained QC Program inspectors shall perform all routine QC testing and inspection tasks as the coating work proceeds in accordance with the requirements of this Section.
11. The Contractor shall submit for approval a Quality Control Testing and Inspection Plan (QCTIP) for the work covered by this Section. The QCTIP shall list all tests and inspection tasks including referenced and applicable standards to be conducted and the frequency in which these tests or tasks shall be performed. This frequency can be addressed for certain tests such as air and substrate temperature or Dew Point measurements on an hourly per shift basis. Or this frequency can be addressed on a per number of square feet basis for tests and tasks such as WFT and DFT tests or adhesion tests. The QCTIP must provide a written record which identifies when (time and date) work not conforming to the specification requirements is identified. The QCTIP must also provide a written record of the proposed corrective actions for such non-conforming work as well as a record of when that action was performed (time and date). All corrective action for non-conforming work shall be described in writing in detail with referenced digital photographs taken of that re-work.

12. The CSA's Quality Control Person (QCP) or persons shall submit a daily QC inspection report that describes and documents all QC tests and inspection tasks performed including frequency of performance and test results (including test data) and referenced standard followed for each shift the Contractor works. These reports shall be submitted on the morning of the following day the work was performed to the Owner's representative. If any non-conforming work is identified, a written account of those non-conforming issues and corrective measures and annotated digital photographs of such work shall be included with the daily QC report. The Contractor shall submit a standard inspection form to be used for these reports for review by the Engineer. The approved inspection report forms shall be used by the Contractor's QC Inspector to record all QC inspection and testing throughout the performance of the coating work.
13. The CSA, with Contractor's oversight, shall complete the Coating System Quality Assurance Checklist, Form 09 96 00-A, included in 01 99 90, for coating system installations. Follow the sequential steps required for proper coating system installation as specified and as listed in the Coating System Quality Assurance Checklist. For each portion of the work, install the coating system and complete sign-offs as specified prior to proceeding with the next step. After completing each step as indicated on the Coating System Quality Assurance Checklist, the Contractor shall sign the checklist indicating that the work has been installed and inspected as specified.

C. Quality Control Minimum Inspection Processes:

1. The CSA shall conduct QC inspections during the coating system installation, including surface preparation. Results of those inspections shall be included in the Daily Inspection Reports. Sign off by all involved parties (GC, CSA, CSM) is required on the project Inspection Checklist, Form 09 96 00-A. QC inspections and testing shall be performed as often as needed to ensure full compliance to this specification. The minimum QC inspections include but are not limited to the following:
 - a. Environment and Site Conditions: Prior to commencing an activity associated with coating system installation, the CSA inspector shall measure, record, and confirm acceptability of ambient air temperature and humidity as well as other conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel. The acceptability of the weather and/or environmental conditions within the structure shall be determined by the requirements specified by the CSM of the coating system being used.
 - b. Conditions Prior to Surface Preparation: Prior to commencing surface preparation, the CSA inspector shall observe, record, and confirm that oil, grease, and/or soluble salts have been eliminated from the surface.
 - c. Monitoring of Surface Preparation: Spot checking of degree of cleanliness, surface profile, and surface pH testing, where applicable. In addition, the compressed air used for surface preparation or vacuum or wash-down cleaning shall be checked to confirm it is free from oil and moisture.
 - d. Post Surface Preparation: Upon completion of the surface preparation, the CSA shall measure and inspect for proper degree of cleanliness and surface profile as specified in this Section and in the CSM's written instructions (Product SDS).
 - e. Monitoring of Coatings Application: The CSA inspector shall inspect, measure, and record the WFT and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.

- f. Post Application Inspection: The CSA shall identify defects in application work including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness, and other problems as may be observed.
- g. DFT Measurements: DFT measurements shall be taken after each coat and recorded in the daily QC inspection reports. DFT readings for steel surface shall be taken as per SSPC- PA2 using Type II Magnetic DFT Gauges for ferrous surfaces and Type II Eddy Current Gauges for non-ferrous surfaces. DFT readings for concrete surface can be taken as per SSPC- PA9 using Ultra Sonic DFT Gauges or by proving materials usage versus square foot coverage. All gauges shall be calibrated by the manufacturer or approved agent within 1 year of use. Following SSPC- PA2 and SSPC-PA9, minimum measurement standards may not provide the QCP adequate measurement intervals to ensure full compliance to the specification. QC personnel are required to take as many measurements necessary to ensure full compliance to this specification.
- h. Post Cure Evaluation: The CSA shall measure and inspect the overall DFT. The CSA shall conduct a DFT survey, as well as perform adhesion testing, holiday detection, or cure testing as required based on the type of project and the specific requirements in this Section and/or in the CSM's written instructions.
- i. Follow-up to Corrective Actions and Final Inspection: The CSA shall measure and reinspect corrective coating work performed to repair defects identified at prior Hold Points. This activity also includes final visual inspection along with follow-up tests such as holiday detection, adhesion tests, and DFT surveys.

D. Quality Assurance Inspection:

- 1. The Owner and Engineer reserve the right to retain the services of a Quality Assurance Inspection firm to perform random audits of the CSA's QC processes and documentation at any time during the project's progress. Any inspections by the Owner, Engineer, or other owner related representatives do not relieve the Contractor from having sole responsibility for the quality of the installed coating system.
- 2. Quality Assurance Hold Point Inspections may include, but are not limited to the following processes
 - a. Conditions Prior to Surface Preparation
 - b. Environment and Site Conditions
 - c. Post Surface Preparation
 - d. Post Primer Application (if Applicable)
 - e. Post Intermediate Coat Application (if Applicable)
 - f. Post Final Coat Application
 - g. Final Cure and Testing (including Holiday Detection)
 - h. Follow-up to Corrective Actions and Final Inspection
- 3. The Contractor/CSA shall coordinate such Hold Points with the Owner's Quality Assurance representative such that this representative may observe the CSA's QC inspections on a scheduled basis. The Contractor/CSA shall provide the Owner's Quality Assurance representative a minimum of 48 hours of notice prior to conducting Hold Point Inspections.

E. Responsibilities of the CTR:

1. General:

- a. The Contractor shall retain or obtain the services of the CTR to be on site to perform the Contractor and/or CSA application training and to routinely verify in writing that the application personnel have successfully performed representative portions of the surface preparation work, filler/surface application, coating system application, and QC Inspection in accordance with this Section. This must include testing, checking, or witnessing the contractors testing for the required degree of cleanliness, surface pH for concrete substrates, surface profile of substrates, proper mixing of coating materials, application (including checking the WFT and DFT of the coating systems), proper cure of the coating systems, and proper treatment of coating systems at terminations, transitions, and joints and cracks in substrates. Refer to paragraph 1.05.E, Coating System Installation Training. for further details on these CTR requirements. This verification is in addition to the inspection performed by the Contractor in accordance with this Section. The CTR must be a technical representative of the CSM's Technical Service Department and not a local sales representative. The CTR shall provide an adequate level of oversight of the contractor's QC processes, at their discretion, to provide sign off that the CSM's products have been properly installed.

2. Coating System Installation Training:

- a. Provide a minimum of 8 hours of classroom and off-site training for application and supervisory personnel of the Contractor (CSA). Provide training to a minimum of 2 supervisory personnel from the CSA. Alternatively, the CTR shall provide a written letter from the CSM stating that the application personnel (listed by name) who shall perform coating work are approved by the CSM without further or additional training.
- b. One CTR shall provide training for all application and supervisory personnel. The training shall include the following as a minimum:
 - 1) A detailed explanation of mixing, application, curing, and termination details.
 - 2) Hands-on demonstration of how to mix and apply the coating systems.
 - a) A detailed explanation of the ambient condition requirements (temperature and humidity) and surface preparation requirements for application of the coating system as well as a detailed explanation of re-coat times, cure times, and related ambient condition requirements.
 - 3) When training is performed, the CTR shall provide a written letter stating that training was satisfactorily completed by the personnel listed by name in the letter.

3. Representative Coating System Inspections:

- a. While on site to verify or witness the QC processes of the contractor, the CTR shall verify representative steps of the coating work are performed properly per the manufacturer's instructions, the CTR shall coordinate and confirm the planned inspections by the Contractor's QC person are being performed per the QCTIP to assure quality of the work meets the requirements of both these specifications and any additional manufacturer's requirements, the CTR shall verify or witness the contractors QC processes of the following QC steps, at their discretion and as delineated above in 1.05.C.:
 - 1) Inspect ambient conditions during various coating system installation at hold points for conformance with the specified requirements.

- 2) Inspect the surface preparation of the substrates where the coating system will terminate or will be applied for conformance to the specified application criteria.
- 3) Inspect preparation and application of coating detail treatment (for example, terminations at joints, metal embedments in concrete, etc.).
- 4) Inspect application of the filler/surface materials for concrete and masonry substrates.
- 5) Inspect application of the primers and finish coats including WFT and DFT of the coatings.
- 6) Inspect coating systems for cure.
- 7) Review adhesion testing of the cured coating systems for conformance to specified criteria.
- 8) Review coating system discontinuity testing for conformance to specified criteria.
- 9) Observe adhesion testing work to assure it meets specification requirements.
- 10) Inspect and record representative localized repairs made to discontinuities identified via continuity testing.
- 11) Conduct a final review of completed coating system installation for conformance to the specifications.
- 12) Prepare and submit a site visit report following each site visit that documents the acceptability of the coating work observed and inspected in accordance with the CSM's Recommendations.

1.06 DELIVERY AND STORAGE

A. General:

1. Conform to the requirements of Section 01 60 00, Materials and Equipment.
2. Materials shall be delivered to the job site in their original, unopened containers. Each container shall be properly labeled. Materials shall be handled and stored to prevent damage to or loss of label.
3. Labels on material containers shall show the following information:
 - a. Name or title of product
 - b. CSM's batch number
 - c. CSM's name
 - d. Generic type of material
 - e. Application and mixing instructions
 - f. Hazardous material identification label
 - g. Shelf life expiration date
4. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold in accordance with the CSM's recommendations. Flammable materials shall be stored in accordance with state and local requirements.
5. Containers shall be clearly marked indicating personnel safety hazards associated with the use of or exposure to the materials.

6. Safety Data Sheets (SDS) for each material shall be provided to the Construction Manager, Owner, Contractor, and CSA.
7. The Contractor/CSA shall store and dispose of hazardous waste according to federal, state and local requirements. This requirement specifically addresses waste solvents and coatings.

1.07 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section, with addendum updates included, and 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 or those parts which are to be provided by the Contractor or others. 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 shall 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 requested deviations to the specification requirements, shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
3. CSM's current printed recommendations and product data sheets for coating systems including:
 - a. Volatile organic compound (VOC) data
 - b. Surface preparation recommendations
 - c. Primer type, where required
 - d. Maximum dry and wet-mil thickness per coat
 - e. Minimum and maximum curing time between coats, including atmospheric conditions for each
 - f. Curing time before submergence in liquid
 - g. Thinner to be used with each coating
 - h. Ventilation requirements
 - i. Minimum atmospheric conditions during which the paint shall be applied
 - j. Allowable application methods
 - k. Maximum allowable moisture content
 - l. Maximum shelf life
4. Affidavits signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements.
5. Safety Data Sheets (MSDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
6. Written list of cleaning and thinner solutions allowed by the CSMs.

7. Storage requirements including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.
8. CSM's detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, gate frames, and other terminations to be determined from the contract drawings. This information shall also include detail treatment for coating system at joints and cracks in concrete.
9. The Contractor and CSA shall provide a minimum of 5 project references each including contact name, address, and telephone number where similar coating work has been performed by their companies in the past 5 years.
10. Written certification that the Contractor's QC person for the work is a Certified SSPC or NACE Coatings Inspector who has the requisite experience identified in 1.05.B.8.
11. Written Quality Control Testing and Inspection Plan (QCTIP) for the coating work covered by the Contract for this project and as specified in this Section.
12. Sample Daily QC Inspection Report Forms to be used by the Contractor's QC person assigned to the work covered by this Section.
13. Written letter from CSM signed by a Company officer that the Contractor's personnel who will perform the coating work have successfully been trained to apply the specified and approved coating materials.
14. Signed Affidavit from CSM that all products provided for the coating work covered by this Section are compliant with applicable VOC regulations.
15. Signed and dated QA Hold Points Checklists per 1.05.C.1. of this Section.

B. Informational Submittals:

1. Procedures: Section 01 33 00.
2. Prior to application of coatings, submit letter(s) from the CTR(s) identifying the application personnel who have satisfactorily completed training as specified in paragraph 1.05 or a letter from the CSM stating that personnel who shall perform the work are approved by the CSM without need for further or additional training.
3. Submit reports specified in paragraph 1.05.B Quality Control Requirements and 1.05.D Quality Assurance Hold Points when the work is underway.

C. Closeout Submittals:

1. Procedures: Section 01 33 00.
2. Submit the Coating System Inspection Checklists using Form 09 96 00-A, included in Section 01 99 90, for the coating work.

D. Spare Supplies: Provide one unbroken gallon container of each color and type of paint and each type of solvent and thinner required by the specification. These spare paint supplies shall be stored as required in paragraph 1.06 until delivery is requested by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Notwithstanding the listing of product names in this Section, the Contractor shall provide affidavits, signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements. No coatings shall be applied to a surface until the specified affidavits have been submitted and have been reviewed and accepted. Failure to comply with this requirement shall be cause for rejection and removal of such materials from the site.

B. Description of Standard High Performance Coating Systems:

Coating systems Designation	Description
HP-1	Amine Cured Epoxy – Immersion Service Wastewater or Sludge – for Metal Substrates.
HP-2	Amine Cured Epoxy and Acrylic Aliphatic Polyurethane – Weathering Exposure for Ferrous Metal Substrates.
HP-4 and HP-4X	Blended Amine Cured Epoxy for Concrete in Biogenic Sulfide Corrosion Exposure – Headspace.
HP-6	Blended Amine Cured Epoxy for Biogenic Sulfide and Immersion Exposure and Abrasive Conditions.
EXT-OCS-1	Epoxy Spot Prime-Rust Penetrating Sealer- Aliphatic Urethane/Polysiloxane

C. Material Requirements for Standard High Performance Coating Systems:

Material Requirements for Standard Coating Systems for United States and Canada, Except for California SCAQMD

Coating Systems Designation	CSM	Pit Filler/Mortar Repair	Primer/Intermediate Coats	Finish Coats
HP-1	Carboline	Carboguard 501	Plasite 4500S	Plasite 4500S
	Sauereisen	#209 Filler	Conoweld 501	Sewergard 210X
	Sherwin Williams	Steel Seam FT 910	Dura-Plate UHS	Dura-Plate UHS
	Tnemec Company	Series 215 Filler	Perma-Glaze G435	Perma-Glaze G435
HP-2	Carboline	Carboguard 501	Carboguard 890 (2 coats)	Carbothane 134VOC
	Sauereisen	#209 Filler	Conoweld 510-Primer x 1C Sewergard 210X- Inter x 1C	Conothane 310
	Sherwin Williams	Steel Seam FT 910	Macropoxy 5500LT 9 (1-2 Coats)	High Solids Polyurethane 250
	Tnemec Company	Series 215 Filler	Epoxoline 141	Endurashield II Series 1075
HP-4 and HP-4X	Carboline	Carboguard 510	Carboguard 690 (optional)	Plasite 4500S
	Sauereisen	Series #208 Series F120 or F121	ConoPrime 502 (optional)	Sewergard 210X

**Material Requirements for Standard Coating Systems for United States and Canada,
Except for California SCAQMD**

Coating Systems Designation	CSM	Pit Filler/Mortar Repair	Primer/Intermediate Coats	Finish Coats
	Sherwin Williams	Dura-Plate 2300 AW Cook MSM	Macropoxy 5000 (Optional)	Cor-Cote FRE
	Tnemec Company	Series 218 Series 217	Series 201 (optional)	Perma-Shield G436
HP-6	Carboline	Carboguard 510	NA	Plasite 5371
	Sauereisen	Series #208 Series F120 or F121	Series 210T	Series 210X (Seal Coat)
	Sherwin Williams	Dura-Plate 2300 AW Cook MSM	NA	Dura-Plate 5900 Mortar
	Tnemec Company	Series 218 Series 217	NA	Perma-Shield 434

Over-Coating Systems	CSM	Pit Filler	Tie Coat/Primer	Spot Primer/Intermediate	Finish Coat
EXT-OCS-1	Carboline	Carboguard 501	Rustbond	Carboguard 890 (Spot Prime)	Carbothane 134 VOC
	Induron	*Aquatapoxy A6 (Thick)	Ebond	PE-70 (Spot Prime)	Permastic LV
	PPG	Amercoat 114A	Amerlock Sealer	Amerlock 2/400 (Spot Prime)	Pitthane Ultra Series
	Sherwin Williams	Steel Seam FT910	Macropoxy 5000	Macropoxy 646FC (Spot Prime)	Hi-Solids Polyurethane 250 Gloss or or Sherloxane 800 Gloss
	Tnemec	Series 215	Probond 3600	Pota-Pox Plus L140 (Spot Prime)	Endura-shield 1094

PART 3 EXECUTION

3.01 COATINGS

A. General:

- Coating products shall not be used until the Engineer or Owner's Representative has accepted the affidavits specified in paragraphs 1.07 and 2.01, and inspected the materials, and the CTR has trained the Contractor in the surface preparation, mixing, and application of each coating system.
- Erect and maintain protective enclosures as stipulated per SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations.

B. Shop and Field Coats:

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum DFT recommended by the CSM. Data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01 B.3. Adhesion Confirmation. Damaged, deteriorated, and poorly applied shop coatings that do not meet the requirements of this Section shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this Section, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.
2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified DFT. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.
3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils
4. The same QC and quality assurance inspection requirements are applicable for shop applications as for field applications.

C. Application Location Requirements:

1. Equipment, Non-immersed: Items of equipment, or parts of equipment that are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires topcoating within a specified period, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.
2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment that are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.

3.02 PREPARATION

A. General:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating specification sheet (COATSPEC) and the following. In the event of a conflict, the COATSPEC sheets shall take precedence.

2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded, and free from contaminants that might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture so as not to cause detrimental contamination of the surfaces to be coated.
3. The Contractor's QCP inspector will review surfaces to be coated before application of a coating. Surface defects identified by the inspector shall be corrected by the Contractor at no additional cost to the Owner.
4. Cleaning and coating shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and coating operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and coating of equipment and walls and, following coating, shall be replaced and reconnected.

B. Blast Cleaning:

1. When abrasive blast cleaning is required to achieve the specified surface preparation, the following requirements for blast cleaning materials and equipment shall be met:
 - a. Used or spent blast abrasive shall not be reused on this project.
 - b. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every 4 hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
 - c. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined above.
 - d. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles at all times during this work.
 - e. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of surface preparation work.
 - f. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 pounds per square in gauge (psig) air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness/specified.
 - g. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.

- h. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by water blasting, reblasting, and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
- i. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area

C. Solvent Cleaning:

- 1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP1 Solvent Cleaning and shall be of the emulsifying type which emits no more than 340 g/l VOCs, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.
- 2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Metallic Surfaces:

- 1. Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Society for Protective Coatings (SSPC) specified for each coating system. See Coat Spec for each coating system in this Section. The profile depth of the surface to be coated shall be in accordance with the COATSPEC requirements in this Section measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the CSM.
- 2. Preparation of metallic surfaces for degree of cleanliness shall be based upon comparison with SSPC-VIS1-89 (ASTM D2200), and as described in the Coat Spec for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
- 3. Blast cleaning requirements for steel, ductile iron, and stainless steel substrates are as follows:
 - a. External surfaces of steel piping shall be prepared in accordance with SSPC SP10 (Near White Metal Blast Cleaning) and primed before installation. Ductile iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05. All other steel surfaces shall be prepared to white metal blast cleaning per SSPC SP5.
 - b. Stainless steel surfaces shall be abrasive blast cleaned in accordance with SSPC SP16 to leave a clean uniform appearance with a minimum surface profile of 1.5 to 2.5 mils that is uniform.
 - c. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.

- d. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
- e. Ambient environmental conditions in the enclosure must be constantly monitored and maintained to ensure the degree of cleanliness is held and no "rust back" occurs prior to coating material application.

E. Concrete Surfaces:

1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13 (also called NACE 6).
2. Prepare substrate cracks and areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per CSM recommendations. This shall precede surface preparation for degree of cleanliness and profile.
3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 310.2 (surface profile replicas). Surface profile requirements shall be in accordance with the Coat Spec requirements and the CSM's recommendations.
4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to application of the coating system.
5. Surface preparation of concrete substrates shall be accomplished using methods such as dry abrasive blast cleaning, high, or ultra high-pressure water blast cleaning in accordance with SSPC SP13. The selected cleaning method shall produce the requirements set forth below.
 - a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or bugholes to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.
 - b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 9.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 9.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
 - c. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt, and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.

6. Should abrasive blast cleaning or high or ultrahigh pressure water jetting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler/surfacers or coating system materials.
7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness and required surface profile prior to application of the coating system.
8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method. ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq ft of surface area to be coated or more often if required by the CSM. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test.

F. Masonry Surfaces:

1. Prepare masonry surfaces such as Concrete Masonry Units (CMU) to remove chalk, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
2. Be certain masonry surfaces are dry prior to coating application. If pressure washing or low-pressure water blast cleaning is used for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or when the minimum ambient temperature is 70 degrees F prior to coating application work.

3.03 APPLICATION

A. Workmanship:

1. Coated surfaces shall be free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices.
2. The Contractor's equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. A paper blotter test shall be performed by the Contractor when requested by the Construction Manager to determine if the air is sufficiently free of oil and moisture so as not to produce deteriorating effects on the coating system. The amount of oil and moisture in spray air shall be less than the amount recommended by the CSM. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and spray nozzles of the proper sizes.
3. Each coat of coating material shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering coating on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.
4. Coating applications method shall be conventional or airless spray, brush or roller, or trowel as recommended by CSM.
5. Allow each coat to cure or dry thoroughly, according to CSM's printed instructions, prior to recoating.

6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. Coating Properties, Mixing and Thinning:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of 2 or more components shall be mixed in accordance with the CSM's instructions. Where necessary to suit the conditions of the surface, temperature, weather, and method of application, the coating may be thinned as recommended by the CSM immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the CSM.

C. Atmospheric Conditions:

1. Coatings shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Coatings systems shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10 degrees F of the dew point, forced dehumidification equipment may be used to maintain a temperature of minimum 40 degrees F and 10 degrees F above the dew point for the surfaces to be coated, the coated surface, and the atmosphere in contact with the surface. These conditions shall be maintained for a period of at least 8 hours or as recommended by the CSM to assure proper coating cure. Where conditions causing condensation are severe, dehumidification equipment, fans, and/or heaters shall be used inside enclosed areas to maintain the required atmospheric and surface temperature requirements for proper coating application and cure.

D. Concrete Substrate Temperatures and Detail Treatment:

1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, and/or blistering in the coating system. The application of the filler/surfacer or restoration mortar and the coating system will only be allowed during periods of falling temperature. This will require that application of the filler/surfacer and coating system shall only occur during the cooler evening hours in most cases. Contractor shall include any cost for working outside of normal hours in the bid.

2. Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the CSM. Should pinholes develop in the filler/surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the CSM's recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler/surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.
 3. Perform application detail work per CSM's current written recommendations and/or drawings.
- E. Protection of Coated Surfaces:
1. Items that have been coated shall not be handled, worked on, or otherwise disturbed until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.
- F. Method of Coating Application:
1. Where 2 or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead, or lead compounds, which may be destroyed or affected by hydrogen sulfide or other corrosive gas, and/or chromium.
 2. Mechanical equipment, on which the equipment manufacturer's coating is acceptable, shall be touch-up primed and coated with 2 coats of the specified coating system to match the color scheduled.
 3. Coatings shall not be applied to a surface until it has been prepared as specified. The primer or first coat shall be applied by brush to ferrous surfaces that are not blast cleaned. Coats for blast cleaned ferrous surfaces and subsequent coats for nonblast cleaned ferrous surfaces may be either brush or spray applied. After the prime coat is dry, pinholes and holidays shall be marked, repaired in accordance with CSM's recommendations, and retested before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed, rolled, or troweled.
- G. Film Thickness and Continuity:
1. WFT of the first coat of the coating system and subsequent coats shall be verified by the Contractor, following application of each coat.
 2. The surface area covered per gallon of coating for various types of surfaces shall not exceed those recommended by the CSM. The first coat, referred to as the prime coat, on metal surfaces refers to the first full paint coat and not to solvent wash, grease emulsifiers, or other pretreatment applications. Coatings shall be applied to the thickness specified, and in accordance with these specifications.

3. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may need to be applied to achieve the specified DFT.
4. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler/surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and bugholes in the concrete substrate are completely filled prior to coating application.

H. Special Requirements:

1. Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of steel supports, pipe hangers, piping in contact with hangers, and contact surfaces that are inaccessible after assembly. The final coat shall be applied after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application.

3.04 CLEANUP

A. General:

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean surfaces and repair overspray or other coating-related damage.

3.05 FINAL INSPECTION.

A. General:

1. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications. At least 48 hours prior to the final inspection, the Contractor shall compile a single, complete set of QC records and signoff sheets that confirm all testing was properly performed on all materials, and appropriate repairs were completed, and any final retesting was successful. These records should include a complete set of CTR records/reports as well.
2. The Engineer or Owner's Representative will subsequently conduct a final observation with the Contractor for general conformance.
3. Any rework required shall be marked. Such areas shall be recleaned and repaired as specified at no additional cost to the Owner.

3.06 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

A. General:

- Coating systems for different types of surfaces and general service conditions for which these systems are normally applied are specified on the following COATSPEC sheets. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified. Coating systems shall be as specified in paragraph 3.06. In case of conflict between the schedule and the COATSPECS, the requirements of the schedule shall prevail.
- Coating Specification Sheets included in Table A are included this paragraph 3.06.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
HP-1	Amine Cured Epoxy or Modified Amine Cured Epoxy	Carbon Steel, Ductile Iron or Cast Iron, Stainless Steel	Continuous Immersion in Wastewater or Wastewater Sludge
HP-2	Epoxy First Coat with Acrylic Aliphatic Polyurethane Finish Coat (for U.V. Light Resistance)	Carbon Steel, Ductile Iron, Cast Iron	Weathering exposure including U.V. sunlight direct exposure. Apply above splash or spray zone.
HP-4 and HP-4X	Blended Amine Cure Epoxy Linings	Concrete and Masonry (Non-Brick)	Headspace Exposure to Biogenic Sulfide Corrosion and Related Sulfuric Acid Attack
HP-6	Blended Amine Cured Epoxy Trowel Applied System	Concrete and Concrete Block Masonry	Intermittent Immersion in Wastewater or Wastewater Sludge and Biogenic Sulfide Corrosion – Headspace Exposure and Abrasive Conditions
EXT-OCS-1	Epoxy Spot Prime/Epoxy Penetrating Sealer/Urethane or Polysiloxane	Previously Coated Steel Surfaces	Atmospheric exposure of pipe supports for corrosion protection

Coating System Specification Sheets (COATSPEC)

Coating System Identification-HP-1

1. Coating Material:	Amine Cured Epoxy or Modified Amine Cured Epoxy
2. Surfaces:	Carbon Steel, Ductile Iron or Cast Iron, Stainless Steel
3. Service Conditions:	Continuous Immersion in Wastewater or Wastewater Sludge
4. Surface Preparation:	
a. Carbon Steel:	Abrasive blast clean to Near White Metal Blast Degree of Cleanliness per SSPC SP10 to achieve a minimum surface profile of 3.0 to 4.0 mils. Vacuum clean to remove all dust, dirt, loose material (including all existing coatings if a complete recoating project).
b. Shop Primed Metals:	DO NOT USE SHOP PRIMED COMPONENTS IN THIS SERVICE unless the shop primer's maximum recoat time has not been exceeded. If there is damage to the shop primer, power tool clean to bare metal all damaged areas in accordance with SSPC SP11 or SSPC SP3 and abrade the peripheral intact coating area around the bare metal by 1-1/2 inches all around for re-priming. Abrading the intact primer must produce a 1.0 to 1.5 mil profile in the existing primer. Vacuum clean to remove all loose dust, dirt, and loose coating material.
c. Galvanized Steel:	DO NOT USE GALVANIZED STEEL in Wastewater or Sludge Immersion Service.
d. Cast Iron or Ductile Iron:	Abrasive blast clean these surfaces in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05. Vacuum clean as required for carbon steel.

Coating System Specification Sheets (COATSPEC)

Coating System Identification-HP-1

e. Stainless Steel Component Surfaces:	Abrasive blast clean in accordance with SSPC SP16 using only aluminum oxide abrasive blast media to produce a minimum, uniform surface profile of 1.5 to 2.5 mils. Vacuum clean the same as for carbon steel surfaces. Stainless steel is only to be prepared and coated when galvanic corrosion (dissimilar metal corrosion) is a concern.
f. Stainless Steel Fastener Surfaces: when stainless steel fasteners are electrically continuous with coated carbon steel	Solvent clean all bolts, nuts, washers, etc. in accordance with SSPC SP1 to remove all traces of cutting oil. Stainless steel fasteners should be field coated with the ferrous metal components that the fasteners connect. Also, these fasteners shall be completely sealed with a polysulfide sealant to prevent future galvanic corrosion between the fasteners and the coated steel or other coated ferrous metal surfaces. The installation of the sealant shall be continued onto the coated ferrous metal surfaces by at least 2 inches in all directions.
5. Field Application:	
a. Coating System Thickness:	30-40 DFT.
b. Coatings:	Primer or First Coats - One coat at CSM's recommended DFT.
c. Finish Coats:	One or more coats at CSM's recommended DFT per coat to achieve the total system DFT.
d. Routine QC Inspection Tasks:	Refer to Tables in 3.09 of this Section.
e. Post Cure QC Testing:	Perform Holiday Detection over 100 percent of the coated surface area in accordance with ASTM D5162. Acceptance Criteria shall be no pinholes or holidays. Perform Adhesion Testing in accordance with ASTM D4541 at a minimum of 24 locations representative of all components making up the internal mechanisms of the clarifiers or sludge thickness or DAFT units, etc. If coating applied to other metal equipment or components, perform number of adhesion tests per the CSM's recommendations. Acceptance Criteria: minimum 850 psi with failure plane at substrate for 75 percent of load fixture surface area.
f. Pinhole, Holiday or Defect Repair Procedure:	Using a grinder or flapper wheel tool, remove the coating at defect or adhesion test area on areas of 1-1/2 inches in diameter to bare metal. Abrade the coating in area comprising periphery of bare metal to 1 inch all around the bare metal area to achieve a 1.5- to 2.0-mil profile in the existing intact coating in periphery area. Vacuum clean the prepared area to remove all loose dust, dirt, and loose coating materials leaving a clean, sound area for coating repair. Tape to mask the peripheral area at the edge of the roughened existing coating. Apply the coating system in 2 or 3 coats as necessary to achieve the total system DFT over the defect and coating prepared area feathering the coatings onto the roughened existing coating around the periphery of the repair area. Allow to cure properly.

Coating System Specification Sheets (COATSPEC)

Coating System Identification-HP-2

1. Coating Material:	Epoxy First Coat with Acrylic Aliphatic Polyurethane Finish Coat (for U.V. Light Resistance)
2. Surfaces:	Carbon Steel, Ductile Iron, Cast Iron
3. Service Conditions:	Weathering exposure including U.V. sunlight direct exposure. Apply above splash or spray zone.

Coating System Specification Sheets (COATSPEC)

Coating System Identification-HP-2

4. Surface Preparation:	Abrasive blast clean to Near White Metal Blast Degree of Cleanliness per SSPC SP10 to achieve a minimum surface profile of 2.0-2.5 mils. Vacuum clean to remove all dust, dirt, and spent abrasive and other loose material. (Including removal of all existing coatings if it is a complete recoating project.)
a. Shop Primed Steel:	DO NOT USE SHOP PRIMED COMPONENTS in this service unless the shop primer's maximum recoat time has not been exceeded. If there is damage to the shop primer, power tool clean to bare metal all damaged areas in accordance with SSPC SP11 or SSPC SP3 and abrade the peripheral intact coating area the bare metal by 1-1/2 inches all around for re-priming. Abrading the intact primer must produce a 1.0- to 1.5 mil profile in the existing primer. Vacuum clean to remove all loose dust, dirt, coatings, or other materials.
b. Galvanized Steel:	DO NOT USE GALVANIZED STEEL in these service conditions.
c. Cast Iron or Ductile Iron:	Abrasive blast clean these surfaces in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05. Vacuum clean as required for carbon steel.
d. Stainless Steel Surfaces:	Above waterline or splash zone, no surface preparation required. Same for stainless steel fasteners – no surface preparation required.
5. Field Application:	
a. Coating System Thickness:	13-20 mils DFT.
b. Coatings:	Primer or First Coat: 1-2 Coats for 10-15 mils DFT. Finish Coat: 3-5 mils DFT.
c. Routine QC Inspection Tasks:	Refer to Tables in 3.09 of this Section.
d. Post Cure QC Testing:	Perform Holiday Detection over 100 percent of the coated surface area in accordance with ASTM D5162. Acceptance Criteria: no pinholes or holidays. Perform Adhesion Testing in accordance with ASTM D4541 at a minimum of 12 locations representative of all components making up the weather exposed mechanisms of the clarifiers or sludge thickness or DAFT units. If other structures are to be coated, perform tests at a number of locations recommended by the CSM. Acceptance Criteria: minimum 850 psi with substrate for 75 percent load fixtures surface area.
e. Pinhole, Holiday or Defect Repair Procedure:	Using a grinder or flapper wheel tool, remove the coating at defect or adhesion test area un areas of 1-1/2 inches in diameter to bare metal. Abrade the coating in area comprising periphery of bare metal to 1 inch all around the bare metal area to achieve a 1.5- to 2.0-mil profile in the existing intact coating in periphery area. Vacuum clean the prepared area to remove all loose dust, dirt, and loose coating materials leaving a clean, sound area for coating repair. Tape to mask the peripheral area at the edge of the roughened existing coating. Apply the coating system in 2 or 3 coats as necessary to achieve the total system DFT over the defect and coating prepared area feathering the coatings onto the roughened existing coating around the periphery of the repair area. Allow to cure properly.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4

1. Coating Material:	Blended Amine Cure Epoxy Linings
2. Surfaces:	Concrete and Masonry (Non-Brick)
3. Service Conditions:	Headspace Exposure to Biogenic Sulfide Corrosion and Related Sulfuric Acid Attack

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4

4. Surface Preparation:	Confirm that the exterior of buried concrete structures will be waterproofed in accordance with Section 07 10 00 prior to application of this coating. All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the Owner, the Engineer, or any other party. If wet abrasive or water jetting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. The exception to this is when filler/surfacers or mortars require pre-wetted substrates to assure proper adhesion. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials. Alternatively, the prepared substrate can be thoroughly washed down with potable water to remove all loose debris, dust, and other materials leaving a clean sound substrate that is dust-free.
a. Concrete:	New concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content shall be tested as specified herein in 3.07. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting or ultrahigh pressure water jetting. Large voids or spalls and cracks shall be repaired as specified in Section 03 01 00. Surface Preparation must open up all shelled-over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform minimum concrete surface profile of CSP 6 in accordance with ICRI 310.2R. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surfacer material) is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP 4 in accordance with ICRI 310.2R prior to coating application. Surface preparation shall produce a minimum concrete surface pH of 9.0.
b. Masonry:	Masonry surfaces shall be allowed to cure for at least 28 days after being constructed and be allowed to dry to the moisture content recommended by the CSM. Holes or other joint defects shall be filled with a material compatible with the primers and finish coats or shall be filled with masonry mortar that shall cure for at least 28 days. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be tested for moisture content in accordance with the CSM's recommendations. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4

5. Field Application:	
a. General:	Surfacer or filler shall be applied per CSM's recommendations prior to application of coating to fill all bugholes and voids and create a complete parge coat of the prepared substrate. This parge coat shall completely fill all bugholes and voids in the substrate, and will also completely cover the substrate unless specified otherwise above such filled voids by 1/8 inch (125 mils) of thickness. Drying time between coats shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions.
b. Coating System Thickness:	100-125 mils dry film in addition to the parge coat.
c. Coatings:	Primer: Optional for controlling outgassing. Finish: One or more coats at CSM's recommended DFT per coat to the specified system thickness.
d. Routine QC Inspection Tasks:	Refer to Tables in 3.07 of this Section.
e. Post Cure QC Testing:	Holiday Detection shall be performed over 100 percent of the coated surface area to identify any holidays or pinholes which could compromise coating system performance. Holiday testing to be performed after application and adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with ASTM D4787. Acceptance Criteria for Holiday Detection is no pinholes or holidays. Perform Adhesion Testing on concrete substrate after surface preparation prior to resurfacing mortar application in accordance with ASTM C1583. Perform at 10 representative locations (3 tests per location) to determine the tensile strength of the concrete substrate. Acceptance Criteria shall be minimum average target pull-off tensile strength of 250 psi. Based on the average ASTM C1583 test values, the acceptance criteria for tensile pull-off strength for coating adhesion can be established. When coating system mock-up application has been performed (DO MOCK-UP of 200 sq ft for verification purposes prior to commencing with production coating work), perform adhesion testing of coating system on mock-up area (6 tests total) in accordance with ASTM D7234. The target acceptance criteria is average of pull-off values of 250 psi, but actual acceptable value to be established by ASTM C1583 tests performed on substrate as required above. The coating system adhesion tests shall be performed at least at one location for every 1,000 sq ft of area to be coated and be performed at areas representative of the entire area to be coated if that is greater. The acceptance criteria for coating pull-off adhesion testing shall also be failure plane percentage of minimum of 75 percent of failure plane on back of load fixture within the concrete substrate.
f. Pinhole, Holiday or Defect Repair Procedure:	Pinholes and holidays identified by Holiday Detection shall be repaired as follows: • Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. • Chip out and remove the concrete to expose the full dimensions in all 3 directions of the air void responsible for the defect. • Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. • Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. • Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4

	- Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations. - Apply the coating system in the number of coats necessary to achieve the specified 125 mils DFT over the defect and coating removal areas and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4X

1. Coating Material:	Blended Amine Cure Epoxy Linings
2. Surfaces:	Existing Concrete Walls and Floors in Primary Storage Basins
3. Service Conditions:	Headspace Exposure to Biogenic Sulfide Corrosion and Related Sulfuric Acid Attack
4. Surface Preparation:	All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the Owner, the Engineer, or any other party. If wet abrasive or water jetting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. The exception to this is when filler/surfacers or mortars require pre-wetted substrates to assure proper adhesion. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials. Alternatively, the prepared substrate can be thoroughly washed down with potable water to remove all loose debris, dust, and other materials leaving a clean sound substrate that is dust-free.
a. Concrete:	New concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content shall be tested as specified herein in 3.07. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting or ultrahigh pressure water jetting. Large voids or spalls and cracks shall be repaired as specified in Section 03 01 00. Surface Preparation must open up all shelled-over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform minimum concrete surface profile of CSP 6 in accordance with ICRI 310.2R. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surfacer material) is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP 4 in accordance with ICRI 310.2R prior to coating application. Surface preparation shall produce a minimum concrete surface pH of 9.0.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4X

5. Field Application:	
a. General:	Surfacer or filler shall be applied per CSM's recommendations prior to application of coating to fill all bugholes and voids and create a complete parge coat of the prepared substrate. This parge coat shall completely fill all bugholes and voids in the substrate, and will also completely cover the substrate unless specified otherwise above such filled voids by 1/8 inch (125 mils) to 1/4 inch (250 mils) of thickness. If concrete restoration is deeper than 1/4 inch (250 mils), use deeper restoration mortar per CSM's recommendations. Drying time between coats shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions.
b. Coating System Thickness:	50-60 mils dry film in addition to the parge coat.
c. Coatings:	Primer: Optional for controlling outgassing. Finish: One or more coats at CSM's recommended DFT per coat to the specified system thickness.
d. Routine QC Inspection Tasks:	Refer to Tables in 3.07 of this Section.
e. Post Cure QC Testing:	Holiday Detection shall be performed over 100 percent of the coated surface area to identify any holidays or pinholes which could compromise coating system performance. Holiday testing to be performed after application and adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with ASTM D4787. Acceptance Criteria for Holiday Detection is no pinholes or holidays. Perform Adhesion Testing on concrete substrate after surface preparation prior to resurfacing mortar application in accordance with ASTM C1583. Perform at 10 representative locations (3 tests per location) to determine the tensile strength of the concrete substrate. Acceptance Criteria shall be minimum average target pull-off tensile strength of 250 psi. Based on the average ASTM C1583 test values, the acceptance criteria for tensile pull-off strength for coating adhesion can be established. When coating system mock-up application has been performed (DO MOCK-UP of 200 sq ft for verification purposes prior to commencing with production coating work), perform adhesion testing of coating system on mock-up area (6 tests total) in accordance with ASTM D7234. The target acceptance criteria is average of pull-off values of 250 psi, but actual acceptable value to be established by ASTM C1583 tests performed on substrate as required above. The coating system adhesion tests shall be performed at least at one location for every 1,000 sq ft of area to be coated and be performed at areas representative of the entire area to be coated if that is greater. The acceptance criteria for coating pull-off adhesion testing shall also be failure plane percentage of minimum of 75 percent of failure plane on back of load fixture within the concrete substrate.
f. Pinhole, Holiday or Defect Repair Procedure:	Pinholes and holidays identified by Holiday Detection shall be repaired as follows: • Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. • Chip out and remove the concrete to expose the full dimensions in all 3 directions of the air void responsible for the defect. • Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. • Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-4X

	• Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. • Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations. • Apply the coating system in the number of coats necessary to achieve the specified DFT over the defect and coating removal areas and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.

Coating System Specification Sheets (COATSPEC)

Coating System Identification – HP-6

1. Coating Material:	Blended Amine Cured Epoxy Trowel Applied System
2. Surfaces:	Concrete and Concrete Block Masonry
3. Service Conditions:	Intermittent Immersion in Wastewater or Wastewater Sludge and Biogenic Sulfide Corrosion – Headspace Exposure and Abrasive Conditions
4. Surface Preparation:	Confirm that the exterior of buried concrete structures will be waterproofed in accordance with Section 07 10 00 prior to application of this coating. All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the Owner, the Engineer, or any other party. If wet abrasive or water jetting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. The exception to this is when filler/surfacers or mortars require pre-wetted substrates to assure proper adhesion. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials. Alternatively, the prepared substrate can be thoroughly washed down with potable water to remove all loose debris, dust, and other materials leaving a clean sound substrate that is dust-free.
a. Concrete:	New concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content shall be tested as specified herein in 3.09. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting surface or ultrahigh pressure water jetting. Large voids or spalls and cracks shall be repaired as specified in the CSM's Crack Treatment Details. Surface Preparation must open up all shelled-over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform minimum concrete surface profile of CSP 6 in accordance with ICRI 310.2R. Surface preparation must produce minimum concrete surface pH of 9.0. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surfacer material is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP 4 in accordance with ICRI 310.2R prior to coating application.

Coating System Specification Sheets (COATSPEC)

Coating System Identification - HP-6

b. Masonry:	Masonry surfaces shall be allowed to cure for at least 28 days after being constructed and be allowed to dry to the moisture content recommended by the CSM. Holes or other joint defects shall be filled with a material compatible with the primers and finish coats or shall be filled with masonry mortar that shall cure for at least 28 days. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be tested for moisture content in accordance with the CSM's recommendations. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.
5. Field Application:	
a. General:	Surfacer or filler shall be applied per CSM's recommendations prior to application of coating to fill all bugholes and voids and create a complete parge coat of the prepared substrate. This parge coat shall completely fill all bugholes and voids in the substrate, and will also completely cover the substrate unless specified otherwise above such filled voids by 1/8 inch (125 mils) of thickness. Drying time between coats shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions.
b. Coating System Thickness:	100-125 mils dry film in addition to the parge coat.
c. Coatings:	Primer: Optional to control outgassing. Finish: One coat at 125 mils Trowel Applied.
d. Routine QC Inspection Tasks:	Refer to Tables in 3.09 of this Section.
e. Post Cure QC Testing:	Holiday Detection shall be performed over 100 percent of the coated surface area to identify any holidays or pinholes which could compromise coating system performance. Holiday testing to be performed after application and adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with ASTM D4787. Acceptance Criteria for Holiday Detection is no pinholes or holidays. Perform Adhesion Testing on concrete substrate after surface preparation prior to resurfacing mortar application in accordance with ASTM C1583. Perform at 10 representative locations (3 tests per location) to determine the tensile strength of the concrete substrate. Acceptance Criteria shall be minimum average target pull-off tensile strength of 250 psi. Based on the average ASTM C1583 test values, the acceptance criteria for tensile pull-off strength for coating adhesion can be established. When coating system mock-up application has been performed (DO MOCK-UP of 200 sq ft for verification purposes prior to commencing with production coating work), perform adhesion testing of coating system on mock-up area (6 tests total) in accordance with ASTM D7234. The target acceptance criteria is average of pull-off values of 250 psi, but actual acceptable value to be established by ASTM C1583 tests performed on substrate as required above. The coating system adhesion tests shall be performed at least at one location for every 1,000 sq ft of area to be coated and be performed at areas representative of the entire area to be coated if that is greater. The acceptance criteria for coating pull-off adhesion testing shall also be failure plane percentage of minimum of 75 percent of failure plane on back of load fixture within the concrete substrate.

Coating System Specification Sheets (COATSPEC)

Coating System Identification - HP-6

f. Pinhole, Holiday or Defect Repair Procedure:	Pinholes and holidays identified by Holiday Detection shall be repaired as follows: - Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. - Chip out and remove the concrete to expose the full dimensions in all 3 directions of the air void responsible for the defect. - Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. - Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. - Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. - Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations. - Apply the coating system in the number of coats necessary to achieve the specified 125 mils DFT over the defect and coating removal areas and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.

Coating System Specification Sheets (COATSPEC)

Coating System Identification - EXT-OCS-1

6. Coating Material:	Epoxy Spot Prime/Epoxy Penetrating Sealer/Urethane or Polysiloxane
7. Surfaces:	Previously Coated Steel Surfaces
8. Service Conditions:	Atmospheric exposure of pipe supports for corrosion protection
9. Surface Preparation:	
a. General Considerations	Prior to surface preparation and coating application, Adhesion Testing in accordance with ASTM D3359 Method A (X-Cut Tape Adhesion Test) must be completed to verify substrate is suitable for overcoating. Minimum Acceptable Value of 4A required before proceeding.
b. Previously Coated Carbon Steel:	Pressure Wash surface to SSPC WJ 4/NACE WJ 4 (HPWC) High Pressure Water Cleaning using 5000-10,000 psi.
c. Areas of Corrosion: (Not including pinpoint or mild general corrosion)	All localized corrosion areas shall be prepared by power tool cleaning to bare metal in accordance with SSPC SP11. Only coatings and tightly adherent corrosion that pass the Dull Putty Knife Test are allowed to remain on the surface. Abrade the peripheral intact coating area around the bare metal in accordance with SSPC-SP3 by 1-1/2 inches all around. Abrading the intact coating must produce a 1.0 to 1.5 mil profile in the existing coating. Vacuum clean to remove all loose dust, dirt, and loose coating material. After surface preparation all areas of remaining tightly adherent corrosion shall be spot primed with the specified epoxy spot primer at the specified DFT, prior to application of the tie coat primer to all surfaces.
d. Previously Coated Galvanized Steel:	Pressure Wash surface to SSPC WJ 4/NACE WJ 4 (HPWC) High Pressure Water Cleaning using 5,000-10,000 psi.
e. Cast Iron or Ductile Iron:	Pressure Wash surface to SSPC WJ 4/NACE WJ 4 (HPWC) High Pressure Water Cleaning using 5,000-10,000 psi.
f. Previously Coated Stainless Steel Component Surfaces:	Pressure Wash surface to SSPC WJ 4/NACE WJ 4 (HPWC) High Pressure Water Cleaning using 5,000-10,000 psi.

Coating System Specification Sheets (COATSPEC)

Coating System Identification - EXT-OCS-1

g. Stainless Steel Fastener Surfaces: When stainless steel fasteners are electrically continuous with coated carbon steel.	Solvent clean all bolts, nuts, washers, etc. in accordance with SSPC SP1 to remove all traces of cutting oil. Stainless steel fasteners should be field coated with the ferrous metal components that the fasteners connect. Also, these fasteners shall be completely sealed with a polyurethane sealant to prevent future galvanic corrosion between the fasteners and the coated steel or other coated ferrous metal surfaces. The installation of the sealant shall be continued onto the coated ferrous metal surfaces by at least 2 inches in all directions.
10. Field Application:	
a. Coating System Thickness:	6.0 – 8.5 mils DFT.
b. Coatings:	2 to 3 Coat System with Spot Primer depending on coverage and aesthetics.
c. Spot Primer:	1 coat of epoxy at a min of 3.0 – 4.0 mils or as per CSM's recommended DFT to all remaining tightly adherent corrosion.
d. Tie Coat:	1 coat of epoxy penetrating primer/sealer at min 1.0 – 1.5 mils or as per CSM's recommended DFT over all surfaces to be top coated.
e. Finish Coat:	1 or 2 coats (to complete coverage) of aliphatic urethane at min 2.0–3.0 mils per coat or as per CSM's recommended DFT.
f. Routine QC Inspection Tasks:	Refer to Tables in 3.09 of this Section.
g. Post Cure QC Testing:	Perform Adhesion Testing in accordance with ASTM D3359 Method A at a minimum of 4 locations representative of all components making up the exterior area of the tank. If coating applied to other metal equipment or components, perform number of adhesion tests per the CSM's recommendations. Acceptance Criteria – minimum 4A. Areas damaged by adhesion testing shall be repaired by the CSA at no additional cost to the Owner.
h. Pinhole, Holiday or Defect Repair Procedure:	Using a grinder or flapper wheel tool, remove the coating at defect or adhesion test area on areas of 1-1/2 inches in diameter to bare metal. Abrade the coating in area comprising periphery of bare metal to 1 inch all around the bare metal area to achieve a 1.5 to 2.0 mil profile in the existing intact coating in periphery area. Vacuum clean the prepared area to remove all loose dust, dirt, and loose coating materials leaving a clean, sound area for coating repair. Tape to mask the peripheral area at the edge of the roughened existing coating. Apply the coating system in 2 or 3 coats as necessary to achieve the total system DFT over the defect and coating prepared area feathering the coatings onto the roughened existing coating around the periphery of the repair area. Allow to cure properly.

END OF SECTION

SECTION 31 05 19
GEOSYNTHETICS FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all labor, incidental materials, tools, supervision, transportation, and installation equipment necessary for the installation of geosynthetic materials as specified herein, as shown on the project Drawings and as otherwise required for a complete and functional installation.
- B. Be prepared to install geosynthetic materials in conjunction with the earthwork and other components of this project.

1.02 REFERENCED STANDARDS

- A. 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.
- B. 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
ASTM D3786	<u>Standard Test Method for Bursting Strength of Textile Fabrics- Diaphragm Bursting Strength Tester Method</u>
ASTM D4355	Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D4491	Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4595	Standard Test Method for Tensile Properties of Geotextiles by Wide Width Strip Method
ASTM D4632	Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	Test Method for Determining Apparent Opening Size of a Geotextile
WSDOT Standard Specifications	Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge, and Municipal Construction

1.03 QUALITY ASSURANCE

- A. Perform all geosynthetics for earthwork in accordance with project drawings and manufacturer's recommended installation procedures.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00 SUBMITTAL PROCEDURES
- B. Informational Submittals:
 - 1. Provide Manufacturer material specifications and product literature,
 - 2. Provide certifications from each geotextile manufacturer that furnished products satisfy the indicated requirements. Certified property values shall be either minimum or maximum roll values, as appropriate, for geotextiles furnished.

PART 2 MATERIALS

2.01 GEOTEXTILE REINFORCEMENT

- A. Woven type consisting of high strength polypropylene fibers – Mirafi RS 380i, or approved equivalent.
- B. Tensile Strength at 2% strain: minimum 600 lbs/ft.
- C. Apparent opening size: maximum 40 U.S. Standard Sieve.
- D. Flow rate: minimum 75 gal/min/ft²

2.02 GEOGRID

- A. Triaxial type manufactured from a punched and stretched polypropylene sheet with ribs oriented in 3 directions – Tensar TriAx Stabilization Geogrid TX 170, or equivalent.
- B. Radial Secant Stiffness at 2 percent strain declared value of 24,667 lbs/ft (360 kN/m) with a tolerance of 4450 lbs/ft (65 kN/m).

2.03 GEOTEXTILE REINFORCEMENT

- A. Soil Separation and Soil Stabilization
 - 1. Per WSDOT Standard Specifications Section 9-33.2(1) Table 3.

PART 3 EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.
- B. Handle products in manner that maintains undamaged condition.
- C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

3.02 LAYING GEOTEXTILE

- A. Notify Owner's Representative whenever geotextile is to be placed. Do not place geotextile prior to obtaining Owner's Representative approval of underlying materials.
- B. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.
- C. Ensure that joints have a minimum overlap of 12 inches or as specified by the manufacturer.
- D. In trenches, place geotextile in a way to completely envelope granular material or separate granular material from native soil with specified overlap at joints. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

3.03 PLACING PRODUCTS OVER GEOTEXTILE

- A. Place materials so that geotextile is not damaged and in accordance with Section 31 23 00, Earthwork.
- B. Notify Owner's Representative before placing material over geotextile. Do not cover installed geotextile prior to receiving authorization from the Owner's Representative to proceed.
- C. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Replace torn, punctured, flawed, or deteriorated, or otherwise damaged geotextile.

END OF SECTION

SECTION 31 09 11
SETTLEMENT AND VIBRATION MONITORING

PART 1 GENERAL

1.01 SUMMARY

- A. This section describes the requirements for structure, settlement, tilt and vibration monitoring including the placement and monitoring of survey benchmarks and geotechnical instrumentation. The survey benchmarks will be used to monitor total and differential settlement that may occur with prosecution of the Work.
- B. Geotechnical instrumentation (structure, settlement, and tilt monitoring points, and vibration monitors) will monitor the site for movement and vibration during the Work.
- C. The purpose of the geotechnical instrumentation monitoring is to ensure trigger levels are not exceeded. Trigger levels are indicative of conditions in which adverse damage may occur to existing structures and facilities and to new structures and facilities which the Owner deems susceptible to damage due to continuing ground disturbing activities.
- D. Minimum instrumentation and monitoring requirements are presented herein. It is the Contractor's responsibility to fulfill the specified minimum requirements determined herein, by the Contractor's chosen means and methods which are necessary for completion of the Work.
- E. The Contractor shall be responsible for limiting damage to and repairing damages to nearby structures and utilities because of construction efforts, at no expense to the City. Repair of structures includes but is not limited to jacking of foundations and repair of concrete surfacing.
- F. Approximate locations of monitoring points are shown in Exhibit A.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with Construction Manager to establish final structure, settlement, tilt and vibration monitoring points after the award of the Contract. Contractor shall assume the responsibilities of the railroad permit obtained by the City of Everett and coordinating with BNSF Railroad. Contractor shall also be responsible for coordinating access to Washington Department of Transportation property and private property, including private property at the Port of Everett.

1.03 DEFINITIONS

- A. Action Trigger Level: Level at which corrective actions are required, including procedural modifications that permit excavation to continue without exceeding the Maximum Allowable Movement.
- B. Contingency Plan: A plan based on a detailed assessment of ground and site conditions that documents contingency measures and procedures that must be implemented to correct a non-conforming condition.

- C. Geotechnical Instrumentation: Devices measuring surface and subsurface movement, and movement of existing infrastructure, including existing structures and utilities and temporary works installed by the Contractor. Includes measurement devices and appurtenant equipment, probes, sensors, cabling, readout devices, data loggers and management systems.
- D. Baseline (Initial) Reading: Instrument readings taken after instrument installation and calibration, and prior to commencement of construction activities that may affect instrument readings. Baseline Readings provide the basis by which subsequent readings will be compared to determine levels of change.
- E. Maximum Allowable Movement: Movement at which no further movement is permitted. If reached, work shall be halted until the cause of movements is identified and corrective actions and restorative measures are implemented.
- F. Settlement Monitoring Array: A series of Surface Monitoring Points arranged systematically to monitor the extents of ground movement away from an excavation.
- G. Structure Monitoring Point: An instrument for monitoring movement of a structure using optical surveying methods.
- H. Surface Monitoring Point: An instrument for monitoring movement of the ground surface using optical surveying methods.
- I. Tilt Monitoring Point: An instrument for monitoring angular displacement of a structure at a discrete point.
- J. Phase I Contractor: The Contractor responsible for constructing the portion of the pipeline alignment up to 25th Street and West Marine View Drive under an earlier contract.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES
- B. Action Submittals:
 - 1. Structure, Settlement, Tilt and Vibration Monitoring Plan (MP) as specified in this Specification.
- C. Informational Submittals:
 - 1. For all instruments, manufacturer's specifications and other data required to demonstrate compliance with the requirements specified herein.
 - 2. A complete materials list, showing all items to be furnished and installed under this Specification.
 - 3. Shop drawing/working sketches of all monitoring devices installed.
 - 4. Permits: Obtain and provide copies of permits and third-party approvals required to perform the Work.
 - 5. Current calibration records indicating the vibration monitors were calibrated within 1 year of their anticipated deployment date to the jobsite and calibration records indicating that the tilt meters were calibrated within 1 year.

- D. Construction Submittals:
 - 1. Structure, Settlement, Tilt and Vibration monitoring survey data as specified in this Section. Readings shall include baseline, ongoing and final monitoring data.
- E. Closeout Submittals:
 - 1. Record copies of final inspection reports, monitoring reports.

1.05 QUALITY ASSURANCE

- A. Retain the services of a qualified Geotechnical Instrumentation Engineer (GIE) who is a Professional Engineer licensed in the State of Washington. The GIE shall have at least three (3) years of experience in design, installation, and monitoring of geotechnical instrumentation for projects similar to this.
- B. Engage an independent Professional Land Surveyor registered in the State of Washington, with a minimum of three (3) years of experience in monitoring and deformation measurements of the types and accuracy specified herein, to perform and/or supervise survey readings for settlement and structure monitoring.
- C. Engage an independent professional vibration and tilt monitoring firm to supply vibration monitors and tilt monitors and monitor tilt and vibrations.
- D. Establish datum for survey based on City provided control point(s).

1.06 STRUCTURE MONITORING POINTS

- A. A portion of the Structure Monitoring System has been installed at the Southern Boundary of the site by the Phase 1 contractor. Coordinate with the Phase 1 contractor on transferring the existing monitoring system. The portion of the Structure Monitoring System not installed in the Phase 1 contract shall be installed by the Contractor. Refer to drawings attached to this Section for approximate locations and direction on establishment of Structure Monitoring Points. Maintain and monitor/survey all Structure Monitoring Points as specified in this Section. All monitoring reports shall be submitted to the Construction Manager and Owner.
- B. Establish Baseline Readings for all Structure Monitoring Points prior to commencement of the Work.
- C. Contractor shall add more Structure Monitoring Points, as needed, to monitor total and differential settlement, and horizontal movement, and ascertain that existing utilities and structures and new work have not undergone adverse movement. If specified tolerances/levels are reached or exceeded, the Contractor shall stop work immediately, notify the Construction Manager, and propose a solution to the Construction Manager to correct the situation.
- D. Contractor shall be responsible for damage or disruption to nearby existing structures and utilities through the settlement or movement of ground and vibrations resulting from any cause related to the Work. Repair the damage to structures and utilities at no cost to the Owner. Restore to equal or better condition.

- E. The minimum structure point monitoring frequency is specified in Part 3 of this Section. The Contractor shall adjust the frequency of monitoring if required to adequately monitor changes resulting from the pace and proximity of the Work and at the direction of the Construction Manager.

1.07 SETTLEMENT MONITORING POINTS

- A. Shall be as indicated in the Contract Drawings and as required by the BNSF Crossing Permit.
- B. Contractor shall add more Settlement Monitoring Points, as needed, to monitor total and differential settlement, and ascertain that existing utilities and structures, and new work, have not undergone adverse movements. If Action Trigger Levels are reached or exceeded, the Contractor shall stop work immediately, notify the Construction Manager, and propose a solution to the Construction Manager to correct the situation and be responsible for all repairs and restorations.
- C. The minimum settlement points monitoring frequency is specified in Part 3 of this Section. The Contractor shall adjust the frequency of monitoring if required to adequately monitor changes resulting from the pace and proximity of the Work and at the direction of the Construction Manager.

1.08 TILT MONITORING POINTS

- A. Refer to Exhibit(s) attached to this Section for approximate locations and directions on establishing Tilt Monitoring Points.
- B. Portion of the Tilt Monitoring System has been installed at the Southern Boundary of the site by the Phase 1 Contractor. Coordinate with the Phase 1 Contractor on transferring the existing monitoring system. The portion of the Tilt Monitoring System not installed by the Phase 1 Contractor, shall be installed by the Contractor.
- C. Additional Tilt Monitoring Points shall be installed by the Contractor where required.
- D. Contractor shall maintain and monitor all Tilt Monitoring Points as specified in this Section. All monitoring reports shall be submitted to the Construction Manager and Owner.
- E. The minimum tilt monitoring frequency is specified in Part 3 of this Section. The Contractor shall adjust the frequency of monitoring if required to adequately monitor changes resulting from the pace and proximity of the Work and at the direction of the Construction Manager.

1.09 VIBRATION MONITORING POINTS

- A. Contractor shall be responsible for installation of vibration monitors and vibration monitoring.
- B. Coordinate with the Owner on the locations of the vibration monitors after contract award. Contractor shall adjust the location of vibration monitors and frequency of monitoring based on real-time data collected, the proposed construction activity and the timeframe of the construction activity.

- C. Vibration monitors shall be placed within 100 feet of areas with substantial construction activities (i.e., using impact or vibratory methods to install shoring, compaction of backfill, etc.).
- D. Vibration monitoring frequency is specified in Part 3 of this Section.

1.10 STRUCTURE, SETTLEMENT, TILT AND VIBRATION MONITORING PLAN

- A. Provide a detailed Structure, Settlement, Tilt and Vibration Monitoring Plan (MP) as specified herein. The submittal shall be signed and sealed by the GIE a minimum of 1 week prior to commencement of ground disturbing activities. The MP shall include, but not be limited to, the following information:
 - 1. Qualifications of the individual(s) responsible for structure, settlement, tilt, and vibration monitoring. Refer to Par. 1.05 herein.
 - 2. The total number, arrangement, and proposed locations of Structure, Settlement, and Tilt Monitoring Points, vibration monitors ("seismographs"), and other instruments. Provide a plan view map(s) indicating the layout and coordinates for each instrument.
 - 3. Instrument details and methods of installation.
 - 4. Monitoring frequency and criteria.
 - 5. Monitoring and reporting procedures and processes. Describe how data will be consolidated, processed and organized in summary reports. Summary reports shall explicitly identify any exceedances during the duration of the monitoring period. Refer to Section 3.05 herein.
 - 6. Schedules for instrument installations, reporting, and instrument removals.
 - 7. Photographs of all structures to be monitored with sufficient detail to document pre-existing cracks or damage.
 - 8. Methods for protecting monitoring points and instruments from theft, damage or vandalism.
 - 9. Sample tabular data record/log for each instrument type.
 - 10. Potential remedial and mitigation action plans and/or contingency measures for each type of monitoring if an Action Trigger Level and/or a Maximum Allowable Movement is reached or exceeded, as specified on the Contract Drawings or the Contractor's submitted MP. Include:
 - a. Name and qualification of personnel responsible for implementing contingency procedures.
 - b. Notification procedures for alerting the Construction Manager, asset/utility owner, on-site inspectors and the Owner when Action Trigger Levels and Maximum Allowable Movements are met or exceeded.
 - c. Description of conditions considered to require remedial measures.
 - d. List of stand-by materials to be used for remedial measures and their immediate availability.
 - e. Method and list of stand-by equipment of implementation of remedial measures and their immediate availability.
 - f. Methods of verification of the successful implementation of remedial measures.

PART 2 PRODUCTS

2.01 MATERIALS/EQUIPMENT

- A. General: All instrumentation, straps, structure monitoring points, anchors, pins and gauges shall be strong, durable, watertight, corrosion resistant, and able to remain stable under extreme temperature changes.
- B. Structure Monitoring Point:
 - 1. Target Stickers: As applicable, use a reflective target sticker by Leica or equal.
- C. Settlement Monitoring Point:
 - 1. Target Stickers: As applicable, use a reflective target sticker by Leica or equal.
 - 2. Survey Pin:
 - a. As applicable, use survey pins (nails) similar to existing and mark with paint.
 - b. Shall consist of reinforcing steel, deformed bar, minimum 25 mm diameter x 1000 mm long driven into the ground a minimum distance of 600 mm, such that the pin can be measured for elevation and horizontal deflection.
- D. Tilt Monitoring Equipment:
 - 1. The tilt monitors shall be Geokon 8901 Wireless LoRa® Tilt Loggers or approved equal. Geokon 8901 Wireless LoRa® Tilt Loggers shall be connected to a compatible gateway or base station capable of measuring tilt to a precision of 0.0075 degrees, have a measurable tilt range of +/- 90 degrees, and capable of operating between - 40 °F to +149 °F temperatures.
 - 2. Tilt monitors shall be connected to a cloud-based measurement management and reporting system. Data storage, data plots, and text message and email notifications shall be processed automatically based on agreed upon distribution lists.
- E. Vibration Monitoring Equipment:
 - 1. The vibration monitors shall be Sigicom C22s, or approved equal, and shall be capable of making triaxial measurements with a frequency range of 1 Hz to 500 Hz and capable of measuring velocity levels up to 10 inches/second.
 - 2. Vibration monitors shall be connected to a cloud-based measurement management and reporting system. Data storage, data plots, and text message and email notifications shall be processed automatically based on agreed upon distribution lists.

PART 3 EXECUTION

3.01 MONITORING FREQUENCY REQUIREMENTS

Table 1: Minimum Settlement, Tilt, and Vibration Monitoring Frequency			
	Settlement Monitoring Frequency	Tilt Monitoring Frequency	Vibration Monitoring Frequency
Structures	Once prior to construction activity commencement to establish baseline. Daily during dewatering, excavation, shoring installation, pile removal, compaction activities, or as directed by the Engineer, within 200 feet of the structure. Weekly for 4 weeks after completion of dewatering, excavation, shoring installation, pile removal, compaction activities, or as directed by the Engineer, within 200 feet of the structure. Every 6 months for Bridge Columns and Retaining Walls. Once after completion of all construction activities.	For 1 week prior to dewatering, excavation, shoring installation, pile removal, and/or compaction activities within 200 feet of the structure. During dewatering, excavation, shoring installation, pile removal, and/or compaction activities within 200 feet of structure. For 4 weeks after completion of dewatering, excavation, shoring installation, pile removal, and/or compaction activities, within 200 feet of the structure. All readings shall be taken every ½ hour.	1 week of continuous monitoring prior to construction activity commencement to develop baseline. During dewatering, excavation, shoring installation, pile removal, compaction activities, or as directed by the Engineer, during other vibration inducing activities. Vibration monitoring equipment shall be in continuous operation during construction.
WMVD Elevated Roadway Bridge Columns (6 Locations)	Required	Required	Required
WMVD Retaining Wall (3 Locations)	Required	Required	Required
BNSF Crossing (28 Points)	Required	N/A	Required
West Marine View Drive Bridge Columns (4 Locations)	Required	Required	Required
West Marine View Drive Bridge Retaining Wall (2 Locations)	Required	Required	Required
Substation Retaining Wall (2 Locations)	Required	Required	Required
Elevated Walkway at 16 th (3 Locations)	Required	Required	N/A
Along Pipeline	Required upon request of Engineer	N/A	Required upon request of Engineer

Note: The frequency of settlement and vibration monitoring may be adjusted based on contractor's initial results.

3.02 PREPARATION

- A. Before installing, repairing or replacing any Structure, Settlement, Tilt Monitoring Points or vibration monitoring instrumentation, the Construction Manager shall be informed a minimum of two working days prior to commencement of Work to allow any necessary measurements and readings to be made.
- B. Confirm all survey and instrument locations with the Construction Manager prior to installation.

3.03 INSTALLATION

- A. The instrumentation specified in this Specification is the minimum required. Contractor shall install and monitor additional instrumentation as necessary to control the Work and provide a safe working environment and shall do so at no additional cost to Owner.
- B. The GIE shall install instruments, following the guidelines included in the manufacturers' instruction manuals, and as detailed in the approved MP or as directed and/or accepted by the Engineer.
- C. Before installing, repairing or replacing any instrumentation, the Construction Manager is to be informed a minimum of two working days prior to commencement of Work to allow any necessary measurements and readings to be made.
- D. Label all instruments with an identifying instrument number.
- E. Structure Monitoring Points
 - 1. Should be placed directly on structural, and not on architectural, elements.
 - 2. Shall have a tag or marking indicating the identification number.
 - 3. Shall be monitored for settlement and horizontal movement in each reading.
 - 4. Structure monitoring points shall be installed to the bridge columns and retaining walls in a manner that does not compromise their integrity.
- F. Settlement Monitoring Points
 - 1. The pin must be of sufficient length to be fixed into the ground and remain stable for the duration of the project. The pin should protrude adequately from the ground and should be marked to avoid damage.
 - 2. An optical survey prism shall be firmly attached to the top of the pin.
 - 3. Shall be monitored for settlement (vertical movement) in each reading.
- G. Tilt Monitoring Points
 - 1. Tilt Monitoring Points shall be installed to the bridge columns using a minimum of two metal straps that attach the tilt monitor to the column. Precautions shall be taken to reduce the probability of theft or vandalism, including installing the instruments at heights greater than 7 feet where column height permits. Tilt monitoring points shall be installed on the north and west side of columns to minimize temperature effects on the instruments. If monitoring points are installed on the south or east side of columns an insulated cover shall be installed to prevent the monitor from being exposed to direct sunlight.

2. Methods of attaching tilt monitors to the column that may compromise the structural integrity of the column are not permitted.
3. Tilt monitors attached to wall surfaces shall be secured at the four corners of the instrument's mounting bracket using masonry/concrete anchors.
4. All tilt meters shall be calibrated within the last 12 months and shall be replaced or recalibrated if they are damaged or disturbed in a way that could compromise the measurements.

H. Vibration Monitors

1. Vibration monitoring for structures should consist of a geophone firmly attached to the structure.
2. Vibration monitoring for utilities may consist of a geophone placed on the ground surface above the utility location and covered with sandbag or equivalent.
3. Vibration monitoring equipment shall be installed in a manner that minimizes the risk of damage from theft or vandalism.
4. All vibration monitoring equipment shall be calibrated within the last 3 months and shall be replaced or recalibrated if it is damaged or disturbed in a way that could compromise the measured levels.
5. The vibration monitoring equipment shall be installed at least two working days before high vibration producing activities to ensure the equipment is operating correctly and to collect baseline vibration levels. The vibration monitors shall be placed on structures or on the ground/concrete next to the structures being monitored.

3.04 INSTRUMENTATION SURVEY

A. Performance Requirements

1. Refer to Table 2 herein.
2. To provide a warning if vibration levels are approaching the Exceedance level of 0.5 in/second for reinforced concrete, steel or timber buildings without plaster, a Trigger level is set to 75% of the Exceedance level. For non-reinforced and non-engineered concrete buildings or masonry building and buildings with plaster, the Exceedance Vibration Threshold shall be developed and submitted by the Contractor's engineer in the MP. The Trigger Vibration Threshold shall be 75 percent of the Exceedance Vibration Threshold for all building types.
3. The vibration thresholds shall be the vector sum of triaxial velocity components. If vibration levels are being monitored on the ground near the base of the structure, additional measurements shall be made to document the coupling loss between the soil and the structure. The resulting coupling loss shall be applied to the vibration levels.

Table 2 – Action Trigger Levels and Maximum Allowable Values

Type of Instrumentation	Action Trigger Level Vertical/Horizontal Movement	Maximum Allowable Vertical/Horizontal Movement	Tilt Action Trigger Level	Maximum Allowable Tilt	Trigger Vibration Threshold	Exceedance Vibration Threshold
Structure Monitoring Point	+/-0.25 inches	+/-0.50 inches	-	-	-	-

Table 2 – Action Trigger Levels and Maximum Allowable Values

Type of Instrumentation	Action Trigger Level Vertical/Horizontal Movement	Maximum Allowable Vertical/Horizontal Movement	Tilt Action Trigger Level	Maximum Allowable Tilt	Trigger Vibration Threshold	Exceedance Vibration Threshold
Settlement Monitoring Point	+/-0.25 inches	+/-0.50 inches	-	-	-	-
Tilt Monitoring Point	-	-	+/-0.5 Degrees	+/-1 Degree	-	-
Vibration Monitor	-	-	-	-	0.375 in/s	0.5 in/s

- B. Reference all readings to at least two stable benchmarks located a minimum of 250 ft away from the construction activity or loaded areas. Submit all readings to the Construction Manager for verification the following day.
- C. Settlement and horizontal movement measurements shall be carried out to a minimum accuracy of +/- 0.01 ft for all monitoring points.
- D. The Construction Manager may request the Contractor to take additional readings or to monitor additional locations dependent upon rate of settlement.
- E. Record weather at all readings, including temperature, humidity, precipitation, etc.
- F. Structure Monitoring Points Survey:
 - 1. Baseline Readings:
 - a. Provide baseline readings a minimum of one (1) week prior to commencement of construction.
 - b. Baseline readings shall be comparable and equal within the rated instrument accuracy.
 - 2. Monitoring Frequency:
 - a. Refer to Table 1 in this Specification.
 - b. Contractor shall provide four (4) surveys of all monitoring points at Owner's request.
- G. Settlement Monitoring Points Survey:
 - 1. Baseline Readings:
 - a. Provide baseline readings a minimum of one (1) week prior to commencement of construction.
 - b. Baseline readings shall be comparable and equal within the rated instrument accuracy.
 - 2. Monitoring Frequency:
 - a. Refer to Table 1 in this Specification.
 - b. Survey all monitoring points a minimum of once per day during auger boring and excavation of launch and reception shafts. Survey all monitoring points weekly for a minimum of 4 weeks after completion of the auger boring.
 - c. Contractor shall provide four (4) surveys of all monitoring points at Owner's request.

H. Tilt Monitoring:

1. Baseline Readings:

- a. Provide baseline readings for one (1) week prior to commencement of construction activities.
- b. Baseline readings shall be comparable and equal within the rated instrument accuracy.

2. Monitoring Frequency:

- a. Refer to Table 1 in this Specification.

I. Vibration Monitoring:

1. At a minimum, the Contractor shall have four (4) vibration monitoring points/monitors for the duration of the project. These four monitors shall be moved on an as needed basis in accordance with the criteria of these specifications and as directed by the Construction Manager.

2. Baseline Readings:

- a. Obtain baseline vibration monitoring readings prior to the start of any construction operations. This Work shall be performed in order to determine the magnitude of vibrations from non-related construction activities as well as the nearby existing rail tracks so as not to affect the interpretation of vibration readings during the required monitoring periods. At a minimum, baseline readings shall consist of one (1) week of continuous 15-minute histogram prior to the start of Work.
- b. Baseline readings shall be comparable and equal within the rated instrument accuracy.

3. Monitoring Frequency:

- a. Refer to Table 1 in this Specification.

4. Peak particle velocity measurements shall be carried out with an accuracy of 0.01 in/s.

5. The Construction Manager may request the Contractor to take additional readings or monitor additional locations depending upon recorded vibrations.

J. Exceeding Action Trigger Levels and/or Trigger Vibration Threshold:

1. Notify the Construction Manager, Engineer and the Owner immediately.
2. If a Trigger Vibration Threshold is exceeded, an alert shall be sent via text message or email notifying the Owner and Engineer.
3. Verify measurement.
4. Review the construction operations and keep a more active review of the trend of the monitored movement.
5. Increase monitoring frequency of readings as follows:
 - a. For instruments read less than every other day, increase frequency to daily.
 - b. For all other reading frequencies, double the frequency of readings.
 - c. Continue increased frequency of monitoring until the relative incremental change of movement has returned to the pre-Action Trigger Level rate or stabilized as determined by the Engineer.

6. Implement remedial/mitigation action plans and/or corrective measures per the approved MP.
 7. Verify success of the implemented mitigation plans and contingency measures as applicable.
- K. Exceeding Maximum Allowable Movement/Tilt and/or Exceedance Vibration Threshold:
1. Cease all related construction activities, take immediate steps to stop the cause of exceedance, and protect all structures against potential damage.
 2. Notify the Construction Manager, Engineer and the Owner immediately.
 3. If an Exceedance Vibration Threshold is exceeded, an alert shall be sent via text message or email notifying the Owner and Engineer.
 4. Verify measurement.
 5. Investigate and correct the excessive movement before work can be resumed.
 6. Adjust uncorrected tilt readings to account for the average tilt fluctuation that occurred due to daily temperature fluctuations prior to commencement of construction activities.
 7. Submit in writing results of the investigation and what additional remedial/mitigation plans and corrective measures are to be implemented.
 8. Implement remedial/mitigation action plans and/or corrective measures per the approved MP.
 9. Under some circumstances, corrective actions may require modification of construction procedures.
 10. Verify success of corrective actions.
 11. Install and monitor additional monitoring points as deemed necessary or as directed by the Construction Manager.
 12. If work activities are suspended, obtain approval from the Owner prior to restarting work activities at that location, under approved procedures. The contractor is responsible for any delays that result from suspended activities due to exceeding the monitoring criteria and the time associated with obtaining approved procedures for restarting the work activities.
 13. With the Owner, contact the owners of any damaged properties or affected facilities and structures and perform corrective and restorative measures on an agreed timetable.

3.05 DATA PRESENTATION AND REPORTING

- A. Submit readings and trending data, with plots organized by date, and ensure that data, plots, sections, and plan views are submitted on a timely basis. Ensure that all data, plots, and sections are provided in Microsoft Excel format.
- B. Unless otherwise approved by the Engineer, the survey readings shall be submitted to the Owner within 24 hours from collecting the readings unless Action Trigger Levels and/or Trigger Vibration Thresholds are exceeded. Exceedance of Action Trigger Levels and/or Trigger Vibration Thresholds shall be communicated in real-time.
- C. Explicitly identify all instances of exceedance, if any, of the limits specified in this Specification by way of an executive summary at the beginning of each consolidated weekly report.

- D. Format and content of readings and trending data shall be as follows:
1. Structures Reporting:
 - a. Identify total settlement and horizontal movement for each structure monitoring point, and differential settlement between adjacent monitoring points.
 - b. Submit a plan view of each structure being monitored showing in numerical format total settlement and horizontal movement at selected monitoring points.
 2. Ground Settlement Reporting:
 - a. Submit a plan view of the area being monitored for ground settlement showing in numerical format total settlement measured at each Settlement Monitoring Point.
 3. Tilt Reporting:
 - a. Identify tilt at all Tilt Monitoring Points.
 4. Vibration Reporting:
 - a. Submit a plan view of the site showing the locations of vibration monitors.
 - b. A vibration report per vibration monitor for each day of continuous monitoring. Vibration reports shall clearly identify the maximum peak particle velocity measured for each velocity component and the respective vibration frequency.

3.06 PROTECTION OF STRUCTURE, SETTLEMENT, TILT, AND VIBRATION MONITORING INSTRUMENTS

- A. Take all necessary measures to protect monitoring points and geotechnical instruments from damage caused by construction activities and others. Make all workers aware of the importance of the instrumentation and the necessity of taking special care to protect them from damage.
- B. Paint the exposed portion of the instrumentation with alternate yellow and black stripes using weatherproof paint.
- C. If the construction operation is carried out in darkness, attach a flashing red lantern to the instrumentation, railings or tripod and keep lighted during all hours of darkness in order to serve as a warning to bulldozer and other traffic working on the fill area and thus prevent disturbance of the gauge.
- D. If, for any reason, any instrumentation is damaged or destroyed during the period of this Contract, immediately repair or replace at no expense to the Owner and as directed by the Construction Manager. All damaged and replaced or destroyed monitoring points shall be given a new, unique identifier with documentation of replacements on monitoring documents and plans. Replacement monitoring equipment should receive a new set of baseline measurements

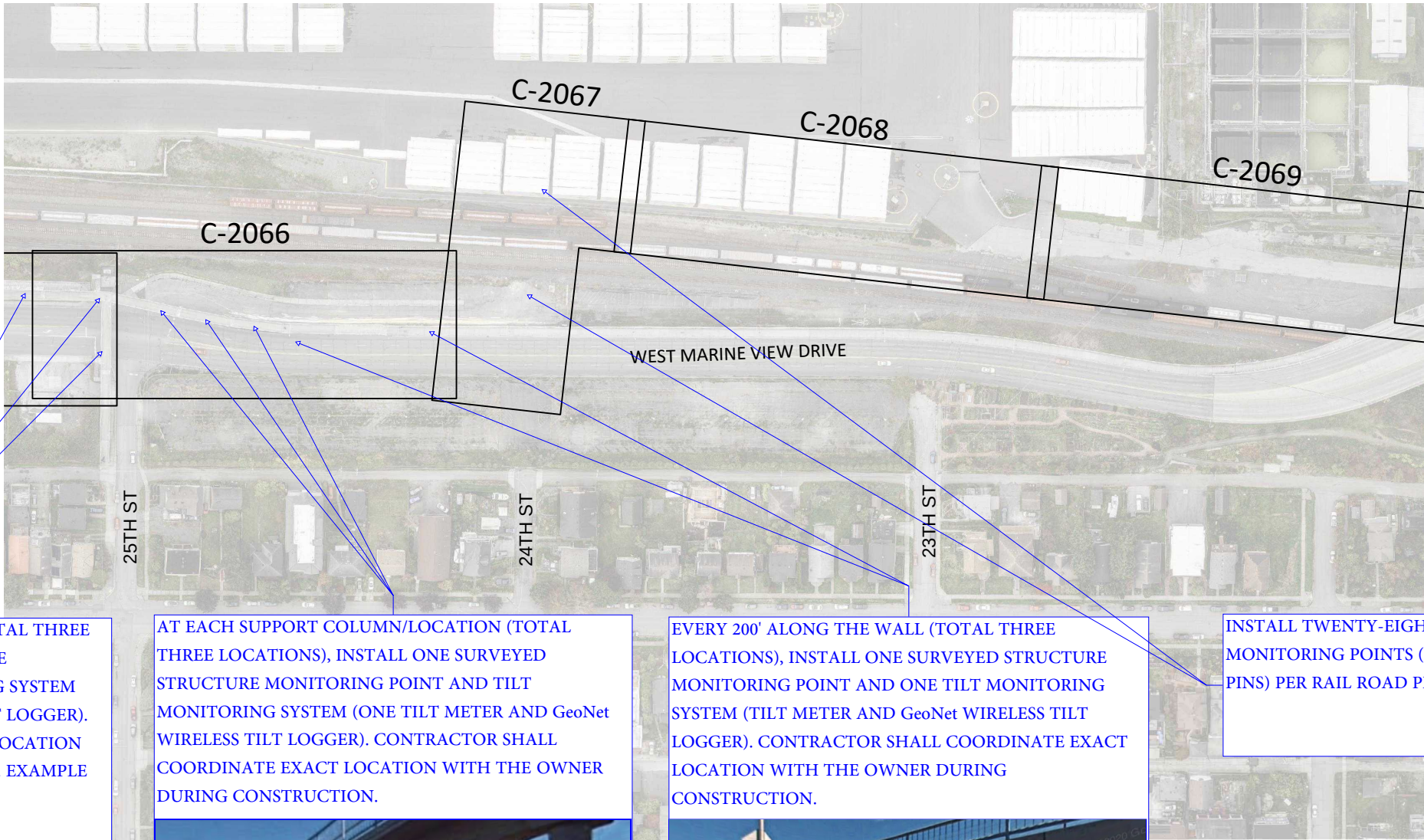
3.07 REMOVAL OF VIBRATION AND SETTLEMENT MONITORING INSTRUMENTS

- A. Instrumentation shall not be demolished, abandoned, removed, disposed of, or rendered inaccessible without prior approval from the Construction Manager.
- B. Remove monitoring points and all instrumentation prior to final acceptance of Work.

- C. Repair pavement, curbs, and gutters in accordance with Owner requirements to equal or better conditions existing before installation.
- D. Fill holes drilled in masonry or concrete surfaces with cement mortar to match existing.

END OF SECTION

Plot date 2/21/2025 9:37 AM
Sheet: 206
C:\BPCW\03784286\3815-02-C-2032.DWG
Designed by R. DAVIES
Drawn by T. FRANKLIN
Checked by K. WEBER
Design Review Level
Plotted by Travis Franklin
Last saved by T. Franklin
City of Everett Field Book/Starting Page
Control Monument
Sheetset Name: Everett
Plot style: Everett-2016.sbt
Page: 1/1



AT EACH SUPPORT COLUMN/LOCATION (TOTAL THREE LOCATIONS), INSTALL SURVEYED STRUCTURE MONITORING POINT AND TILT MONITORING SYSTEM (ONE TILT METER AND GeoNet WIRELESS TILT LOGGER). CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH THE OWNER DURING CONSTRUCTION. EXAMPLE LOCATION PROVIDED BELOW.

COORDINATE WITH CONSTRUCTION PACKAGE 1 CONTRACTOR ON TRANSFERRING EXISTING MONITORING SYSTEMS.



AT EACH SUPPORT COLUMN/LOCATION (TOTAL THREE LOCATIONS), INSTALL ONE SURVEYED STRUCTURE MONITORING POINT AND TILT MONITORING SYSTEM (ONE TILT METER AND GeoNet WIRELESS TILT LOGGER). CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH THE OWNER DURING CONSTRUCTION.



EVERY 200' ALONG THE WALL (TOTAL THREE LOCATIONS), INSTALL ONE SURVEYED STRUCTURE MONITORING POINT AND ONE TILT MONITORING SYSTEM (TILT METER AND GeoNet WIRELESS TILT LOGGER). CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH THE OWNER DURING CONSTRUCTION.



INSTALL TWENTY-EIGHT (28) SETTLEMENT MONITORING POINTS (GROUND SURFACE SURVEY PINS) PER RAIL ROAD PERMIT REQUIREMENTS.

GENERAL NOTES:
THE PURPOSE OF THIS DRAWING IS TO DOCUMENT NEW STRUCTURE AND SETTLEMENT MONITORING POINTS TO BE INSTALLED BY THE CONTRACTOR.

Designed	R. DAVIES
Drawn	T. FRANKLIN
Checked	K. WEBER
Design Review Level	



PORT GARDNER STORAGE FACILITY
WEST MARINE VIEW DRIVE
STORM AND COMBINED SEWER DESIGN
WORK ORDER UP3815-02

EXHIBIT A SECTION 31 09 11
SETTLEMENT MONITORING

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies site preparation which consists of clearing, grubbing and demolition.
- B. Existing Conditions: The Contractor shall determine the actual condition of the site as it affects this portion of work.
- C. Protection: Site preparation shall not damage structures, landscaping or vegetation adjacent to the site. The Contractor shall repair or replace any damaged property.
- D. Clearing and grubbing where required shall be performed within the easement or public right-of-way as permitted by the Owner and/or governing agencies. Debris resulting from the clearing and grubbing shall be disposed of by the Contractor in accordance with the terms of all applicable permits and local, State and Federal requirements.

1.02 QUALITY ASSURANCE

A. REFERENCES

- 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
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

B. Measurement And Payment

1. Measurement and payment guidelines for above referenced sections and subsections shall not be incorporated into the Contract Documents. Work in this section is consider ancillary to Work in accordance with the Bid Schedule.

PART 2 NOT USED

PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

- A. Unless otherwise specified, the Contractor shall remove obstructions such as brush, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work require their removal.
- B. Material that is removed and is not to be incorporated in the work shall be disposed of off the site.

3.02 DEMOLITION AND REMOVAL

- A. Structures: Demolition and removal of structures consist of removal of abandoned superstructures, foundation walls, footings, slabs and any other structures. Excavations caused by existing foundations shall be cleared of waste, debris and loose soil, and refilled as specified.
- B. Pavement: When portions of asphalt pavements and concrete pads are to be removed and later construction is to be connected, edges shall be saw cut, on a neat line at right angles to the curb face.
- C. Salvage: The Owner has the right to salvage any items scheduled for removal. The Contractor shall notify the Construction Manager 5 days prior to any salvage or demolition work to determine the disposition of items to be removed. The Construction Manager will mark items to be salvaged. Such items shall be properly disconnected, removed from their foundations, cleaned, and stored at a location on the plant site as specified.

3.03 UTILITY INTERFERENCE

- A. Where existing utilities interfere with the prosecution of the work, the Contractor shall relocate them in accordance with the General Conditions of the Contract Documents.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies materials and execution requirements for excavation, subgrade preparation, fills, embankments, bedding, backfilling, compaction, geotextile (for separation), unsuitable material removal, hauling, placement, and stockpiling and disposal of excess material required for construction of the Work. This Section also specifies requirements for “as-built” conditions of the final grading.
- B. Definitions: Terminology used in this Section conforms to the following definitions:
1. Compaction: Degree of compaction is specified as percent compaction. Maximum or relative densities refer to dry soil densities obtainable at optimum moisture content as determined by AASHTO T180/ASTM D1557.
 2. Deleterious Material: Any material comprised of wood, organic waste, coal, charcoal, debris, wash pond silt, or other extraneous or objectionable material.
 3. Pipe Embedment: Material between the upper and lower pipe zone limits.
 4. Excavation: Includes, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.
 5. Excavation Slope: An inclined surface formed by removing material from below existing grade.
 6. Embankment Slope: An inclined surface formed by placement of material above existing grade.
 7. Overburden: Soil above a defined grade line or soil which may not be suitable as backfill, such as grass cover, topsoil, or soils containing deleterious material.
 8. Pipe Zone: Area surrounding pipe in trench, consisting of material directly under the pipe to the bedding, haunch, and backfill over the pipe as shown.
 9. Utilities: Buried and aboveground piping, conduits, wire, cable, ducts, manholes, vaults, services, appurtenances, pull boxes and the like, located in the vicinity of the project.
 - 10.

1.02 QUALITY ASSURANCE

A. REFERENCES

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
AASHTO T 27 / ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T 180 / ASTM D1557	Moisture-Density Relations of Soils Using a 10 in (4.54 kg) Rammer and an 18 in (457 mm) Drop (Modified Proctor Test)
AASHTO T 265 / ASTM D2216	Laboratory Determination of Moisture Content of Soils
AASHTO T 310 / ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D1073	
Chapter 296-62 WAC	WISHA General Occupational Health Standards
Chapter 296-155 WAC	WISHA Safety Standards for Construction
Chapter 296-155 WAC	Part N, Excavation, Trenching, and Shoring
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
RCW 49.17	Washington Industrial Safety and Health Act (WISHA)
RCW 39.04.180	Trench Safety Systems, Safety Systems Required
WSDOT Standard Specifications	Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge, and Municipal Construction, latest edition
WSDOT Materials Manual	Washington State Department of Transportation (WSDOT), Materials Manual, latest edition

1.03 SUBMITTALS

A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES

B. Action submittals:

1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from Section requirements.
2. Product data for geotextiles.
3. Test Results on imported materials including pipe bedding material, pipe zone material, trench backfill material:
 - a. Provide copies of laboratory test reports demonstrating that the proposed imported materials meet the specification requirements. Test reports shall be dated no more than 6 months prior to the date of submission. Submit maximum modified proctor densities and the optimum water content for all imported materials.

4. Provide certification that import fill materials to the Port of Everett property came from a commercial quarry, i.e. native soils directly mined from the earth and not reused fill. Additionally, provide certification of chemical constituents for the imported fill materials brought onto the Port of Everett property, either through documentation of existing chemical analyses or by project-specific testing and analyses, as directed by the Engineer in consultation with the Port of Everett and in Consultation with The Department of Ecology. The Department of Ecology and the Port of Everett has specified import chemical criteria that Contractor provided for materials used at the Port of Everett

The Department of Ecology and the Port of Everett has specified site specific import chemical criteria that Contractor provided import material is required to meet, which is provided in the table below.

Analyte	Analytical Method	Acceptance Criteria (saturated) / Port Standard
Total Petroleum Hydrocarbons (mg/kg)		
Gasoline-range hydrocarbons	NWTPH-Gx	20
Diesel-range total petroleum hydrocarbons	NWTPH-Dx	200
Oil-range total petroleum hydrocarbons	NWTPH-Dx	200
Metals (mg/kg)		
Arsenic	EPA 6020B	20
Copper	EPA 6020B	36
Lead	EPA 6020B	56
Mercury	EPA 7471	0.1
Nickel	EPA 6020B	48
Zinc	EPA 6020B	85
PAHs (mg/kg)		
Acenaphthene	EPA 8270 SIM	1.2
Acenaphthylene	EPA 8270 SIM	210,000
Anthracene	EPA 8270 SIM	1,100,000
Benzo(g,h,i)perylene	EPA 8270 SIM	110,000
Fluoranthene	EPA 8270 SIM	140,000
Fluorene	EPA 8270 SIM	140,000
Phenanthrene	EPA 8270 SIM	1,100,000
Pyrene	EPA 8270 SIM	110,000
1-Methylnaphthalene	EPA 8270 SIM	4,500
2-Methylnaphthalene	EPA 8270 SIM	0.64
Naphthalene	EPA 8270 SIM	0.87
Total cPAH TEQ	EPA 8270 SIM	0.16
PCBs (mg/kg)		
Total PCBs (sum of aroclors)	EPA 8082	0.12

Materials from sources other than commercial quarries may be subject to additional testing depending on the source and as directed by the Engineer. No imported materials with any exceedance of clean-up levels for any contaminants will be acceptable and if delivered shall be removed at the Contractor's sole expense.

Submit import material test results, in report format (Import Chemical Testing Results Submittal), for all testing performed. The Import Chemical Testing Results Submittal must be prepared by a licensed qualified environmental professional (i.e., licensed engineer, geologist, or hydrogeologist), and shall include, but not be limited to, a cover letter describing the details of the sampling program (e.g., source of the samples, sampling methodology, time of samples, etc.) and the results of testing; chain of custody(s); map showing sample locations, the raw laboratory analytical reports; data validation report; a data summary table, including sample identifications, date of sample acquisition, sample analytical results, data qualifiers, the import chemical criteria, and identification of any exceedances of the criteria. Provide certification that the samples tested and the results provided are representative of the materials that are to be delivered to the site.

Submit import material test results, in report format, for all testing performed. Provide certification that the samples tested and the results provided are representative of the materials that are to be delivered to the site. Reports shall clearly identify the following:

1. Source of samples
2. Sampling data
3. Chain of custody
4. Sampling locations

Whenever the source or stockpile from which the imported fill materials are obtained is changed, certificates of compliance and the required laboratory test results from these new sources will also be required at no additional cost to the City.

The Engineer must approve independent testing laboratories to perform testing required for import backfill material as discussed above. Contractor shall ensure that chemical analytical testing is performed by an Ecology- accredited laboratory and by accredited methods.

5. Provide laboratory tests reports certifying:
 - a. Moisture density relationships.
 - b. Gradation test reports.
 - c. Gradation curves.
 - d. Unit weight
 - e. Other tests as specified in the WSDOT Standard Specifications for each material type.

C. Informational submittals:

1. Field testing reports.

D. Closeout Submittals:

PART 2 MATERIALS

2.01 GENERAL

- A. Materials must be approved in advance of work. All earthwork materials used in the Work shall be free of deleterious material and shall meet the referenced standards. The chemical testing of all fill materials imported to the Port of Everett is required. Fill materials imported to the Port of Everett shall meet the Criteria Specified herein. Import material shall be sampled and tested under the oversight of a qualified licensed environmental professional (i.e., licensed engineer, geologist, or hydrogeologist), at a rate of five samples for the first 1,000 cubic yards of imported material, and one sample for each additional 1,000 cubic yards to verify that the material meets import fill criteria. The Contractor shall provide the Import Chemical Testing Results Submittal to the Engineer for review. Engineer shall review materials and respond within 14 business of receiving the analytical results. Once the material has gained approval from the Engineer, the material may be transported to the Site. Whenever the source or stockpile from which the imported fill materials are obtained is changed, the initial rate of sampling starts over at five samples for the first 1,000 cubic yards.
- B. Testing, notification, and the time delays specified herein are included in the base bid, no additional compensation will be made for resulting work delays, retesting aggregates that do not meet the analytical criteria, or ancillary costs.

2.02 PIPE BEDDING MATERIAL

- A. Solid Wall Pipe: Lightweight utility trench backfill; along West Marine Drive, between 16th Street and 24th Street
- B. Solid Wall Pipe: Crushed Surfacing Base Course for Pipe Zone Bedding, WSDOT Standard Specification Section 9.03.9(3), unless otherwise specified.
- C. Perforated Drain Pipes: Gravel Backfill for Drains, WSDOT Standard Specifications Section 9-03.12(4).
- D. Natural Gas Pipe: Fine Aggregate for Portland Cement Concrete, Class 2, per WSDOT Standard Specifications Section 9-03.1(2).

2.03 PIPE ZONE MATERIAL

- A. Solid Wall Pipe: Lightweight utility trench backfill; along West Marine Drive, between 16th Street and 24th Street
- B. Solid Wall Pipe: Crushed Surfacing Base Course for Pipe Zone Bedding, WSDOT Standard Specification Section 9.03.9(3), unless otherwise specified.
- C. Perforated Drain Pipes: Gravel Backfill for Drains, WSDOT Standard Specifications Section 9-03.12(4).
- D. Natural Gas Pipe: Fine Aggregate for Portland Cement Concrete, Class 2, WSDOT Standard Specifications Section 9-03.1(2).

2.04 TRENCH BACKFILL MATERIAL

- A. Lightweight utility trench backfill: along West Marine Drive, between 16th Street and 24th Street, excluding trench backfill placed in the Port of Everett – Material shall meet the following gradation requirements (similar to WSDOT Standard Specifications Section 9-03.2(1)):

Sieve Size	Percent Passing
½ inch	100
No. 4	100
No. 10	85 – 100
No. 40	30 – 60
No. 60	2 – 20
No. 100	0 – 10
No. 200	0 – 3

- B. Imported Gravel Borrow, WSDOT Standard Specification Section 9-03.14(3) Option 3, unless otherwise as specified.

2.05 IMPORTED FILL

- A. Common Borrow/Low Permeability Fill, WSDOT Standard Specifications Section 9-03.14(3), Option 3

2.06 STRUCTURAL FILL

- A. Trench Backfill within the Port of Everett, Gravel Borrow, WSDOT Standard Specifications Section 9-03.14(1).

2.07 WALL BACKFILL (FREE DRAINING GRAVEL BACKFILL)

- A. Clean drainage sand and gravel that is well-graded, crushed, partially crushed, or naturally occurring material produced in accordance with WSDOT Standard Specifications Section 3-01.
- B. Material shall meet the following gradation requirements:

Sieve Size	Percent Passing
1 ½ inches	100
¾ inches	70 – 90
No. 4	30 – 60
No. 30	10 – 30
No. 200	0 – 2

2.08 FILTER SAND

- A. Imported material conforming to ASTM International (ASTM) Standard D1073 for fine aggregate and gradation No. 3 material.

2.09 CONTROLLED LOW STRENGTH MATERIAL (CLSM) AND CONTROLLED DENSITY FILL (CDF)

- A. WSDOT Standard Specifications Section 2-09.3(1)E.

2.10 AGGREGATE FOR GRAVEL BASE

- A. WSDOT Standard Specifications for Aggregate for Gravel Base, Section 9-03.10.

2.11 CRUSHED SURFACING BASE COURSE (CSBC)

- A. Imported material conforming to WSDOT Standard Specifications for Crushed Surfacing Base Course, Section 9-03.9(3).

2.12 CRUSHED SURFACING TOP COURSE (CSTC)

- A. Imported material conforming to WSDOT Standard Specifications for Crushed Surfacing Top Course and Keystone, Section 9-03.9(3).

2.13 QUARRY SPALLS

- A. Imported material conforming to WSDOT Standard Specifications Sections 9-13 and 9-13.6 for Quarry Spalls, except that material shall consist entirely of broken stones, not concrete.

2.14 PERMEABLE BALLAST

- A. Imported crushed permeable material conforming to WSDOT Standard Specifications Sections 9-03.9 (2).

2.15 WEED BARRIER

- A. The weed barrier shall be:
1. Heavy-duty, professional grade fabric that prevents weeds without chemicals.
 2. Highly durable polyester or polypropylene fabric with exceptional strength to weight ratio- exceptionally strong and puncture resistant-that allows air, water and nutrients to permeate the soil.
 3. Resistant to UV, exposure and weathering.
 4. Secured with stainless steel type 316 staples.
- B. In addition to the property values specified, the weed barrier shall:
1. Retain its structure during handling placement and long-term service.
 2. Be capable of withstanding direct exposure to sunlight for a minimum of 30 days with no measurable deterioration.
- C. Acceptable Manufacturers:
1. ProMat, Landmaster, RSI, or approved equal.

2.16 CONSTRUCTION WATER

- A. WSDOT Standard Specifications Section 9-25.

- B. The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts, and other impurities. Water quality must be acceptable to the Construction Manager.

2.17 BACKFILL FOR CAPILLARY BREAK

- A. Crushed Surfacing Base Course (CSBC) as specified herein.

2.18 SODIUM BENTONITE (TRENCH CUT-OFF WALL APPLICATION)

- A. Use TRENCHSEAL by Western Clay or approved equivalent.
- B. Bentonite shall be pulverized (powder or granular) premium grade.
- C. Material shall meet the following gradation requirements:

Sieve Size	Percent Passing
No. 12	90
No. 20	67
No. 100	22
No. 200	11

PART 3 EXECUTION

3.01 EXISTING UNDERGROUND UTILITIES

- A. The locations of existing utilities indicated on the Drawings are approximate. Physically verify the location and elevation of existing utilities prior to starting construction in accordance with Section 01 12 16. Mark the ground surface where existing underground utilities are discovered.

3.02 DRAINAGE AND DEWATERING

- A. So that construction operations progress successfully, completely drain the construction site during periods of construction to keep soil materials sufficiently dry. Throughout construction, grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary swales and other drainage features and equipment as required to maintain dry soils and prevent erosion. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented in the Geotechnical Report and the construction requirements in the plans and specifications and based on this assessment, to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

- B. Groundwater flowing toward or into excavations shall be controlled with dewatering controls in accordance with Section 31 23 19 to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation, and to eliminate interference with orderly progress of construction. Dewatering controls shall be in place by the time excavation reaches the groundwater level. While excavation is open, the water level shall be maintained continuously at least 2 foot below the working level. French drains, sumps, ditches, or trenches will not be permitted within 3 feet of the foundation of any structure, except with written approval from the Construction Manager.

3.03 TRENCH CUT-OFF WALL

- A. Contractor shall install low permeability trench cut-off walls as indicated in the Contract Drawings. The trench cut-off wall shall be of sodium bentonite or other approved material achieving a maximum in-place permeability of 1×10^{-5} cm/sec.
- B. Refer to Paragraph 2.18 herein for sodium bentonite material requirements.
 - 1. Material shall be placed and compacted to a dry density of 95pcf at an 8%-12% moisture content.
- C. Trench cut-off walls shall not encompass a pipe joint.
- D. Damage or sagging of pipe beyond allowable limits as a result of the bentonite placement shall be repaired at Contractor expense.

3.04 EXCAVATION GENERAL REQUIREMENTS

- A. In accordance with the Geotechnical Report, it is expected that on-site soils are not acceptable for use as fill and shall be transported off-site for disposal and all backfill material shall be imported. The contractor shall base his bid on disposal of all excavated soils off-site and not used for fill or backfill. All material for fill and backfill shall be imported. If, during excavation, on-site soil is determined to be suitable for use as fill, as concurred by the Construction Manager, suitable excavated material for fill shall be placed in the proper section of the Work or shall be separately stockpiled if it cannot be readily placed. Suitable excess excavated material (fill) shall be disposed of as designated by the Construction Manager. An adjustment to the appropriate bid item shall be made for the quantity (in cubic yards) of on-site soil that is not disposed of but used as fill. All on-site soil that is used and not disposed of shall be quantified and tracked by the contractor and agreed to by the Construction Manager and City. All pipe trench backfill shall be imported and no on-site soil may be used for trench backfill.
- B. Naturally occurring cobbles and boulders that exceed the maximum particle size for the aggregate class specified shall be stockpiled at a Construction Manager designated location or location designated on Drawings.
- C. Assume ownership of and dispose of all excavated debris offsite, including concrete, scrap pipes, and other materials determined by the Construction Manager to be unsuitable for onsite placement. Comply with the applicable ordinances and environmental requirements for disposal.
- D. Contractor use of staging and storage areas on-site are subject to Construction Manager approval. Coordinate with the Construction Manager prior to stockpile of topsoil for use in site restoration. Excess or unsuitable topsoil shall be disposed of off-site.

- E. Notify Construction Manager immediately in the event that any suspected contaminated or hazardous material is encountered on site. Testing, handling, removal, and disposal of the contaminated or hazardous material shall be in accordance with applicable laws.
- F. Storage Of Material: Neatly place excavated and/or fill materials far enough from the excavation to prevent stability problems. Keep the materials segregated and shaped to minimize interference with Plant operations, other construction activities, and drainage. Coordinate with Construction Manager for storage site.
- G. Other Unsuitable Soils: Soils encountered at the site that are unsuitable due to excessive moisture content, but are otherwise satisfactory for use as fill or backfill, shall be segregated and then dried or treated to restore to a useable condition. Coordinate with Construction Manager for storage site.

3.05 SUPPORT OF EXCAVATIONS

- A. Comply with Section 31 50 00.
- B. The Contractor is responsible for selecting all excavation methods, monitoring slopes for safety and providing shoring, as required to protect personnel and property. All temporary cuts and fill slopes are required to be at a stable angle. Excavations must conform to Chapter 49.17 RCW and Chapter 296-155 WAC, Part N. All temporary cuts in excess of 4 feet in height shall be sloped appropriately or provided with shoring systems adequate to protect workers.
- C. Adequately support all excavations to meet all applicable requirements in the current rules, laws, orders, and regulations. Excavations shall be adequately shored, braced, and sheeted to prevent excessive soil deformation and movements so that all existing and new structures, pipelines, conduits, and other facilities will be fully protected from damage or undercutting. Keep vehicles, equipment, and materials far enough from the excavation to prevent instability.
- D. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, undercutting, or sliding soils resulting from high groundwater or the nature of the soil excavated.
- E. The support for excavations shall remain in place until the installation of the pipeline, conduit, or structure has been completed. During the backfilling of the pipeline, conduit, or structure, the shoring, sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.06 SLOPE STABILITY AND SETBACKS

- A. Maximum allowable slope faces:
 - 1. Temporary Slopes: No steeper than 1.5:1 (H:V), unless specifically noted otherwise on the Drawings.
- B. Setbacks from top and toe of slopes:
 - 1. Top of slope stockpiles and travel ways shall be offset by 1/3 the slope height, with a minimum required offset of 5 feet and a maximum of 40 feet.

2. Toe of slope stockpiles and travel ways shall be offset by 1/2 the slope height, with a minimum required offset of 5 feet and a maximum of 15 feet.
3. If seepage is observed on the slope face, then slope offsets shall be increased as directed by the Construction Manager.

3.07 COMPACTION REQUIREMENTS

A. General

1. All earthwork materials shall be moisture conditioned, placed, and compacted as specified herein.
2. Compact each material to the percentages specified in Paragraph 3.09 Material and Compaction Schedules or as indicated on the Drawings, whichever is more stringent.
3. Use compaction equipment appropriate for the use and material to achieve the specified level of compaction.
4. Compaction methods involving water flooding, ponding, or jetting shall NOT be used.

B. Moisture Conditioning:

1. All earthwork materials shall be properly moisture conditioned prior to compaction, without exception.
2. Add water to or dry the material as necessary to obtain moisture content that is no more than three (3) percent above or below optimum, unless otherwise approved by the Construction Manager. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each lift being compacted.

C. Material Placement:

1. After the material has been moisture conditioned, place and spread the material using approved equipment in level uncompacted lifts of thicknesses not to exceed those specified in the Material and Compaction Schedule, except that uncompacted layer thickness shall not exceed 4 inches for hand-operated compaction devices in all cases.

- D. If the backfill material becomes saturated from rains or any other source because it was not compacted to the specified density or was not backfilled and compacted to surface grade, through negligence or otherwise, remove the faulty material and replace it with suitable material compacted to the specified density.

- E. When densities of compacted materials do not meet the requirements, remove and/or recompact the material and re-test until the requirements are met.

3.08 TESTING FREQUENCY

- A. In-place compaction tests shall be made by the Construction Manager's testing service using the frequency in the table below:

Compaction	
Embankment	1 per 2,500 CY
Pipe Bedding, Pipe Zone Material, and Trench Backfill	1 per 100 LF (per lift)
Cut Section	1 per 500 CY

Surfacing	1 per 1,000 SF (per lift)
General Backfill	1 per 500 CY
Structural Backfill	Per Table 3 on drawing S-4002
Structural Base	Per Table 3 on drawing S-4002

3.09 MATERIAL AND COMPACTION SCHEDULES

MATERIAL AND COMPACTION SCHEDULE FOR PIPELINE AND CONDUIT TRENCHES			
Description	Material	Max. Lift Thickness ¹	Min. Compaction ²
Pipe bedding and pipe zone material	Pipe Bedding Material	4 inches	95%
Utility Trench backfill (above the pipe zone to within 12 inches of finished grade) in areas that are 5 feet or greater from the edge of structures, vaults, footings, and slabs.	Lightweight backfill	6 inches	95%
Trench backfill (above the pipe zone within 12 inches of finished grade to finished grade) in undeveloped areas that are 5 feet or greater from the edge of structures, vaults, footings, slabs, and roadways ³ .	Imported Fill	8 inches	90%
Trench backfill (above the pipe zone within 12 inches of finished grade to finished grade or roadway subgrade) within 5 feet horizontally of and beneath structures, vaults, footings, slabs, roadways ³ , and manholes and vaults.	Structural Fill	8 inches	95%

¹ Lift thickness measured before compaction.

² Material fill shall be placed and compacted in accordance with Section 2-03.3(14)C, Method C of the WSDOT Standard Specifications. Compaction and moisture control tests shall be conducted in accordance with Section 2-03.3(14)D of the WSDOT Standard Specifications.

³ Roadway: Paved, graveled, or unfinished surface intended for vehicular traffic as shown on the Drawings (including driveways, parking, and maneuvering areas).

MATERIAL AND COMPACTION SCHEDULE FOR STRUCTURES, SITEWORK, AND EARTHMOVING			
Material or Description	Max. Lift Thickness ¹	Minimum Compaction ²	Other Requirements
Crushed Surfacing Top Course	2 inches	95%	
Filter Sand	6 inches	95%	
Crushed Surfacing Base Course	6 inches	95%	
Pipe Zone Material	3 inches	95%	
Wall Backfill			
Below foundations, structures and vaults	8 inches	95%	Proof roll
Structural Fill			
Prepared pavement and roadway subgrade ³	8 inches	95%	Proof Roll
Imported Fill			
Other locations between structures	12 inches	95%	
Undeveloped areas that are 10 feet or greater from the edge of structures, vaults, footings, slabs, and roadways ³	12 inches	90%	
Scarified native soil	12 inches	95%	

¹ Lift thickness measured before compaction.

² Material fill shall be placed and compacted in accordance with Section 2-03.3(14)C, Method C of the WSDOT Standard Specifications. Compaction and moisture control tests shall be conducted in accordance with Section 2-03.3(14)D of the WSDOT Standard Specifications.

³ Roadway: Paved, graveled, or unfinished surface intended for vehicular traffic as shown on the Drawings (including driveways, parking, and maneuvering areas).

3.10 EXCAVATION AND PLACEMENT OF FILLS ASSOCIATED WITH ROUGH SITE GRADING, EMBANKMENT CONSTRUCTION, EARTHMOVING AND ROADWAYS

- A. Excavate to the lines, grades, and elevations shown on the Drawings.
- B. Clear and grub the native and/or excavated surfaces. The prepared surfaces shall not contain standing water and shall be free of loose material, foreign objects, and rocks greater than 6 inches in maximum dimension. If buried foundation elements or concrete debris are encountered excavate and remove to a minimum of 2 feet below the pipe invert elevation.
- C. The Construction Manager shall observe completed subgrade preparation and review tests prior to the placement of fills. Do not place any fill until receiving approval from the Construction Manager.
- D. After the subgrade preparation has been completed, the Contractor shall promptly place and compact the first lift of fill on the subgrade to prevent loosening of the surface. If the subgrade surface is loosened, the Contractor shall remoisten and recompact the surface to the specified condition.
- E. Construct fills as shown on the Drawings, true to line, grade, and cross-section unless directed to over excavate to remove deleterious material by the construction manager.
- F. Rough graded fills shall be constructed of Structural Fill, unless otherwise indicated on the Drawings.
- G. Compaction of fill associated with rough site grading shall in accordance with Paragraph 3.09, Material and Compaction Schedule for Structures, Sitework, and Earthmoving, and referenced standards.
- H. In any areas where materials become soft or yielding, such materials shall be removed, disposed of, and replaced with specified material.
- I. The surface of the fill shall be maintained to permit travel of construction equipment. Ruts in the surface of any layer shall be filled and leveled before compacting.
- J. When the fill material consists of large, rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Place sufficient earth or other fine material around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill.
- K. Fill shall be sloped at all times during construction so that water will drain.
- L. The temporary differential elevation between any two adjoining zones of the fill due to construction operations shall not exceed 24 inches.

- M. If the compacted surface of any layer of material is too smooth to bond properly with the succeeding layer, the surface shall be scarified. If required, moisture condition the surface before the succeeding lift is placed. Surface crust formed on a layer of fill material that has been dumped and spread shall be broken up by harrowing and, if required, the full depth of the affected layer shall be moisture conditioned immediately prior to rolling.
- N. Where fills are to be made and compacted on sloping ground surfaces steeper than 5:1, such slopes shall be benched a minimum of 6 feet horizontally as the work is brought up. Recompact material thus removed by benching along with the new embankment material.
- O. It may be necessary to overbuild slopes and trim back to the compacted core to achieve adequate compaction of slope faces.

3.11 TRENCH EXCAVATION AND BACKFILL

A. General:

- 1. Excavation for pipe and other utilities such as duct banks shall be open cut.
- 2. Should the Contractor desire to use other equivalent methods, submit method of construction to the Construction Manager for favorable review prior to its use.
- 3. Provide ladders for access to the trench by construction and inspection personnel.

B. Trench Dimensions:

- 1. Comply with the minimum and maximum trench widths shown on the Drawings and Standard Details. Notify the Construction Manager for direction if the trench width exceeds the maximum allowable width for any reason.
- 2. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings.
- 3. The sides of the trenches shall be vertical in paved areas unless allowed otherwise by the Construction Manager.
- 4. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings.

C. Trench Bottom Grade:

- 1. Grade trenches such that the installed pipeline:
 - a. Is uniformly sloped between the pipe elevations shown on the Drawings, or;
 - b. Conforms to the piping profiles or elevations shown on the Drawings, or;
 - c. If no elevations or cover depths are shown on the Drawings, provide 3 feet of minimum cover unless otherwise specified elsewhere.
- 2. Accurately grade the bottom of the trenches and the specified Pipe Bedding Material to provide uniform bearing and support for each section of the pipe or conduit at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints.

3. Dig bell holes and depressions for joints after the trench bottom has been graded and compacted. In order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth and width as required for properly making the joint.
 4. Remove stones to avoid point bearing on the pipeline.
- D. Overexcavation:
1. Take care not to over excavate, unless required to remove deleterious or otherwise unsuitable material, or as required in paragraph 2 below.
 2. Over-excavation will be required where unsuitable soils (e.g., peat, wood waste) area exposed at the subgrade elevation for foundations and for the pipelines specified to require over-excavation per the Yard Piping Schedule.
 3. Excavation for bedding beneath the pipe shall be in accordance with the drawing details.
 4. The over-excavation zone shall be the full width of the utility trench.
 5. Backfill and compact accidental excess over-excavations with Structural Fill for structure excavation; and Lightweight utility trench backfill for trenching excavation.
- E. Trenches in Filled Areas:
1. For all piping or conduits to be placed in any filled or excavated and backfilled areas, such as at manholes or for building connections, the specified backfill material shall be first compacted to a level at least 3 feet from the top of the piping or conduit elevation and then retrenched to pipe grade.
- F. Trench Backfilling:
1. Backfill material shall not be placed over the pipe or conduit until after the joints have been completed, tested, and inspected by the Construction Manager and the Contractor has surveyed locations as specified in Section 01 78 39.
 2. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings. Compact each material to the degree specified or as shown on the Drawings, whichever is more stringent.
 3. Place bedding and backfill materials in horizontal lifts as specified.
 4. The difference in level on either side of a pipe shall not exceed 4 inches.
 5. Compact by suitable hand methods under the haunches of the pipe and in areas not accessible to mechanical tampers unless otherwise specified or shown on the Drawings. The minimum level of compaction shall not be less than the specified amount.
- G. Protect the Pipe or Conduit:
1. It shall be incumbent upon the Contractor to protect the pipe or conduit from damage during the construction period.
 2. The Contractor shall bear responsibility to repair broken or damaged pipe at no extra cost to the Owner.
 3. Carefully place backfill around and over the pipe and do not allow it to fall directly upon the pipe. During initial fill lifts trench backfill shall not be bulldozed into the trench or placed directly onto the pipe.
 4. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the position of the pipe.

H. Restoration of Traffic:

1. Traffic (including construction traffic) shall not be allowed on the trench until the trench is properly backfilled to the level equal to adjacent grade, and compacted as specified, and has been repaved (in paved areas).
2. Trench plating shall be provided for open trenches in roadways that are not immediately backfilled and repaved. The plates shall be recessed flush with the existing pavement on all sides within the public right-of-way. Fill gaps along the periphery of the plating with cold patch asphalt. Butt adjacent plates together flush and without gaps.

3.12 DRAINAGE CHANNEL, DITCH AND SWALE CONSTRUCTION: NOT USED

3.13 EXCAVATION AND BACKFILL FOR STRUCTURES

A. Excavation Dimensions:

1. All excavations for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein.
2. Excavate to such width outside the lines of the structure to be constructed as may be required for proper working methods, sheeting, bracing, shoring, the erection of forms, and the protection of the work.

B. Foundation Excavation:

1. Prepare the subgrade of the foundation base layer as follows:
 - a. Overexcavate the underlying material to a depth of 12 inches (minimum) below the subgrade of the base layer.
 - b. Scarify and recompact the underlying material to a depth of 9 inches to 12 inches as specified.
 - c. Backfill with Structural Fill and compact as specified to the grade of the base layer subgrade.
2. If the foundation base layer subgrade is shown or specified to be undisturbed, take care to preserve the material in an undisturbed condition. If the Contractor overexcavates or disturbs the material without written authorization of the Construction Manager, it shall fill such overexcavations with Structural Fill and compact as specified.

C. Examination of Excavation:

1. The Construction Manager will examine all structural foundation subgrades prior to subsequent work.
2. Notify the Construction Manager when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the excavation has been examined by the Construction Manager.

D. Unsatisfactory Foundation Subgrade Material:

1. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be overexcavated by up to 2 feet and replaced with Permeable Ballast conforming to WSDOT Standard Specifications Sections 9-03.9 (2) as directed by the Construction Manager and compacted as specified. A geotextile separation fabric meeting the requirements of Table 3 in WSDOT Standard Specifications Section 9-33.2 should be placed above the Permeable Ballast to prevent migration of the pipe bedding material into the underlying Permeable Ballast.

E. Overexcavation:

1. Backfill and compact overexcavations with Structural Fill.

F. Foundation Base Layer and Capillary Break:

1. Place a base layer of compacted material meeting the requirements of Paragraph 2.17 Backfill for Capillary Break under all cast-in-place and precast structures, slabs-on-grade, and foundations, regardless of whether shown or not on the Drawings.
2. The minimum compacted thickness of the base layer shall be 6 inches, unless shown otherwise on the Drawings.

G. Backfill Adjacent to Structures:

1. The top 12 inches of sidewall for buried structures shall be backfilled with material meeting the requirements of Paragraph 2.05 Imported Fill.
2. Buried structures shall be backfilled below the top 12 inches with a two-part filter system comprised of Filter Sand material placed against the native subgrade soils and Wall Backfill material against the structure wall. To facilitate construction, the Filter Sand material may be separated from the Wall Backfill material using geotextile for underground drainage. Geotextile material shall not be placed directly against native subgrade soils. Backfill materials shall be compacted as specified herein unless specifically shown otherwise on the Drawings.
3. Do not place backfill against structures until the concrete has been patched and cured as required by Section 03 30 00.
4. Place backfill in uniform, level layers, not exceeding the thickness specified in Paragraph 3.09 Material and Compaction Schedules. Bring backfill up uniformly on all sides of the structure, and on both sides of buried walls.

3.14 EARTHWORK WITHIN LANDSCAPED AREAS

- A. Prepare landscaped area subgrade by excavating and backfilling to within 6 inches of final grade. Compact backfill in accordance with Paragraph 3.09 Material and Compaction Schedules.

3.15 WET WEATHER EARTHWORK

- A. The following measures shall be taken in wet weather or under wet conditions when proper control cannot be exercised over soil moisture content:
1. Prior to excavation all surface drainage shall be diverted to temporary sedimentation and erosion control facilities as approved by the Construction Manager.

2. During excavation and earthwork operations, surface water shall be conveyed and handled using sloping, ditching, sumps, dewatering pumps, and piping as necessary to prevent sloughing of soils and to facilitate moisture control of materials.
 3. Fill material shall contain no more than 5 percent fines (material passing the No. 200 sieve) by weight, based on wet sieving the material fraction passing a 3/4 inch sieve. Any fines present shall be non-plastic.
 4. Earthwork shall be accomplished in small sections and carried through to completion to minimize exposure to wet weather. The size and type of equipment shall be limited to prevent soil disturbance.
 5. No soil at the bottom of the excavation shall be left uncompacted so that it can soak up water. Soils which become too wet for compaction shall be removed and replaced with the specified fill material. The cost for such work shall be borne by the Contractor.
- B. Excavation and fill placement operations will be observed by the Construction Manager during wet conditions.

3.16 GRADING

- A. When the work is at an intermediate stage of completion, the lines and grades shall be as specified plus or minus 0.5 foot to provide adequate drainage.
- B. Ditches shall be cleaned, reshaped, and maintained in a satisfactory condition until final acceptance.
- C. Finished surfaces shall be smooth, compacted, and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.
- D. Finished grade shall be as specified by the contours plus or minus 0.10 foot except where a local change in elevation is required to match existing contours, sidewalks, curbs, manholes, and catch basins; or to ensure proper drainage; or allow for subbase and pavement thickness.
- E. All surfaces including ditches shall be free draining with no standing water.
- F. Allowance for topsoil and grass cover shall be made so that the specified thickness of topsoil can be applied to attain the finished grade. The finished grade shown on the Drawings shall be the top surface of the topsoil.
- G. The Contractor shall conduct his operations in such a manner as to avoid damage to any previously constructed structures and facilities.

3.17 QUALITY CONTROL

- A. Source Quality Control:
 1. Test all import materials proposed for use to demonstrate that the materials conform to the specified requirements. Submit reports to the Construction Manager for review.

B. Field Quality Control:

1. The Construction Manager shall take samples and perform moisture content, gradation, compaction, and density tests during placement of backfill and embankment materials to check compliance with these specifications.
2. The Contractor shall remove surface material at locations designated by the Construction Manager and provide such assistance as necessary for sampling and testing. The Construction Manager may direct the Contractor to excavate inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these Specifications.
3. Costs for rework resulting from non-compliant tests shall be borne by the Contractor.
4. Tests made by the Construction Manager do not relieve the Contractor of its responsibility to determine to its own satisfaction that its work meets the specifications.
5. Tests will be made in accordance with WSDOT Standard Specifications Section 1 06.2(1) and the following:

Test	Standard Procedure
Moisture content	AASHTO T 265 / ASTM D2216
Gradation	AASHTO T 27 / ASTM C136
Density in-place	AASHTO T 310 / ASTM D6938
Moisture-density relationships	AASHTO T 180 / ASTM D1557

C. Proof Rolling:

1. Proof roll areas designated in the Material and Compaction Schedules and elsewhere in the Contract Documents or as directed by the Construction Manager to detect soft zones.
2. Proof rolling shall be done on an exposed subgrade free of surface water (including wet conditions resulting from precipitation) which would promote degradation of an otherwise acceptable subgrade.
3. The Construction Manager shall be present at all proof rolling tests. Notify the Construction Manager at least 3 days prior to proof rolling test.
4. Proof roll by passing over all required areas with a loaded scraper, front-end loader with loaded bucket, or other heavy rubber-tired vehicle with high tire pressure, in the presence of the Construction Manager. Operate the proof rolling vehicle at speeds between 2-1/2 to 3-1/2 miles per hour.
5. The Construction Manager shall determine what areas tested by proof rolling are soft zones that require corrective work.
6. Perform the following corrective work, unless otherwise specified:
 - a. Remove all material within the Construction Manager identified soft zones. Removed material shall be considered unsuitable for subsequent backfill, unless remedied to meet specifications for use as fill. Soils containing deleterious material shall not be used for backfill.
 - b. Fill the resulting voids with moisture conditioned Structural Fill in maximum 8 inch uniform lifts and compact as specified.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the requirements for lowering or controlling groundwater including, design, installation, operation, and maintenance, groundwater treatment and disposal, and removal of dewatering equipment.
- B. Submittals required in this specification shall be coordinated with related Section 31 50 00 Excavation Support and Protection. Make submittals pursuant to this Section and Section 31 50 00 concurrently.
- C. Provide all labor, equipment, materials and services necessary to dewater trench and structure excavations as necessary to perform the Work.
 - 1. Methods for dewatering shall be chosen by the Contractor and their Professional Engineer/HydroGeologist, subject to the Owner's review and acceptance.
 - 2. The Geotechnical Report (Volume 4 Attachment B) contains boring logs, soil properties, aquifer parameters, and limits and constraints for dewatering applicable to the methods of dewatering to be chosen by the Contractor.
 - 3. At all times, conduct activities with appropriate precautions to avoid the risk of bodily harm to persons or the risk of damage to any property or the environment. The Contractor shall continuously inspect all work, materials, and equipment and shall be solely responsible for discovery, determination, and correction of any conditions that may involve such risks.
- D. Identify and secure permits required for dewatering. Owner will secure a Construction Stormwater General NPDES Permit with Companion Order stipulating conditions for dewatering water disposal to surface water through Deepwater Outfall 100 that includes water quality requirements for discharge. The Construction Stormwater General NPDES Permit and Companion Order will be transferred by the Owner to the Contractor once obtained from the Washington State Department of Ecology. Dewatering activities shall be in compliance with local, State and federal regulations. Discharge to the City's sewer system must comply with the City of Everett Discharge Authorization request permit provided in Section 01 99 90, Industrial Discharge Approval Request Form.
- E. The Contractor shall be responsible for selecting, designing, installing, operating, and maintaining all dewatering systems, including treatment systems required for dewatering water quality prior to offsite discharge. Dewatering pumping rates are approximated to be on the order of up to 3,000 gallons per minute for pipeline construction excavations with limited length.

- F. The contractor shall provide a dewatering system capable of dewatering to a depth of 2 feet below the pipe invert without damaging City property or adjacent property and without exceeding the specified allowable settlements indicated in the Settlement and Vibration Monitoring Specifications (31 09 11). For excavations on the west side of the BNSF tracks the system shall be capable of conveying construction water from the trench excavation to the temporary dewatering treatment plant shown in 01 12 16 Construction Sequence, Exhibit A-1, and treated to the requirements of Construction Storm Water General NPDES permit. On the east side of the tracks the contractor shall conform with the City of Everett Industrial Discharge Permit and discharge to an allow location as shown on Specification 01 12 16 Construction Sequence, Exhibit A-1. At the time of bidding, the water quality standards required for discharge of treated groundwater under NPDES Construction Stormwater General Permit for construction activities have not been issued by the Washington Department of Ecology for the construction related dewatering discharges to the on-site Everett Deep Water Outfall 100. However, water quality testing requirements and water quality standards for discharge have been established for the adjacent Port Gardner Storage Facility project, which will utilize the same on-site Everett Deep Water Outfall 100. For informational purposes, the required marine water parameters, and sampling requirements at the adjacent PGSF site are included in Appendix N.
- G. As established in 01 12 16, the Contractor shall coordinate with the Owner and Owner's Representatives to establish a structure for cost sharing of the groundwater treatment system with the PGSF contracts. This cost sharing shall minimize the Owner's overall cost of mobilization, operation, and demobilization of the dewater water treatment system. Refer to Section 01 12 16 Exhibits A-2 and A-3 for example dewatering treatment system.
- H. Refer to EXHIBIT A-1 – SECTION 01 12 16 STORMWATER, DEWATERING & SEWERAGE MANAGEMENT SEQUENCING AND CONSTRAINTS for additional dewatering water disposal restrictions.
- I. Attachment F - Utility Property Cleanup Action Plan Memorandum (Floyd Snider, February 5, 2021) contains site soils characterization, constituent contaminants, and concentrations documented along with past site remediation activities pursuant to the City's Cleanup Action Plan (CAP) for the overall Port Gardner Storage Facility Site. In May 2020, the available data from the property described in the memorandum were reviewed with the Washington State Department of Ecology and it was determined that remediation would not be required per the Model Toxics Control Act. The Geotechnical Report (Volume 4, Attachment B) contains groundwater monitoring data for several on-site monitoring wells installed under this project. Contractor shall make their own assessment based on available information in the referenced sources as to the presence or absence of specific water quality parameters and degree, if any, of contamination that falls within actionable levels pursuant to state and local permits.
- J. This project is part of the historical Kimberly-Clark Worldwide MTCA Site and is adjacent to the historical ExxonMobil/ADC MTCA site, which are listed on the Washington State Department of Ecology's (ECY) Confirmed and Suspected Contaminated Sites List.

- K. Because the work is located within a listed site where hazardous substances are present and may be encountered that are above regulatory cleanup levels in soil, The Contractor shall comply with, at a minimum, the provisions of 29 CFR 1926, WAC 296-155, and the Contractor's site-specific health and safety plan throughout the duration of the work. Additionally, the Contractor shall exercise due caution when excavating soil and dewatering in any location to minimize the potential health hazard to all project participants.
- L. Conduct activities with appropriate precautions to avoid the risk of bodily harm to persons or the risk of damage to any property or the environment. Continuously inspect all work, materials, and equipment and be solely responsible for discovery, determination, and correction of any conditions that may involve such risks.
- M. Supply all equipment, materials, and personnel necessary to meet the requirements of this Section and all applicable codes and regulations for safe handling and disposal of contaminated construction water.
- N. Definitions:
1. Aquifer: Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit water to pumped wells, well points and sumps.
 2. Confined groundwater: Groundwater under pressure that is greater than atmospheric pressure. Confined groundwater is separated from direct contact with atmospheric pressure because of overlying impermeable or relatively low permeability layers (confining layers) of soils, sediments, or rock.
 3. Confining layer: A body of material of lower hydraulic conductivity/permeability that is stratigraphically adjacent to one or more aquifers. It may lie above or below the aquifer and is less permeable than the adjacent aquifer.
 4. Dewatering system: A system that will lower the water table, piezometric, or potentiometric surface adequately to improve excavation and excavation subgrade stability for work to be performed.
 5. Groundwater: Water that is found in fully saturated soils, sediments, and rocks below the ground surface, and which flows primarily in response to gravitational forces or differences in pressure head.
 6. Groundwater table: A particular potentiometric surface for an unconfined aquifer.
 7. Incidental sump pumping: Sump pumping of perched or pocketed groundwater in an excavation where the static groundwater table has already been lowered below subgrade using wells or vacuum well points.
 8. Hydrostatic head: The difference in elevation between the surface of the static head of groundwater in a confined or unconfined confined aquifer and the elevation of target drawdown.
 9. Perched groundwater: Groundwater that is separated from an underlying body of groundwater by unsaturated or relatively low permeability soil.
 10. Potentiometric surface/piezometric level: Theoretical (imaginary) surface of the static head of groundwater in an aquifer. The water table is a particular potentiometric surface for an unconfined aquifer.
 11. Sand/gravel pack: A sand or gravel material which is placed in the annular space between a drilled hole and the well casing and/or well screen.

12. Screen (well screen): A cylinder, typically steel or plastic material with slots or perforations used to allow water to enter a well while preventing the sand/gravel pack and sediment or rock particles from entering the well.
13. Specific capacity: The volume in gallons per minute of a pumped well's discharge divided by the concurrent drawdown of the pumped well's water level in feet during pumping.
14. Piezometric level/head: The level representing the total hydraulic head of groundwater in a confined aquifer.
15. Piezometric pressure: Pore water pressure at a specific point.
16. Pumped well: A hole in the ground with a casing and screen that includes its own motorized pump in the casing or screen to lift water to the surface.
17. Pumping level: The level of water in a well casing or screen when pumping is in progress.
18. Observation well: A non-pumping well used to observe changes in the elevation of the water table or the potentiometric surface/piezometric head.
19. Recharge well: A well established to reinject groundwater into an aquifer to maintain groundwater drawdown in an aquifer at acceptable levels to prevent damage to adjacent properties, utilities, or work.
20. Subgrade: The finished grade level of an excavation below any slab or pipe invert including excavation for foundation materials.
21. Sump: A shallow hole in the ground adjacent to or in excavation trench with a slotted or perforated casing containing a pump and surrounded by filter sand or gravel to prevent the pumping of formation material.
22. Unconfined groundwater: Water in an aquifer that has a water table that is at atmospheric pressure.

1.02 QUALITY ASSURANCE

A. References:

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
WAC Chapter 173-160	Minimum Standards for Construction and Maintenance of Wells

Reference	Title
AWWA A100	Standard for Water Wells
COE	City of Everett, Design and Construction Standards and Specifications for Development
Construction Stormwater General Permit (CSWGP)	National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Stormwater Discharges Associated with Construction Activity, State of Washington, Department of Ecology
SMMWW	Department of Ecology's Stormwater Management Manual for Western Washington
WISHA	Washington Industrial Safety and Health Act
WSDOT Standard Specifications	Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge, and Municipal Construction, latest edition

B. Quality Assurance:

1. Dewatering System Designer Qualifications:
 - a. Construction dewatering design experience on at least five projects of similar size and scope within the previous five years.
 - b. Professional Engineer or Hydrogeologist licensed in the state of Washington with a minimum of 10 years' experience in the design of ground water control systems.
2. Dewatering System Geotechnical Engineer Qualifications:
 - a. Specializing in geotechnical engineering, and who performs analyses of piping at the base of excavations and of impacts of dewatering system groundwater drawdown on nearby properties, structures, utilities, and facilities, and who provides recommendations and designs to mitigate effects of groundwater drawdown.
 - b. Professional Engineer licensed in the state of Washington.
3. Specialty Dewatering Subcontractor Qualifications:
 - a. Dewatering experience on at least five projects of similar size and scope within the previous five years. The Contractor shall employ a specialty dewatering contractor with experience in the field of large pipeline dewatering system design, installation, operation, and maintenance. The Contractor shall document successful completion of at least 5 projects in soils and groundwater conditions similar to the project area which included multiple well or wellpoint, high volume (1,000 gpm+) systems. A specialty dewatering Contractor includes those companies that meet the above experience requirements and whose annual revenues are derived specifically and primarily (> 75%) from construction dewatering activities, or companies that have operated for more than 2 years, special divisions and/or groups of personnel who meet the above experience and revenue requirements.
4. Well Driller Qualifications:
 - a. Licensed in the state of Washington by the Department of Ecology (Ecology).

1.03 SUBMITTALS

A. Procedures: Section 01 33 00 SUBMITTAL PROCEDURES

B. Action Submittals

1. A copy of this specification section, addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations.
2. Qualifications pursuant to Paragraph 1.02.B.
3. Dewatering Work Plans (including Treatment and Disposal) signed and sealed by a professional engineer or licensed hydrogeologist registered in the state of Washington
 - a. Work Plan shall include description of opportunities for and proposed and negotiated cost and/or equipment sharing of dewatering water treatment system with the PGSF contracts per Section 01 12 16.
 - b. Submit drawings and complete design data showing methods and equipment the Contractor proposes for dewatering, including sheet piling plan, hydraulic gradient and factor of safety against piping at the base of excavation, relief of hydrostatic head, depth and size of wells/wellpoints, headers, sumps, ditches; size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from the project site to an acceptable disposal location(s); management of other water, and in maintaining the excavation in a dewatered, hydrostatically controlled condition.
 - c. Submit drawings and complete design data showing methods and equipment the Contractor proposes to treat and dispose of the dewatering water and meet the required permit limits.
 - d. Submit the following for temporary pump/dewatering systems and treatment systems:
 - 1) Layout plan for pumps, piping, secondary containment, and staging area.
 - 2) Size, material, location, and method of installation for suction and discharge piping. Include proposed leakage and pressure testing procedures.
 - 3) Pump catalog information to include: size, capacity, number, and pump curves showing operating range.
 - 4) Calculations of static lift, friction losses, and flow velocity, including pump sizing for discharge through Deepwater Outfall 100.
 - e. Proposed approach for blocking flows at structures, including information on temporary sewer plugs and proposed approach for construction of any bulkheads.
 - f. Schedule for installation, inspection, and maintenance of pumps and piping.
 - g. Qualifications of the proposed single point of contact responsible for the operation and maintenance of the temporary pumping systems, as specified below.
 - h. Filtration and treatment of dewatering stream prior to direct discharge, with requirements as provided by the City concurrent with the Discharge Authorization Request Construction Storm Water General NPDES Permit and Companion Order.
 - i. Location of final discharges and associated flow rates.
 - j. Method of connecting to the existing 32-inch HDPE outfall with the 10-inch yard piping for dewatering purposes. Indicate type of tee fitting.

4. Dewatering Discharge Permit (Industrial Discharge Authorization Request Form, see Section 01 99 90).
 - a. Obtain and submit a dewatering discharge permit prior to any dewatering discharge to the City sewer system.
 - 1) Contractor is responsible for obtaining the City of Everett Industrial Discharge Authorization Request Form and performing any sampling and laboratory analyses required as part of permit compliance.
 - 2) Submit record copies of correspondence, sampling and analysis and permits for dewatering operations.
 - 3) Contractor is responsible for efforts associated with sampling activities and administration for treatment/disposal and verification. Contractor shall sample each location separately.
 5. Construction Storm Water General NPDES Permit with respect to its companion order for dewatering.
 - a. The Owner applied for this permit and the permit will be transferred onto the Contractor after the contract award. Obtain the Construction Storm Water General NPDES Permit and Companion Order from the Owner prior to any dewatering discharge to the City's Deepwater Outfall 100.
 - 1) The Contractor is responsible for obtaining the Construction Storm Water General NPDES Permit permit from the Owner and performing any sampling and laboratory analyses required as part of permit compliance.
 - 2) Submit record copies of correspondence, sampling and analysis and permits regarding dewatering operations.
 - 3) Contractor is responsible for efforts associated with sampling activities and administration for treatment/disposal and verification. Contractor shall sample each as required by the permit.
 6. Dewatering action submittals and shoring action submittals shall be coordinated and submitted within 60 days following notice to proceed.
- C. Informational Submittals
1. Dewatering well logs.
 2. Daily record of dewatering system operation, including list of pumps. Any pumping wells, groundwater drawdown, flow from pumps and/or wells and flow from the entire dewatering system.
 3. Sampling results and reporting to the City and Ecology.

1.04 SITE CONDITIONS

- A. The Contractor shall satisfy themselves as to the level of effort necessary to dewater where required. Refer to the Geotechnical report, Volume 4 Attachment B, for information on groundwater levels, limited water quality sampling, and aquifer pumping tests for this project. The use of the available data and information in no way relieves the Contractor from the sole responsibility for proper installation, operation, maintenance, and any failure of any component of the dewatering systems for the duration of this Contract.

- B. Use of available soil information in no way relieves the Contractor from its responsibility for design, installation, and operation of a properly functioning dewatering system. Refer to Attachment C- Utility Property Cleanup Action Plan Memorandum (Floyd Snider, February 5, 2021) and also refer to the Geotechnical Report (Volume 4, Attachment B).
- C. Contractor may anticipate preliminary discharge limits for dewatering water disposal to surface waters through the City's Deepwater Outfall to be equal to the Practical Quantitation Limits (PQLs) found in the monitoring well laboratory test result forms in Volume 4, Attachment B Geotechnical Report. Actual limits will be contained in the Construction Stormwater General NPDES Permit and Companion Order.
- D. See additional requirements in Section 31 23 00 – Excavation and Fill and Section 01 11 10 – Geotechnical Information.

1.05 SAMPLING

- A. Contractor is responsible for performing all sampling, laboratory analyses, and record keeping required as part of permit compliance.

1.06 CONSTRAINTS

- A. Do not place dewatering or dewatering treatment facilities in any areas that would impact the access, operation, or performance of existing facilities. Schedule constraints shall be documented per Section 01 32 16, CONSTRUCTION PROGRESS SCHEDULE.
- B. Coordinate with the Owner on providing access to other contractors working on other City projects in the vicinity of the site. Refer to Section 01 12 16 for work sequencing constraints.
- C. The length of excavation open at one time and extents of active dewatering shall be limited to reduce construction dewatering discharge rates to less than 3,000 gallons per minute West of the BNSF Railroad Tracks and less than 300 gallons per minute East of the BNSF railroad tracks, unless otherwise approved in writing by the Engineer.

PART 2 PRODUCTS

2.01 DEWATERING SYSTEMS

- A. The dewatering systems shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering systems shall include sheet piles, any deep wells, well points, sumps, dewatering pumps, and other equipment, appurtenances, and related earthwork or soil modification necessary to complete the Work.
- B. Provide and maintain equipment necessary for dewatering. Standby equipment shall be kept available at all times to ensure efficient dewatering and maintenance of dewatering operation during power failure.

2.02 DEWATERING WORK PLANS

- A. Contractor shall provide a Ground Water Control Plan (GWCP) developed by a Washington licensed professional engineer with expertise in geotechnical engineering, or hydrogeologist with a minimum of 10 years' experience in the design of ground water control systems. The Contractor shall submit information sufficient for the Engineer to understand the dewatering system including, but not limited to the following:
1. Specifications and manufacturer's literature of the materials and a description of the methods proposed for use in the construction of a dewatering system.
 2. Flow meter type and locations, including calibration certificates.
 3. Drawings indicating the location and size of sheet piles, berms, dikes, ditches, wells, vacuum wellpoints, sumps, monitoring wells, gravel drains, discharge lines, and flow meters. The drawings shall include, at a minimum, all dewatering system elements.
 4. Capacities of pumps, prime movers, and standby equipment.
 5. Information supporting the location, size, adequacy and number of pumps, any wells, vacuum wellpoints, gravel drains, sumps and discharge lines, and the adequacy and suitability of discharge pipe sizes, pumps, filters/gravel packs, and screens.
 6. Information supporting the design of the dewatering wells, vacuum wellpoints, gravel packs and water treatment systems, duration of dewatering and degree of groundwater lowering in the trench and adjacent areas.
 7. Settlement monitoring plan coordinated with Section 31 09 11 that includes anticipated drawdowns with distance from the dewatering system, monitoring schedules and a contingency plan including action items if settlement is detected.
 8. The location of settlement monitoring points and a photo log of all structures including walls, slabs, exposed piping that might be affected by settlement due to lowering of the ground water.
 9. Monitoring well logs.
 10. Dewatering schedule, operation, maintenance, and abandonment procedures.
 11. Project descriptions for dewatering projects of similar scope and size completed by the Contractor's specialty dewatering subcontractor and licensed engineer or hydrogeologist.
 12. Dewatering well logs.
 13. Information submittals: Daily record of dewatering system operation including list of pumps, pumping wells, drawdown in pumping wells, flow from pumps and wells and flow from entire dewatering system.

2.03 DEWATERING TREATMENT AND DISPOSAL SYSTEMS WORK PLANS

- A. Contractor shall provide a dewatering treatment and disposal plan developed by a Washington licensed professional engineer with a minimum of 10 years' experience in the design of ground water treatment and disposal systems. The Contractor shall submit information sufficient for the Engineer to understand the dewatering treatment and disposal system including, but not limited to the following:
1. Specifications and manufacturer's literature of the materials and a description of the methods proposed for use in the construction of dewatering treatment and disposal system.
 2. Drawings indicating the location and size of treatment facilities, discharge lines, flow meters. The drawings shall include, at a minimum, all dewatering system elements.

3. Capacities of treatment system, pumps, and standby equipment.
 4. Dewatering treatment and disposal schedule, operation, maintenance, and decommissioning and system removal procedures.
 5. Project descriptions for dewatering treatment and disposal projects of similar scope and size completed by the Contractor's specialty subcontractor and licensed engineer or hydrogeologist.
 6. Daily record of dewatering treatment and disposal system operation.
- B. The dewatering treatment and disposal system shall be designed using accepted and professional methods of design and engineering.
 - C. The Contractor shall be experienced in dewatering treatment and disposal design, installation, operation and maintenance, or shall employ the services of a subcontractor who is generally acknowledged as, and experienced in, treatment and disposal design, installation, operation and maintenance.
 - D. Provide and maintain equipment necessary for treatment and disposal. Standby equipment shall be kept available at all times to ensure efficient treatment and disposal and maintenance of system operation during power failure.
 - E. The dewatering treatment and disposal system shall be designed to meet requirements noted in the discharge permits listed in Paragraphs 1.03 B.7. and B.8.

2.04 POWER SUPPLY

- A. Provide power, electrical service, separate and dedicated solely to the operation of the dewatering and treatment systems. Contractor shall use electrical generators or obtain electrical service from the utility company.

2.05 DEWATERING WATER DISCHARGE/DISPOSAL LOCATIONS

- A. Dewatering discharge/disposal locations shall be in accordance with the approved dewatering permits noted in Paragraphs 1.03 B.7 and B.8. Dewater, treat, and dispose of the water so as not to cause injury to public, private, or other property, or to cause a nuisance or a hazard to the public.
- B. The City has identified two potential discharge options described below on where the Contractor may discharge water from groundwater dewatering activities. Refer to "EXHIBIT A-1 SECTION 01 12 16" for information about dewatering discharge options, locations, limitations, and additional dewatering requirements.
 1. **City Sewer:** City's sewer manholes located in West Marine View Drive and in Lower Norton Road located upstream of Lift Station No. 6 and Lift Station No. 7. Refer to Section 01 12 16 Exhibit A-1 for the available discharge manhole locations and seasonal capacities to accept dewatering operations flow.
 - a. The Contractor is required to request and obtain written approval from the City and meet the requirements outlined by the City prior to use of the aforementioned locations. Should the Contractor elect to use another alternative for dewatering water discharge, provide documentation that the location, storage, handling, and method of disposal meets applicable local, state and federal requirements.

- C. **Deepwater Outfall 100:** The previously bid PGSF project will install a discharge connection on the City's Deepwater Outfall to provide groundwater dewatering capacity up to 3,000 gpm at the site. Refer to Section 01 12 16 Exhibits A. Refer to Section 31 23 19 Exhibit A for the estimated high and low pumping system curves for discharge to the Deepwater Outfall.
 - 1. The City is applying for the Construction Storm Water General NPDES Permit with respect to its companion order for dewatering to allow discharge directly to the Deepwater Outfall 100 pipe. The Contractor is required to obtain the permit from the City and comply with the permit requirements for treatment, sampling, laboratory analysis and reporting.
 - 2. Contractor is responsible to design, operate and maintain and remove the treatment and disposal system as required in this specification.
- D. Contractor shall install in-line flowmeters, or equivalent, on all dewatering system discharge pipes. All meters shall be installed to manufacturer's specifications and calibration documentation shall be submitted. Contractor shall keep a log, on a daily basis, the cumulative total flow indicated on the flowmeters, and the rate of flow at the time of recording. The log shall be submitted to the Owner once per week as an informational submittal and available daily for inspection.
- E. Dewatering discharges shall be tested for contamination prior to discharge.
- F. The Contractor must coordinate with the Owner on allowable dewatering rates to the City sewer and the Deepwater Outfall 100 at all times. The noted allowable dewatering rates listed in EXHIBIT A-1 – Section 01 12 16 may be decreased to allow other City projects utilize dewatering capacities, for lift station maintenance, and to reserve capacity for anticipated severe weather events.

PART 3 EXECUTION

3.01 GENERAL

- A. Dewatering operations shall continue throughout construction to maintain the groundwater level a minimum of 2 feet below bottom of excavation to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. Provide:
 - 1. Competent personnel skilled in the operation, maintenance, and replacement of system components.
 - 2. Testing as required to assure a properly functioning system and compliance with permits.
 - 3. Standby and spare equipment of the same capacity and quantity.
 - 4. Other work, components, and materials required to maintain the systems.
 - 5. Dewatering systems shall not be shut down between shifts, on holidays, or weekends, or during work stoppages, without written permission from the Owner's Representative.
- B. Control surface runoff so as to prevent entry or collection of water in excavations or in other isolated areas of the site. Site grading shall promote drainage. Surface runoff shall be diverted from excavations. Maintain a trench bottom free from standing water.

- C. The Contractor shall design, construct, operate, and maintain the dewatering system such that the fine fraction of the foundation soils will not be removed upon pumping. The Contractor shall monitor discharge from all parts of the system to ensure that the sand content of the discharge water does not exceed 10 ppm as determined by a centrifugal, separating meter such that as that described in the Journal AWWA, 46:123 (February 1954) (Rossum SAND TESTER) or equivalent. The Contractor shall take sand content measurements daily until 10 days after the last well has been installed and weekly thereafter.
- D. Dewatering shall preserve the undisturbed bearing capacity of the sub-grade soils at proposed bottom of excavation. Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions. Dewatering systems shall not remove natural soils. In addition, the Contractor shall minimize groundwater level drawdowns to avoid adverse impacts to adjacent structures.
- E. The potential for confined groundwater conditions exists at the site. Flotation, quick conditions, piping, boils, or bottom heave shall be prevented by maintaining a positive and continuous removal of water and counteracting confined groundwater pressures below the excavated areas using depressurization of deeper confined groundwater if needed. Contractor shall be fully responsible and liable for all damages that may result from failure to adequately keep excavations dewatered. Adjust lines and grades of new work that is detrimentally affected by trench heave at any time to satisfaction of Engineer.
- F. Limit dewatering efforts to localized areas for specific structures and to not impact structures within the zone of influence of the dewatering system. If the excavation subgrade or sidewalls are compromised as a result of the Contractor's dewatering methods, restore the integrity of the subgrade to preexisting conditions.
- G. Leased dewatering and treatment systems identified to meet dewatering and treatment performance criteria stated by Contractor's delegated design professionals shall be overseen by the vendor(s) responsible for providing the system(s).

3.02 EXISTING WELLS

- A. The approximate locations of existing monitoring wells are shown in the geotechnical report Contractor may use these to measure water levels. Upon or before the physical completion date, the contractor shall abandon, per WAC 173-160, all existing monitoring wells shown on the on the geotechnical report unless otherwise directed by the engineer in writing.

3.03 WATER DISPOSAL

- A. Release of groundwater to its static level shall be controlled to prevent disturbance of the natural foundation soils or compacted fill and to prevent flotation or movement of structures or pipelines. Disposal of water shall not damage property or create a public nuisance. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.

3.04 WELL DRILLING AND DEVELOPMENT

- A. The development, drilling, and decommissioning of wells shall comply with Chapter 173-160 WAC and AWWA A100. The Contractor shall obtain variances as required to construct dewatering systems that achieve the level of groundwater control specified.
- B. The Contractor shall notify the Engineer seven days prior to installation of any wells.

3.05 WATER SUPPLY FOR SYSTEM INSTALLATION

- A. The Contractor shall bear full responsibility for acquiring a water supply with which to install any groundwater control systems necessary to achieve proper completion of all work performed under this Contract (i.e., drilling and jetting).

3.06 MONITORING SYSTEM

- A. The Contractor shall maintain hydrostatic pressures 2 feet below the excavation and install monitoring or observation wells as necessary to ensure collection of data showing the level of the groundwater level below the excavation.
- B. The Contractor shall bear full responsibility for obtaining and maintaining a continuous, accurate and precise daily record of all water level measurements for pumping wells, observation wells and flow measurements for flow meters included as part of the groundwater control system. The Contractor shall measure water levels to 0.01-foot precision and flow to 10-gpm precision. The Contractor shall take and submit to the Engineer on a form provided by the Engineer, daily measurements, including water levels in all observation wells, rate and total flow in all discharge system flow meters, and time measurements were taken.

3.07 DECOMMISSIONING AND RESTORATION

- A. Abandon and decommission dewatering system at completion
- B. Restore areas impacted by the dewatering system to their original condition.

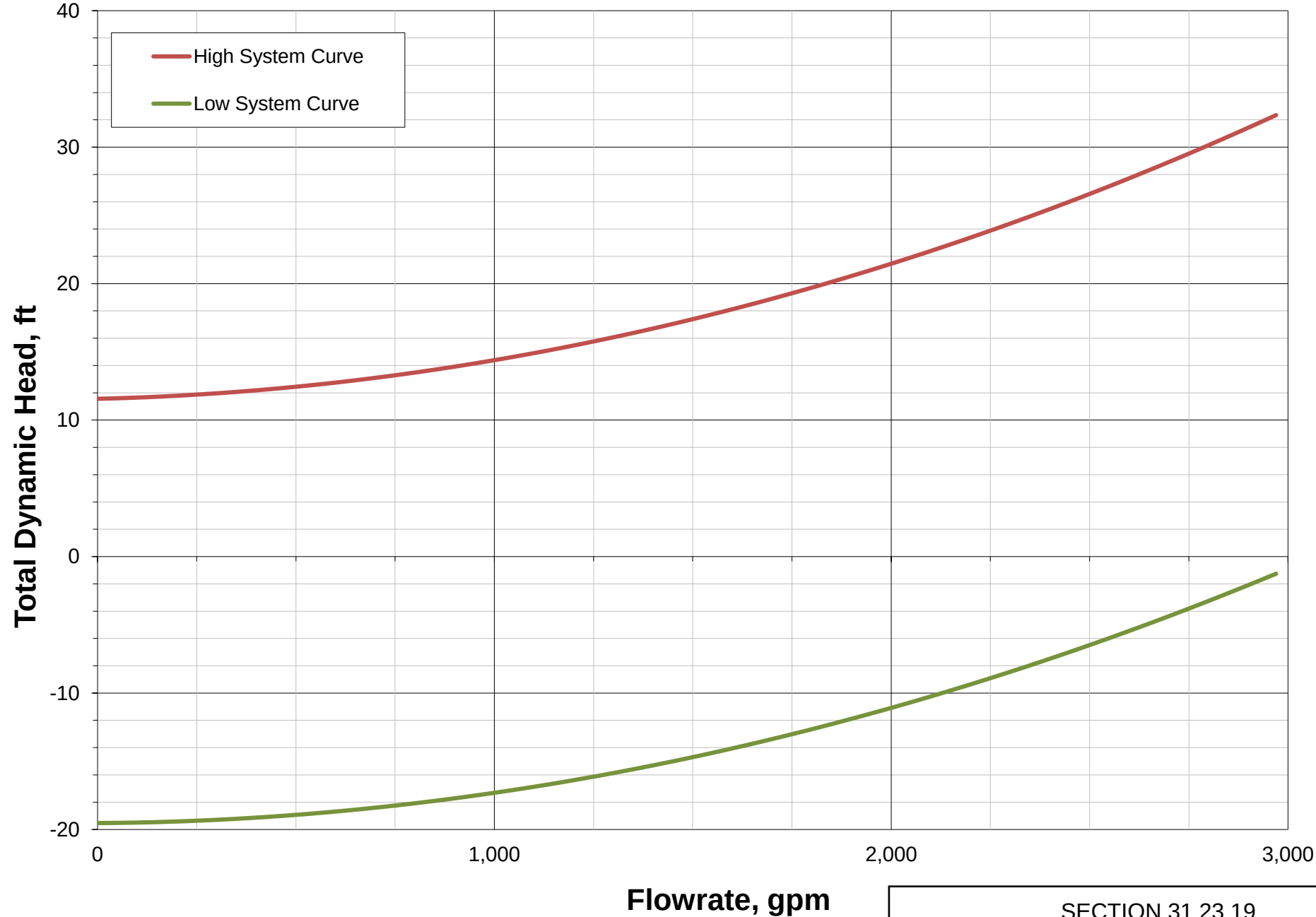
3.08 MEASUREMENT AND PAYMENT

- A. Groundwater dewatering, treatment, and disposal services are provided on a Force Account basis and shall comply with Schedule of Value requirements outlined in 01 22 13 Measurement and Payment.
- B. Services provided for treatment of dewatering water may coincide with the Port Gardner Storage Facility project. This parallel project may also require treatment of dewatering water. As detailed in Section 01 12 16 Work Sequence, the Contractor shall coordinate with the Owner and Owner's Representatives to identify opportunities for dewatering treatment cost and/or equipment sharing to eliminate the need for independent mobilization, operation, and demobilization of separate treatment systems for each project. The terms of cost sharing shall be documented in the final accepted Dewatering Work Plan submittal per Paragraph 1.03.

END OF SECTION



DWO-100 Dewatering System Curves



SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE

- A. This section covers work to implement structural and nonstructural best management practices (BMPs) to control erosion by wind or water and keep eroded sediments and other construction-generated pollutants from moving off project sites. Requirements described in this section and shown on drawings are part of the project Temporary Erosion and Sedimentation Control Plan (TESC Plan) and are the minimum for all project construction sites and conditions. This specification covers all project activities, including material sources, disposal sites, and offsite mitigation areas unless specific project activities are excluded elsewhere in this specification or in other contract documents controlling the work.
 - 1. Provide the latest BMPs and meet the applicable requirements of the City of Everett (COE) Design and Construction Standards and Specifications (DCSS) and Stormwater Management Manual (SWMM), Department of Ecology's (DOE) Stormwater Management Manual for Western Washington (SMMWW), and WSDOT Standard Specifications and Plans. In the case of conflict between the requirements of this specification and the governing rules and regulations, the more stringent requirement shall govern as determined by the Owner's Representative.
 - 2. The work shall also include, but not limited to, measures within the disturbance limits and areas impacted by construction activities such as staging, stockpiling, hauling, or alteration of drainage patterns as required to complete the Work.
- B. National Pollutant Discharge Elimination System (NPDES): Comply with federal, state and local laws, rules, and regulations, and the NPDES Construction Stormwater Discharge Permit. NPDES General Construction permits are required on projects that involve disturbance of 1 acre or more with potential to discharge stormwater to surface waters.

1.02 SYSTEM DESCRIPTION

- A. Erosion and Sediment Control: Provide, maintain, and operate temporary facilities to control erosion and sediment releases during construction period.
- B. Certified Erosion and Sediment Control Lead (CESCL):
 - 1. Identify the CESCL at the preconstruction discussion. The CESCL shall have certification in construction site erosion and sediment control as required by COE SWMM BMP 160.
 - 2. The CESCL shall be responsible for implementing, monitoring, and revising the TESC plan, including the following:
 - a. Installing and maintaining all temporary erosion and sediment control BMPs included in the TESC Plan to assure continued performance of their intended function. Damaged or inadequate TESC BMPs shall be corrected immediately.
 - b. Perform periodic inspections at the required frequency.
 - c. Updating TESC Plan to reflect current field conditions, and maintaining a TESC Site Log Book.

3. CESCL shall also inspect all areas disturbed by construction activities, all onsite erosion and sediment control BMPs, all stormwater discharge points, all temporarily stabilized inactive sites per schedule in the SWPPP. Complete erosion and sediment control inspection form as detailed in the SWPPP for each inspection.
- C. Temporary Erosion and Sediment Control Plan (TESC Plan) and Stormwater Pollution Prevention Plan (SWPPP)
1. Required minimum elements included in the TESC Plan and SWPPP are provided by the DOE SMMWW and NPDES permit.
 2. A Draft TESC Plan is furnished as part of the drawings, which helps fulfill part of the plan requirement of the NPDES Permit. This initial TESC Plan may be used as the basis of the construction TESC Plan. Additional or revised erosion and sediment control features, not shown on the initial TESC Plan, may be required depending on methods of operation and schedule.
 - a. The Contractor shall prepare a TESC Plan incorporating the features shown on the TESC Drawings and provide additional measures as required to protect the adjacent facilities and property, comply with the applicable regulations, and as required by the Owner's Representative.
 - b. Indicate and provide an explanation for deviations from the TESC Drawings.
 3. During the construction period, the BMPs shall be upgraded and modified as needed to meet discharge requirements for changing construction activities, storm events, and changing site conditions.
 - a. Indicate the minimum requirements at the start of work.
 - b. Schedule BMP implementation correlated to Wet and Dry Season activities. This may include activities such as temporary seeding and permanent seeding activities that change with the seasons.
 4. Update the TESC Plan and Drawings thirty days prior to the start of the Wet Season each year of construction until Substantial Completion is granted by .
 5. Keep a copy of the approved, active TESC Plan with updated changes on-site during all construction activities. Continually update the TESC Plan and implementation schedules as needed for unexpected storm or other events to ensure that sediment-laden water does not leave the construction site. Changes to the TESC Plan shall be incorporated no later than 24 hours after implementation.
 6. The TESC Plan shall include, at a minimum, the following information about the erosion control measures to be provided:
 - a. All requirements in the Drawings and Specifications.
 - b. Name, title, and qualifications/certification of the designated CESCL.
 - c. Locations and construction details of all proposed ESC BMPs.
 - d. Approximate slopes, contours, and direction of stormwater flow before and after major grading activities
 - e. Location of cut and fill slopes
 - f. Location of off-site material, stockpiles, waste storage, borrow areas, and vehicle/equipment storage areas
 - g. Locations, types, and quantities of all plantings, slope coverings, and ditch liners
 - h. Measures to prevent the addition of process water or domestic wastewater into the stormwater

- i. Locations and construction details of all ditches, berms, culvert pipes, pump stations, enhanced treatment measures, sediment basins, filters, and basin outfalls.
 - j. Location and design of all construction entrance(s) and wheel wash(es).
 - k. Installation, inspection, maintenance, and removal schedule for temporary erosion control facilities.
 - l. Rerouting of existing surface and underground drainage pathways and facilities within the site.
 - m. Location and design of traps, basins, and filters to collect transported sediment before entering the existing drainage systems and disposal areas.
 - n. Location of outlets from subsurface drainage systems.
 - o. Methods of monitoring water quality and quantity.
- 7. Inspections and Reporting
 - a. Inspect BMPs in accordance with the schedule in the SWPPP.
 - b. The inspection reports shall follow the Construction Stormwater Site Inspection Form provided in the SWPPP and include, but not be limited to:
 - 1) Date and time of the inspection.
 - 2) Name, title and signature of the person conducting the site inspection, a phone number or other reliable method to reach this person, and the following statement: "I certify that this report is true, accurate, and complete to the best of my knowledge and belief."
 - 3) Weather information including, the general conditions during inspection and the approximate amount of precipitation since the last inspection, and precipitation within the last 24 hours.
 - 4) When, where, and how TESC measures were installed, maintained, modified, and removed.
 - 5) Repairs needed, repairs made, and date when repairs were made.
 - 6) Observations of TESC measures effectiveness and proper placement.
 - a) Quantitative measurement shall be provided, in part, by weekly measurements of turbidity, transparency, and pH at discharge points.
 - 7) Recommendations for improving performance of TESC measures
- D. Owner or Engineer may identify additional temporary control measures if it appears pollution or erosion may result from weather, nature of materials, or progress on the work.
- E. Stormwater Pollution Prevention and Spill Plan
 - 1. The Contractor shall prepare a Stormwater Pollution Prevention and Spill Plan (SWPPS Plan) meeting the requirements of the SMMWW.
 - 2. At a minimum, SWPPS Plan requirements are:
 - a. A site plan showing the location and description of BMPs required to prevent pollution and control spills from construction activities and from chemicals and other materials used and stored by the Contractor on the construction site. Implement the following BMPs when applicable:
 - 1) Written spill prevention and response procedures
 - 2) Employee training on spill prevention and proper disposal procedures

- 3) Spill kits in all vehicles
 - 4) Regular maintenance schedule for vehicles and machinery
 - 5) Material delivery and storage controls
 - 6) Training and signage
 - 7) Covered storage areas for waste and supplies
 - b. A Pollution Prevention Report listing the potential sources of pollution and identifying the operational, source control, and treatment BMPs necessary to prevent and/or mitigate pollution from these sources.
 - c. A Spill Prevention and Cleanup Report describing the procedures and BMPs for spill prevention and including provisions for cleanup of spills should they occur.
 - d. Refer to the SMMWW for specific requirements for the Pollution Prevention Report and the Spill Prevention and Cleanup Report. -
- F. If Owner or Engineer orders the work suspended, continue to control erosion, pollution, and runoff during the shutdown.
- G. Nothing in this section shall relieve Contractor from complying with other contract requirements.

1.03 REFERENCED STANDARDS

- A. 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.
- B. 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
ASTM D882	Standard Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1388	Standard Test Method for Stiffness of Fabrics
ASTM D1777	Standard Test Method for Thickness of Textile Materials
ASTM D3776	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D4355	Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D4491	Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632	Test Method for Grab Breaking Load and Elongation of Geotextiles

Reference	Title
ASTM D4751	Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D5035	Standard Test method for Breaking Force and Elongation of Textile Fabric
ASTM D6460	Standard Test Method for Determination of Rolled Erosion Control Product Performance in Protecting Earthen Channels from Stormwater-Induced Erosion
Chapter 173-201A WAC	Water Quality Standards for Surface Waters of the State of Washington
COE	City of Everett, Design and Construction Standards and Specifications for Development
Construction Stormwater General Permit (CSWGP)	National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Stormwater Discharges Associated with Construction Activity, State of Washington, Department of Ecology
SMMWW	Department of Ecology's Stormwater Management Manual for Western Washington
WSDOT Standard Specifications	Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge, and Municipal Construction

1.04 QUALITY ASSURANCE

- A. Perform all work under this Section in accordance with all pertinent rules and regulations including, but not limited to, those stated in these Specifications. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.
- B. All fines imposed for improper erosion and sedimentation and control shall be paid by the Contractor responsible for the work.
- C. Do not allow activities which lead to violations of:
 - 1. Local and state Water Quality Standards for stormwater discharge, including, but not limited to surface water quality standards, ground water standards, sediment management standards and human health-based criteria in the National Toxics Rule (40 CFR PART 131.36)
 - 2. Local agency sewer discharge permits if discharge is placed in sanitary sewer system.
- D. Conform to the requirements of any project permits.

1.05 SUBMITTALS

- A. Procedures: Section 01 33 00 SUBMITTAL PROCEDURES
- B. Action Submittals:
 - 1. A copy of this specification section, addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations.
 - 2. Temporary Erosion Control and Sedimentation Control (TESC) Plan
 - a. Modified TESC Plans shall meet all requirements of the applicable jurisdictions.

- b. The TESC Plan shall cover all areas that may be affected inside and outside the limits of the project (including all Owner-provided sources, disposal sites, and haul roads, and all nearly land, streams, and other bodies of water).
 - c. Allow at least 5 working days for Engineer to review any original or revised TESC Plan. Failure to approve all or part of any such plan shall not make Owner liable to Contractor for any work delays.
 - d. Provide proposed changes to the TESC Plans for approval by the Engineer per jurisdictional requirements. Allow at least 5 working days for Engineer to review, approve and incorporate any revisions to the current TESC Plan.
- C. Informational Submittals:
 - 1. Certified Erosion and Sediment Control Lead (CESCL)
 - a. Submit name, credentials, experience and contact information.
 - 2. Construction Stormwater Pollution Prevention Plan (SWPPP)
 - a. Prior to any construction activity, the Contractor shall submit record copies of the approved SWPPP.
- D. Construction Submittals:
 - 1. Updates to the Stormwater Pollution Prevention and Spill Plan (SWPPS Plan)
 - 2. Record copies of inspection reports

1.06 DEFINITIONS

- A. Dry Season: May 1 – September 30.
- B. Wet Season: October 1 – April 30.
- C. Process Water:
 - 1. Process water discharges include, but are not limited to: truck wash water, tire bath wastewater, wheel wash water, equipment wash water, petroleum products, and chemical wastes.
 - 2. Water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.
 - 3. Water that comes in contact with uncured concrete.
 - 4. Decant water from excavated spoils stockpile.
 - 5. Sump pump discharge from excavation.
- D. NTU: Nephelometric Turbidity Units

1.07 SITE CONDITIONS

- A. See additional requirements in Section 31 23 00, Excavation and Fill and Section 01 11 10, Geotechnical Information.
- B. The Contractor shall provide BMP measures coordinated with their excavation limits, support system and dewatering plan to address stormwater and ground water flows within the disturbance limits.

1.08 DRAINAGE REQUIREMENTS

- A. Stormwater from any area under the influence of construction activities shall not be allowed to leave the site or drain to the existing stormwater drainage system without first removing sediment and other debris to be consistent with the specified BMPs and to meet required discharge standards.
- B. Convey stormwater from excavations, staging areas, stockpiles, embankments, and nearby upland areas to stormwater treatment systems or temporary sedimentation pond(s) or tanks provided by the Contractor.
 - 1. Construct temporary sedimentation pond(s) or enhanced treatment systems at location(s) designated on the approved TESC Plan. Contractor shall also provide necessary gravity or pumped conveyance systems to deliver the runoff to said facilities.
 - 2. When disturbed by construction activities, runoff shall be collected and re-routed to treatment facilities.
- C. Stormwater runoff from the site will be allowed to drain into the existing storm drain system, provided catch basin inserts, silt fences, or other approved measures are in place. Straw bales, tubes or similar measures that allow unfiltered overflow or bypassing during heavy rainfall events are not acceptable. Should measures prove ineffective, Contractor shall coordinate with the Owner's Representative to develop alternative measures, which may include plugging of the pipeline to the outfall and redirecting the flow to other areas within the site to temporary sedimentation pond(s) and/or enhanced treatment systems.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Silt Fence: Per BMP C233: Silt Fence as modified by COE Standard Detail 212 and WSDOT STANDARD SPECIFICATIONS 8-01.3(9)A2
 - 1. Filter fabric shall be Geotextile for Temporary Silt Fence per WSDOT Standard Specification 9-33.2(1) Table 6, equal to Mirafi 100X, inert to chemicals commonly found in soil and resistant to mildew, rot, insects, and rodent attack.

Geotextile Property	Test Method	Posts with Wire or Polymeric Mesh
AOS slit	ASTM D4751	0.60 mm max. for film woven (#30 sieve). 0.30 mm max. for all other geotextiles. 0.15 mm min. (#100 sieve).
Water permittivity	ASTM D4491	0.02 sec-1 min.
Grab Tensile Strength	ASTM D4632	100 lbs. min.
Grab Failure Strain	ASTM D4632	30% max. at 180 lbs. or more
Ultraviolet (UV) Radiation Stability	ASTM D4355	70% strength retained min., after 500 hrs. in weather meter

- 2. Temporary silt fence wire backing per 2.01 D:
- 3. Install Temporary Silt Fence in accordance with DSSC Standard Detail 214.
- 4. Perform maintenance in accordance with WSDOT STANDARD SPECIFICATIONS 8-01.3(9)a, and 8-01.3(15). Wire Fabric: 2-inch x 2-inch mesh, 14 gauge.

B. Erosion Control Matting and Blankets

1. BMP C122: Nets and Blankets
2. Temporary erosion control blanket shall be made of natural plant fibers. Supply independent test results meeting the following:
 - a. For installations steeper than 3H:1V : WSDOT Standard Specifications Section 9-14.5(2) Table 6
 - b. For installations flatter than 3H:1V: WSDOT Standard Specifications Section 9-14.5(2) Table 7
 - c. For ditch applications: WSDOT Standard Specifications Section 9-14.5(2) Table 8
3. Stapling and Anchoring Materials: Staples shall be used to anchor temporary blankets. U-shaped wire (11 gauge or greater) staples with legs at least 6 inches in length and a crown of one inch or appropriate biodegradable staples can be used. Staples shall be of sufficient thickness for soil penetration without undue distortion.

C. Reinforced Plastic Fabric

1. Per BMP C123: Plastic Covering
2. Plastic covering shall meet the requirements of ASTM D4397 for polyethylene sheeting
 - a. ASTM D4397 for polyethylene sheeting.
 - b. Construed, copolymer laminate.
 - c. Physical strength requirements:
 - 1) Tear strength, lbs.: 130 per ASTM D1004.
 - 2) Elongation: Less than 50 percent per ASTM D4632.
 - 3) Minimum life expectancy: 2-1/2 years of outdoor exposure.
 - d. Reinforcing: Non-woven grid of high strength nylon cord submerged in a permanently flexible adhesive medium.
 - e. Equal tear resistance in all directions.
 - f. Ultraviolet light stabilized.
 - g. Material to be from a single manufacturer.

D. Geotextile Fabric

1. Stabilized construction entrance geotextile fabric shall meet the following:

Property	Test	Survivability
AOS Sieve	ASTM D4751	20-45 US Standard Sieve
Grab Tensile Strength	ASTM D4751	200 psi min
Grab Tensile Elongation	ASTM D4632	30% max.
Mullen Burst Strength	ASTM D3786	400 psi min.

2. Soil Separation and Stabilization
 - a. Per WSDOT Standard Specifications Section 9-33.2(1) Table 3.
3. Temporary silt fence geotextile fabric shall meet the following:
 - a. Per WSDOT Standard Specifications Section 9-33.2(1) Table 6.

E. High Visibility Fence

1. High visibility fence shall be composed of a UV stabilized, high-visibility orange, high-density polyethylene or polypropylene mesh at least four feet in height. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.
2. Support posts shall be wood or steel in accordance to Standard Plan I-10.10. The posts shall have sufficient strength and durability to support the fence through the life of the project.

F. Temporary Silt Fence

1. Temporary silt fence shall be a minimum of 5 feet in height, and fabric shall meet the requirements Section 2.01, Geotextiles.
2. Support posts shall be in accordance with the Standard Plans.
3. The posts shall have sufficient strength and durability to support the fence through the life of the project.

G. Quarry Spalls

1. Per WSDOT 9-13.1(5), conform to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
8 inch	100
3 inch	40 max
3/4-inch	10 max

2. For construction entrances, meet the above requirements with the exception that the percent passing the 3/4-inch screen shall be limited to 5 percent maximum.

H. Storm Drain Inlet Protection

1. Prefabricated units specifically designed for storm drain inlet protection per Standard Detail C11001C.
2. Remain securely attached to the drainage structure when fully loaded with sediment and debris.
3. Lifting handle for removal.
4. Overflow to prevent ponding.
5. Drain Guard, Silt Sack, or Approved Equal.

I. Compost Filter Sock

1. Compost material encased in a biodegradable mesh tube. See Standard Detail C12001P for more information.
2. Compost sock shall have a minimum diameter of 8 inches and shall be free from any type of preservative.
3. Sock shall be a mesh tube, oval to round in cross section and shall be clean, evenly woven, and free of encrusted concrete or other contaminating materials and free from cuts, tears, broken or missing yarns and thin, open or weak places.

4. Sock shall have a minimum tensile strength of 44 psi.
 5. Sock shall be composed of either degradable plastic or polyester netting or composed of biodegradable jute, sisal, burlap, or coir fabric.
 6. Sock shall have a life expectancy of approximately one year.
- J. Sandbags
1. See Standard Detail C12001P for more information.
 2. Sandbag length shall be 24 inches. Width shall be 16 inches. Sandbag thickness shall be 6 to 8 inches.
 3. Minimum weight of a sandbag shall be 50 pounds.
 4. Sandbag material shall be polypropylene, polyethylene or polyamide woven fabric with a minimum unit weight is 4 ounces per square yard, with a mullen burst strength exceeding 300 psi in conformance with the requirements in ASTM D3786; and ultraviolet stability exceeding 70 percent in conformance with the requirements in ASTM D4355.
 5. Clean coarse sand shall be used inside the sandbag.
- K. Enhanced Treatment System
1. Temporary on-site water treatment system that removes turbidity from site stormwater in compliance with the City and Washington State Department of Ecology requirements.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site. If, in the opinion of the Engineer, the Contractor's temporary erosion and sedimentation control measures are inadequate, the Contractor shall provide additional maintenance for existing measures or additional devices to control erosion and sedimentation on the site at no additional cost to the Owner.
- B. All erosion and sedimentation control devices and structures shall be inspected by the CESCL, as defined by State and local regulations, whichever is more stringent. Frequency of all inspections shall be determined by NPDES permit requirements as outlined in the prepared TESC, Stormwater Pollution Prevention Plan (SWPPP) and State and local permit regulations.
- C. All erosion and sedimentation control measures and devices shall be constructed and maintained as indicated on the Drawings, in the prepared SWPPP, or specified herein until adequate permanent disturbed area stabilization has been provided and accepted by the Engineer. Once adequate permanent stabilization has been provided and accepted by the Engineer, all temporary erosion and sedimentation control structures and devices shall be removed.
- D. Construction activities must avoid or minimize excavation and creation of bare ground during wet weather.

- E. The intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments.
- F. Inspect BMPs in accordance with the schedule in the Ecology NPDES permit or as directed by Engineer.
- G. Complete an inspection report within 24 hours of an inspection. Each inspection report shall be signed and identify corrective actions. Document that corrective actions are performed within 7 days of identification. Keep a copy of all inspection reports at the site or at an easily accessible location.
- H. Initiate repair or replacement of damaged erosion and sediment control BMPs immediately and work completed by end of next work day. Significant replacement or repair must be completed within 7 days, unless infeasible.
- I. Within 24 hours, remediate any significant sediment that has left construction site. Investigate cause of the sediment release and implement steps to prevent a recurrence of discharge within same 24 hours. Perform in-stream cleanup of sediment according to applicable regulations.
- J. At end of each work day, stabilize or cover soil stockpiles or implement other BMPs to prevent discharges to surface waters or conveyance systems leading to surface waters.
- K. Temporarily stabilize soils at end of shift before holidays and weekends, if needed. Ensure soils are stable during rain events at all times of year.
- L. Initiate stabilization by no later than end of next work day after construction work in an area has stopped permanently or temporarily.
- M. Provide permanent erosion control measures on all exposed areas. Do not remove temporary sediment control practices until permanent vegetation or other cover of exposed areas is established. However, do remove all temporary erosion control measures as exposed areas become stabilized, unless doing so conflicts with local requirements. Properly dispose of construction materials and waste, including sediment retained by temporary BMPs.

3.02 SEQUENCING AND SCHEDULING

- A. Submit a TESC Plan for each phase of construction or whenever significant modifications are made to the current TESC Plan or its implementation.
 - 1. Contractor shall revise the TESC Plan and its implementation as needed or when requested by the Owner's Representative based on the actual construction methods, procedures, and observed performances of the provided measures.
- B. Establish measures identified for implementation prior to commencing any clearing, grading, excavation, or other work that will disturb the ground surface. Surface water drainage and erosion and sediment control devices must be provided before other work commences.

- C. Perform periodic inspections as required by the TESC Plan.
 - 1. The frequency will depend on the time of the year and the construction activities underway at any given time.
 - 2. Unless otherwise required, each TESC measure shall be inspected daily and immediately after each rainfall event greater than 0.1 inch of rainfall in 24 hours.
 - 3. Prepare TESC Inspection Reports for each inspection and include the report in the TESC file and Site Log Book.
 - 4. Submit a record copy of each report to the Owner's Representative daily.
 - 5. Preparing and maintaining an TESC file and Site Log Book.
- D. Maintain TESC measures for the duration of the contract and/or until restoration of surfaces and ground cover is established to prevent erosion and sedimentation and to ensure stormwater, groundwater and surface flows will be conveyed and controlled in accordance with applicable regulations.
- E. TESC measures shall be installed, maintained, and removed as indicated in the most recent revision of the approved TESC Plan.
 - 1. Any maintenance of facilities which might necessitate unavoidable interruption of operation shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Owner's Representative.
- F. Submit a separate Final TESC Plan for erosion control and BMP measures that will remain in place after completion of construction, and indicate temporary measures that will be removed. Install permanent erosion control measures and final landscaping as soon as practical after final earthwork activities have been completed within a specific area of Work.
- G. Submit the TESC Plan and receive a review action of "1" or "2" per 01 33 00 prior to commencement of Work.
- H. Install perimeter protection prior to clearing and grubbing.
- I. Construct erosion and sediment control BMPs prior to commencing trenching, cut and fill, or other earthwork activity.

3.03 SITE PREPARATION

- A. Prior to clearing, demolition below grade, excavation, and placement of fill; install clearing limits fences, perimeter silt fences, temporary stabilized construction entrance and perimeter control.
- B. Prepare Site for surface water to flow away from excavations and disturbed soils.
- C. Sediment control BMPs (sediment tanks, traps, diversion dikes, berms, etc) shall be constructed as a first step in grading. These BMPs shall be functional before other land disturbing activities take place.

- D. The boundaries of the clearing/construction limits indicated on the Drawings shall be clearly marked in the field by a continuous length of high visibility fencing.
 - 1. No disturbance beyond the clearing limits shall be permitted.
 - 2. Maintain the clearing limit fencing for the duration of construction.
- E. Protect storm drainage inlets to drainage system from sediment influx by installing and maintaining inlet protection.
- F. In preparation of paving, clean all catch basins and conveyance lines. The cleaning operation shall not flush sediment-laden water into the downstream system.
- G. Prepare any permanent flow control facilities that will be used as a temporary settling basin with the necessary erosion control measures and provide adequate storage capacity.

3.04 INSTALLATION

- A. Soils and Slopes
 - 1. If soil stockpiles (imported or native) are placed on or along a street Right-of-Way, these shall be covered with plastic at all times when not being actively worked, use hold-downs where appropriate.
 - 2. Any areas of exposed soils (i.e. excavated areas, spoil piles and imported or stored fill) that will not be disturbed for two days during the wet season or seven days during the dry season shall utilize approved erosion control BMP methods to prevent turbid runoff into surface waters.
- B. Temporary Spoil Piles
 - 1. Place material in a contained area with sediment control.
 - a. Contain area with ecology blocks and/or sediment fences to control runoff.
 - b. Cover or use sprinkler to control dust and sediment runoff.
- C. Erosion Control Matting and Blankets
 - 1. Provide cover measures to protect all disturbed areas from erosion, including flat graded areas, the faces of cut and fill slopes, and stockpiles.
 - a. Provide cover measures if an area is to remain unworked for more than seven (7) days during the dry season (May 1 to September 30) unless otherwise approved by the Owner's Representative on a case-by-case basis.
 - b. Provide cover measures if an area is to remain unworked for more than two (2) consecutive days during the wet season (October 1 to April 30), unless otherwise approved by the Owner's Representative on a case-by-case basis.
 - c. Cover slopes and stockpiles with side slopes 3:1 or steeper that will remain unworked for more than 12 hours.
- D. Plastic Sheeting
 - 1. The use of plastic sheeting shall be limited to the covering stockpiles, or very small graded areas for short periods of time. Duration of installation is limited to 30 days before permanent measures are installed.
 - 2. Embed edges a minimum of 6 inches in soil around the entire perimeter of plastic sheeting.

3. Overlap joints with minimum two feet lap and tape seam.
4. Install hold downs at all excavation faces and at stockpiles.
5. Secure hold downs with polypropylene rope at ten feet on center, 10 feet maximum each way, across the entire surface of plastic sheeting.
6. Anchor the polypropylene rope by driving 2-inch x 4-inch stake at the top of excavations or bottom of stockpiles and tying rope to stake.
7. Sandbag hold-downs:
 - a. Secure with 1/4-inch polypropylene rope at ten feet on center maximum each way.

E. Stabilized Construction Entrance

1. Per BMP C105, Stabilized Construction Entrance SMMWW
2. Establish Construction entrances at transitions from disturbed areas to paved areas, including on-site paved areas.
3. Construction entrances shall be a minimum of 100 feet in length and shall provide full width of ingress/egress area (15 feet minimum).
4. Provide culverts where roadside ditches are present.
5. Installation:
 - a. Install in accordance with the Drawings and at all locations vehicles access and exit the Site.
 - b. Constructed of 4-inch to 8-inch quarry spalls, placed to a minimum thickness of 12 inches.
 - c. Separation geotextile shall be placed under the quarry spall to prevent fine sediment from pumping into the rock pad.
 - d. Install driveway culvert if there is a roadside ditch present.

F. Wheel Wash

1. Per BMP C106, Wheel Wash, SMMWW
2. Provide a wheel wash station at the construction site exit to serve traffic exiting the site and prevent tracking of dirt or other construction debris onto the access road.
3. Use of the wheel wash is not necessary for vehicles that only enter onto the stabilized areas that will not cause tracking of dirt.
4. Operate, maintain, and adjust the wheel wash station to provide high pressure spray to the tires, underside, sides, front, and back of all vehicles using high pressure sprays. The wash-off water shall be collected in a closed-loop, recycled water system; with solids collected, monitored, and removed regularly; and wash water disposed occasionally in compliance with the construction permits. If the Owner's Representative deems the vehicle wash spraying to be inadequate for permit compliance assurance, Contractor shall modify or adjust the system or perform manual spraying that does so.

G. High Visibility Fence

1. Install high-visibility fence in areas to:
 - a. Restrict clearing to approved limits
 - b. Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.

- c. Limit construction traffic to designated construction entrances, exits, or internal roads.
 - d. Protect areas where marking with survey tape may not provide adequate protection.
 - 2. Installation:
 - a. Posts for fencing shall be placed every 6 feet on center (maximum) or as needed to ensure rigidity. Fencing shall be fastened to the post every 6 inches with a polyethylene tie. On long continuous lengths of fencing a tension wire or rope shall be used as a top stringer to prevent sagging between posts,
- H. Temporary Silt Fence
- 1. Comply with the installation detail shown in the Standard Details. Secure wire fabric and geotextile fabric to the upslope side of posts. Posts shall not exceed the spacing shown on the Standard Detail.
 - 2. Install silt fences around the perimeter of all stockpiles.
 - a. Install filter fabric over wire backing.
 - b. Secure filter fabric to wire fabric:
 - 1) Secure at top, middle, and bottom of each post.
 - 2) Wire fabric to extend to the top edge of the above ground filter fabric.
 - c. Use steel fence posts.
 - 1) Set posts at six foot on-center maximum.
 - d. Bury wire fabric in trench upslope and adjacent to the steel posts for the full length.
 - e. Bury bottom 8 inches of fabric in a 4x4 trench upslope.
 - f. Field joints:
 - 1) Lap joints:
 - a) 2-foot minimum.
 - b) Remove all dirt, dust, moisture, and foreign materials.
 - c) Splice only at support posts with wire fabric.
 - 2) Repairs:
 - a) Patch with filter fabric.
 - b) Extend lap six inches from damaged area in all directions.
 - c) Proceed as specified for joint.
- I. Storm Drain Inlet Protection
- 1. Storm Drain Inlet Protection shall be installed at all inlets under the influence of construction activities and maintained throughout construction. Install at all locations indicated on the Drawings, TESC Plan, and where inspection deems necessary.
 - 2. Install according to Manufacturer's recommendations.
 - 3. Install in provided or replaced catch basins and storm drain inlets prior to allowing any water to flow into the catch basin or storm drain inlet.
 - 4. Install in catch basins and storm drain inlets prior to any earth disturbing activity uphill of the structure and prior to allowing any water to flow into the structure.

J. Compost Filter Socks

1. Install as shown on the Drawings.
2. Upon completion of project cut open compost sock, spread soil, and remove and dispose of mesh sock.

K. Check Dams

1. Sandbag check dams:
 - a. Install at all locations indicated on the Drawings and at all locations required by the TESC Plan.
 - b. Stack sandbags at least 2-3 bags high and 1-2 bags thick.
 - c. Butt ends of bags tightly.
 - d. Overlap butt joints of row beneath with each successive row.
 - e. Leave a weir gap at the center of the check dam.
 - 1) Ensure that the edges of the structure are at a higher elevation than the weir gap to prevent flow from escaping around the sides of the dam.
 - 2) Place a sandbag(s) as a splash pad on the downstream side of the weir opening.
2. Rock check dam:
 - a. Construct out of 4-inch to 8-inch quarry spalls.

L. Pipe Slope Drains

1. Install at all locations where storm water will be conveyed over cut or fill slopes or away from bare soils to prevent gullies, channel erosion, and saturation of slide-prone soils.
2. Install diversion dikes or swales to collect and route water to the slope drain at the top of the slope.
3. The soils around and under the pipe and entrance section shall be compacted to prevent undercutting.
4. The pipe shall be secured to prevent movement.
5. The area below the outlet shall be stabilized with an energy dissipation structure.

M. Sediment Ponds and Traps

1. Divert all stormwater runoff from the construction area to a sediment pond, sediment trap, or enhanced treatment system before disposal.
2. Provide overflow structure and piping for each sediment pond and sediment trap, where shown on the approved TESC Plan.
3. Immediately inform the Owner's Representative whenever an overflow from any of the sediment ponds or traps is imminent.

N. Catch Basin Closure and Sump Pump System

1. Install a properly sized plug in the underground pipe outlet when site water discharge to a catch basin in a drainage system, public or private, exceeds 25 NTU.
2. Install an automated electrical sump pump in the basin and pump site water exceeding 25 NTU to the site discharge location per Section 31 23 19, DEWATERING.

3.05 MAINTENANCE

- A. Inspect, maintain, and repair measures on a regular basis to assure continued performance.
 - 1. Maintain and modify the measures throughout construction to meet specified and/or permit requirements and as indicated in the TESC Plan.
 - 2. If erosion is occurring, immediately make modifications to stop erosion and to mitigate the sedimentation.
 - 3. If temporary measures are no longer needed, they may be removed with the approval of a revised TESC Plan.
 - 4. Repair or replace damaged or missing items immediately.
 - 5. Maintain seeded surfaces throughout construction.
 - 6. Inspect each TESC measure daily and immediately after each rainfall event greater than 0.1 inch of rainfall in 24 hours per paragraph 3.02.C.2 and perform proper maintenance as required.
- B. Sediment Removal
 - 1. Remove accumulated sediments from sediment ponds and traps when the accumulated sediment depth reaches 12 inches.
 - 2. Remove sediment from behind silt fences when deposits are 6 inches deep or greater.
 - a. Inspect uphill side of silt fence for signs of fence clogging, acting as a barrier to flow, and causing channelization of flows parallel to fence. Remove trapped sediment and replace silt fence.
 - b. Replace filter fabric where clogged, damaged, deteriorated due to ultraviolet light breakdown, or as directed by the Owner's Representative.
 - 3. Remove sediment from catch basin inserts and/or replace inserts when no longer providing filtration and through-flow.
 - 4. Prevent sediments from being flushed to the downstream system during cleaning.
- C. Sediment Disposal
 - 1. If sediment has obvious contamination such as unusual color, staining, corrosion, unusual odors, fumes, or oily sheen, notify the Owner's Representative for direction.
 - 2. Disposal of sediment that does not have obvious contamination:
 - a. May be distributed uniformly across the areas that are to be seeded prior to the seeding operation.
 - b. Disposed of at an on-site location designated by the Owner's Representative.
- D. Be responsible for the implementation of the TESC Plan, including all revisions, and the construction, inspection, maintenance, replacement, and modification of the erosion and sedimentation control facilities.
- E. Make revisions to the TESC Plan and perform the work necessary to meet the requirements of the SMMWW.
- F. If unanticipated site circumstances require installation of additional BMPs, the additional BMPs shall be installed within ten calendar days.

- G. Use form "Construction Stormwater Site Inspection Checklist" from Ecology Publication #06-10-020 or approved equal to conduct weekly Construction Site Stormwater Site Inspections:
 - 1. Assign a CESCL to conduct these inspections as required by Ecology NPDES permit.
- H. Inspect BMPs as required in this Section and by the permits. When results of weekly Construction Stormwater Site Inspection Checklist show that a BMP needs repair or maintenance or that an additional BMP is needed, the corrective actions must be implemented within 10 days of the date of the inspection.
- I. Prevent solids or turbid runoff from entering storm drains or local surface water bodies by utilizing appropriate source control BMPs.
- J. Where erosion occurs, make modifications to the source control BMPs to eliminate the cause of the erosion and then mitigate its effects.
- K. Street Cleaning
 - 1. See Section 01 50 00.
- L. Erosion Control Matting and Blankets
 - 1. Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
 - 2. Fix and repair eroded areas.
- M. Plastic Sheeting
 - 1. Inspect installed sheeting for erosion, undermining, and anchorage failure.
 - 2. Repair any failures immediately.
 - 3. Replace torn sheets and repair open seams.
 - 4. Remove all plastic sheeting when no longer needed.
- N. Temporary Silt Fence
 - 1. Remove sediment from behind silt fences when deposits are 6 inches deep or greater.
 - 2. Remove filter fabric where deteriorated.
 - 3. Replace sections of filter fabric that have been torn or ripped.
- O. Storm Drain Inlet Protection
 - 1. Remove sediment and replace inserts when no longer providing filtration and through-flow according to manufacturer's recommendations.
- P. Check Dams
 - 1. Remove accumulated sediments when the accumulated sediment depth reaches 6 inches or $\frac{3}{4}$ of the height of the check dam, whichever is first.
 - 2. Prevent sediments from being flushed to the downstream system during cleaning.

- Q. Catch Basin Closure and Sump Pump System
 - 1. Operate and maintain pipe plug to prevent leakage.
 - 2. Replace plug if leaks cannot be stopped.
 - 3. Operate and maintain automated sump pump to ensure site water in closed catch basins is discharged to the site water treatment system at all times

3.06 COMPLETION OF CONSTRUCTION

- A. TESC BMPs
 - 1. Shall be kept operational until the Site has undergone final stabilization (e.g., soils have been stabilized by permanent measures, landscaping is installed, etc.) and through Substantial Completion of the Work.
 - 2. Remove within 30 days after the Site has undergone final stabilization.
 - a. Remove TESC measures in accordance with the TESC Plan unless directed otherwise by the Owner's Representative.
 - 3. Removal procedures shall ensure that trapped sediments are removed and disposed of correctly. Trapped sediments shall not be released to the storm drainage system.
 - 4. When removing silt fences and diversions, ensure trapped sediments are removed along with the fence and diversion materials, or are stabilized, so that sediment will not be eroded in the future and carried into the surface water drainage system.
 - 5. Components of the TESC measures shall be the property of the Contractor. The Contractor shall be responsible for transport and disposal in accordance with local, state, and federal regulations.
- B. Final Clean-up shall be performed in accordance with the requirements of Section 01 74 23, OPERATION AND MAINTENANCE DATA.

3.07 SYSTEM COMPLIANCE

- A. The Project Representative and regulatory agencies will determine the effectiveness of the TESC Plan.
- B. Upgrade and modify TESC Plan as required within five days of written Correction Notice from the Project Representative until effective. Refusal to modify and upgrade the TESC Plan may result in the work being completed by the Project Representative and the cost of the work being deducted from the Application for Payment.
- C. Non-compliance with the erosion control requirements and water quality requirements may result in stoppage of work.

END OF SECTION

SECTION 31 50 00
EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for excavation support systems of trenches and open excavations. Where sheet piling, shoring, sheeting, bracing, or other supports are necessary, remove all, except as shown or specified otherwise.
- B. This Section also specifies requirements for support of Snohomish County PUD (SnoPUD) facilities

1.02 REFERENCED STANDARDS

- A. This Section incorporates by reference the latest revisions of the embedded standard referenced herein. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

Reference	Title
WAC 296-155	Washington Safety Standards for Construction Work
WAC 296-155 Part N	Excavation, Trenching, and Shoring

1.03 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES
- B. Action Submittals:
 - 1. Design documents including detailed excavation support drawings and installation and removal plan and sequencing. Provide information required by the Washington Safety Standards for Construction Work (WAC Chapter 296-155 Part N).
 - 2. Provide procedures for drilling or driving shoring required for installation and removal of the excavation support system.
 - 3. Structure, settlement, tilt monitor and Vibration and settlement monitoring results.
 - 4. Design for utility pole bracing and support meeting the requirements of Snohomish County PUD (SnoPUD).

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Excavation Support Systems Designer: Professional Engineer currently registered in the state of Washington with a minimum of three years' experience in the design of earth retaining structures for temporary construction of similar type and depth proposed in similar soil and groundwater conditions in this Contract.
 - 2. All welders shall hold current certification by AWS (American Welding Society).

1.05 DESIGN REQUIREMENTS

- A. The design, planning, installation, and removal, of all sheeting, shoring, sheet piling, lagging, and bracing shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
- B. Design sheeting, shoring and bracing in accordance with WAC 296-155 Part N.
- C. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
- D. Design to include dewatering requirements for support of the excavation and its support system. Construction at the Port Garnder Storage Facility (PGSF) is anticipated to occur concurrently with the pipeline construction included in this bid document. The length of excavation open at one time shall be coordinated with the PGSF contractor to limit the combined construction dewatering discharge rates to the allowable rates provided in Section 01 12 16 Exhibit A-1. Comply with Section 31 23 19 DEWATERING.
- E. Address vibration and settlement effects on the surrounding structures, utilities, and property. Comply with Section 31 09 11 SETTLEMENT AND VIBRATION MONITORING.
- F. Where applicable, the design shall be in accordance with the IBC, with special inspection and testing as required.
- G. Soil parameters and loading requirements shall be in accordance with the following:
 - 1. Use earth, groundwater, and surcharge pressures provided in Attachment B, Geotechnical Report, as the minimum design parameters. Loading shall be increased as necessary to account for construction activities, sequencing, and loading.
 - 2. Material stresses for any part of the excavation support system shall not exceed the prescribed stress by more than 20 percent. Overstressing shall not be allowed for any element of the excavation support system.
 - 3. Pile embedment and bending moments shall be calculated using both Free Earth and Fixed Earth Support methods. The design shall be able to withstand the largest calculated value for both the embedment and bending moments.
 - 4. Struts or other structural components shall be designed to withstand the maximum load produced using the following calculations: Free Earth Support, Fixed Earth Support, and Apparent Earth Pressure.
- H. Excavation Support System within an existing railroad track, footing or foundation zone of influence
 - 1. The zone of influence shall be a line that slopes down at a 1:1 slope from the edge of the footing or foundation nearest an excavation of any type.
 - 2. Excavation that enters the zone of influence is any excavation below the Zone of Influence Line.
 - a. Any excavation that enters the zone of influence shall be supported to prevent settlement, displacement or cracking of the existing footing, foundation or structure.
 - b. Trench boxes are not an acceptable means of excavation support for excavations within a zone of influence.

- c. Slide rail systems that fit tight to the excavated soils are an acceptable means of excavation support for excavations within a zone of influence provided that installation does not adversely affect the existing structure, footing or foundation by settlement, displacement or cracking during installation or removal.
 - d. Soldier piles and lagging, tangent piles, secant piles and sheet piles, that are tight to the excavated soils, are acceptable means of excavation support provided that their installation does not adversely affect the existing structure, footing or foundation by settlement, displacement or cracking during installation or removal.
- I. Utility pole bracing when excavation is within close proximity to existing electrical poles.
- 1. Excavation, particularly along the southern side of the site, will be close to two overhead high voltage power poles owned by SnoPUD. Excavation will be within the prism requiring pole bracing during excavation through complete backfilling and compaction operations. Pole bracing shall meet the requirements of SnoPUD and shall consider the soil type, offset of edge of excavation, excavation depth, and electrical pole foundation dimensions and depth.
 - 2. Contractor shall notify and coordinate with SnoPUD for bracing requirements, inspections, approval of bracing system, and installation. Copies of the SnoPUD bracing plan shall be provided to the City.

1.06 SUPPORT SYSTEM REQUIREMENTS

- A. Submit design calculations and method of installation and removal of all sheeting, sheet piling, shoring, and bracing.
- B. Submittal review will be to assure the Owner of the Contractor's general compliance with the references and shall not be construed as a detailed analysis for the adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.
- C. Information to be provided shall include the following:
 - 1. All calculations, methods, and installation and removal procedures shall be prepared by, stamped, dated and signed by a professional engineer currently registered in the State of Washington. The engineer is required to meet the criteria as developed in Washington State law and the requirements of the local jurisdiction in which the facility is being built.
 - 2. Comply with applicable requirements of the Washington State Administrative Code and the rules of the WISHA Department of Labor and Industries with respect to excavation and construction.
 - 3. When the construction sequence of structures requires the transfer of bracing to portions of any new structure or to any existing structure, provide a complete design analysis of the expected impact of that bracing on the structure. This action shall in no way absolve the Contractor of responsibility of damage resulting from said bracing.

- D. Excavation will be required adjacent to retaining walls, elevated structures and other improvements. Maintain a minimum 2-foot offset between shoring and existing retaining wall footings. Shoring must account for surcharge loading due to the presence of adjacent structures. Provide monitoring of adjacent retaining walls, elevated structures and other improvements along Lower Norton Avenue and WMVD.
- E. Internally braced soldier pile shoring is required to support the existing retaining wall supporting West Marine View Drive located between approximately Sta of 27+60 to 24+60 of the 48-inch diameter storm drain as shown on sheet C-2311 of the project plan.

PART 2 PRODUCTS

2.01 SHORING

- A. For shoring within the zone of influence to existing structural foundations, railroad tracks and supports, trench boxes are not permitted, slide rails or internally braced soldier pile walls must be used as described in 1.05. Design Requirements.

PART 3 EXECUTION

3.01 GENERAL

- A. Construct the excavation support systems in such a manner as to not disturb the state of soil adjacent to the trench or excavation and below the excavation bottom.
- B. Unless otherwise indicated, remove all sheeting, shoring, and bracing after placement and compaction of backfill.
- C. Abandoned elements of excavation support systems shall be indicated on the Record Drawings.
- D. Excavation support must account for the load from containers stacked on the adjacent property to prevent any settlement from excavation or dewatering for installation of the facilities proposed under this contract. Excavation support must avoid conflict with the overhead power lines and power poles. Coordination with SnoPUD is required and must be consulted to approve the intended excavation support design and plan.

3.02 MONITORING

- A. Monitor for vibration and settling per Section 31 09 11, SETTLEMENT AND VIBRATION MONITORING.

END OF SECTION

SECTION 31 63 33
DRILLED MICROPILES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies drilled micropiles to be installed by the Contractor to develop the ultimate load capacities shown in the following table. The location, sizes, batter, and materials are shown on the Contract Drawings. The micropile depths shall be determined by the Contractor in order to develop the required ultimate capacity within the non-liquefiable dense glacial soils. A permanent steel casing shall be installed through the liquefiable soils and embedded a minimum of 5 feet into the non-liquefiable dense glacial soils and to a minimum elevation of minus 12 feet.

MH ID	Design Ultimate Pile Capacity	Static Ultimate Capacity of Liquifiable Zone for 9 5/8" Pile	Test Load
	kip	kip	kip
SSMH 010	-	-	-
SSMH 011	80	15	95
SSMH 200	80	21	101
SSMH104	-	-	-
SSMH105	80	15	95
SSMH106	80	21	101
SSMH107	80	21	101
SSMH108	80	21	101
SSM 508	-	-	-
SSM 509	80	15	95
SSM 600	80	21	101

- B. The micropile load capacities shall be verified by verification and proof-load testing as required:
1. One pre-production verification test shall be conducted on a sacrificial micropile.
 2. One proof-load test shall be conducted per manhole structure.
 3. Loads assume micropile installation from existing ground surface.
- C. Contractor shall furnish all design, materials, products, accessories, tools, equipment, services, labor and supervision, and manufacturing techniques required for design, installation, and testing of micropiles for the Work.

1.02 QUALITY ASSURANCE

- A. References:
1. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case 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 time of Invitation to Bid notice. 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, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ASTM C33	Concrete Aggregates
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Portland Cement
ASTM C494	Chemical Admixtures for Concrete
ASTM C618	Fly Ash and Raw or Calcified Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM D3689	Standard Test Method for Individual Piles Under Static Axial Tensile Load
ASTM D1143	Standard Test Method for Piles Under Static Axial Compressive Load
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A252	Welded and Seamless Steel Pipe Piles
ASTM A333	Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A615/A615M REV B	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A706/A706M REV B	Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A722	Uncoated High-Strength Steel Bars for Prestressing Concrete
ASTM A36/A36M	Structural Steel
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
FWHA-NHI-05-039	Micropile Design and Construction Reference Manual
COP -SCS	City of Portland Standard Construction Specifications, 2010 Version

1.03 REGULATORY REQUIREMENTS, SPECIAL INSPECTION

A. GENERAL:

1. Special Inspection of piling work shall be performed by the Owner's Special Inspector and in conformance with the COP-SCS. Special Inspection of piling is in addition to, but not replacing, other inspections and quality control requirements herein, such as paragraph 3.01 D. Where testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

B. PILING WORK TO RECEIVE SPECIAL INSPECTION:

1. All piling installation and testing shall receive Special Inspection in accordance with the International Building Code and requirements of the Geotechnical Engineering Report.

1.04 QUALIFICATIONS OF MICROPILE SUBCONTRACTOR AND PERSONNEL

- A. The micropile subcontractor shall be experienced in the construction and successful load testing of micropiles, evidenced by references for at least eight projects in the last five years with a minimum total of 100 micropiles. The on-site foreman and drill rig operators shall each have at least four years of experience and shall have been involved with at least four of the referenced projects. The micropile contractor shall assign a Micropile Design Engineer with at least three years of experience in design and construction of micropile foundations to supervise the Work.
- B. The Construction Manager will review references submitted to determine if those qualifications meet the project's needs. Acceptance criteria include, but are not limited to:
 - 1. Evidence of successfully designed and installed micropiles without claims requests. Field and/or payment adjustments responding to changed conditions shall not be considered claims requests.
 - 2. Successful design and installation are evidenced by piles which achieve specified strength, and which were installed without delay to schedule, as adjusted considering changed conditions or Owner-originated changes.

1.05 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES
- B. Action Submittals:
 - 1. Contractor's qualifications. Refer to paragraph 1.04 herein.
 - a. List of contractor reference projects, each indicating project name, owner name and telephone number, general contractor, date of work, type of micropiles, capacity of piling, number of piles, name of on-site foreman and drill rig operator.
 - 2. Detailed, step-by-step description of the installation procedures including personnel and equipment. Describe how surface water, drill flush and excess waste grout will be controlled and disposed. This information shall have sufficient detail to allow the Construction Manager to monitor the construction and quality of the micropiles.
 - 3. A minimum of two weeks prior to starting verification load testing, submit the micropile verification load testing program described in paragraph 3.03.
 - 4. Grout mix design and either confirming cylinder reports for this particular mix conforming to ACI Chapter 5, Section 5.6, or historical data similar to ACI Chapter 5, Section 5.3.
- C. Construction Submittals:
 - 1. Certified mill test results for reinforcing steel, casing and plates, or coupon tests for casing and plates if no mill certification is available.
- D. Closeout Submittal:
 - 1. Pile installation log and certification described in paragraph 3.01 herein.
 - 2. Pile Load test results described in paragraph 3.03 herein.

1.06 PRE-INSTALLATION MEETING

- A. A pre-installation meeting shall be scheduled by the Contractor at least 14 days prior to the start of micropile construction and after review and acceptance of submittal items. The Construction Manager, Contractor, micropile subcontractor, and Micropile Design Engineer shall attend. Attendance is mandatory. The pre-installation meeting will be held to clarify the construction requirements, testing protocol(s), coordinate and schedule activities, and identify relationships and responsibilities among the various parties.

PART 2 MATERIALS

2.01 MICROPILES

A. PILE TYPE:

- 1. Micropiling shall be Type B according to FWHA-NHI-05-039 with permanent casing extending through the compressible liquefiable stratum and approximately 5 feet into the dense glacial soils non-liquefiable stratum (EI -12 feet), neat cement grout as specified is placed under gravity or pressure full height, and with a single reinforcing bar centered along the pile length. Contractor may elect to use post-grout tube at his own discretion. The micropile locations, and sizes installed shall conform to the Drawings.

B. PERMANENT STEEL CASING/PIPE:

- 1. The permanent casing/pipe shall have minimum yield strength of 80 ksi and meet the requirements of ASTM A519, A106 or A252 or API N80 with mill certificates confirming minimum yield strength 80 ksi. Permanent casing shall be 9-5/8" in diameter and installed from the top of the pile to a depth of 5ft into the underlying non-liquifiable soil materials as identified in the Geotechnical Engineering Report. Below 5 feet into the non-liquifiable layer, the micropile may be uncased.

C. GROUT:

- 1. Neat cement or sand/cement mixture.
- 2. Compressive strength at 3 days: 2,000 psi
- 3. Compressive strength at 28 days, f'_g : 4,000 psi
- 4. Slump as required for placing and pumping: 9 inches $\pm$ minimum.
- 5. Sand conforming to ASTM C144.
- 6. Cement ASTM C150 Types II, III, or V.
- 7. Class F flyash optional, ASTM C618, not to exceed 20 percent of total cementitious materials.
- 8. Water/cement ratio at or below 0.42, including flyash.
- 9. Mix water conforms to specification Section 03 30 00.
- 10. Admixtures conform to ASTM C494.
- 11. This grout mix may be utilized in actual construction if supported by calculations and submittals, otherwise such submittals shall provide a different mix design and substantiating data.

D. REINFORCING:

1. Reinforcing shall conform to ASTM A 615 Grade 75 ksi, epoxy coated threaded bars for full length. Couplers shall develop 150 percent reinforcing bar strength and with a current ICC-ES Report.

E. CENTRALIZERS AND SPACERS:

1. Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, steel or material non-detrimental to the reinforcing steel. Wood shall not be used. Centralizers and spacers shall be securely attached to the reinforcement, sized to center the reinforcement in the pile, sized to allow grout tremie pipe insertion to the bottom of the drill hole, and sized to allow grout to freely flow up the drill hole and casing between adjacent reinforcing bars.

F. PLATES AND SHAPES:

1. Plates and shapes shall conform to Section 05 10 00.

PART 3 EXECUTION

3.01 MICROPILE INSTALLATION

A. GENERAL:

1. The micropile subcontractor shall select the drilling method, grouting procedure and the grouting pressure to use for the installation to meet the minimum ultimate load capacities specified in paragraph 1.01.
2. The drilling equipment and methods shall be suitable for drilling through the site-specific conditions. The drill hole must be open along its full length by means of temporary casing or other approved method prior to placing grout. Flushing and drilling of the pile shall be accomplished in such a way as to not move the pile out of horizontal alignment.
3. Each pile's installed centerline shall be placed within the specified tolerances from the location indicated on the Drawings. If piles are installed outside of these tolerances, the Contractor shall provide remedial measures as directed by the Construction Manager at no additional cost. Such remedial action may include installation of one or more additional piles and associated foundation changes required to effectively transfer the required loads.
4. Each pile's installation and associated testing shall be logged by the Special Inspector. After all piles have been installed, tested, and accepted, the Special Inspector shall submit a report summarizing such work and including the installation log for all piles.

B. REINFORCING:

1. Reinforcement may be placed either prior to grouting or placed into the grout-filled drill hole before the temporary casing is withdrawn. The Contractor shall adjust all installed micropiles to the planned elevations. Centralizers and spacers shall be placed on the reinforcing at 10-foot centers and a maximum 5 feet from the top of the pile. This reinforcing shall be lowered into the casing without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. The Contractor shall redrill and reinsert reinforcing steel when necessary.

C. GROUTING:

1. Micropiles shall be grouted the same day as pile is drilled. Inject the grout by beginning at the lower end of the drilled borehole. The drill hole and pipe casing shall be filled with specified grout free of voids from bottom to top of micropile. Post-grouting shall be accomplished in a timely manner according to the reviewed and accepted submittals.
2. Provide means and methods of measuring the grout quantity and pumping pressure of the grout during the grouting operations. Contractor shall keep records showing the quantities and pressures for inspection by the Construction Manager.
3. The grouting process shall produce a grout free of lumps and free, dry cement. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer shall be capable of continuously agitating the grout. The grout pressures and grout pumping shall be controlled to prevent excessive soil heaving (heaving greater than 3 inches at any time) due to grouting operations.

D. GROUT TESTING BY SPECIAL INSPECTOR:

1. The Owner's Special Inspector will conduct grout tests as follows:
 - a. For each day's grouting, cast and cure nine mortar cubes according to ASTM C109.
 - b. Test three cubes at 3 days and three at 28 days according to ASTM C109. Reserve three cubes for 56-day tests if required.
 - c. Strength results reported shall be the average of each three cubes tested, unless adjusted for faulty cubes according to ASTM C109. Report results of compressive strength tests within two days of the 3-day test and seven days after testing at 28 days.
 - d. For every ten piles grouted, test grout consistency and density according to ASTM C188.

E. PILE SPLICES:

1. Construct pile splices conforming to reviewed and accepted submittals to develop the full strength of the pile section. Lengths of pile to be spliced shall be secured in proper alignment and in such a manner that no eccentricity between the axes of the two lengths to be spliced, or angle between them results. Threaded casing is permitted provided the Contractor confirms it meets the required design capacity

3.02 TOLERANCES

A. Tolerances: Construct micropiles within the following tolerances.

1. Plan Location: Centerline of pile projecting from the ground shall be located within 3 inches from the position indicated on the Drawings.
2. Plumbness: Pile shall be plumb or battered within 1/8-inch in 10 feet.
3. Elevation: Top of pile shall be within plus 1 inch or minus 1 inch of specified elevation.

B. If specified tolerances are exceeded, prepare corrective design and submit for review and approval before proceeding.

3.03 PILE LOAD TESTS

A. GENERAL:

1. Pile load tests shall be performed to verify micropiles meet the capacity specified. Pile load test results shall be submitted, reviewed, and accepted by the Project Representative prior to beginning production piles. Grout shall attain adequate strength prior to load testing, minimum 2,000 psi.

B. VERIFICATION TESTS:

1. Pre-production Verification load test shall be performed to confirm the design load capacities of the micropiles for compression and uplift. The installation method, diameter, and depth of embedment for the test pile shall be identical as for the production piles. Perform the test at a location to be determined by the Owner's Representative.
2. One verification test pile shall be constructed. Tension test to loads shown in this Specification and the Geotechnical Engineering Report. The overall testing program shall conform to FWHA-NHI-05-039 Chapter 7 and herein.
3. The verification load tests shall be made by incrementally loading the micropile in accordance with the following schedule:

Proof Load	Hold Time (minutes)
AL ¹	1
0.25 DL ²	2.5
0.50 DL	2.5
AL	1
0.25 DL	2.5
0.50 DL	2.5
0.75 DL	2.5
AL	1
0.25 DL	2.5
0.50 DL	2.5
0.75 DL	2.5
1.00 DL	2.5
AL	1
0.25 DL	2.5
0.50 DL	2.5
0.75 DL	2.5
1.00 DL	2.5
1.50 DL	Creep Test ³
1.75 DL	2.5
2.00 DL	10
Maximum Test Load	
AL	1

¹ AL = Alignment Load = 0.05 Design Load

² DL = specified Design Load

³ Hold load at 1.5DL for 10 minutes. Record movement at 1, 2, 3, 4, 5 and 10 minutes. If movements between 1 and 10 minutes is greater than 0.04 inches hold for an additional 50 minutes. Record movement at 20, 30, 40, 50, and 60 minutes.

4. The micropile verification load test program shall indicate the minimum following information:
 - a. Type of apparatus for measuring the load.
 - b. Type of apparatus for applying the load.
 - c. Type of apparatus for measuring the pile deformation.
 - d. Type of reaction load system.
 - e. Hydraulic jack calibration report.
5. If a micropile verification test fails to meet the design requirements, the micropile subcontractor shall revise the installation procedure and repeat the verification test.

C. PROOF TESTING:

1. One proof-load test shall be conducted per manhole structure.
2. The proof tested micropiles shall be loaded to the test loads shown in paragraph 1.01. The central reinforcing bar shall be proportioned such that the maximum stress does not exceed 80 percent of the ultimate strength of the steel. The jack shall be positioned at the beginning of the test such that unloading and repositioning of the jack during the test will not be required.
3. The proof load tests shall be made by incrementally loading the micropile in accordance with the following schedule: (Utilize for both compression and tension loading.)

Proof Load	Hold Time (minutes)
AL ¹	
0.25 DL ²	2.5
0.50 DL	2.5
0.75 DL	2.5
1.00 DL	2.5
1.25 DL	2.5
1.50 DL	Creep Test ³
Maximum Test Load	
AL	1

1. AL = Alignment Load

2. DL = specified Design Load

3. Hold load at 1.5DL for 10 minutes. Record movement at 1, 2, 3, 4, 5 and 10 minutes. If movements between 1 and 10 minutes is greater than 0.04 inches hold for an additional 50 minutes. Record movement at 20, 30, 40, 50 and 60 minutes.

4. Measurement of pile movement shall be obtained to within 0.01 inch at each load increment. The load-hold period shall start as soon as the test load is applied and the pile movement, with respect to a fixed reference, shall be measured and recorded at 1, 2, 3, 4, 5, and 10 minutes.

D. ACCEPTANCE CRITERIA:

1. Strength test requirements will be considered acceptable if the micropile supports the specified test loads without failure.

2. For both verification and proof testing, the pile shall sustain the compression and tension design capabilities (1.0 DL) with no more than 0.50-inch total vertical movement at the top of the pile that is measured relative to the top of the pile prior to the start of testing.
 3. Deflection during 10-minute tests will be considered acceptable if the total movement between the 1 minute and the 10-minute reading is 0.04 inch or less.
 4. Creep Test: If the movement between 1 and 10 minutes exceeds 0.04 inch, the load may be held an additional 50 minutes and a creep curve plotted of movement versus the logarithm of time. If the creep curve shows a decreasing creep rate that is less than 0.08 inch, the test is successful. If the creep rate exceeds 0.08 inch per log cycle of time, then the load capacity of the pile shall be downgraded to a value of 65 percent of the load that the pile can support without excessive creep. Additional production piles may need to be installed for the reduced load capacity.
- E. Reporting Results: The Special Inspector shall provide the Construction Manager written confirmation concerning micropile testing within seven working days after the completion of the verification tests. This written confirmation will either confirm or reject the piles based upon the result of the tests.
- F. Remedial Work: When a micropile is rejected, either in verification or proof testing, the Contractor shall modify the design, the construction procedure, or both. These modifications may include, but are not limited to, installing replacement micropiles, modifying the installation methods, increasing the embedment length, or changing the micropile diameter. Any modification which requires changes to the structure shall have prior review and acceptance of the Construction Manager. Modification of piling design, piling construction procedures, or the structure supported so as to accommodate modified, additional, or relocated piling, shall be at the Contractor's expense. Remedial piling work due to changed conditions shall be considered extra work.

3.04 PROTECTION OF EXISTING FEATURES

- A. Pile installation shall be conducted so as not to damage existing buildings and structures, wet wells, and utilities on the site and immediately adjacent. Subgrade micropile work shall not occur until all existing utilities in the construction area have been located to verify clearance and, if necessary, relocated.

3.05 CLEANUP AND CLOSEOUT

- A. At the completion of pile installation, testing, and acceptance, Contractor shall demobilize all equipment used and clear the site of unused materials. Cuttings, excavated material, drilling mud and other waste materials shall be properly disposed of at an off-site location in accordance with laws and regulations.
- B. If work area is inside of an existing structure, the work area shall be cleaned sufficiently to reveal the existing structure and allow visual inspection. Should this inspection reveal damage or finish deterioration caused by the piling work, contractor shall effect repairs as directed by the Construction Manager at no additional cost.

- C. Contractor shall cooperate with Construction Manager to provide the pile installation log for review and acceptance.

END OF SECTION

SECTION 32 10 00
SURFACE RESTORATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies surface restoration. Provide all labor, equipment, materials, and services required to replace existing surfaces and improvements removed, damaged, or worn during performance of the Work.
- B. Restoration shall include surfaces, all improvements, and maintaining or detouring traffic including, but not limited to, utility covers and boxes, monuments, markers and striping, signage, permanent pavement and surfacing; sidewalks; curbs; gutters; valley gutters; and base and subgrade aggregate, driveways, traffic control devices (e.g. loop detectors) and all ancillary components removed or disturbed.
- C. Surface restoration shall meet the requirements of the government agency having jurisdiction (AHJ) of the right-of-way.
 - 1. This Work shall consist of the reconstruction and patching of trenches and other excavations in paved streets and other paved areas in accordance with COE Division 05.
 - 2. Improvements shall be reconstructed to equal or better, in all respects, than the existing improvements removed.
 - 3. In the case of conflict between the listed Agency's requirements and as required herein, the requirements affording the greatest protection to the Public and/or Owner shall apply, as determined by the Owner's Representative.
- D. Paving activities to conform with WSDOT 5-04.3(1) Weather Limitations.
- E. All materials are subject to testing and prior approval.
 - 1. Work within the Port property crosses and is adjacent to the Kimberly-Clark Worldwide MTCA Site and the ExxonMobil/ADC MTCA site, which are listed on the Washington State Department of Ecology's (ECY) Confirmed and Suspected Contaminated Sites List.
 - 2. All import materials to be used for borrow, backfill and bedding are subject to the Port requirements for testing, including contaminate and quality testing and acceptance prior to delivery to the project site. Refer to City of Everett Special Provision Section 3-01 for additional requirements. Chemical testing of all import materials is required per Subparagraph 2.08.
- F. Pipe construction, trenching and backfill plan submittal requirements are per Section 7-08.3.

1.02 REFERENCE

- A. 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.
- B. 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
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
COE SP	City of Everett Special Provisions, current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

- C. Measurement And Payment
1. Measurement and payment guidelines for above referenced sections and subsections shall not be incorporated into the Contract Documents. Work in this section is consider ancillary to Work in accordance with the Bid Schedule.
 2. Compensation for permanent pavement replacement and all required Work appurtenant thereto shall be included in the applicable Linear Foot Price for related pipe rehabilitation or replacement for the Work in accordance with the Bid Schedule. No separate payment shall be made for replacement of pavement and appurtenant Work.

1.03 SUBMITTALS

- A. Procedures: Section 01 33 00 SUBMITTAL PROCEDURES.
- B. Action Submittals
1. Provide submittals of all materials, methods, and required testing intended for use on the project from this section.
 2. Submitted data shall be in accordance with the applicable standard specifications unless otherwise specified.
- C. Information Submittals
1. AIS step certification letter(s) for all applicable materials provided. Refer to Specification 01 11 00, Summary of Work.

- D. Construction Submittals
 - 1. Quality assurance and testing reports as required by the permitting agency.
- E. Record Submittals
 - 1. Per Section 01 78 39 PROJECT RECORD DOCUMENTS.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified by permit or these Contract Documents, pavement replacement shall comply with the requirements of the government agency having jurisdiction of the right-of-way in which the Work is completed.
 - 1. See additional requirements in Section 32 12 16 ASPHALT PAVING.

2.02 STRIPPING AND MARKERS

- A. Replace/restore stripping and markers in Kind (e.g. tape stripping shall be replaced with tape stripping, ground into the asphalt. Substitution with thermoplastic paint will not be allowed.)

2.03 ROADBASE

- A. Provide Road base per Section 32 11 23 AGGREGATE BASE COURSE, WSDOT Chapter 4 and Division 9 Materials.

2.04 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS

- A. Cultivated or planted areas and other surface improvements within the ROW which are damaged during completion of the Work shall be restored to their original condition or better. Restoration shall take place within 1 week or sooner as directed by the Owner's Representative.
- B. Existing guard posts, barricades, signs, and fences shall be protected and replaced in their current location, if removed or damaged.

2.05 CONCRETE PANELS

- A. Restore concrete panels in kind, in their entirety in accordance with WSDOT requirements, All materials shall conform to the requirements of WSDOT/APWA Standard Specifications, COE Section 3-14 and Division 5 Surface Treatments and Pavements.
 - 1. For Cement concrete base pavement patching provide high early strength cement concrete. Provide minimum 4000 psi mix having minimum 3000 psi compressive strength after curing time of three days.
 - 2. Cement concrete pavement patch shall be Class 4000 HES meeting the requirements of Section 6-02.
- B. Contractor shall demolish and replace in kind full panels cut or damaged in the performance of the Work. Saw cut excavation limits and replacement sections.
 - 1. Cement Concrete Panel Joints and transitions shall conform to WSDOT Standard Plan A-10.10-04

2. Streets which have cement concrete pavements surfaced with asphalt concrete shall be patched as shown on Standard Drawing 326.
3. HMA plant mix shall not be placed until three days after the cement concrete base has been placed or otherwise permitted by the Construction Manager.
4. The HMA plant mix shall not be placed until the concrete base has received a tack coat of CRS-2 at a rate of 0.12 to 0.20-gallons per square yard.
 - a. The edges of the existing asphalt and castings shall also be painted with the tack coat. The HMA pavement shall then be placed, leveled, and compacted to conform to the surface of the existing HMA. Immediately thereafter, all joints between the new and original asphalt pavement shall be painted with CSS-1 asphalt emulsion and covered with dry sand before the asphalt solidifies
 - b. Asphalt shall be compacted to 92-percent of maximum density as determined by WSDOT Test Method 705.

2.06 UNTREATED ROADWAY SURFACES

- A. Existing crushed rock, gravel, and oil mat streets shall be restored with Crushed Surfacing Top Course to a compacted depth of four inches within the neat lines of the trench. Crushed surfacing shall be mixed, placed, spread and shaped in accordance with the requirements of COE Section 4-04.

2.07 INCIDENTAL PAVEMENT PATCHING

- A. Incidental pavement patching shall be done only at the direction of the Engineer for patching and restoring areas between the back of new sidewalks and adjacent asphalt driveways, paving ramps at the ends of sidewalks, and gutters that are adjusted to grade.
- B. Asphalt for incidental pavement patching shall be HMA CL 1/2", PG 64-22.

2.08 PORT OF EVERETT MATERIAL TESTING

- A. Import material shall be sampled and tested under the oversight of a qualified licensed environmental professional (i.e., licensed engineer, geologist, or hydrogeologist), at a rate of five samples for the first 1,000 cubic yards of imported material, and one sample for each additional 1,000 cubic yards to verify that the material meets import fill criteria. The Contractor shall provide the Import Chemical Testing Results Submittal to the Engineer for review and approval in consultation with the Department of Ecology. Once the material has gained approval from the Engineer and the Port of Everett, the material may be transported to the Site. Whenever the source or stockpile from which the imported fill materials are obtained is changed, the initial rate of sampling starts over at five samples for the first 1,000 cubic yards. The gradation and moisture-density testing of all imported materials shall be sampled and tested at a rate of one sample per 1,000 truck cubic yards to verify that the material is in conformance with the project requirements. Once it has passed this verification, the material may be transported to the Site. Imported materials delivered to the site that are not in conformance with the project requirements shall be removed by the Contractor his sole expense.
- B. The following additional material submittals are required:
 1. Contractor shall submit Pipe Construction and Backfill Plan as described in Section 7-08.

2. Prepare and submit a list of proposed material suppliers. Provide address from where the material is originating.
3. All material import to the site is subject to review and acceptance by the Engineer prior to importing any backfill material to the site:
 - 1) Certification of gradation and material compliance with plans and specifications, along with copies of associated laboratory test results.
 - 2) Certification that the imported fill materials were obtained from a commercial quarry or pit permitted by the State of Washington.
4. Provide certification of chemical constituents for the imported fill materials, either through documentation of existing chemical analyses or by project- specific testing and analyses, as directed by the Engineer in consultation with the Port of Everett and Department of Ecology. The Department of Ecology and the Port of Everett has specified site specific import chemical criteria that Contractor provided import material is required to meet, which is provided in the table below.

PART 3 EXECUTION

3.01 GENERAL

- A. Pavement, sidewalk, curb and gutter, driveway, etc. shall be cut vertically parallel to the lines forming the trench, or at the nearest full joint, in such a manner as to not cause damage to adjoining pavement, sidewalk, curb and gutter, driveway, etc. The portion to be removed shall be broken up in a manner that will not cause damage to the pavement or concrete outside the limits of the trench.
- B. Unless otherwise required by the agency with jurisdiction, incidental concrete shall meet COE Standards and Specification and WSDOT Standard Specifications.
- C. Sawcut lines and joints will not be permitted within the limits of a travel lane. Pavement replacement limits and resurfacing limits shall extend to the edge of any travel lane in which pavement must be replaced, as approved by the Owner's Representative.
- D. Do not install asphalt or concrete surfacing until trench compaction is accepted by Owner's Representative. Final saw cuts shall only be made after trench backfill to prevent undermining of the existing surface, unless otherwise approved by the Owner's Representative.

3.02 SCHEDULING

- A. Scheduling of surface restoration shall comply with the environmental limitation requirements of the government agency having jurisdiction of the right-of-way.

3.03 COORDINATION OF TRAFFIC

- A. Hazardous areas shall be barricaded to protect pedestrian and vehicular traffic.

3.04 PAVEMENT REPLACEMENT LIMITS

- A. The approximate limits of required pavement replacement are shown on the Contract Drawings. Pavement replacement should be considered as part of the means and methods selected by the Contractor for their own convenience and as required by the government agency having jurisdiction of the right-of-way as a result of the Contractor's work.
- B. Except where specifically required elsewhere in these Specifications, provide a permanent pavement replacement as follows:
 - 1. In accordance with the requirements of the Agency Encroachment Permit/Street Cut permit and applicable specifications.
 - 2. If a cut is made in an asphalt surface under moratorium, three (3) years old or less, the roadway will be rotomilled from the edge of each cut to the next designated lane divider, curb or as directed by the Agency inspector, whichever is greater.
 - 3. Recycled asphalt shall only be provided where allowed by the permitting agency.
 - 4. For all older road surfaces, asphalt will be required for the length and width of the cut with applicable pavement Restoration t-sections. Any adjustments may be required by the Agency inspector/Engineer based on the location of any seams when compared to the traveled paths upon the roadway.
 - 5. Replace asphalt to lip of gutter if extent of surface repair is less than 5 feet from lip of gutter.
 - 6. Where composite pavements are present, provide flowable fill into all excavations 12" or less in width prior to application of an asphalt finished surface.
 - 7. Pavement shall be replaced with the same type and thickness of asphalt to match the existing asphalt or 4" inches, whichever is greater.
- C. If Contractor's operations cause damage to existing pavement beyond specified limits, remove and replace damaged pavement to the limits required by the agency with jurisdiction.
 - 1. Replace any damaged or disturbed pavement not specified for removal at no additional cost to the Owner.
 - 2. Contractor's means and methods which result in additional pavement replacement shall be considered as part of the Contractor's bid for their own convenience at no additional cost to the Owner.
- D. Contractor shall protect in place or replace pavement markings, traffic loops, and signage as required by the government agency having jurisdiction of the right-of-way at no additional cost to the Owner.

3.05 TEMPORARY PAVEMENT

- A. Temporary pavements shall only be provided where allowed by permit issued by the Agency having jurisdiction over the right-of-way.

B. Where permitted:

1. A temporary pavement patch may be utilized to reopen the paved travel lanes at the end of each construction day. Temporary patches shall be in accordance with the agency requirements or consists of a minimum of two (2) inches of hot or cold plant mix unless otherwise allowed by permit and accepted by the Owner's Representative.
2. The temporary pavement patch shall be maintained at all times.
3. Temporary pavement patches may not be left in place in excess of the permit, or a maximum of seven (7) working days, if not specified, following completion of backfilling operations.

3.06 CONCRETE SUBSTRATE

- A. Restore concrete substrate in kind, where removed or damaged.

3.07 CONCRETE PANELS

- A. Restore concrete panels in kind, in their entirety. Saw cut excavation limits and replacement sections.

3.08 ADJUSTING MANHOLES AND CATCH BASINS TO FINISHED GRADE

- A. Adjust manholes, catch basins and other structures to final grade after completing pavement operations. Cut and remove overlay in neat circle to adjustment of the casting and frame to proper grade to within 1-1/2 inches of finished pavement surface.
- B. After concrete or mortar has set a full 24-hours, paint the edges of the asphalt concrete pavement and the outer edge of the casting with hot asphalt cement. Place hot asphalt concrete to match finished pavement surface and compact with hand tampers and a patching roller. Asphalt concrete and cement concrete shall be considered incidental to the Work. Match the patch with existing paved surface for texture, density, and uniformity of grade. Carefully paint the joint between the patch and the existing pavement shall then be carefully painted with hot asphalt cement or asphalt emulsion and immediately cover with dry paving sand before the asphalt cement solidifies.
- C. Thoroughly mortar and plaster the inside throat of the structure.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SCOPE

- A. Section includes aggregate base course, aggregate surface course, and aggregate shoulder.

1.02 GENERAL

- A. Governing Standards
 - 1. AASHTO (American Association of State Highway and Transportation Officials) M147 – Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.
 - 2. AASHTO T180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 10 Pound (4.54 kg) Rammer and an 18 inch (45.7 cm) Drop.
 - 3. ASTM (American Society for Testing Materials) C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 4. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft – lbf/ft³ (2,700 kN – m/m³)).
 - 5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 6. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - 7. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 8. 2025 WSDOT (Washington Department of Transportation) Standard Specifications for Road, Bridge, and Municipal Construction.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with 2025 WSDOT Standard Specifications for Construction, except where modified herein.

1.04 SUBMITTALS

- A. The following submittals shall be provided in accordance with Section 01 33 00:
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 ENGINEER 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.
- B. Samples
1. Submit, in air-tight containers, 5 lb (2.27 kg) sample of each type of material to testing laboratory. Wherever materials proposed have WSDOT designated classifications, submit a certificate of conformance with applicable WSDOT specifications for each type of materials to be furnished.
- C. Materials Source
1. Submit name of imported materials suppliers.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate
1. The coarse aggregate for base course, surface course, or shoulders, may consist of gravel, stone, or slag, generally conforming to WSDOT Standard Specification Section 4-2, and as modified below.
 2. Stone material shall be crushed rock, crushed boulders, crushed stone, or crushed gravel, and shall consist of angular fragments of hard, durable particles. When gravel is used in the production of stone, all materials before crushing shall be retained on a sieve $\frac{1}{2}$ inch (1.3 cm) larger than the maximum size permitted in the crushed product. The material shall be 100 percent crushed; that is each particle shall have a minimum of one fractured surface. The aggregate shall be reasonably free of clay lumps and other foreign matter.
 3. Crushed slag shall consist of clean, tough, angular fragments of air cooled blast furnace slag, reasonably uniform in density and quality and reasonably free from glassy pieces, coke, dirt, or other objectionable matter. The slag shall weigh no less than 75 pounds per cubic foot (1201.4 kg per cubic meter) dry rodded.
 4. For aggregate bases to be surfaced with bituminous mixtures, Class A Aggregate shall be used unless otherwise indicated on the Drawings.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry. No aggregate shall be placed until substrate has been approved by Engineer.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting. Unsuitable substrate material shall be excavated to firm soil and replaced with suitable fill when requested by the Engineer. Unless otherwise indicated, suitable fill shall be a type which can be compacted to the density specified, and shall be free from rubbish or debris, vegetable matter, frozen lumps, boulders, large stones, concrete fragments, or other road material, lumber, tree roots, or branches. Blue clay shall not be considered suitable backfill material. Do not place fill on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Aggregate Placement
 - 1. Place aggregate in conformance with Master Specification Section 32 11 23, Aggregate Base Courses, and applicable WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.
- B. Backfill
 - 1. Excavated earth materials suitable for backfilling behind the aggregate base course, surface course or shoulder shall be deposited and spread in not more than 8 inch (20.3 cm) layers, loose measure, or as directed by the Engineer. Compaction shall be by pneumatic or vibratory type compactors, or other approved methods.
- C. Tolerances
 - 1. Plus or minus $\frac{3}{4}$ inch (1.9 cm) from plan dimensions per WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.

3.04 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with Section on Roadway Earthwork of the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.05 MAINTENANCE

- A. Completed aggregate base course, surface course, and shoulder shall be maintained with grades in a smooth, compacted condition, substantially true to line, grade, and cross-section until surface treatment is applied, or the surface is accepted.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies paving consisting of aggregate base, asphaltic concrete, and associated materials.

1.02 QUALITY ASSURANCE

A. References:

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
ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in (457-mm) Drop
COE	City of Everett, Design and Construction Standards and Specifications (2025)
WSDOT/APWA	Standard Specifications for Road, Bridge, and Municipal Construction (2025)
HWA GeoSciences Inc.	Geotechnical Report Port Gardner Storage Facility – West Marine View Drive Storm and Combined Sewer Conveyance Project (August 2025)

B. Testing:

1. Testing will be conducted by the Contractor to determine compliance with the specified degree of compaction and moisture content.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate Base:

1. Aggregate base shall be Class A, 3/4 -inch maximum grading conforming to WSDOT Standard Specification Section 4-02.

- B. Liquid Asphalt:
 - 1. Liquid Asphalt for tack coats and treatment of aggregate base shall be Grade MC 250 and shall comply with Class A WSDOT Standard Specification Section 5-02.
- C. Asphalt concrete:
 - 1. Aggregate shall be Class B, 1/2-inch maximum grading, conforming to WSDOT Standard Specification Section 9-03.8.
 - 2. Asphalt binder shall be paving asphalt, Grade AR-4000, and shall comply with WSDOT Standard Specification Section 9-02.1.
 - 3. Asphalt concrete mixing and proportioning shall comply with WSDOT Standard Specification Section 9-03.8.
- D. Seal Coat:
 - 1. The seal coat shall be slurry type with Grade SS1 asphaltic emulsion conforming to WSDOT Standard Specification Section 5-03.
- E. Striping:
 - 1. Traffic line paint shall be a white latex traffic paint 21209 by Glidden, Vin-L-Stripe acrylic epoxy traffic paint W-801 by Dunn-Edwards, or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Preparation of roadway surface shall comply with COE Standards and Specification and WSDOT Standard Specifications 5-02.3(2).
- B. Construction shall conform to the details, dimensions and grades specified on Plans. Maximum variations in finished grade of paving shall be plus or minus 0.05 feet.
 - 1. Provide final surfaces of uniform texture, conforming to required and existing grades and cross-sections.
 - 2. Patches shall match existing grade and cross section unless otherwise directed by the Officer-in-Charge.

3.02 AGGREGATE BASE PLACEMENT

- A. Subgrade:
 - 1. Before any paving is placed, bring the subgrade to the required line, grade, and cross section. Subgrade shall be prepared specified by WSDOT Standard Specification Section 2-06.
 - 2. Compact the subgrade to a depth of 6 inches. Compaction shall achieve 95 percent of the maximum density determined by the compaction control tests for granular materials as described in WSDOT Standard Specification Section 2-03.3(14)D and ASTM D1557.
 - 3. Subgrade to be scarified to a minimum depth of 6 inches and moisture conditioned to 2 percent above optimum moisture content.

4. Subgrade should be compacted to a minimum 95 percent compaction as determined by ASTM D1557.
 5. Any soft or yielding areas detected during subgrade compaction shall be removed, replaced with structural fill, and compacted.
- B. Aggregate Base:
1. Subbase materials shall be placed and spread per WSDOT Standard Specification Section 4-04.3(4).
 2. Subbase materials shall not be placed in more than 8-inch-thick horizontal loose lifts, moisture conditioned to within 2 percent of the optimum moisture content and compacted to a relative compaction of minimum 95 percent as determined using methods set forth in ASTM D1557.
 3. The nominal depth of the compacted material shall not exceed 0.75 foot.
- C. Base Course Crushed Surfacing
1. Crushed Surfacing Base Course Crushed Surfacing shall be placed and spread per WSDOT Standard Specification Section 4-04.3(4).
 2. Existing base course should be properly compacted prior to construction of a new pavement.
 3. Relative compaction shall be a minimum of 95 percent as determined using methods set forth in ASTM D1557.
 4. The nominal depth of the compacted material shall not exceed 0.35 foot.

3.03 ASPHALT CONCRETE PAVEMENT

- A. Asphalt Concrete:
1. Asphalt concrete application shall comply with COE Standards and Specification 3-14.4 and WSDOT Standard Specifications 5-04 and 5.05.
 - a. Provide materials conforming to the requirements specified for the materials in Sections 5-04 & 5-05 except as modified herein.
 - b. For HMA pavement patching provide HMA CL 1/2", PG 64-22 as specified in COE Section 5-04.
 - c. For temporary asphalt patch provide either cold mix MC 250 as specified in COE Section 9-02 or HMA (CL 1/2", PG 64-22)
 - d. Provide crushed surfacing top course used for pavement patching conforming to the requirements of 9-03.9(3) of the Standard Specifications.
 2. Asphalt concrete pavement shall be placed to a thickness of 1 inch greater than the existing asphalt pavement depth or to a minimum of 3 inches, whichever is greater. Asphalt shall be compacted to 92% of maximum density as determined by WSDOT Test Method 705.
- B. Tack Coat:
1. Tack coat shall be applied to all vertical surfaces of existing pavement which asphalt concrete will be placed; to pavements to be surfaced; and where specified; and where specified at the approximate rate of 0.05 gallons per square yard. Application shall comply with WSDOT Standard Specification Sections 5.02 and 5-04.3(5). Immediately prior to placing asphalt concrete, additional tack coat shall be applied to areas where the tack coat has been damaged.

C. Traffic Line Painting:

1. Traffic lines shall be painted on pavement surfaces where specified. Surfaces are to be free of contaminants that may interfere with adhesion. Thinning and coverage shall be as recommended by the manufacturer, but coverage shall not exceed 400 square feet per gallon. Traffic lines shall be uniform width with the edges straight and even. Traffic shall be restricted from the area until the paint has dried.

D. Seal Coat:

1. Immediately prior to applying the seal coat, surfaces shall be cleaned of all dirt and loose materials. Following cleaning, surfaces shall be uniformly dampened with water at the approximate rate of 0.15 gallons per square yard. The seal coat shall be applied at the approximate rate of 0.12 gallons per square yard. Application shall comply with WSDOT Standard Specification Section 5-03.

3.04 ROAD RESTORATION REQUIREMENTS

- A. The Contractor's responsibility as to road restoration shall include, but not limited to, proper backfill and compaction of excavation, shaping and general restoration of the pavement, restoration of public and private improvements when damaged by construction, restoration of drainage facilities, scarification of existing surfacing, if required, removal of debris and surplus of material, and all other requirements of these Specifications.
- B. New manhole rings, valve boxes, and monument cases shall be adjusted as necessary to be flush with the restored surface and shall be done to the satisfaction for the Officer-in-Charge. Tops of vaults shall be flush with the finished asphalt surface and the surface shall slope away from the vault.
- C. Place asphaltic concrete at line and grade to match existing manhole rings, valve boxes, and monument cases, unless noted otherwise on the plans. Ensure that no ponding will occur at existing manholes, valve boxes, or monument cases. If ponding will occur, coordinate with Officer-in-Charge for modification to covers or grades.
- D. The Contractor shall restore any existing improvements within Project vicinity including, but not limited to culverts, driveways, curbs, headers, walkways, road markings, parking stripes, pavement markings, parking areas, signs, or other permanent improvements. Restoration shall be in accordance with the WSDOT Standard Specifications and COE Standards and Specifications.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies galvanized chain link fence comprising fences, gates, and appurtenances.
- B. PGSF Site Fenceline
 - 1. Provide a Type 3 Wire Fence per Section 8-12 WSDOT and Section 9-16 WSDOT, except as modified by herein.
 - a. Fence shall match detail C24001C tall,
 - b. All materials shall be iron or steel per Section 2.01,
 - c. Line, corner, gate, and pull posts shall be set in concrete,
 - d. Eye bolt set-in concrete, and
 - e. Type II, three strand vertical arm.
- C. Norton Terminal, Port of Everett
 - 1. Replace existing fence demolished or damaged in kind.
 - a. See Attachment F: KPFF Dwg C6.1 through C6.6 and Section 32 31 13 Port of Everett Norton Terminal Development & MTCA 3rd Interim Action.
 - 2. Provide Temporary Secure Fencing per Section 01 56 26 Temporary Fencing.

1.02 QUALITY ASSURANCE

- A. References:
 - 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
ASTM A475	Standard Specification for Metallic-Coated Steel Wire Strand

Reference	Title
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of HotDip Galvanized Coatings
ASTM A824	Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link
ASTM F552	Standard Terminology Relating to Chain Link Fencing
ASTM F567	Standard Practice for Installation of Chain Link Fence
ASTM F626	Specification for Fence Fittings
ASTM F900	Specification for Industrial and Commerical Swing Gates
ASTM F1043	Specification for Strength and Protective Coatings of Metal Industrial Chain Link Fence Framework
ASTM F1083	Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
CLI	Chain Link Fence Institute
COE	City of Everett, Design and Construction Standards and Specifications for Development
WSDOT/APWA	Standard Specifications and Plans for Road, Bridge, and Municipal Construction (2024)

B. Factory Testing

1. Wire fabric and barbed wire shall be tested for zinc coating weight by the method specified in ASTM A90. Ferrous metal, except the fabric, shall be tested for zinc coating uniformity by the method specified in ASTM A239; zinc coating shall withstand six 1-minute dips.

1.03 SUBMITTALS

A. Procedures: Section 01 33 00

B. Action Submittals

1. Manufacturer's product information for fencing, gates, etc. designating specific materials provided.
2. Results of the factory testing specified in paragraph 1.02 Factory Testing.
3. Shop drawings: Site plan showing layout of fence as it is to be provided with dimensions, location of gates and opening size, cleared area, elevation of fence and gates, details of attachments, bracing configurations, footings and accessories.
4. Certifications: Manufacturers material certifications in compliance with current ASTM and/or AASH to specifications.
5. Domestic certifications: Material certifications, Made in U.S.A, Buy American Act or Buy America when required.
6. Design calculations demonstrating the fence is suitable for installed conditions and loading (e.g. wind loads to prevent overturning).

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials in accordance with manufacturer's requirements and per applicable ASTM and/or AASHTO requirements.**

PART 2 PRODUCTS

2.01 MATERIALS

- A. All material used in the construction of chain link fence and gates shall be zinc-coated steel, hot-dipped galvanized steel with Grade 1 zinc coating 1 per ASTM A121 and/or AASHTO M181. Posts and fittings shall have a minimum coating of at least 1.2 ounces of zinc per square foot of surface in accordance with ASTM A123 or A153, whichever is applicable.
 - 1. Material upon which serious abrasions of galvanizing occur shall not be acceptable.
- B. Chain Link Fabric:
 - 1. Chain link fabric shall be 1-inch mesh 11-gage wire, hot-dip galvanized after fabrication. Width of fabric shall match detail C24001C(plus or minus 3/4 inch). Fabric shall conform with the requirements of ASTM A392 and shall have a Class 2 zinc coating.
- C. Tension Wire:
 - 1. Metallic Coated Sterel Marcellled Tension Wire: minimum 7-gauge marcellled wire complying with ASTM A924. Match coating of chain link fabric.
- D. Posts, Top Rail, Braces and Gate Frames:
 - 1. Round steel pipe and rail, schedule 40 pipe, Group IA Heavy Industrial Fence Framework per ASTM F1083, Regular Grade 30,000 psi yield steel. Galvanizing shall apply at least 2.0 ounces of zinc per square foot of surface.
 - a. Line posts shall be either "H" columns weighing not less than 2.7 pounds per foot or 2-3/8-inch outside diameter pipe weighing 3.65 pounds per foot.
 - b. Corner and end posts shall be minimum 2-7/8-inch outside diameter pipe weighing a minimum of 5.79 pounds per foot. Braces and top rails where specified, shall be 1 5/8-inch outside diameter pipe weighing 2.27 pounds per foot.
- E. Fittings:
 - 1. In compliance with ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/ft². Match coating of chain link fabric.
 - 2. Truss rods shall be fabricated of 3/8-inch diameter steel rods and shall have turnbuckles or similar means of adjustment.
 - 3. Tension Bars shall be fabricated of 1/4-inch by 3/8-inch, galvanized steel, one piece length, 2-inch less than the fabricated height.
 - 4. Gate hinges, drop bar locking devices, caps, gate stops, and miscellaneous bolts, bands, and other appurtenances shall be consistent in quality and strength to the rest of the fence.
- F. Tire Wire and Hog Rings
 - 1. Tie wire and hog rings per ASTM F626, 9-gauge, galvanized steel preformed power-fastened wire ties. Match coating of chain link fabric.

- G. Eye bolts:
 - 1. Type 1 regular pattern per ANSI B18.15
- H. Concrete:
 - 1. Concrete for post foundations shall be Class C.

2.02 SWING GATES

- A. Provide single Pedestrian gate per detail C24002CC.
- B. Provide double vehicle gate per detail 24002C.
- C. Galvanized steel welded fabrication in compliance with ASTM F900. Gate frame members 1.900 in. OD, ASTM F1043 Group IA schedule 40 pipe.
- D. Frame members spaced no greater than 6 ft (2440 mm) apart vertically and horizontally. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A780.
- E. Positive locking gate latch fabricated of 5/16 in. (7.9 mm) thick by 1 3/4 in (44.45 mm) pressed steel galvanized after fabrication.
- F. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges.
- G. Match gate fabric to that of the fence system.
- H. Gate posts shall be 6 5/8-inch outside diameter weighing 19.0 pounds per foot.

2.03 SLIDING GATES

- A. Provide 20' sliding gate per detail C24003C.

2.04 LOCKS

- A. For fire department access, use the following lock systems:
 - 1. For manual gates, use Knox padlock.

PART 3 EXECUTION

3.01 GENERAL

- A. Clearing of the fence line will be required. Clearing shall consist of the removal and disposal of all tress, brush, logs, upturned stumps, roots of down trees, rubbish, and debris.
 - 1. Clearing width shall be approximately 3 feet.
 - 2. Grubbing will not be required except where short and abrupt changes in the ground contour will necessitate removal of stumps in order to properly grade the fence line. All stumps within the clearing limits shall be removed or close cut.

- B. Grade the fence line to prevent short and abrupt breaks in the ground contour.
- C. Deviations in alignment to miss obstacles will be permitted only when approved by the Owner's Representative.

3.02 FENCE INSTALLATION

A. Line Posts

1. Equally space Line Posts between corners, end posts, and gate posts at a spacing not exceeding 10 feet. The top of the footing shall be at least 1 inch above grade and sloped for drainage.
2. Set posts plumb and accurately aligned with their tops level or at a constant slope between changes in grade. Minimum depth shall be 24-inch plus and an additional 3-inch for each foot of fence height over 4-feet per ASTM F567.
3. Tubular posts shall be fitted with extension arms for barbed wire, post top to permit passage of top rail or rainproof malleable iron caps as applicable.

B. Corner, End, and Gate Posts

1. Brace corner, end, and gate posts to the nearest line post. Corner and end posts shall be diagonally braced. Bracing for gate posts shall be horizontal braces with truss rods. Line posts shall be braced horizontally and trussed in both directions with truss rods at 1000-foot minimum intervals. Top rails, where specified, shall be in lengths not less than 18 feet and shall be fitted with couplings for connecting lengths into continuous runs. Couplings shall be not less than 6 inches long and allow for expansion and contraction of the rail. Concrete post base shall be buried to a minimum of 2 feet below grade.

C. Chain Link Fabric

1. Fabric shall be taut and shall be attached to posts, rails, and wires with galvanized fabric bands or tie wires at a maximum spacing of 12 inches on posts and 18 inches on the rails and tension wires. Stretcher bars shall be provided at ends of fabric. The bottom tension wire shall be stretched tight and shall be located 2 inches maximum above finished grade and on a straight grade between posts by excavating the high points of ground, and in no case shall depressions be filled.

3.03 SWING GATES

- A. Gate frames shall be fabricated with welded joints or rigid connectors. The fabric shall be the same as that used for the fence and shall be rigidly attached to the frames. Frames shall be suitably braced and trussed. Gates shall be equipped with suitable offset hinges to permit a 270-degree swing and a drop bar locking device with provision for padlocking. A stop to hold the gate open and a center rest with catch shall be provided. Unless otherwise specified, three strands of barbed wire shall be provided on top of chain link gates.

3.04 SLIDING GATES

- A. Sliding gate frames shall be fabricated with welded joints. The fabric shall be the same as that used for the fence and shall be rigidly attached to the frames. Frames shall be suitably braced and trussed. Gates shall be equipped with suitable rollers to permit the gate to move completely out of the gate opening and a drop bar locking device with provision for padlocking. Three strands of barbed wire shall be provided on top of sliding gates.

3.05 CLEAN UP

- A. The area of the fence line shall be left neat and free of any debris caused by the installation of the fence.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.01 SCOPE

- A. This section covers placing and grading topsoil, turf establishment, preparation for seeding, seeding, and mulching. The Contractor shall provide all materials, labor, and equipment to complete all landscape work in accordance with the drawings and specifications.

1.02 GENERAL

- A. All seeded work shall be performed by a landscape contractor or nursery having demonstrated experience in the installation of seeding material on projects of similar size and who employs only experienced personnel who are familiar with the required work and who shall provide adequate supervision by a qualified foreman at all times when the work is in progress.
- B. Finish Grades and Soil Conditions
 - 1. Shall be subject to approval before commencing work under this section.
- C. Certificates of Inspection
 - 1. All shipments of seeding material shall be inspected at the nursery or at the growing site by the authorized Federal and State Agencies. All necessary inspection certificates shall accompany the invoice for each shipment.
 - 2. Any seeding material which indicates signs of insects, their eggs or larvae, and diseases shall be rejected and immediately removed from the project and shall be replaced with proper materials within one working day, weather permitting. Removal and replacement shall be at the expense of the Contractor.

1.03 SUBMITTALS

- A. The following submittals shall be provided in accordance with Section 01 33 00:
 - 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 ENGINEER 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.

B. Sample

1. Samples of topsoil, Humus, Peat Moss, Mulch, and Filler Fabric shall be submitted for analysis and testing; they shall be submitted in approved containers, appropriately labeled as to kind of material and its sources.

C. Test Reports and Certificates

1. Shall be submitted as specified in Master Specification Section 01 33 00, Submittals.

D. Certification

1. Certificates of inspection for seeding materials and material certificates for landscape materials shall be submitted in project Submittals section.

E. Seeding Schedule

1. The proposed seeding schedule shall be submitted indicated dates for each type of landscape work during normal seasons for such work in the area of the site. Once accepted, dates shall be revised only if accepted in writing and after documentation of reasons for delays.

F. Maintenance Instructions

1. Instructions shall be submitted which recommend procedures to be established by the Engineer for maintenance of landscape work for one full year. Maintenance procedures shall be performed by the Contractor for recommended procedures.

G. Landscape Foreman

1. The Contractor shall submit to the Engineer in writing the name of the landscape foreman to be in attendance at the project site during progress of the work. Should a change in foremanship be necessary during any period in the progress of the work, the Engineer shall be notified promptly and the name of the new foreman submitted.

1.04 SUBSTITUTIONS

- A. If a seed is found not to be available, the Contractor shall notify the Engineer. The Engineer will select a reasonable alternate or inform the Contractor of the availability of the original seed. If a substitution is selected, it shall be of the same value, and quality as the original seed.

1.05 WARRANTY

A. Guaranteed Period

1. All seeded areas shall be subject to one year correction period which shall commence upon the date of Final Acceptance by the Engineer. Any turf planted during this period, which dies or partially dies (25% or more) shall be replaced at the Contractor's expense. Replacements made under the Contractor's warranty shall be covered by a like warranty for a period of one year after completion of the replacement. Rejection of seeds by the Engineer will be final. When notified by the Engineer that certain seeded areas require replacement, the replacements shall be made within 30 days of notification, providing the 30 day period falls within the planting season.

B. Replacements

1. All replacements shall be of the same kind as originally seeded and shall be made at no extra cost. The Contractor shall repair any damage, including ruts in seeded areas incurred in making replacements.
2. At the direction of the Engineer, replacements may be seeded at the start of the next planting and digging season.

C. Notification

1. The Engineer will conduct additional inspections, and will notify the Contractor of any turf that dies or requires replacement during the one-year warranty period. The Contractor shall provide and coordinate seeding of replacements.

D. Final Warranty Inspection

1. At the conclusion of the warranty period, the Contractor and Engineer shall conduct a final warranty inspection at a time mutually agreeable. It will be the Contractor's responsibility to notify the Engineer in writing requesting the inspection. The Owner will assume full responsibility after Final Warranty Inspection Approval.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials

1. Packaged materials shall be delivered in containers showing weight, analysis, and name of manufacturer. Materials shall be protected from deterioration during delivery and while they are stored at the site.

1.07 PROJECT CONDITIONS

A. Time of Seeding

1. The Contractor shall perform seeding activities only during periods within the planting season when weather and soil conditions are suitable for each species to be planted and in accordance with local accepted practice.
2. Seeding shall be performed between the dates of May 1 and October 10, provided adverse conditions do not exist.

B. Soil and Drainage Conditions

1. The Contractor shall notify the Engineer in writing of all soil or drainage conditions, which the Contractor considers detrimental to growth of seeding material. The Contractor shall state conditions and submit a proposal for correcting conditions, if feasible, including change in cost, if any.
2. If rock, underground construction work, tree roots, or obstructions are encountered in the excavation of plant pits, alternate locations may be selected by the Engineer. Where locations cannot be changed as determined by the Engineer, the cost required to remove the obstructions to a depth of not less than 6 inches (15.2 cm) below the required pit depth shall be submitted. Work will proceed only after acceptance by the Engineer. Fragmented bedrock that can be reasonably removed shall not be considered an obstruction.

C. Sequencing

1. Landscape work shall progress as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required. Final grades shall have been established, top soil spread, and bound to subgrade, fills and backfills allowed to settle, and any required mechanical compaction completed before commencing work in any area.

D. Job Conditions

1. All existing trees and other plant material to remain shall be clearly designated and marked under the direction of the Engineer shall be properly protected by means of fencing or by another approved manner. Any existing tree or plant material designated to remain that is subsequently damaged by operations under this Contract shall be replaced with plant material of the same size and kind at the Contractor's expense.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil

1. Topsoil for planting operations shall be fertile, friable, natural loam containing a liberal amount of humus, and shall be capable of sustaining vigorous seed growth and shall not be delivered in a frozen state. Topsoil shall be free of subsoil and shall be reasonably free of stone, lumps, clods of hard earth, plants or their roots, stalks, and other extraneous matter. Topsoil shall contain at least five percent (5%) but not more than twenty percent (20%) by weight of organic matter.
2. If it is necessary to bring topsoil into the site it shall be subject to inspection and approval at the sources of supply or upon delivery.

B. Fertilizer

1. Fertilizer shall be pelleted or granular in an analysis of equal parts of available nitrogen, phosphorus, and potash such as 12-12-12. Nitrogen shall be a combination of inorganic and slow release or slowly soluble substances. Fertilizers shall be delivered mixed in standard size bags of the manufacturer showing weight, analysis, and the name of the manufacturer. If not used immediately after delivery, it shall be stored in a dry place in such a manner that its effectiveness will not be impaired.

C. Mulch

1. Mulch for application to seed bed areas shall include straw and wood cellulose fiber.
2. Straw mulch shall be baled, dry, unweathered, and shall not contain an excessive amount of seed as determined by the Contractor. Material for anchoring straw shall be as per the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.
3. Wood cellulose fiber mulch for hydromulching shall be in accordance with WSDOT Section 9-4-48 and COE requirements.

D. Manure

1. Manure shall be well rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to seeds.

E. Seed

1. Seed shall be certified seed tagged and sealed in accordance with Federal and State seed laws. Samples of all seed used shall have been tested within 9 months prior to seeding by an official seed testing laboratory. Seeding mixtures shall have a maximum weed seed content of 0.5 percent, with no noxious weed seed, and shall be composed of certified seed of the purity, germination, and proportion by weight as indicated below:

Species	Percent Mix
Norlea Perennial Ryegrass	30
Kentucky Blue Grass	30
Creeping Red Fescue	40

2. Seed shall be furnished in sealed, standard containers with certification label attached. Seed that is wet or moldy or that has been otherwise damaged in transit or storage will not be acceptable.

F. Water

1. Water shall be furnished by the Contractor. The Contractor shall also provide all necessary hoses, hose connections, temporary pipe, and other equipment necessary for watering.

PART 3 EXECUTION

3.01 INSTALLATION

A. General

1. Prior to grading and tilling, vegetation that may interfere with operations shall be mowed, grubbed, and raked. The collected material shall be removed from the site. The surface shall be cleared of stumps, stones larger than 3 inches (7.62 cm), roots, cable, wire, and other materials that might hinder the work for subsequent maintenance.
2. Locations of underground utilities shall be determined prior to any excavation. Work shall be performed in a manner which will avoid possible damage. Hand excavation will be used as required. Grade stakes shall be maintained until removal is mutually agreed upon by parties concerned.
3. Landscaping work shall not be started until substantially all earthwork has been completed. Backfills and fills shall be allowed to settle and finish grading completed immediately before the work is started. All surface and subsurface construction debris shall have been removed completely.

B. Placing Topsoil

1. Place topsoil in areas where seeding is required to a nominal depth of 3 inches (7.6 cm) plus or minus ½ inch (1.3 cm). Place topsoil during dry weather. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade. Remove roots, weeds, rocks, and foreign material while spreading. Manually spread topsoil close to building to prevent damage. Remove surplus subsoil and topsoil from site. Leave stockpile area and site clean and raked, ready to receive landscaping.

C. Grading

1. Established grades, as indicated on the drawings, shall be maintained in a true and even condition. Eroded areas and areas having inadequate drainage, as indicated by the ponding of water, shall be filled. Ruts, deep tracks, dead furrows, and ridges shall be eliminated.

D. Tilling

1. The area to be seeded shall be thoroughly tilled to a depth of at least 3 inches by discing, harrowing, or other accepted methods until the soil is well pulverized and smoothed by harrowing, floating, or dragging. After completion of the tilling operation, the surface shall be cleared of all stones, stumps, or other objects larger than 1-1/2 inches (3.8 cm) in thickness or diameter, and of roots, wire, grade stakes, and other objects that might be a hindrance to maintenance operations. Paved areas over which hauling operations are conducted shall be kept clean and dirt that may be brought upon the surface shall be removed promptly.
2. Any objectionable undulations or irregularities in the surface resulting from tillage or other operations shall be removed before seeding begins. Bed preparation shall be performed only during periods when satisfactory because of drought, excessive moisture, or other causes, the work shall be stopped until such condition have been corrected to the satisfaction of the Engineer.
3. All operations shall be done in a direction parallel to proposed contour lines, and not uphill nor downhill.

E. Fertilizing

1. Fertilizer shall be applied within 24 hours prior to the tilling operation. The material shall be distributed uniformly over the entire area. Fertilizer shall be applied at a rate to give one and one-half pounds (0.68 kg) of each pure chemical per 1000 square feet (92.9 square meters) such as 12 pounds (5.5 kg) of 12-12-12, or 15 pounds (6.8 kg) of 10-10-10 per 1000 square feet (92.9 square meters). Alternatively, follow recommendations for fertilizer and lime application rates based upon topsoil testing.

F. Seeding

1. Seeding equipment calibration tests shall be made to determine the equipment setting required to apply the seed at the specified rates. In unplanted skips and areas noted after germination and growth of the grass, the unplanted areas shall be seeded at no additional cost. The seed box shall be kept at least half full during seeding operations to ensure even distribution of seed over all the areas seeded.

2. Leguminous seeds shall be inoculated with a standard pure culture of nitrogen fixing bacteria. The culture shall be mixed with sufficient water to distribute it thoroughly. The seed shall be wetted thoroughly with the solution and allowed to dry sufficiently to be in condition for sowing. Inoculated seed shall be sown within 30 hours after the treatment.
3. All areas shall be seeded with five pounds of seed per 1000 square feet (92.9 square meters).
4. Seeding and fertilizing shall not be done during periods of severe drought, high winds, excessive moisture, muddy or frozen ground, as determined by the Engineer, because satisfactory results are not likely to be obtained.
5. Do not seed areas in excess of that which can be mulched on same day.
6. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of topsoil testing.
7. Refer to additional requirements of the current edition of WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.

G. Covering and Firming

1. Unless a cultipacker type seeder is used, the seed shall be covered with a shallow-set spike tooth harrow or a chain, plank, or brush drag. The depth of cover shall not exceed ¼ inch. In small areas, covering may need to be performed by light hand raking. After covering, the areas shall be firmed by rolling or with the use of a cultipacker.

H. Mulching

1. Straw mulch shall be spread uniformly in a continuous blanket at 1-1/2 inch depth loose measurement. Mulch shall be spread by hand or by a blower type mulch spreader. All wire from baled much shall be collected as it is removed from the bale.
2. Wood cellulose fiber mulch as specified shall be applied at a rate of one ton (900 kg) per acre (0.4 ha) in areas designated by the Engineer. A 4 foot by eight foot (1.2 x 2.4 m) plywood sheet shall be used along all walks and structures to prevent overspray.
3. Immediately following spreading, the straw mulch shall be anchored in the soil to a depth of 2 to 3 inches (5.08 to 7.6 cm) by a coulter disc mulch anchor machine designed to force the mulch into the soil surface. The machine shall be weighted and operated in such a manner to secure the mulch firmly in the ground to form a soil-binding mulch and prevent loss or bunching of the hay by wind. The coulter shall be at least 10 inches (25.4 cm) in diameter. Mulch shall be secured within 24 hours after seeding. Two or more passes may be required to anchor the mulch to the satisfaction of the Engineer.

I. Protection

1. After completion of construction operations, seeded areas shall be protected where necessary against traffic by erecting barricades or placing warning signs in appropriate areas. Such protective devices shall be maintained until final acceptance of the project.

3.02 CLEAN-UP

- A. After completion of the planting operations, the entire site shall be cleared of excess soil and waste material resulting from the Contractor's work including, but not limited to, stones, stumps, roots, brush, wire, grade stakes, and all objects that might be a hindrance to maintenance operations or affect the visual appearance of the site. Soil clods and debris left on the surface shall be removed.

3.03 MAINTENANCE

- A. The Contractor shall maintain all material beginning immediately after the work is started and continuing until final acceptance. The Owner will assume all maintenance work upon final acceptance, including the removal of stakes and guy wires at the proper time.
- B. Watering
 - 1. Maintenance shall include a thorough initial watering with programmed or hand watering of seeded areas thereafter when soil moisture is below optimum level for establishment and growth. Watering in seeded areas shall be by fine mist.
- C. Maintenance of Grades and Repair of Erosion Damage
 - 1. Original grades of the grass areas shall be maintained after commencement of planting operations and during the maintenance period. Any damage to the finished surface from construction operations shall be promptly repaired. In the event erosion occurs from either watering operations or rainfall, such damage shall be promptly repaired. Ruts, ridges, tracks, washouts or gullies, and other surface irregularities shall be corrected and areas replanted where required.
- D. Maintenance of Lawn Areas
 - 1. Shall consist of watering, mowing, fertilizing, weed control, re-seeding bare areas if necessary, repair of erosion damage, maintenance of mulch, trimming, and any other operation necessary to produce a first quality lawn. The lawn shall be mowed as necessary, keeping the lawn height to a maximum of 3-1/2 inches (8.9 cm) until acceptance. Do not cut more than 1/3 of grass blade at any one mowing. The first mowing shall take place when seedlings are 40 percent higher than desired height. Neatly trim edges and hand clip where necessary and immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps. The Contractor shall provide all maintenance of the lawn areas as described until it has been thoroughly established.
- E. Maintenance of Mulched Areas
 - 1. Mulch in seeded areas shall be maintained until covered with growing grass seedlings. Mulch material that has been removed from the site by wind or other causes shall be replaced and secured. Repair work that is required because of faulty operations or negligence on the part of the Contractor shall be performed at no additional cost.
- F. Weeding and/or Weed Killer Application
 - 1. Shall be scheduled as necessary to keep the seeded areas as free of weeds as possible. All mulched areas shall be weed free at final acceptance. Remedy damage resulting from improper use of herbicides.

3.04 FINAL ACCEPTANCE

- A. When the work has been completed, the Contractor shall notify the Engineer in writing requesting a final acceptance. At a time mutually agreeable, the Contractor and Engineer will inspect the work and report findings as to acceptability and completeness. Any work remaining to be done shall be subject to another review. The Contractor will be notified in writing by the Engineer of the provisional acceptance of completed portion of the work.
- B. This final acceptance shall serve as the start of the guarantee period.

END OF SECTION

SECTION 33 01 30.16
CCTV INSPECTION OF PIPELINES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies Closed Circuit Television (CCTV) inspections. Provide all labor, equipment, materials and services necessary to perform inspections of pipe and structures.
1. The nature of the inspections shall be to verify condition of the pipe and to provide a permanent record of the pipe condition, required liner dimensions, materials, structural, operational or construction defects.
- B. Inspections shall be performed:
1. Prior to demolition of pipe or structures,
 2. After completion of major ground disturbing construction activities where specified, and
 3. As part of project completion quality assurance inspections and activities
- C. Requirements:
1. Inspections shall be performed in accordance with NASSCO standards by NASSCO PACP certified operators.
 2. Inspect pipeline interiors using a color closed circuit television camera (CCTV) and document the inspection with a digital datalogger and software.
 3. All inspection video shall be submitted electronically in MPEG file format (.mpg) and saved external hard drives for submittal. Each inspected pipe reach, end to end or structure must have an associated MPEG file. Electronic PDF (.pdf) files of each inspection log and digital photographs (.jpg) files) shall accompany the video inspections.
 4. Contractor shall maintain a copy of all inspection documentation (videos, pictures, databases, and logs) for the duration of the project.

1.02 REFERENCES

- A. This Section includes references to the following standards. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements affording the greatest protection to the Owner shall apply, as determined by the Construction Manager.

Reference	Title
NASSCO	National Association of Sewer Service Companies (NASSCO)
PACP	Pipeline Assessment and Certification Program Version 7.0 or later.

1.03 QUALITY ASSURANCE

- A. Contractor's Qualifications: The Contractor shall have a minimum of three (3) years of experience in such work necessary to successfully meet the specified requirements. Provide references for five (5) pipeline inspection projects involving remote CCTV pan and tilt inspection of similar diameter. The reference projects shall contain a minimum of 20,000 lf of CCTV pan and tilt.
 - 1. The CCTV contractor shall provide examples of previous CCTV Inspections performed. Electronic copies of the example inspections and documents shall be provided with video, audio commentary and inspection log(s). The submitted example shall be the work of the operator(s) to be used on this project.
 - 2. The Contractor shall be responsible for modifications to equipment and/or inspection procedures to achieve report material of acceptable quality.
- B. CCTV Operator Qualifications: Operators, who are responsible for performing inspections and/or logging defects into the data collection software must be trained and currently certified through National Association of Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP).
- C. CCTV Inspection Systems: CCTV Inspection software must be PACP-certified, which assures that the software can be used to export a database of all inspection and defect details that conform to the NASSCO PACP database standard. Inspections shall be performed and exported CCTV data shall be provided in a PACP exchange database, PACP version 7.0 or later.
- D. Where required, add Owner specific defect codes to the database as required to ensure uniform defect identification and naming.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES
- B. Action Submittals:
 - 1. Submit Contractor Experience per Paragraph 1.03. A.
 - 2. Submit current NASSCO PACP Certifications for CCTV inspection operator(s).
 - 3. Submit an example of previous work per Paragraph 1.03 A for approval.
- C. Informational Submittals:
 - 1. Manufacturer's product literature for all CCTV video equipment including but not limited to crawlers, cabling, camera, monitor, footage counter, video titling device, recorder and software.
 - 2. Submit documentation demonstrating software compliance with NASSCO PACP and the specified version.
- D. Construction Submittals:
 - 1. Record copies of CCTV inspections including the following minimum information summarizing the submittal:
 - a. Contractor Name
 - b. Date of submittal

- c. Content.
 - d. Operator.
 - e. Reaches inspected.
 - f. Electronic copies of CCTV inspections.
- E. Closeout Submittals:
- 1. Provide a complete set of CCTV inspections performed for the project.

PART 2 PRODUCTS

2.01 INSPECTION EQUIPMENT

- A. Select and use inspection equipment specifically manufactured for the anticipated conditions. Equipment shall be capable of providing outputs per requirements under this specification and the Contract Documents.
- B. Mainline Pipe Inspection Camera: Produces a video using a pan-and-tilt, radial viewing, conduit inspection camera that pans ± 275 degrees and rotates 360 degrees. Camera shall have an integrated footage counter that accurately displays on the display monitor the exact distance of the camera (to the nearest tenth of a foot). Camera shall be equipped with a height adjustment feature to align perspective view per NASSCO requirements for the size and shape conduit noted within the Contract Documents. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe. The video camera shall be capable of showing on the digital inspection the OWNER name, Project name, CONTRACTOR name, date, line size and material, line identification (usually access point ID numbers assigned by OWNER) and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the OWNER; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment. No payment will be made for an unsatisfactory inspection.
- C. LiDAR Laser Scanning (Profiling): Imaging system that measures conduit geometric shape, horizontal alignment and vertical alignment to a 0.5% accuracy with a continuous 360-degree image capture of the interior wall. Scans shall be completed at a frequency of length that provides sufficient detail of the conduit's interior condition. Dwell scans shall be completed at a frequency of once every 50-foot, maximum, in straight conduit, and once every 5 feet, maximum, at locations of horizontal or vertical deflection, such as at horizontal bends and vertical slope changes, or at locations where deformation of the circular conduit shape is noted.

2.02 VIDEO RECORDINGS

- A. The video recordings of the inspections shall be made using digital video equipment. The digital recording equipment shall capture inspection on CD, DVD, external hard drive or flash drive, with each sewer reach inspection recorded as an individual movie file (.mpeg, .mpg).

- B. Audio of an inspection is limited to PACP and LACP methodologies utilizing the digital overdubbing feature from the datalogger system. MACP Level 2 inspections using a remote camera may use audio dubbing or live recording to supplement the inspection. Walk-through inspections may include audio to supplement the video observations.

PART 3 EXECUTION

3.01 GENERAL

- A. It is the responsibility of the CONTRACTOR to comply with applicable health and safety regulations, including but not limited to, OSHA regulations. The costs for development and execution of health and safety plans are considered incidental unless specified otherwise.
- B. Prior to mobilizing onsite the CONTRACTOR shall submit and obtain approvals by the Owner for traffic control plans in support of the WORK. The costs for development and execution of traffic control plans are considered incidental unless specified otherwise.
- C. The CCTV camera shall be positioned as close to the spring line as possible while maintaining the required equipment stability. The Contractor shall fully dewater and clean the pipelines prior commencing the CCTV inspection. The Contractor shall also inspect and document all connections or structures encountered during the inspection activities. The camera shall pan the periphery of the structure from casting to invert. All recordings shall begin and end in the center of the structure as applicable. Post inspection videos shall include video of both downstream and upstream ends of the pipe where they connect to manholes.
- D. The speed that the camera or survey unit is conveyed through the pipe while performing general inspections shall be uniform and shall be limited to a maximum of 30-feet per minute. The survey unit shall be slowed, stopped, or backed-up to perform detailed inspections of significant features. The camera shall be stopped at all defects, changes in material, water level, size, side connections, manholes, junctions, or other unusual areas. When stopped at the defect or feature, the operator shall pan the camera to the area and along the circumference of the pipe. The operator shall also record audio of the type of defect or feature, clock position, footage, extent or other pertinent data. Still photographs or screen captures shall be taken at all defects and general line condition photographs should be taken at least every 200 feet.
- E. At the Contractor's discretion or direction of the Construction Manager, the camera shall be stopped or backed up (when conditions allow) to view and analyze conditions that appear to be unusual or uncommon for a sound pipe. The lens and lighting shall be readjusted, if need be, in order to ensure a clear, distinct, and properly lighted feature. The video recorder shall be paused if the camera progress is stopped for a period longer than 30 seconds due to breakdown of the equipment, or any purpose other than analyzing conditions of the pipe. The operator shall document the delay on the recording when progress resumes.
- F. The Contractor shall be responsible for all traffic control measures required.

3.02 LINEAR MEASUREMENT

- A. The Contractor shall measure the camera progress along the full length of each reach. The length counter shall be zeroed at the beginning of each inspection (the center of the starting manhole/access point), and at any intermediate manhole. In the case of resuming an inspection at an intermediate point along the pipeline, the length counter shall start at the last point recorded. The Contractor shall ensure that the counter starts to register immediately when camera progress starts. The device shall be observable at ground level. Markings on the cable, instruments requiring observation inside a manhole, or correction of the length for the depth of the manhole are not acceptable.
- B. Prior to commencing inspections, the Contractor shall demonstrate compliance with the linear measurement tolerance specified below:
 - 1. The equipment shall measure the location of the camera unit in 1-foot increments from the beginning (upstream end) of each continuous section. This footage location must be displayed on the CCTV monitor and recorded.
 - 2. The accuracy of the measured location shall be within + 0.5% of the actual length of the pipe reach being surveyed, or 1 foot, whichever is greater.

3.03 CCTV MONITOR DISPLAY

- A. The images displayed on the CCTV monitors shall be a view of the pipe above the water surface as seen by the CCTV camera as the unit is conveyed through the pipe.
- B. The camera lighting shall be fixed in intensity prior to commencing the survey and the white balance set to the color temperature emitted. In order to ensure color constancy, ideally no variation in illumination shall take place during the survey.

3.04 DATA DISPLAYS

- A. The CCTV images shall include an initial data display that identifies the pipe reach being surveyed and a survey status display that provides continuously updated information on the location of the survey unit as the survey is being performed. These data displays shall be in alphanumeric form. The size and position of the data shall not interfere with the main subject of the monitor picture.
- B. The on-screen display should be white during inspections where the background behind the display is dark and, conversely, black where the background is light.
- C. At the beginning of each reach of pipe being inspected, the following information shall be electronically generated and displayed on the CCTV monitors as well as included in the audio track:
 - 1. Date of survey
 - 2. Pipe name/location
 - 3. Connection or manhole number to manhole number (in order of inspection)
 - 4. Direction of survey (upstream or downstream)
 - 5. Time of start of survey.

- D. During inspections, the following information shall be electronically generated, automatically updated, and displayed on the CCTV monitors:
 - 1. Survey unit location in the pipe line in feet and tenths of feet from adjusted zero
 - 2. Pipe diameter
 - 3. Abbreviated manhole reference numbers (upstream and downstream manholes in order of survey direction).

3.05 PHOTOGRAPHS

- A. CCTV Inspection:
 - 1. During CCTV inspections, screen captures shall be taken from the monitor images and saved electronically of typical conditions every 200 feet and at all defects. The screen capture shall have the pipe name, reach, survey direction, footage, and date when photograph was taken. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 1/4-inch, and shall be type-printed. The annotation shall be positioned on the front of the photograph so as to not interfere with the subject of the photograph. Files shall be named using upstream/downstream connections (Area numbers) or manhole numbers.
 - 2. The image of the pipe shall fill the photographic image. Photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment. Where significant features exist within 6-feet of each other, one photograph shall be made to record these features. Where there is a continuous feature, photographs shall not be taken at intervals of less than 6-feet unless absolutely necessary to show a change in the feature.
 - 3. The images shall be kept electronically, copied to an external hard drive, and submitted with the inspection videos and logs as per paragraph 3.10.

3.06 STRUCTURE/ACCESS POINT NUMBERING, INSPECTION FORMS AND DEFECT CODES

- A. The Contractor shall use the Owner's connection or manhole numbering system as found on the drawings when performing the inspections for this project. The manhole numbering must be used when referring to an upstream/downstream manhole for a pipe reach. Defect codes shall conform to those specified in the NASSCO PACP specification.

3.07 PRE-CLEANING INSPECTIONS

- A. If the camera cannot pass the entire pipe reach from its starting direction, the reach shall be inspected as much as possible from both upstream and downstream directions. If the pipe cannot be fully inspected from either the upstream and downstream connections the Contractor shall notify the Construction Manager. Such notification shall be written and include reach numbers and the reason why inspection cannot be completed. The Contractor shall assume that pipeline dewatering and heavy cleaning will be required prior to inspection work.
- B. If any Contractor equipment becomes stuck in the pipe, the Contractor shall be responsible for all costs associated with extracting the equipment from the pipe.
- C. Any damages to public or private property resulting from Contractor activities shall be repaired by the Contractor at no cost to the Owner.

3.08 FILE NAME REQUIREMENTS

- A. The Contractor shall name video files by their pipe ID number and indicate if it is pre- or post-construction. For example, a pre-construction inspection video pipe SM003785 would have the following file name:
 - 1. SM003785_pre.
- B. If there is more than one (1) video of the same lateral during either pre- or post-construction, the Contractor shall label each video with a sequential numerical value. For example, where two (2) post-construction videos exist:
 - 1. Initial video: SM003785_post_1
 - 2. Second video: SM003785_post_2

3.09 SITE RESTORATION

- A. After televising a reach or reaches in an area, the WORK site shall be cleaned and restored to pre-WORK conditions.

3.10 REPORT

- A. A single copy of the inspection videos in sequential order from upstream manhole to downstream manhole saved in mpeg format on an external hard drive; electronic version (.jpg) of still photographs saved on external hard drives; a digital Microsoft Access database conforming to the NASSCO PACP database standard populated with all inspection and defect information; and hard copies and electronic pdf files of the inspection logs shall be submitted to the Construction Manager for review and approval. Recordings or sections thereof that do not conform to the specifications shall be re-recorded in the field at the Contractor's expense. Original recordings and re-recorded runs shall be edited to provide a record with all inspections in sequential order from upstream to downstream. Recordings not in sequential order are unacceptable.
- B. The TV inspection report shall include video recordings, pictures and any Owner required inspection forms and defect codes. Contractor shall provide equal documentation on both the videos and forms. Contractor shall maintain a copy of all report material. The Contractor shall provide comments as necessary to fully describe the existing condition of the pipe, both through the voice over on the videos and on the inspection forms. Photographs shall further document both typical pipe features, and defects. The photographs shall be copied to an external hard drive and submitted to the Construction Manager along with the videos and logs.
- C. Payment will not be made for any work until the Construction Manager has received, reviewed and approved up to date copies of all report documentation. The Contractor shall submit these report documentation items a minimum of 10 days in advance of any payment request to provide the Construction Manager ample time to review the files.

3.11 TESTING AND ACCEPTANCE

- A. All new pipelines within the public right-of-way and those in easements to be maintained by the Owner must be inspected by the Contractor. Inspections must be performed in the presence of the Construction Manager.

- B. CCTV Inspections shall be submitted for review by the Owner. Any deficiencies noted shall be corrected to the satisfaction of the Owner.
- C. Once repairs are completed, the pipe shall be reinspected.
- D. Inspection costs, reinspection costs and repairs shall be borne by the Contractor and included in their bid price and considered incidental to the pipeline installation.

END OF SECTION

SECTION 33 01 30.50
BYPASSING AND DEWATERING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies the requirements for temporary bypassing and dewatering of combined sewers, sanitary sewers and storm drains as required to complete the Work.
- B. The Contractor shall provide all labor, equipment, materials, personnel, and services necessary.
 - 1. Utilize staff and/or a subcontractor that has been directly responsible for bypass pumping of sewage, combined sewage and stormwater flows. The Contractor shall be responsible for any Subcontractors design (if used) on this Project.
- C. Requirement:
 - 1. Bypass and dewater sewers, combined sewers and storm drains by means of continuously monitored bypass pumping. The means and methods of providing bypass pumping and maintaining uninterrupted service shall be the sole responsibility of the Contractor. The actual design of the bypass arrangement shall be prepared by the Contractor or Subcontractor performing the Work, and a bypass plan submitted for review and acceptance to determine conformance with the Contract Documents.
 - 2. All references to the bypass pumping and/or bypass pumping system shall include, but not be limited to, personnel, pumps, piping, valves, fittings, temporary structures and excavations, and other equipment needed to convey flow from one location to another.
 - 3. Service shall be maintained at all times throughout the duration of the project. Contractor shall be responsible for diverting flow away from the limits of construction through the use of bypass pumping
 - 4. No bypassing to the ground surface, other receiving waters, storm drains, or bypassing that results in soil or groundwater contamination or any potential health hazards shall be permitted.
 - 5. Discharge velocities shall not create scour, undermining, or other detrimental effect within the vicinity of discharge piping outlet. Discharge piping shall be protected from construction operations and vehicle movements.
 - 6. A Bypass Plan shall be submitted for each area of work.
 - a. Bypass Plans shall include as a minimum the requirements per Paragraph 1.03 and Paragraph 2.02.
 - b. Bypass plans shall be prepared and stamped by a Registered Professional Engineer in the State of Washington.
 - 7. Side laterals and service connections Service to laterals shall be maintained in service throughout the duration of the project. If approved, any disruptions to service must be coordinated with the Owner and with the public impacted.
 - a. Where allowed, service shall not be disrupted for a period greater than 8 hours.
 - b. Laterals within residential areas shall only be out of service between the hours of 8:00 am to 5:00 pm, Monday through Friday.

- c. Laterals within business areas shall be addressed on a case by case basis.
 - d. Provide alternate means of service without disrupting use of the service by the owner/resident.
- 8. Maintain pedestrian and vehicular traffic and comply with ADA regulations for access to all residential and commercial property unless written approval is otherwise obtained from the property owner allowing for reduced access.
 - a. The Contractor is responsibility to arrange all necessary access and temporary construction agreements with all affected parties for the location of the bypass pumping system.
- 9. The bypass pumping system shall be designed to normally maintain the flow below the top of the pipe, without surcharging.
- 10. Before any flow is bypassed, the complete bypassing system must be in place and successfully pressure tested at 1.5 times the maximum operating pressure of the system.
- 11. Notify the Construction Manager and Owner a minimum of 48 hours prior to initiating bypass operations.
- 12. The bypass operation must be continuously monitored to ensure operation and to ensure compliance with water quality limits.
- 13. Immediately cleanup any spill that occurs, regardless of amount, and notify the Construction Manager.

1.02 SUBMITTALS

A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES

B. Action Submittals:

- 1. Project-specific Bypass Plan(s). Contractor shall submit a separate bypass plan for each Section of the project.
- 2. Project specific Odor Control Plan
- 3. Emergency Response Plan and Sewage Spill Prevention Plan
- 4. Bypass Plans:
 - a. Submit drawings and complete design data showing methods and equipment to perform sewer bypassing for review and acceptance. The submittal shall include the following information:
 - b. Drawings indicating the scheme and location of temporary sewer plugs and bypass discharge lines. The drawings shall also show the method and location for discharging the bypass lines.
 - c. Capacities of pumps, prime movers, and standby equipment.
 - d. Design calculations proving adequacy of the system and selected equipment.
 - e. Standby power source.
 - f. Staffing plan.
 - g. Show suction and discharge points with elevations & stationing on the design plans.
 - h. Provide pump performance curves.
 - i. Submit calculations to verify suction lift of pumps has not been exceeded.

- j. Noise control and exhaust control plans for pumping equipment.
 - k. Plan for disruption of sewer service laterals.
 - l. Bypass piping inspection plan.
- C. Informational Submittals:
- 1. Submit access and release documents including:
 - a. Record copies of executed right-of-entry and/or right-of-access agreements from private property owners.
 - b. Record copies of executed waiver and release forms from the private property owners.

1.03 JOB CONDITIONS

- A. Available Flow Data:
- 1. Available flow data for the sanitary and storm sewers to be rehabilitated at the project site is located in paragraph 3.01 of this section. Flow data for the service laterals is not available. The Contractor shall determine the flow in the service laterals.
- B. Protection:
- 1. In areas where flows are bypassed, all bypass flows shall be discharged per the accepted bypass plan. No bypassing to the ground surface, receiving waters, storm drains, or bypassing which results in soil or groundwater contamination or any potential health hazards shall be permitted.
- C. Scheduling:
- 1. The bypassing system shall not be shut down between shifts, on holidays or weekends, or during work stoppages without written permission from the Construction Manager. The bypass system will have an attendant around the clock whose only duty is to maintain the bypass pumping system until the bypassing of that specific pipeline is no longer required.
 - 2. Schedule construction activities based on data National Weather Service Forecasts to reduce the probability of high flows and/or surcharging from stormwater during construction. Obtain a forecast of the weather conditions for the next five days at the Site based on the National Weather Service forecast for as presented on the following website: <http://forecast.weather.gov/MapClick.php?lon=-122.207&lat=47.989>. Coordinate schedule with the Construction Manager.

1.04 PUGET SOUND NAVAL COMPLEX

- A. Additional restrictions may apply and coordination is required with the Navy regarding bypassing and shut down durations for maintenance of service and final connections on the 12" sanitary sewer force main on Lower Norton Ave and 20th St. The Navy typically pumps 750 gpm every 15-20 minutes for a total of 45,000 gallons per day; however, flows are subject to change quickly depending on Navy activity. Shut down durations are limited to 8 hours. Notification required 2 weeks in advance of work.

PART 2 PRODUCTS

2.01 PUMPING SYSTEMS

- A. Two different bypass pumping system criteria have been identified for this project. These criteria are identified below. Projects that are in environmentally sensitive areas or that have a high flows will require one or more of these criteria as specified herein.
 - 1. Flows within the basin vary with seasonal rainfall event patterns.
 - a. Base flow Bypass: Flows per 10-year return period.
 - b. High Flow Bypass: A high flow bypass pump system shall be implemented for Work after September 1st through April 30th. Flows shall be the greater of the 25 and 50-year return period. See Subparagraph 3.02 below
 - 2. Work stoppage may be required due to a large storm event common to the seasons for which the Work is scheduled. The Emergency Response Plan shall describe the activities that are triggered in the event of a large storm event in excess of the bypass operation capacity to minimize damage to the public, the Work area and downtime. See Subparagraph 3.02 below
- B. Criterion 1 - Bypass Pumping System with flows equal to or less than 2.5 MGD
 - 1. Contractor shall maintain on site, the following minimum requirements for all bypass pumping systems:
 - a. Sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. The COMPLETE bypass system, including all piping, shall be continuously monitored by Contractor personnel.
 - b. A system of pumps and piping operating on site to maintain a minimum 50% over capacity of the anticipated maximum flow (as determined by the Contractor). In addition, the Contractor shall have a standby pump, equal in capacity to the largest pump in the system, piped, plumbed and ready for operation. Standby pumps shall be fueled and operational at all times.
 - c. The Contractor shall maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping, hoses and other parts of system hardware to ensure immediate repair or modification of any part of the system as necessary.
- C. Criterion 2 - Bypass Pumping System with flows greater than 2.5 MGD
 - 1. In addition to the requirements identified under Criterion 1, Contractor shall design construct, operate and maintain the bypass system specified herein:
 - a. All bypass piping shall be fused HDPE piping.
- D. The bypass piping system shall include multiple pipelines to convey 150% of the maximum anticipated flow (as determined by the Contractor). A minimum of one additional (spare) pipeline will be constructed and plumbed for immediate operation that is equal in diameter to the largest pipe size in use for the bypass setup. All other requirements shall be the same as identified under Criterion 1 of these specifications.

2.02 BYPASS PUMPING AND FLOW CONTROL PLAN

- A. The actual design of the bypass arrangement and alignment shall be prepared by the Contractor. The Contractor shall prepare and submit a project specific Bypass Pumping and Flow Control Plan (Bypass Plan) for review and approval by the CONSTRUCTION MANAGER.
- B. Approval of the Bypass Plan shall in no way relieve the Contractor of their responsibility for the protection of adjacent properties, downstream drainage systems and water tributaries against sewage spill. Any litigation, claims, fines, etc. associated with any sewage spill shall be the responsibility of the Contractor.
- C. Bypass operations shall be incorporated into Traffic Control Plan(s) submitted for review and approval by the government agency with jurisdiction of the right-of-way.
- D. The Bypass Pumping and Flow Control Plan(s) shall include, but not be limited to, the following:
 - 1. Flow monitoring data, location of monitoring and design calculations for flow diversions.
 - 2. A summary of flow to be bypassed including measured flows and any flows diverted.
 - 3. Drawings indicating the scheme and location of pumps, suction piping, discharge piping, and temporary sewer plugs for each of the project sites
 - 4. Capacities and sizes of pumps, standby equipment, and power requirements if applicable.
 - 5. Design calculations proving adequacy of the system and selected equipment, including static lift, friction losses, fitting losses, flow velocity, pump curves showing operating range, suction pipe, and discharge pipe (thickness calculations in conjunction with pavement ramp details assuming an HS20 live loading).
 - 6. Suction and discharge locations including any new manholes proposed by the Contractor.
 - 7. Sewer plugging method and type of plug.
 - 8. Method of noise and exhaust control for each pump and generator.
 - 9. Measures to prevent movement, support or anchor bypass piping including but not limited to thrust and restraint block sizes, placement of barriers and strapping.
 - 10. Staffing plan demonstrating compliance for continuous monitoring.

2.03 ODOR CONTROL PLAN

- A. Contractor shall include an odor control plan which includes deodorizers and neutralizers that control H₂S levels at the suction and discharge points below Lower Exposure Limits of 0.010 PPM and no greater than 100 odor units unless otherwise required by local, state or federal standards.
- B. The plan shall include the following:
 - 1. Manufacturer's product data for all equipment, materials and chemicals to be provided
 - 2. Liquid Phase Chemical Addition:

3. Nitrate Addition: Dosing agents shall include nitrate salts that are non-flammable and release no hazardous substances into the collection system. Approved products include Pro Chem Neutron, TryOxyn, Nutriox, Bioxide AE or approved equal.
 4. Manufacturer recommended dosing (gallons per hour), reaction time, and location for dosing for each bypass operation based on preliminary monitoring of pH, temperature, dissolved H₂S concentration, and strength of hydrogen sulfide odors.
- C. Air/Odor Monitoring and Control:
- D. Activated Carbon Treatment System
- E. Activated Carbon Treatment Product Information
- F. Odor Control at Suction Manholes: Site plan, and proposed method of air ventilation including tenting or tarping.
- G. Odor Control at Discharge Location: Site plan and proposed method of air ventilation including tenting or tarping. When diversion piping discharges through a maintenance hole cover, install a temporary cover sized to accommodate the piping and cover the annular space to minimize escape of odors and noise.
- H. Contractor response plan to address odor complaints.

2.04 CONTRACTOR'S EMERGENCY RESPONSE PLAN (ERP)

- A. Submit an Emergency Response Plan prior to mobilization to the Work site.
1. Include provisions for an industrial hygienist and a standby subcontractor for the cleanup of exterior and building interior spaces that might be affected by a spill or overflow.
 2. The cleanup subcontractor shall be certified by the Institute of Inspection Cleaning and Restoration (IICR) and follow the Standard and Reference Guide for Professional water damage Restoration IICRCS500 for the cleanup of Category-3 Gray/Black Water.
 3. Identify solid and liquid material disposal facilities.
 4. Include the name and phone number of the emergency cleanup contractor and industrial hygienist.
 5. Include the Contractor's responsible parties for response including names, phone numbers, and responsibilities.

2.05 NOISE RESTRICTIONS

- A. Noise Control: Contractor shall comply with local, State and Federal noise limitation requirements. The Bypass Plan shall reflect these requirements.
- B. Contractor shall be required to limit noise production by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.

2.06 TEMPORARY BRIDGES AND RAMPS

- A. Design and provide suitable temporary bridges or temporary road ramps where necessary for the maintenance of vehicular and pedestrian traffic in accordance with the requirements of the encroachment and traffic control permits issued by the government agency controlling the right-of-way.
 - 1. Bridges and ramps shall be designed for HS20-44 traffic load. If placed in areas of heavy traffic, additional requirements shall apply.
 - 2. Field verify ADA access is maintained where bridges or ramps are placed for pedestrian access.
- B. The Contractor shall assume responsibility for the maintenance, sufficiency and safety of all such temporary work on bridges and for any damage that may result from their failure or their improper construction, maintenance, or operation.
- C. Bypass piping crossing major intersections or access to commercial and/or residential property shall be buried. Any temporary closing of intersections or streets for bypass pumping will require approval by the agency with jurisdiction and/or the City Traffic Engineer as part of the Contractor's Traffic Control Plan.

PART 3 EXECUTION

3.01 GENERAL

- A. Completely dewater portions of the pipeline where required to complete the Work.
- B. Any diversion configurations that deviate from that shown in the plans will require approval by the Construction Manager.
- C. Sewer Diversion shall be done in such a manner as not to damage private or public property or create a nuisance or public menace. Flush diversion pipes with potable or reclaimed water and drain prior to disassembly.

3.02 ESTIMATED FLOWS AND SEWER CAPACITY PROJECT PIPELINE

- A. Daily Flow Data
 - 1. The following paragraph provides observed daily flow information for the project pipeline. The information was estimated from models of the City of Everett sewer, storm, and combined sewer networks. For additional information contact the City of Everett during normal business hours. Use of this flow data in no way relieves the Contractor from his responsibilities for design, construction and operation of an adequate and properly functioning bypass system. Any additional monitoring or gathering of flow data is the responsibility of the Contractor.
 - 2. The average daily and peak flows for combined sewer/sanitary sewer or storm drain directly impacted by the Work are provided below. Bypass of additional laterals and reach may be required. The average daily and peak hour flows are estimated from model simulations during dry weather.

Package 02	Location	Modeled Average Day And Peak Hour Dry Weather Flows		Model-Estimated Peak 15-minute Flows (Wet Weather)					
		Average Daily Flow (mgd)	Peak Hour Flow (mgd)	1-yr (mgd)	2-yr (mgd)	5-yr (mgd)	10-yr (mgd)	25-yr (mgd)	50-yr (mgd)
EX. 10" SS CLAY – SML1995K04 to SMH1995Q05	WMVD to 25th St	0.034	0.045	0.82	1.15	1.33	1.75	1.79	1.79
EX. 10" SS CLAY – SMH1995Q06 to SML1995Q05	WMVD to 25th St	0.010	0.013	0.30	0.53	0.65	1.03	1.76	1.22
EX. 10" SS CLAY SMH1995Q07 to SMH1995Q05	25th St to WMVD	0.014	0.018	0.65	0.85	1.36	1.06	2.10	2.07
EX. 10" SS CLAY SMH1995Q05 to SMH1995Q04	25th St & Lower Norton Ave	0.072	0.094	2.17	3.10	4.21	3.84	7.08	6.63
EX. 12" SS CONC – SML1995K21 to SMH1995G03	Lower Norton Ave	0.004	0.006	UNK	UNK	UNK	UNK	UNK	UNK
EX. 6" SS TO SMH1995G03	Lower Norton Ave Navy Station	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK
EX. 12" DIP Navy SS FM* – SML1995B12	Lower Norton Ave- Navy sewer vault 20th St Transition Structure	.045	1.08	NA	NA	NA	NA	NA	NA
EX. 12" SS CONC – SML1895Y02	WMVD	0.007	0.009	UNK	UNK	UNK	UNK	UNK	UNK
EX. 12" SS PVC – SML1895T10	WMVD	0.002	0.003	UNK	UNK	UNK	UNK	UNK	UNK
EX. 12" DIP/HDPE SS FM** (LS7 effluent)	WMVD and GAPB	.218	1.42	2.73	2.40	2.80	3.99	4.24	4.46
EX 30" CS PVC (SMH1895T18 to SMH1895T27)	WMVD and GAPB	0	0	5.53	4.37	6.26	6.09	8.00	8.13
EX 18" CP SD - DMH1995Q03 to DMH1995Q01	25th St To Lower Norton Ave	0	0	0	2.41	4.78	3.13	9.61	8.74
EX. 8" CP SD - DCB1995Q07 to DMH1995Q03	25th St	0	0	0	1.90	3.68	2.41	7.46	6.73
EX. 18" PVC SD - DCB1995Q01 to SMH1995Q25	25th St and WMVD	0	0	0	2.41	4.78	3.13	9.61	8.74
EX. 12" SD CP - DCB1995G13 to DMH1995G08	Lower Norton Ave (North)	0	0	UNK	0.12	0.16	0.19	0.23	0.26

Package 02	Location	Modeled Average Day And Peak Hour Dry Weather Flows		Model-Estimated Peak 15-minute Flows (Wet Weather)					
		Average Daily Flow (mgd)	Peak Hour Flow (mgd)	1-yr (mgd)	2-yr (mgd)	5-yr (mgd)	10-yr (mgd)	25-yr (mgd)	50-yr (mgd)
EX. 36" CMP SD DETENTION PIPE DMH1995G08 to DCB1995G19	Lower Norton Ave (North)	0	0	UNK	0.49	0.66	0.78	0.95	1.09
EX. 12" PE SD - DCB1995G12 TO DCB1995G19	Lower Norton Ave (North)	0	0	UNK	0.05	0.06	0.07	0.09	0.10
EX. 12" CP SD - DCB1995G10 TO DCB1995G19	Lower Norton Ave (North)	0	0	UNK	0.16	0.22	0.26	0.32	0.37
EX. 36" PVC SD	WMVD and GAPB	0	0	0	20.59	24.53	20.77	57.22	57.52
EX. 12" PE SD - DCB1895T19	WMVD and GAPB	0	0	0	0	0	0	24.22	24.86

Abbreviations: mgd – million gallons per day

* see paragraph 1.04 A

**Coordinate with City for Lift Station 7 shut down

B. Flow Conditions:

1. The Contractor is responsible for obtaining current flow condition information at the time of construction. The Owner is not responsible for any deviations in flow quantities at any time during the construction period. Higher flows may be encountered depending on weather and other upstream conditions.

3.03 INSPECTION

- A. The Contractor shall inspect the entire bypass pumping and piping system for leaks for spills on an hourly basis. The Contractor shall also create an inspection log and shall enter the time of the inspections and the condition of the piping and the name of the inspector into the log for review by the Construction Manager.

3.04 DAMAGES

- A. The Contractor shall repair, without cost to the owner, any damage that may result from his negligence, inadequate or improper installation, maintenance and operation of bypassing system, including mechanical or electrical failures.
- B. Cleanup shall be in accordance with the accepted Emergency Cleanup Plan.

3.05 FULL SCALE DEMONSTRATION

- A. For each diversion location determined by the Project Representative perform a demonstration of the proposed Sewer Diversion system before the scheduled date of the actual need for Sewer Diversion. Demonstrate that the proposed methods of Sewer Diversion are fully functional and reliable and capable of continuously diverting all flow to the downstream system.
- B. Notify the Project Representative at least 7 days in advance of the date and time of the demonstration.
- C. Demonstration:
 - 1. Duration: 4 hours between 9:00 pm and 5:00 am Monday through Friday. Do not conduct the demonstration on a Saturday, Sunday, or a holiday.
 - 2. Following 2 hours of normal operation conduct a simulated pump failure to demonstrate operation of standby equipment.
- D. The full-scale demonstration shall be deemed to have failed if at any time during the demonstration all flows are not accommodated through the Diversion system or the upstream flow levels cannot be maintained.
- E. If the full-scale demonstration fails determine and correct the deficiencies that caused the demonstration to fail and conduct another full-scale Demonstration. Full scale Demonstrations shall be performed until all flow is accommodated for the entire 4-hour time of the Demonstration.
- F. Do not begin diverting flows until a successful full-scale demonstration has been completed.

3.06 CLEAN-UP

- A. Upon completion of bypass pumping operation, Contractor shall remove all materials, equipment and piping used for the diversion and bypass activities, clean disturbed areas, restoring to original condition including, but not limited to, pavement restoration and landscaping at least equal to that which existed prior to start of Work.

END OF SECTION

SECTION 33 01 30.53

PIPELINE CLEANING

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies the requirements for cleaning of pipelines and structures prior to inspection, demolition, or replacement. Provide all labor, materials, services, and supervision required to complete the work in accordance with the Contract Documents.
- B. Pipe and structures shall be dewatered and cleaned prior to inspection or demolition of debris, roots, grease accumulations and other deleterious materials.
 - 1. Pipe and structures shall include sanitary sewer, storm sewer, combined sewer, and abandoned water pipelines.
 - 2. All materials dislodged during cleaning shall be removed and disposed of by the Contractor.
 - 3. Television inspection is not required during cleaning operations. However, the Contractor may, at his own expense, inspect pipe and structures to view current conditions.
- C. Kimberly Clark Pipe, Structures and Port of Everett Site.
 - 1. See Section 31 23 19 Dewatering for requirements and disposal procedures/requirements for groundwater in pipes and structures.
 - 2. Contractor shall follow the same groundwater dewatering procedures and requirements for the existing 30" W and 48" W pipelines being demolished and repurposed. The Contractor shall assume that all pipes with standing groundwater/liquid will contain heavy sediment/debris from former papermill Kimberly-Clark Worldwide MTCA operation.
 - 3. Work is located within a listed site where hazardous substances are present. Hazardous substances may be encountered that are above regulatory cleanup levels in soil and pipeline liquids, The Contractor shall comply with, at a minimum, the provisions of 29 CFR 1926, WAC 296-155, and the Contractor's site-specific health and safety plan throughout the duration of the work. Additionally, the Contractor shall exercise due caution when dewatering in any location to minimize the potential health hazard to the public and workforce.

1.02 MAJOR BLOCKAGE

- A. A major blockage shall be defined as an obstruction within the pipeline which cannot be removed by cleaning with commercially available hydraulic or mechanical cleaning equipment.

1.03 SUBMITTALS

- A. Submittal Procedures: Section 01 33 00.
- B. Action Submittals:
 - 1.
- C. Informational Submittals:
- D. Construction Submittals:
 - 1. Record copies of cleaning forms.
- E. Closeout Submittals:
 - 1.

PART 2 MATERIALS

2.01 EQUIPMENT

- A. General:
 - 1. All equipment provided shall be in good working condition and manufactured or fabricated to withstand the severity of the work to be completed.
- B. Hydraulic And Mechanical Cleaning:
 - 1. Hydraulic cleaning equipment shall be truck mounted. Water jet cleaning equipment shall include a water tank, auxiliary engine, pumps, and hydraulically driven hose reel. The Contractor shall provide a minimum of 600 feet of high-pressure hose and a selection of high velocity nozzles, each having a capacity of 60 gallons per minute at working pressures of 1000 to 1500 pounds per square inch. Pressure to the nozzle shall be regulated by a relief valve adjustable from 1 to 1500 psi. Nozzles shall be capable of producing a jet stream angle of 15 to 45 degrees from the horizontal. The Contractor shall also provide a high velocity gun with sufficient discharge and pressure to thoroughly clean structure interiors.
 - 2. Sewer pigs which are propelled by water shall be readily collapsible at any time during the cleaning operations to protect against flooding of the sewer lines. The Contractor shall provide pigs in sizes consistent with the pipe diameters encountered. Each pig shall have a flexible scraper at its periphery to ensure the total removal of grease. Sewer pigs which are not readily collapsible are prohibited.
 - 3. Mechanically powered equipment such as bucket machines shall be provided in pairs and shall be belt-driven or employ an overload device. Power rodding machines shall be a "continuous rod" type capable of rodding distances of up to 1000 feet in one setup. Rodding machines shall have the ability to spin the rod either clockwise or counterclockwise and be able to be pushed straight out or pulled back without rotating the machine. It shall be capable of pulling pipe-size swabs or brushes back through the pipeline for cleaning and flushing purposes. The rodding machine shall have a positive drive and shall be capable of producing a 2000-pound pull. The rod shall be specifically designed for use with the rodding machine.
- C. Root Removal:
 - 1. Provide cleaning equipment to cut all roots encountered back to the pipe surface.

D. Debris Removal:

1. Provide suitable equipment to remove all debris dislodged during cleaning operations from the nearest downstream access point.
2. Equipment or methods which require physical entry into the pipe or structure to remove or excavate debris from within are prohibited without full compliance with all local, state, and federal requirements. Physical entry must be reviewed and approved on a case-by-case basis by the Construction Manager.
3. All debris shall be promptly removed from the pipeline from the nearest access point or structure and shall be disposed of offsite in a lawful manner at an OWNER-approved location. Hauling containers shall be watertight.

PART 3 EXECUTION

3.01 GENERAL

- A. Conduct work at all times to prevent any blockage and minimize surcharging in the pipe, structures, and any connecting facilities. Damage to existing facilities as a result of the Contractor's work shall be promptly repaired in kind at the Contractor's expense.

3.02 BYPASSING AND DEWATERING

- A. Contractor shall be responsible for dewatering and bypassing flow around the work area as required to complete the Work.
- B. Bypass sewer and combined sewers in accordance with the requirements of Section 33 01 30.50.

3.03 CLEANING

- A. Cleaning shall remove all sludge, rocks, debris, roots, grease accumulations and obstructions. Cleaning methods may include water jetting, rodding, pigging, or bucketing.
- B. Unless otherwise directed by the Construction Manager, the Contractor shall select the cleaning methods according to the site condition.
 1. Where bucketing is warranted, bucket machines shall be used to remove the major portion of debris. Bucket operations shall proceed in the upstream direction in one pipeline reach at a time. The operation shall continue until the buckets can pass the entire reach with minimum collection of debris. Upon completion, the line shall be cleaned using a pipeline pig and then hydraulically cleaned.
- C. During cleaning operations, provide a means of catching and removing the dislodged debris. Transport of debris to downstream facilities is not allowed.

3.04 RECLEANING

- A. Where the pipeline is not adequately cleaned as determined by the Engineer through television inspection review, Contractor shall remove all equipment or materials from the pipeline and reclean the pipeline at no additional expense to the Owner.

3.05 TAG LINES

- A. The Contractor may install a tag line after cleaning for later TV inspection equipment connections. However, the tag line shall not be left in the pipeline longer than overnight. This allowance may be rescinded by the Engineer at any location if unacceptable procedures are used by the Contractor to secure the tag line. Damage caused by sewage backup due to the tag line shall be the responsibility of the Contractor.

END OF SECTION

SECTION 33 01 30.82
EPOXY COATING FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the application of corrosion protection and/or rehabilitation of concrete or brick structures or manholes using an approved 100% solids, high build epoxy coating systems.
- B. Provide all labor, equipment, materials, incidentals, and services required to protect concrete structures or manholes. Work shall include, but not be limited to bypass pumping, cleaning of surfaces, stopping infiltration, surface preparation including repair, rebuilding and profiling surfaces, preparation and repair of reinforcing steel if required, application of coating, and inspection and quality control testing
- C. Specific coating terminology used in this section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions:
 - 1. MONOLITHIC: A material of uniform composition applied as a continuous surface or structure.
 - 2. COATING SYSTEM: All components together as a unit used to repair the substrate and protect against further corrosion. These components include, as applicable: defect filler and reprofiling materials, material used to repair or rebuild walls, bench and channel, infiltration control, primer and finish coats.
 - 3. DRY FILM THICKNESS (DFT): The thickness of one (1) fully cured continuous application of coating.
 - 4. COATING SYSTEM APPLICATOR (APPLICATOR): The subcontractor/workers applying the provided coating system.
 - 5. Termination Point: The vertical beginning and end of the coating system application.
 - 6. Chimney Seal: The seal applied to the grade rings and manhole frame.

1.02 REFERENCES

- A. 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.
- B. 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
ASTM C109	Compressive Strength Hydraulic Cement Mortars
ASTM C191	Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM C267	Standard Test Method for Chemical-Resistance of Mortar, Grouts, and Monolithic Surfacing and Polymer Concrete
ASTM D 496	Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C579	Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C580	Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D790	Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM C 882	Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4258	Standard Practice for Surface Cleaning Concrete for Coating
ASTM D4259	Standard Practice for Abrading Concrete
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM F2414	Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
ICRI 310.2	International Concrete Repair Institute (ICRI) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
OSHA 29 CFR	Occupational Safety and Health Administration (OSHA), 1926 / 1910 Safety and Health Standards
COFR Title 40 Part 59	Architectural Coatings – VOC Limits
SSPC	Steel Structures Painting Council Specifications, Vol. 2.
NACE No 6/SSPC-SP 13	Surface Preparation of Concrete
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

- C. Other Sections, not referenced herein, may also be related to the proper performance of the Work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.

1.03 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES.

B. Action Submittals

1. Submit 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. 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 ENGINEER 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. Submit Coating System Application Plan per Paragraph 1.07.

C. Informational Submittals

1. Manufacturer's Product data including the following:
 - a. Product literature including technical specifications, application instructions with curing, and environmental requirements, storage and handling requirements and safety data (MSDS, GHS). Application instructions must include the following minimum information:
 - 1) Surface preparation and profile recommendations.
 - 2) Primer type, where required.
 - 3) Thinner where required.
 - 4) Ventilation requirements.
 - b. Environmental conditions for application including but not limited to temperature range, humidity, surface temperature and pH.
 - c. Maximum dry and wet mil coating thicknesses per application.
 - d. Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - e. Curing time before submergence in liquid.
 - f. Allowable application methods.
 - g. Maximum allowable moisture content.
 - h. Maximum storage life.
 - i. Limitations, exceptions, precautions, and requirements that may adversely affect the application and performance of the coating under project specific conditions.
 - j. If the Manufacturer's requirements differ from the Contract Documents, the Contractor must clearly state where deviations are required and provide acceptance by the Manufacturer.
2. Submit Manufacturer's Representative(s) information including the following:
 - a. Experience.
 - b. Contact information.

3. Submit the following certifications:
 - a. Certificate of Responsibility attesting that the Contractor has assigned a Quality Assurance Manager (QAM) and that the individual accepts responsibility for installation of the products provided.
 - 1) Submit Quality Assurance Manager's (QAM) name and Contact information, NACE Certification, and experience.
 - b. Submit a list of qualified applicators with Manufacturer's Certification per Paragraph 1.04. Only listed applicators may perform the Work.
 - c. Submit Manufacturer's third-party testing results for the provided coating system per Paragraph 2.08.
- D. Construction Submittals:
 1. Submit Equipment Calibration Certificates.
 - a. Holiday testing equipment.
 - b. Adhesion testing equipment.
 2. Any other testing equipment proposed for use by Contractor in performing the Work.
- E. Close out submittals
 1. Final Inspection and Testing:
 - a. Submit adhesion test results for each test of each manhole or structure.
 - b. Submit certifications and qualifications of third-party tester performing holiday and adhesion testing.
 - c. Holiday (Spark) test for each manhole or structure.
 2. Submit warranty information per Paragraph 1.06. Sample warranty shall be provided during initial submittal approval process with a final warranty provided at substantial completed of the project.
 3. Submit Quality Assurance Manager and Manufacturer's Representative certification that the proper procedures and equipment have been used by the Applicator and that the coating has been applied in accordance with the manufacturer's requirements. Certification shall include site photos from this project of the equipment, products, surface prep and coating application.

1.04 QUALIFICATIONS AND CERTIFICATIONS FOR APPLICATOR

- A. The coating system shall be applied by an Applicator that has been certified by the coatings system manufacturer [for over 5 years. The certification program shall include an annual renewal. The training outline for the certification program shall be submitted to the Owner for review. The Contractor shall provide evidence that the personnel performing the product application for each project received the manufacturer's training for certification.
- B. The Applicator shall appoint a Quality Assurance Manager (QAM) to take full responsibility for the quality of the Work.
 1. The Quality Assurance Manager shall be a level 3 coating inspector (NACE Certified Coating Inspector - Level 3) with a minimum 2 years' experience with the provided coating system within the geographical area. This project's work is being performed: (i.e., Southwestern or Rocky mountain Western Region, United States.)

2. The Quality Assurance Manager must:
 - a. Initiate and enforce quality control procedures consistent with the approved Coating System Application Plan and all applicable ASTM and NACE standards.
 - b. Be present during preparation, coating and testing and
 - c. Verify in writing that the proper procedures and equipment have been used and applied per the Coating System Application Plan.

1.05 MANUFACTURER'S REPRESENTATIVE AND QUALIFICATIONS

- A. The Manufacturer's Representative is a representative authorized to act on behalf of the epoxy coating manufacturer regarding technical issues and recommended preparation, application and testing of the provided coating system.
- B. The Manufacturer's representative shall provide field inspections of coating installations as follows:
 1. Manufacturer's Representative must be present during the first 25% of installations for the project or as deemed necessary by the ENGINEER.
 2. The Manufacturer's Field Representative shall be present and shall verify in writing that the proper procedures and equipment have been used by the applicator and that the coating has been applied per the Manufacturer's requirements and Coating System Application Plan.

1.06 BONDED WARRANTY

- A. The Contractor shall provide a two-year Guaranty Bond in accordance with Section 00653. The bond shall cover both the material costs and the labor costs associated with the installing the approved coating. The bond shall also be unconditional in nature covering any type of failure in the coating and agreeing to repair or replace it at no cost to Owner at any point during the two-year period.
- B. A written warranty against coating failure shall be provided for the entire coating system, including all repair material including but not limited to defect fillers, substrate reprofiling, primers, intermediate coating, infiltration control materials and finish coats. The minimum duration of the warranty shall be 5 years after Final Completion of the project. The product and the installation may both be covered by the manufacturer's warranty, or separate warranties may be issued by the manufacturer and the installer.
- C. This warranty shall state that the coating will not fail for a minimum period of 5 years after Final Completion of the project. Coating failure is defined as blistering, cracking, embrittlement, or softening, or failure to adhere to the substrate. The warranty shall also apply to any repair materials, primers, or other products used in the application.

1.07 COATING SYSTEM INSTALLATION PLAN

- A. A Coating System Application Plan must be prepared and submitted including the following minimum items:
 1. PRODUCTS
 - a. Complete list of all products with product data and their use.

2. QUALITY ASSURANCE PROCEDURES:
 - a. Training program to qualify personnel in the correct storage and handling of coating materials, and the necessary safety requirements.
 - b. List of application and testing equipment to be used, including calibration and inspections confirming satisfactory condition of equipment.
 - c. Detailed procedures and methods for surface preparation including repair and reprofiling if required, application of primer and final coating, and testing.
3. Cleaning and abrasion.
 - a. Procedures to clean surfaces.
4. Surface Preparation.
 - a. Detailed plan of surface preparation, including repair and reprofiling.
 - b. Target profiles and criteria for acceptance of surface preparation.
5. Infiltration.
 - a. Method for infiltration control and sealing active leaks.
6. Application.
 - a. Details of application of primer, epoxy and finish coats, including application method (e.g. spray, trowel,) number of passes, and curing times.
 - b. Detailed product technical specifications for application including environmental conditions such as temperature range, humidity, and provisions to achieve and monitor environmental conditions.
 - c. Detailed application schedule including considerations such as protecting work area from environmental conditions negatively impacting the coating performance or community impacts, e.g. working at night.
 - d. Recommended coating repair procedures
7. Testing procedures and schedule.
 - a. Wet and Dry film thickness testing.
 - b. Holiday testing.
 - c. Adhesion testing
8. Plan for sewage diversion under Section 33 01 30.50, if required.

1.08 STRUCTURE AND MANHOLE COATING

A. Manholes/structures shall be coated in accordance with the following schedule.

Sheet	Manhole	Dia (in) ^{*1}	Approx. Depth (ft) ^{*1}	Comments
C-2206	SSMH100	72	18.8' +/-	Precast MH w/ cast-in-place base
C-2206	SSMH101	48	17.5' +/-	Precast MH
C-2206	SSMH102	48	15.0' +/-	Precast MH
C-2207	SSMH103A	48	8.3' +/-	Precast MH
C-2207	SSMH103	48	16.1' +/-	Precast MH W/ Drop
C-2207	SSMH104	48	13.8' +/-	Precast MH
C-2208	SSMH105	48	14.1' +/-	Precast MH w/ cast-in-place base
C-2209	SSMH106	60	13.6' +/-	Precast MH w/ cast-in-place base
C-2209	SSMH107	60	14.1' +/-	Precast MH w/ cast-in-place base

Sheet	Manhole	Dia (in) ^{*1}	Approx. Depth (ft) ^{*1}	Comments
C-2209	SSMH108	60	20.0' +/-	Precast MH w/ cast-in-place base and Drop
C-2213	SSMH300	60	14.6' +/-	Precast MH
C-2214	SSMH400	48	8.7' +/-	Precast MH
C-2215	SSMH401	48	9.0' +/-	Precast MH
C-2215	SSMH402	48	9.7' +/-	Precast MH

1) See Contract Documents for additional information/ Depth shown to invert

2) Cast-in-place Transition structures shall be coated per Section 09 96 00

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. The products furnished will be installed in wastewater facilities (e.g. manholes, structures, channels) structures. The products will be exposed to the extremes of temperatures and humidity. In addition, the products will be exposed to corrosive, abrasive and reactive liquids and gasses associated with wastewater conveyance. The products will be immersed or intermittently immersed in wastewater, and the product surfaces are subject to splashing of wastewater.
- B. Surface repair materials and coatings shall consist of an approved coating system provided by a single manufacturer. The following list are approved manufacturers and corresponding product materials:
 - 1. Sauereisen: Sewergard 210.
 - 2. Raven Lining Systems: Raven 405.
 - 3. Environmental Coatings: Sewershield 150.
 - 4. Or approved equal
- C. Primer, Defect filler, surface reprofiling, and repair materials shall be as recommended by the Manufacturer for each installation.

2.02 COATING SYSTEMS

- A. Coating Systems shall be compatible with the concrete or brick surface preparation methods provided. Any limitations or deviations requested by the manufacturer shall be approved in writing by the ENGINEER prior to surface preparation.
- B. Thicknesses specified herein are the minimum dry film thickness required and do not include the primer thickness, unless otherwise noted:
 - 1. Provide 125 percent thickness of manufacturer's minimum thickness or a minimum of 125 mils, whichever is thicker. The coating shall be applied in a single coat.
 - 2. Provide greater thickness where recommended by the manufacturer.
 - 3. Provide greater thickness where the hydrostatic design and calculations require a thicker coating than the minimum thickness specified.

- C. Where applicable and specified during application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, in the presents of the Owner's representative, documented and attested to by Contractor for submission to Owner.

D. PRODUCT TESTING

1. The Contractor shall provide third-party chemical and physical testing results to the ENGINEER. Results shall be certified by the third-party testing facility.
2. Chemical Resistance Testing.
 - a. Chemical resistance tests shall be completed in accordance with ASTM G 20, modified for use with concrete or brick specimens.
 - b. Exposure shall be for 112 days in each of the following fluids at 77 degrees F +/- 5 degrees F.

Chemical Solution	Concentration ¹	Tolerance	Check Concentration	Replace Chemical Solution
Sulfuric Acid (H ₂ SO ₄)	20%	±0.1%	NA ²	NA
Sodium Hydroxide (NaOH)	5%	±0.2%	56 days	When < 4.8%
Ammonium Hydroxide (NH ₄ OH)	5%	±1.0%	28 days	When < 4.0%
Nitric Acid (HNO ₃)	1%	±0.1%	28 days	When Turbid
Ferric Chloride (FeCl ₃)	1%	±0.2%	28 days	When Turbid
Sodium Hypochlorite (NaOCl)	1%	±0.1%	NA	28 days
Soap	0.10%	NA	NA	28 days
Detergent (Linear alkyl benzyl sulfonate or LAS)	0.10%	NA	NA	28 days
Bacteriological (BOD)	≥ 700 ppm	NA	NA	7 days

¹ Volume percentages - Actual concentration of reagent must be corrected to 100%.

² NA - Not Applicable.

3. After exposure to the solutions, specimens shall not exhibit any spalling, cracking, blistering and weight change shall not exceed the following values. Adhesion of the coating to the substrate shall be tested per ASTM D7234, and the mode of failure shall be such that the substrate fails before the coating separates from the substrate. Any changes to appearance such as color and texture shall be noted. Any changes to appearance such as color and texture shall be noted.

Thickness of Sample (Inches)	Weight Change ^{1,2}
0.375	± 0.75%
0.50	± 0.63%
0.75	± 0.50%
1.0	± 0.44%
1.5	± 0.38%

¹ With respect to initial test results.

² Allowable percent weight gain or loss for the thickness between the designated values can be a straight-line interpretation.

4. Physical Testing. Results of the following tests, performed on cured and coated concrete specimens after being subjected to sulfuric acid resistance testing per paragraph 1.07 Testing for Resistance to Sulfuric Acid and Other Compounds above, shall be provided.

Test	ASTM	Results
Compressive Strength	ASTM C579	> 4,000 psi
Water Vapor Transmission	ASTM D1653, Method B	< 0.25 grams/ 100 sq. in. in 24 hrs.
Water Absorption	ASTM D543, Procedure A with distilled water	< 0.5% in 30 days following 14 days of cure
Abrasion Resistance	ASTM D4060	< 125 mg loss/1,000-gram load in 1,000 cycles in 14 days using a CS17 wheel
Flexural Strength and Modulus of Elasticity	ASTM D790	500,000 psi
Tensile Strength	ASTM D638	> 2,000 psi
Elongation	ASTM D638	> 1.0 %
Adhesion	ASTM D7234	> 200 psi pull / substrate failure.

2.03 CORROSION INHIBITOR FOR REINFORCING STEEL

- A. Reinforcing steel, exposed by corrosion or during surface preparation operations, shall be treated with a water-based epoxy resin, anti-corrosion coating and bonding agent such as Armatec 110 EpoCem, manufactured by the Sika Corporation, or approved equal.

2.04 ACID RESISTANT MORTAR

- A. Cementitious mortar shall be fast-setting and consist of cement, fine-aggregate, water, and admixtures for high early strength and bonding to existing concrete surface.
- B. Cementitious mortar shall be designed for application to vertical or overhead surfaces. The minimum compressive strength requirements are 2000-psi at 1 day and 4000-psi at 3 days when tested in accordance with ASTM C 109.
- C. Cementitious mortar shall be Structural Concrete V/O manufactured by Five Star; Rapid Set Mortar Mix manufactured by CTS Cement; C-120 Cement manufactured by Environmental Coatings, LLC; Sauereisen F-120/F-121 manufactured by Sauereisen, Inc.; or approved equal as recommended by the epoxy-coating manufacturer. The cementitious mortar must be acceptable in writing by coating manufacturer.

2.05 BONDING COMPOUNDS

- A. All surfaces where new concrete will be bonded with existing concrete shall be coated with a bonding compound as recommended by the manufacturer of the concrete repair material.

2.06 MANHOLE FRAME AND COVER REPLACEMENT OR ADJUSTMENT

A. FRAME AND COVER

1. Manhole frames and covers shall be replaced if the cover is recessed 1/2-inch or lower than the frame or as indicated on the Drawings or in the Rehabilitation Schedule in this section.
2. The manhole shall provide an area from which a grade ring can be installed to accept a typical metal frame and cover and have the strength to support a traffic load without damage to the manhole. The grade ring should be extended past the perimeter of the manhole at least 1 inch in order to transfer as much of the load as practical to the exterior wall of the manhole.
3. The Contractor shall perform work in accordance with the Drawings and these Specifications. Frames and covers shall be Product Numbers 2230Z (frame) and 2230A (cover), as manufactured by East Jordan Iron Works, or approved equal. The covers shall contain the Owners name, official logo and the words "Sanitary Sewer." The frames and covers shall have a nominal opening diameter of 30 inches.
4. The cover shall seat firmly into the frame without rocking. If the cover does not firmly fit into the frame without rocking, it shall be returned to the manufacturer and replaced with one that will seat firmly into the frame without rocking.

B. GRADE RINGS

1. Grade rings shall be a chemically inert composite material such as high-density polyethylene (HDPE) Adjusting Rings manufactured by Ladtech Inc or Pro-Ring manufactured by Cretex or concrete reinforced adjusting rings coated with an approved epoxy-coating system in accordance with this Section.
2. Grade rings shall meet AASHTO HS20 design live loading applied to manhole cover and riser sections.

C. CONCRETE COLLARS

1. The Portland cement concrete collar around the frame or box shall be circular, and shall be a minimum of 8 inches thick, placed flush with the adjacent new pavement surface. Concrete shall be a minimum of Class AA. All concrete shall be obtained from plants approved by the Construction Manager.
2. A single No. 4 rebar hoop shall be placed in each concrete collar. The hoop diameter shall be such that its placement is centered between the edge of the manhole frame or valve box, and the outer edge of the concrete collar, the depth of the hoop shall be centered in the thickness of the collar. Each concrete ring shall be scored radially at quarter-circle points. Score lines shall be 1/4-inch wide by 1/2- inch deep. The concrete collar surface shall be medium broom finished.
3. Traffic shall not be allowed on the concrete collars until the concrete had reached a minimum compressive strength of 2500-psi on residential and 3000-psi on collector and major streets. On major streets the Contractor shall use "high-early" in the concrete mix, approved by the ENGINEER, to minimize delay in reopening the street(s) to traffic.

2.07 INFILTRATION CONTROL

- A. Chemical grout shall be used for infiltration elimination. Chemical grout shall be Sauereisen InstaPlug No. F-180, No. F-370 Chemical Grout, No. F-190 H2OPRUF manufactured by Sauereisen; or Environmental Coatings – Hydrophobic Grout Polyurethane System manufactured by Environmental Coatings; or approved equal, and as recommended by the coating manufacturer. Surface preparation and application shall be as recommended by the product manufacture.

2.08 DELIVERY AND STORAGE

- A. Materials shall be delivered to the job site in their original, unopened containers. Each container shall bear the manufacturer's name, coating type, batch number, and date of manufacture, storage life, volatile organic compounds (VOCs), and listing directions for their proper use. All products shall conform to 40 CRF 59.
- B. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat and cold. Refer to manufacturer's storage recommendations for additional requirements.
- C. Flammable materials shall be stored in accordance with applicable local, state and federal codes.
- D. Epoxy based coatings shall be applied within two (2) months of their date of manufacture (unless the manufacturer's requirements are more stringent), or otherwise approved in writing by the ENGINEER. Materials exceeding this requirement shall be removed from the site and replaced at no additional cost to the Owner.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall provide means, labor and equipment to prevent solid waste contamination during construction activities. If necessary, install and operate sewage diversion pumping equipment to maintain sewage flows without backup, overflow or spill.

3.02 SAFETY AND VENTILATION REQUIREMENTS

- A. The Contractor shall exercise precaution at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws pertaining to such protection, including all Federal, State and local occupational safety and health acts, standards and regulations promulgated thereunder.
- B. In performance of the work, the Contractor shall (a) comply with all applicable Federal, State and local statutes, regulations and ordinances regarding health and safety including, but not limited to, applicable portions of Title 29 of CFR (29 CFR 1910 and 1926; Occupational Safety and Health Administration OSHA); (b) prepare and comply with its own Health and Safety Plan and written safety and health procedures; and (c) comply with any applicable safety requirements established by the City of Phoenix for the site.

- C. Special attention should be given to Section 29 CFR 1910.146 and 29 CFR 1926 for Confined Spaces. By definition, the interior of the sanitary sewer manhole structure shall be considered a permit-required confined space.

3.03 SEQUENCE OF WORK

- A. The Contractor shall perform the work in the following sequence:
 - 1. Coating System:
 - a. Replace frame and cover
 - b. Clean and assess manhole interior.
 - c. Remove all defective or failing materials throughout manhole.
 - d. Reinforcing steel treatment.
 - e. Structural repair (as directed by the ENGINEER).
 - f. Repair of concrete defects.
 - g. Surface preparation.
 - h. Coating installation.
 - i. Testing.

3.04 INSPECTION HOLD POINTS

- A. At certain stages in the coating-application process, the Contractor shall request approval from the ENGINEER to proceed with the next stage of the installation. The Contractor shall provide 24-hour notice that approval of an Inspection Hold Point is needed. The ENGINEER shall respond to the approval request within 24 hours. Failure to receive authorization from the ENGINEER at one of the designated Inspection Hold Points may prevent the acceptance of the work by the ENGINEER on behalf of the Owner. The following are the designated Inspection Hold Points for each installation.
 - 1. Completion inspection of cleaning, remove all defective or failing materials throughout manhole, and assessment of interior.
 - 2. Completion inspection of repairs, reprofiling, and substrate preparation prior to coating.
 - 3. Witness of coating application to include primers, intermediate coating and final coatings.
 - 4. Witness of testing to include holiday testing, adhesion testing and if required retesting.
- B. When requested the Contractor shall provide the ENGINEER (Inspector) safe access to complete Hold Point inspections; the Contractor shall provide safe access to permit required confined space in accordance with all Federal, State and local confined space entry regulations. The Inspector will provide documentation of training in accordance with Occupational and Safety Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.146, 29 CFR 1910.21-32 and 29 CFR 1926.500-503. Additional site-specific training will be further defined at the pre-construction meeting between the Contractor and Inspector. Inspections will be coordinated with the Contractor'S work sequence or during final holiday testing.

- C. The ENGINEER inspection shall in no way relieve the Contractor of their responsibility to install coating systems the coatings in accordance with the Manufacturer's requirements or for quality control and performance of the applied coating.
- D. Existing equipment and apparatus may be present in manholes. The Contractor shall be responsible for the coordination and notification of the Owner for removal and reinstallation of existing equipment and apparatus.

3.05 SEWAGE DIVERSION

- A. Provide means, labor, and equipment to divert flow from branch pipelines entering the manhole as necessary to prevent sewage flow from contacting surfaces to be coated.
- B. In no case shall the Contractor allow any sewage to surcharge and backup into homes or businesses, or in any way overflow into the environment.
- C. Provide means, labor, and equipment to prevent solid waste generated during rehabilitation activities from entering the sewage flow.

3.06 CLEANING AND SURFACE PREPARATION

- A. Contractor and Manufacturer's Representative shall inspect all surfaces specified to receive a coating system prior to surface preparation. Contractor shall notify ENGINEER of any noticeable disparity in the surfaces, which may interfere with the proper preparation, or application of the coating system.
- B. Contractor shall remove all steps prior to cleaning. Unless otherwise directed by the ENGINEER, steps shall be cut using a handsaw flush with the manhole wall. Voids or holes remaining from removal of the steps shall be filled and troweled flush with the wall using a manhole patching material approved by the Manufacturer's Representative.
- C. The entire interior including frame, walls, and bench shall be cleaned and prepared prior to rehabilitation to meet SSPC SP13, ICRI or NACE Number 6 requirements to clean and remove low PH concrete material from the manhole surfaces. Media blast will be required where a new concrete surface is encountered.
 - 1. Water Cleaning: Washing equipment including pumps, hoses, connectors, valves and nozzles shall be capable of producing a minimum blast pressure of 5000-psi.
 - 2. Media Blast: Where mechanical cleaning is accomplished by blast cleaning.
 - a. The abrasive used shall be washed, graded and free of contaminants, which might interfere with the adhesion of the coatings.
 - b. The air used for blast cleaning shall be sufficiently free of oil and moisture to not cause detrimental contamination of the surfaces to be coated.
 - c. Solid blast materials shall be collected, removed, and disposed of in the same manner as other cleaning debris.
 - 3. All concrete, brick, or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound, neutralized surface.

- D. All contaminants including oil, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease, or other hydrocarbon residues from the concrete. A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacteria growth prior to final rinse and coating system.
- E. Contractor shall also remove all dirt, blast material, rocks, rust, spalled masonry (including mortar, concrete, or brick), roots, sludge, grit, and other deleterious materials and debris from the interior manhole. Debris from cleaning operations shall be collected within the manhole and disposed of daily at an approved off-site location. Hauling containers shall be watertight.
- F. Contractor shall also be responsible for any additional surface preparation beyond water blasting as required by the coating Manufacturer. Where additional preparation is required, including abrasive blasting, shot blasting, grinding, scarifying or acid etching, the Contractor shall provide all labor, materials, and equipment as necessary, and at no additional cost to the Owner.
- G. Infiltration shall be stopped by using a material that is compatible with the coating system and is approved for use by the Manufacturer's Representative.
- H. Test prepared surfaces after cleaning but prior to application of the epoxy coating system to determine pH and moisture content of the concrete, as required according to manufacturer's recommendations.
- I. Ensure that the moisture content of the surface is in accordance with the coating Manufacturer's recommendations and/or requirements.
- J. The Contractor shall perform pH testing to the substrate after the surface has been cleaned. The surface shall be dry and have a pH greater than 7.

3.07 ENVIRONMENTAL LIMITS

- A. Coating and concrete repair shall not be performed if environmental conditions are not within the manufacturer's recommended limits. No coating work shall be performed under the following conditions:
 - 1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2. Dust- or smoke-laden atmosphere.
 - 3. Damp or humid weather where relative humidity is above manufacturer's maximum allowable.
- B. The project is located in a sanitary sewer environment where the work will be exposed to hydrogen sulfide-laden air and extended periods of high relative humidity. These atmospheric conditions may restrict the application and inhibit the cure of the specified coating systems. The Contractor shall provide facilities to maintain substrate and atmospheric conditions within the controlled environment, with respect to temperature and relative humidity, within the limits established by the manufacturer of the product(s) selected to ensure proper application and cure of the coating systems.

3.08 SURFACE DEFECT REPAIR

- A. Surface preparation method(s) should be based upon the conditions of the substrate, service environment, and the requirements of the coating to be applied. Surfaces shall be restored to the original surface profile. The finished interior surface shall consist of sound concrete or brick with adequate profile and porosity to provide a strong bond between the necessary repair materials and/or coating and the substrate.
- B. Concrete with honeycombing which exposes the reinforcing steel or with defects that affect the structural strength shall be repaired. The proposed repair method shall be approved by the ENGINEER.
- C. The area between the manhole and the manhole ring and any other area that might exhibit movement or cracking due to expansion and contraction shall be grouted with a watertight, expansive grout, approved for use by the Manufacturer's Representative.
- D. The Contractor shall restore up to four (4) inches of the manhole profile surface, including the wall, bench, channel or invert, to the original thickness. All surface defects including tie holds, any honeycombing or otherwise defective concrete or brick shall be removed to solid concrete to a depth of at least one (1) inch.
- E. Finishes shall be equal in workmanship, texture and general appearance to that of the adjacent undamaged concrete or brick. Repaired surfaces shall be finished to match the profile of the adjoining surface.
- F. Where corrosion or surface preparation activities have exposed reinforcing steel, if half the diameter of the reinforcing steel, or more, is exposed, chip out behind the reinforcing steel a minimum of 1/2 inch for placement of grout or polymer concrete. Media blast all exposed reinforcing steel surfaces to remove all contaminants and corrosion products. Apply a 20 mil (wet) coat of corrosion inhibitor to all surfaces of the clean, exposed reinforcing steel with stiff brush or spray equipment. Cure to tack-free 2 to 3 hours. Apply a second 20 mil (wet) coat of corrosion inhibitor and allow for 2-hour to 3-hour cure prior to placement of polymer mortar, cementitious mortar, or grout.
- G. Bench and Channel Restoration:
 - 1. The Contractor shall repair manhole bench and channel with acid-resistant mortar. At a minimum, the Contractor shall raise manhole channel to the same elevation as high as the crown of the pipe. Manhole bench shall be sloped as shown. Minimum mortar thickness shall be 3/4-inch.
 - 2. If there are branch main connections at the bench elevation; the bench shall be channeled to direct the lateral flow into the main channel of the manhole.
- H. All infiltration shall be stopped prior to coating application using materials compatible with the coating system and approved for use by the manufacturer's representative.

3.09 COATING APPLICATION

- A. All coatings shall be applied in accordance with Manufacturer's requirements and all applicable ASTM, NACE standards and any specific Owner requirements.

- B. Contractor must confirm that the environmental conditions are within the manufacturer's recommended ranges. Coatings shall be applied at a time of day when the ambient temperature and humidity is expected to be steady or falling.
- C. Coatings shall be applied within 48-hours of cleaning and surface preparation, but not until inspected and approved for coating by the ENGINEER.
- D. Coatings applied without Hold Point approval must be removed to the base structure for reinspection prior to re-coating. Removal, preparation and recoating will be at the Contractor's expense.
- E. The prime and finish coat (as applicable) shall be a contrasting color. The color of the final coat shall be chosen by the ENGINEER, if different colors are available.
- F. The coating shall be applied to a minimum thickness specified. The Contractor shall verify and measure the wet film thickness during the application.
- G. Where multiple coating applications are required drying time between coats shall be as recommended by coating Manufacturer.
- H. Ensure that pump, hoses, gun, tip, and pressure are properly matched for the coating to be applied. Ensure that the application equipment has been properly cleaned prior to application of coating. Test spray pattern for uniformity of distribution.

3.10 COATING CURING

- A. Cure coatings in strict accordance with the Manufacturer's recommendations.
- B. Protect surfaces from rapid drying due to heavy wind or hot sun.

3.11 QUALITY ASSURANCE AND TESTING

- A. General
 - 1. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the ENGINEER.
 - 2. The Contractor shall make all repairs to areas of the manhole that are found to be defective or not in compliance with this specification or other project requirements. Repairs shall be in accordance with the manufacturer's recommendations and as approved by the ENGINEER. All costs for any repairs and retesting shall be at the Contractor's expense.
 - 3. Testing shall be completed and any repairs and retesting made prior to the final acceptance inspection.
- B. Manned Entry Inspection
 - 1. The ENGINEER will have an inspector enter all manholes periodically during various stage of the rehabilitation and application process to ensure that the work meets the acceptance criteria outlined in this specification. The inspector might impact the coating areas with a hammer and possibly perform destructive and nondestructive testing in order to ensure adequate bonding and thickness of the coating.
 - 2. Inspection and testing shall be supplemented with digital images of the manhole surfaces using a high-resolution remote camera.

C. Infiltration Testing

1. No infiltration of groundwater shall be observed through the coating system once cured. The ENGINEER reserves the right to perform dye testing as needed. The test shall introduce water around the outside of the manhole to ensure that the manhole rehabilitation products are properly bonded and providing a seal at all product terminations.

D. Spark (Holiday) Testing

1. The complete surface shall be tested including seams and termination points. Testing shall be performed by a qualified testing company.
2. Testing Instruments shall be portable, all-purpose electrical inspection equipment capable of maintaining a given voltage in spite of electrical load on the circuit or charge on the battery. Manufacturer's shall be D.E. Stearns Tinker & Rasor, Elocometer, KTA-Tator, or approved equal.
3. Test voltages shall be determined by the testing company based on site conditions, manhole parameters, coating thickness and properties and submitted prior to testing. Supporting documentation shall demonstrate testing equipment and voltages shall be sufficient to force grounding and detect pinholes or discontinuities in the coating but not high enough to damage the material.
4. Recommended spark tester shall provide 12,500 volts for 125 mil thickness coatings, and 25,000 volts for 250 mils. Any defects shall be marked, repaired and retested.
5. Prior to coating, the ENGINEER reserves the right to require a baseline (grounding voltage) test be conducted to establish conductivity of the structure and verify proposed testing voltages. The grounding voltage shall be established performing the test, brushing the sensing probe along the manhole surface starting at the highest voltage of the meter and progressing down to the lowest voltage that produces an audible signal and spark.

E. Adhesion Testing

1. The purpose of the test shall be to demonstrate the coating are adequately bonded to the structure surface and that the mode of failure will be the tensile strength of the existing concrete or brick structure and not the adhesion of the individual coating.
2. The Contractor shall perform an adhesion test after proper cure for 15% of manhole structures completed on this project with a minimum of three (3) dollies per structure tested. The Owner or Owner's Representative will determine the structures to be tested and the location of the tests within the structure. Testing will be in accordance with ASTM D7234 to demonstrate that the specified field coatings adhere to the substrate. The adhesion test shall be witnessed by the Owner's Representative. Test results showing an adhesion rating a minimum of 200-psi on concrete and 100-psi on brick and some portion of substrate shall be adhered to coating and dolly shall be considered acceptable.
3. The ENGINEER reserves the right to perform additional adhesion testing using its own workforce or a qualified testing company.

F. DRY MIL THICKNESS TESTING

1. The Contractor shall use the adhesion test dollies to verify the dry mil thickness of the epoxy coating. Epoxy-coating systems shall have a minimum thickness as required in this specification, not including any primer or surface preparation material thickness.

3.12 CLEANUP

- A. Upon completion of coating application, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray, splashes, splatters or other coating related damage. Any damage resulting from cleanup activities must be cleaned, prepared and repaired to the satisfaction of the ENGINEER.

END OF SECTION

SECTION 33 05 04.30
SELECTIVE DEMOLITION FOR UTILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes materials and procedures for the abandonment, removal, or replacement of gravity sewer pipelines, structures, manholes, and service laterals. Provide all labor, materials, equipment, and services necessary to complete the Work.
- B. The Contractor is cautioned that hydrogen sulfide, methane, and other potentially hazardous and/or explosive gases may be present in existing or new sanitary sewers. There also may not be sufficient oxygen to support life. Therefore, the Contractor is advised to take suitable precautions to protect its work forces and the general public from exposure and shall provide odor control and other systems suitable for such conditions:
- C. DEFINITIONS
 - 1. REMOVE: Facilities to be removed shall be completely removed from the site in its entirety. Removal shall include but not be limited to all facility components, bases, encasements, concrete collars, and fill.
 - 2. REMOVE AND REPLACE: Facilities shall be removed per 1.01, C.1. Work shall also include excavation and backfill, conditioning, stabilization and preparation of subgrade, trench bottom, and bedding including removal of existing bedding or unsuitable materials and placement of imported bedding and pipe zone backfill per Section 31 23 00 EXCAVATION AND FILL.
 - 3. ABANDON: Facilities to be abandoned shall remain in place and be abandoned in accordance with procedures as specified.
 - 4. SALVAGE: Equipment and appurtenances to be salvaged shall be removed without damage and delivered to Owner as specified.
- D. Transition Structure -
- E. Flow Meter Vault – Lower Norton Avenue

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. [Additional related sections may apply that are not specifically listed below]:
 - 1. Section 33 01 30.16 - Inspection of Gravity Conduits
 - 2. Section 33 01 30.50 - Sewer Bypassing and Dewatering
 - 3. Section 33 01 30.53 - Sewer Cleaning

1.03 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASCE 38-22	Standard Guideline for Investigating and Documenting Existing Utilities
ASCE 75-22	Standard Guideline for Recording and Exchanging Utility Infrastructure Data
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

1.04 SUBMITTALS

- A. Submittal Procedures: Section 01 33 00.
- B. Action Submittals:
 - 1. Submit plans for abandonment or removal of each section of gravity sewer pipe, manhole or structures to be abandoned or removed.
 - a. Plan shall include work schedule, sequence, materials, and installation plan for plugs, grouting and/or backfill.
 - 2. Submit materials to be used for grouting including manufacturer's data, GHS sheets, application procedures including environmental conditions.
 - 3. Submit [flowable fill/LDCC] mix design and test results demonstrating material requirements.
- C. Information Submittals
 - 1. Submit record copy of permits required by regulatory agencies for demolition Work, handling hazardous materials, and traffic control including sidewalk and street closings.
- D. Construction Submittals
 - 1. For each reach:
 - a. Record copies of cleaning reports
 - b. Record copies of pre-demolition inspection for pipes with a written log of connection locations prior to beginning the abandonment process.
- E. Closeout Submittals:
 - 1. Record copies of post inspections recordings and reports
 - 2. Locations of abandoned pipe ends, service connections.

1.05 PROJECT CONDITIONS

- A. Field verify information shown. Owner assumes no responsibility for actual condition of structure(s) to be demolished. Information provided is based on best available data.
- B. Hazardous Materials: If hazardous materials are encountered/discovered, notify Owner as soon as possible.

1.06 HEALTH AND SAFETY

- A. Comply with all health and safety and environmental regulations for access, removal and disposal of demolished components.
- B. All facilities to be demolished shall be thoroughly cleaned prior to abandonment or removal.

1.07 DEMOLITION

- A. Demolish existing sanitary sewer manholes or structures and pipelines as specified.
- B. Remove interfering portions of pipe, manholes, or structures as required for construction of new facilities. Provide stub out connections and field closure couplings as required to construct new manholes or cleanouts. Stub outs and field closures shall be in accordance with the Contract Documents.

PART 2 PRODUCTS

2.01 FLOWABLE FILL FOR ABANDONMENT

- A. Flowable fill shall be self-leveling composed of various combinations of cement, supplemental cementitious materials (CSM), aggregate, water, and chemical admixtures.
 - 1. Provide compressive strength of 50 to 150 psi at 28 days. Slump shall be 6 to 10 inches at the time of placement.
- B. At the CONTRACTOR's option, Low Density Cellular Concrete (LDCC) may be used to fill abandoned manholes and pipelines. LDCC shall be in accordance with Section 03 64 00, Injection Grouting.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform "Call before You Dig" before commencing Work requiring excavation to remove or abandon existing facilities.
- B. Notify and coordinate with utility companies before starting work and comply with their requirements.
- C. Erect and maintain traffic control, physical barriers, and security devices including but not limited to secure fencing and gates as necessary for protection of the public and Owner. Do not close or obstruct roadways, sidewalks, or hydrants without applicable permits.
- D. Protect existing improvements and facilities not to be demolished, including but not limited to adjacent structures; walls; fences; sidewalks and roadways not designated to be demolished; utilities not designated to be abandoned, removed, or salvaged; and any other items not designated to be abandoned, removed, or salvaged.
- E. Remove materials from site as Work progresses. Do not allow materials to accumulate on-site.

- F. Excavate and backfill open pits and holes resulting from demolition in accordance with Section 31 23 00 EXCAVATION AND FILL.
- G. Accurately record the physical location of capped utilities for record documents. Physical location shall include horizontal and vertical location.

3.02 INSPECTION

- A. Field verify and inspect existing pipelines, manholes and structures prior to beginning demolition procedures.
- B. Perform CCTV inspections of existing mainline sewer(s) to be demolished prior to beginning the Work to locate existing pipe connections and confirm no active connections are present.
 - 1. Connection locations shall be delineated by the horizontal distance along the pipe centerline from the closest manhole with a written log of connection locations prior to beginning the abandonment process.
- C. Where pressure grouting is utilized, sewers that receive flows from the grouted sewer must be inspected to verify that the sewer remaining in service is not obstructed.
 - 1. Visual inspections at manholes shall be performed in the presence of the Construction Manager. Provide photographs and documentation of the inspection.

3.03 REMOVAL OF MANHOLE FRAME AND COVER

- A. Dispose of frames and covers not salvaged to the Owner. Manhole frames and covers removed and/or salvaged as part of demolition work shall not be reused.

3.04 ABANDONMENT OF GRAVITY SEWER MANHOLES AND STRUCTURES

- A. Where manholes and structures are abandoned in place, remove the frame/cover, grade adjustment, cone, and wall section to the minimum depth specified below finished grade; crack the base to permit drainage; and dispose of all removed materials in accordance with local regulations.
 - 1. Minimum depth shall be three (3) feet.
 - 2. Minimum depth shall be five (5) feet in WSDOT Rights-of Way.
- B. Prior to demolition, structures are to be thoroughly cleaned and drained. Do not permit any sewage to escape into adjacent or underlying soil. Notify the Construction Manager prior to fracturing the base, to insure all preparatory work has been performed satisfactorily. Break (fracture) manhole base completely to allow drainage of abandoned manhole.
- C. Remaining portions of the manhole shall be filled with flowable fill per paragraph 2.01 .

3.05 ABANDONMENT OF GRAVITY SEWER PIPES, STORM DRAINS, AND SERVICE LATERALS

- A. Pipes to be abandoned shall be cleaned prior to demolition per Paragraph 1.06.

- B. Unless otherwise specified, abandon existing pipes 8-in in diameter or less by installing a permanent water-tight concrete plug at each end of the pipe.
 - 1. Concrete plugs shall be minimum 300 psi Type II/V Portland cement extending into the abandoned pipe at least 24 inches in 15-inch mains and larger and a minimum of 12 inches in sewer mains smaller than 15 inches.
- C. Unless otherwise specified, abandon existing pipes greater than 8-in in diameter by pressure grouting with material per paragraph 2.01 and plugging the ends.
 - 1. Provide bulkheads or other means of stopping grouting/fill material at both ends of the pipe. The pipe run shall be filled from a point of injection installed at the pipe invert. A point of relief shall be installed at the head end and grout shall be injected at the invert until it is observed at the point of relief.
 - 2. Trowel smooth the channels in manholes remaining in service after the connecting pipes have been grouted. Any grout in the main sewers and/or manholes remaining in service shall be removed by the Contractor at no cost to the Owner.
- D. Sewer service connections shall be sealed robotically from within the sewer line. Seals shall be watertight.
 - 1. PVC laterals shall be capped with a premium joint cap (O-ring or solvent weld) at a point outside the limits of demolition, or within ten feet of the property line.
 - 2. Provide a horizontal and vertical location to the abandoned service at the main and end of lateral.

3.06 REMOVAL OF GRAVITY SEWER PIPES, STORM DRAINS AND SERVICE LATERALS

- A. Pipes to be removed shall be cleaned prior to demolition per Paragraph 1.05.
- B. Remove pipe in its entirety by open cut excavation.
- C. Where pipe is to be removed and replaced, scarify the bottom of the trench to remove loose or unsuitable subgrade or soils. Scarify 4 to 6 inches of trench bottom, and compact to 90% relative compaction prior to placing imported pipe bedding.
 - 1. If saturated soil conditions are encountered, notify the Construction Manager immediately.
 - 2. If required, Trench Over-Excavation shall be performed in accordance with [Section for Earthworks or Trenching Over Excavation.]
- D. Subgrade and bedding shall be inspected and tested prior to placement of bedding and laying of pipe:

END OF SECTION

SECTION 33 05 07.03

PIPE RAMMING

PART 1 GENERAL

1.01 SUMMARY

- A. The work specified in this section includes the requirements for steel casing installation using Pipe Ramming to install two 60-inch and one 36-inch steel casings at locations shown on the drawings.
- B. This Section defines in general terms the Work to be completed. The Contractor shall have sole responsibility for the means and methods utilized to install the casing to the line and grade shown on the Drawings and to prevent settlement, all within the tolerances specified herein and related Sections, and subject to review by the Engineer and Public Works Inspector.

1.02 QUALITY ASSURANCE

- A. The Contractor shall allow access to the Engineer and Public Works Inspector and shall furnish all necessary assistance and cooperation to aid the Engineer and Public Works Inspector in observations, measurements, data, and sample collection, including but not limited to access to the launch and receiving pits prior to, during, and following all Pipe Ramming operations. The Contractor shall provide safe access in accordance with all safety regulations.
- B. Qualifications:
 - 1. Pipe Ramming shall be provided by a Contractor regularly engaged in Pipe Ramming construction activities for at least five years.
 - 2. Pipe Ramming machine operator shall have completed a minimum four installations in the past five years using the equipment proposed for use to install casing with diameter of 60-inch or greater and installation lengths of 140 feet or longer.
 - 3. Welder shall be AWS Certified
- C. Grade Control:
 - 1. Use benchmarks to establish the location of the guide rails in the ramming pits to ensure they are aligned to the line and grade shown on the Contract Plans.
 - 2. All copies of field notes used to establish equipment set-up to match the design line and grade shall be submitted to the Engineer for review prior to initiating the pipe ram.
 - 3. In preparing for Pipe Ramming, the contractor shall set up all equipment to construct the steel pipe to the line and grade shown on the contract plans.
 - 4. The rails shall be placed in the pit to support the pipe to the design line and grade. A cradle to support the hammer shall match the design line and grade.
 - 5. The rails, hammer, and hammer cradle shall be surveyed to ensure they are set to design alignment. Any deviation between the design line and grade and the slope of the rails, cradle, or hammer shall be corrected prior to pipe ramming operations.

1.03 DEFINITIONS

- A. Pipe Ramming: A non-steerable trenchless construction technique which involves ramming an open-ended steel casing pipe using a percussive hammer from a Launch Pit to a Receiving Pit. The soil enters the casing pipe during ramming and is displaced by the wall thickness of the casing. The soil is removed from the casing once the casing is fully installed from the Launch Pit to the Receiving Pit.
- B. Annular Space: Volume between the outside diameter of the carrier pipe and the inside diameter of the casing pipe.
- C. Annular space grouting: Process of injecting a controlled grout mixture into the space between the exterior surface of a carrier pipe and the interior surface of a casing pipe.
- D. Break-ins and Break-outs: Area of the pit through which the pipe penetrations for connections into and out of pits.
- E. Casing Pipe: A pipe that houses a carrier pipe, conduit, or duct specifically designed to be installed using trenchless technology.
- F. Carrier Pipe: A pipe used to transmit a fluid, liquid, gas, or other non-static material and is installed inside the casing pipe.
- G. Contact Grout: The grout injected into the external void space at the completion of the pipe ramming operation.
- H. Casing pipe plug: It is a barrier installed in the first section of the casing pipe to prevent soil, water, or other material from entering the pit through the casing pipe.
- I. Dewatering: The act of removing groundwater or lowering the groundwater elevation, using a system of wells and pumps.
- J. Annular Overcut: Volume created between the outside of the casing pipe and the outer diameter of the cutting shoe.
- K. Launch Pit: An excavation from which pipe ramming initiates. The launch pit may incorporate a thrust wall to spread reaction loads to the ground.
- L. Receiving Pit: An excavation into which the cutting shoes of the pipe ram casing emerges at the completion of the pipe ramming operations.
- M. Lubrication: Bentonite slurry or polymer mixture injected into the external annular overcut.
- N. Obstruction: An object or feature that stops forward progress of the steel casing.
- O. Grout port: A factory-installed port within the steel pipe fitted with a one-way valve for injection of grout into the external void space between the installed steel pipe and the ground.

- P. Physical Location: As it is related to existing underground facilities, the facility is located via potholing, or another means of excavation and the depth and location of the facility as shown on the contract plans or any other confirmed source.
- Q. Underground Utility: Existing pipelines, conduits, and cables.
- R. Underground Facility: All underground features including pipe networks, underground structures, piles, and footings.

1.04 DESIGN CRITERIA

- A. The Contractor shall use Pipe Ramming equipment specifically designed for installation through the ground conditions indicated in the Contract Documents referring to Specification Section 01 11 10.
- B. Install Casing to the line and grade shown on the Drawings within the following tolerances:
 - 1. Horizontal Casing Tolerance: Maximum one foot deviation from design.
 - 2. Vertical Casing Tolerance: Maximum one foot deviation from design.
- C. Maximum settlement over the centerline of the bore shall not exceed 0.5 inches. If settlement reaches 0.25 inches, Public Works Inspector must be notified immediately.
- D. Conduct Pipe Ramming in a manner to prevent over-excavation above the pipeline, to prevent the formation of voids, and to prevent damage to existing utilities, railroads, highways, and structures.
- E. Carrier pipe must be installed to the design line and grade shown on the Drawings.
- F. Pipe ram will have a plug to resist ground movement into the first section of pipe.

1.05 EQUIPMENT

- A. Pipe Ramming Equipment - Use pipe ramming equipment specifically designed for ramming through the soil materials identified in the Contract documents.
- B. Hammer shall be sized according to the manufacturer's recommendations and the Contractor's knowledge of ramming in soils similar to those at the site.
- C. Hammer connection, adapters shall form a tight fit between the hammer and the casing pipe to maximize energy transfer. Adapters shall be designed to resist flaring of the steel pipe.
- D. The thickness of the cutting shoe shall be compatible with the soil conditions, stiffness characteristics of the selected casing, and the designed maximum ramming loads. A full circumferential cutting shoe is required on both the inner and outer diameter of the casing pipe to prevent damage to the casing leading edge.
- E. The cutting shoe shall be beveled to provide relief of the soil into the casing, consistent with Best Practices.. The casing diameter-to-shoe thickness ratio shall not be greater than 60. The cutting shoe shall be attached as a full circumferential inner and outer band.

- F. The compressor/compressors shall have sufficient capacity to deliver the air pressure to develop the full hammer energy as rated by the manufacturer.
- G. Contractor shall have the equipment and capacity to provide pipe lubrication during ramming. Lubrication lines shall be steel or protected from damage during ramming. Provide a suitable pressure gauge on the lubrication supply line.

1.06 SUBMITTALS

- A. Qualifications of Contractor and Pipe Ramming Machine Operator. Provide the name and resume meeting the qualifications specified herein. For each qualifying project provide the project name, date, location, owner, contact information, single installation length and installed diameter. Do not submit projects that do not meet the qualification requirements. General project lists that include the Pipe Ramming Contractor's work history will not be accepted.
- B. Submit Working Drawings and design calculations in accordance with Specification Section 01 33 00 except as modified by this subsection to comply with Standard Specification. All calculations shall be stamped by a Professional Engineer registered in the State of Washington.
- C. Submit detailed Pipe Ramming Work Plan and Method statement at least 30 days prior to starting any of the work specified herein. The detailed Work Plan shall contain the following elements:
 - 1. Details on all equipment, equipment set up and staging areas, drawing to scale and referencing the Plan drawings.
 - 2. Launch and Receiving Pits, including support equipment and method of soil removal after ramming is complete.
 - 3. Details of the casing pipe and hammer cradles.
 - 4. Layout drawings detailing their location within the Launch pits.
 - 5. Layout of pipe ramming and ancillary equipment at launch pit location.
 - 6. Shop drawings, including configuration of both the inner and outer cutting shoe.
 - 7. Spoil removal system details.
 - 8. Casing pipe lubrication. Include Material Data Sheets.
 - 9. Grade and alignment control details.
 - 10. Groundwater control provisions including details on launch plugs within the pipe.
 - 11. Design of the Launch pit and Receiving pit.
 - 12. Details of the pipe ramming equipment complete with ramming capacity, hammer energy, diameter, pipe adapters, frames and manufacturer's literature regarding the hammer.
 - 13. Indicate the setup of the pipe ramming equipment at the launch pit including hammer support and attachment of the guide rails within the launch pit.
 - 14. Calculations indicating that the estimated ramming force to complete the ram does not exceed the available ramming capacity of the hammer.
 - 15. Spoils Removal Plan including all equipment necessary to remove the material from the rammed casing. Location and sequence of disposal shall be detailed. Procedures and equipment required to remove soil, boulders, and cobbles from inside the casing.

16. Details of launch and receiving pit seals to prevent groundwater and lubrication flow into the pits.
17. Material specifications and shop drawings of casing. Include materials certifications.
18. Cutting Shoe Details including manufacture, material, and dimension. Detail how the cutting shoe was designed to accommodate the soil conditions and stiffness characteristics of the casing at the calculated maximum ramming loads.
 - a. Provide calculations and basis for the thickness of the cutting shoe and why it is appropriate for the site conditions, calculations and drawings stamped by a registered professional engineer in the State of Washington.
19. Information on contact grouting materials and methods to grout around the outside of the installed casing upon completion of the ramming.
20. Contingency Plans to address potential challenges that may arise during pipe ramming operations and describe the observations that would indicate a problem as well as the methods to address it. Plan shall require the equipment and materials to be on site ready for use during the pipe ramming operations. Contingency plans shall be prepared for the following scenarios:
 - a. Obstruction encountered at the leading edge of casing.
 - b. Large settlements and loss of ground.
 - c. Ramming forces in excess of estimated maximum leading to refusal of the ram.
 - d. Water intrusion into the casing in excess of the capacity that can be handled by sump pumps.
 - e. Spoils in the casing are difficult to remove due to large particle sizes.
 - f. Settlement observed at the surface exceeding the allowable limits.
 - g. Deviation from planned alignment.

1.07 CONSTRUCTION REPORTING

- A. The Contractor shall submit daily records for each shift during pipe ramming operations. Reports shall be submitted on a daily basis by noon on the next working day following the shift for which the data or records were taken. At a minimum, log the following:
 1. Date, time, and name of operator
 2. Installed casing pipe number, location identification per stationing on the plans and total installed length.
 3. Date and starting and finishing time of the shift.
 4. Equipment in use.
 5. Time required to install each casing section.
 6. Pneumatic or Hydraulic Operating pressure, and rate of advance.
 7. Hammer strokes per minute measured two (2) times per casing section at equal intervals.
 8. Volume of pipe lubricant used (in gallons), pumping pressure, and viscosity.
 9. Any problems encountered, corrective measures employed, and results.
 10. Duration and reason for downtime.
- B. Field drawings for recording as-built conditions. Provide survey of casing invert on maximum 20' spacing. The drawings shall be legibly marked with all field changes and information and shall be properly dated. This set of drawings shall be kept up to date.

1.08 NOTIFICATIONS

- A. Meeting requirements of BNSF permit.
- B. Minimum of 72-hour notification prior to the launch of the steel casing.
- C. Minimum of 48-hour notification prior to the beginning of contact grouting.

PART 2 PRODUCTS

2.01 CARRIER PIPE

- A. As shown on the Plans.

2.02 STEEL CASING

- A. The steel casing pipe shall have a minimum outer diameter of 60 inches, or 36 inches as shown on the Plans.
 - 1. Furnish size of casing to permit construction of the product pipe to the required line and grade indicated on the Plan.
 - 2. Minimum Yield Strength - 52,000 psi.
 - 3. Minimum wall thickness
 - a. 60-inch shall be a minimum of one (1) inch. Should the Contractor's means and methods indicate a thicker or higher strength steel is needed, the cost increase shall be included in the bid price.
 - b. 36-inch casing shall be minimum 0.625 inch.
 - 4. Shall have a thickness conforming to E-80 loading requirements.
 - 5. Have the capacity to withstand the maximum axial force that can be delivered the hammer with a safety factor of 2.0.

2.03 DIMENSION TOLERANCE

- A. Roundness: Less than 1% difference in roundness between the major and minor outside diameter, or 1/4 inch, whichever is less.
- B. Circumference: Circumference shall be within 1% of the nominal circumference, or 1/2 inch.
- C. Straightness: Maximum allowable straightness deviation: 1/8-inch in any 10-foot length.
- D. Pipe Ends: Perpendicular to the longitudinal axis of the pipe within 1/16 inch per foot of diameter with a maximum deviation of 1/4 inch measured with a straight edge and square across the end of the pipe.
- E. Square cut with beveled ends.
- F. Factory installed grout ports, flush with the inside and outside of casing, minimum of 3 grout ports per 10-feet of casing length as shown in the Plans.

2.04 CORROSION PROTECTION

- A. The corrosion protection on the steel casing shall be FBE with ARO overcoating, meeting the requirements of the BNSF permit.

2.05 WELDS

- A. Full penetration butt welded joints.
- B. Welding procedures must be consistent with the provisions of AWS and AWWA C2016 and the joints must be welded by an AWS certified welder.
- C. Mechanical press-fit joints are not permitted without additional welding to enhance tensile resistance at the joints, as accepted by the Engineer.

2.06 CONTACT GROUT

- A. Within one week of completing each installation, contact grout the overcut space, completely filling the annulus in conformance with Specification Section 03 64 00.

2.07 LUBRICANT

- A. Lubricant shall consist of bentonite and/or polymer and potable water. Polymer shall be non-toxic.

2.08 ANNULAR SPACE GROUT

- A. Furnish grout for filling the annular space between the carrier pipe and the casing pipe per specification 03 60 00.

2.09 CASING SPACERS

- A. Shall meet the requirements of the City of Everett Standard Specifications and as shown on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

- A. Install Casing pipe and Carrier pipe using Pipe Ramming in accordance with BNSF permit.
- B. Pipe ramming work shall be executed in accordance with the work plan prepared, submitted, and accepted by Engineer.
- C. The pipe ram shall be installed to allow placement of the pipe within the casing to the line and grade shown on the Project Plans.
- D. The contractor shall notify the Public Works Inspector any time the contractor intends to remove spoils from the casing prior to completion of the pipe ram. If soil is removed from the casing during ramming, a soil plug sufficient to prevent soils inflows shall remain in the pipe at all times.

- E. Contractor shall be responsible for locating any and all underground facilities regardless of Owner's previous efforts in this regard. Contractor shall be responsible for all losses and repairs caused by damage to underground facilities resulting from Pipe Ramming operations. Contractor shall undertake the following steps prior to commencing Pipe Ramming operations in a location which might contain underground facilities:
 - 1. Identify the locations of existing underground facilities and their appurtenances as shown on the Plans
 - 2. Physically locate and stake all existing lines, cables, or other underground facilities including exposing any facilities which are located within 10 feet of the proposed alignment or the launch and receiving pits.
 - 3. The Contractor shall compare the underground facility locations, depths, dimensions, and appurtenances as shown on the Plans with the actual facility locations, depths, and dimensions. Any deviations in utility location from those shown on the Plans shall be reported to the Engineer prior to the initiation of Pipe Ramming.
 - 4. Conflicts between existing utilities and the ramming path shall be resolved before Pipe Ramming can start.
 - 5. Identify existing utilities through the One Call Location service. Utility marking shall be within 10 lateral feet of the bore path.
 - 6. Contact all private utility owners to provide utility locations and depths.
- F. Do not begin Pipe Ramming operations until the following conditions have been met:
 - 1. The Contractor has coordinated with BNSF and the BNSF representative is on site.
 - 2. All pipe ramming submittals have received and accepted by the Engineer.
 - 3. Pit excavation and support has been completed in accordance with Section 31 50 00 – Excavation Support and Protection.
 - 4. All groundwater control has been established.
 - 5. All instrumentation has been installed, and baseline readings have been taken.
 - 6. Ensure that all work on the Launch and Receiving Pits, including any related ground improvements at the pits for break-in and break-out, has been completed prior to use of the pits for pipe ramming. A final line and grade survey shall be conducted at the completion of the pipe ramming.
- G. Furnish all necessary equipment, power, water, and utilities for excavation, ramming Steel Casing installation, lubrication mixing and pumping, removal and disposal of spoils, and other associated work consistent with the methods of construction.
- H. If a steel pipe section is damaged during the installation, the Contractor shall repair the steel pipe. All voids resulting from damaged steel pipe repair shall be filled to the satisfaction of the Engineer.

3.02 PIPE RAMMING

- A. Ram each pipe section forward in such a way to prevent ground flowing condition into face or pits. Take special care when setting the Casing pipe on the guide rails in the pit to ensure the Casing pipe is aligned to the line and grade shown on the drawings.
- B. If the casing installation exceeds the specified tolerances, the Contractor is responsible for correcting the installation. All corrective Work shall be performed as described in the accepted Contingency Plan at no additional cost to the Owner.

- C. Provide groundwater control at the pit locations as required for proper execution of the Work.
- D. Provide Launch and Receiving Pits seals comprised of a rubber gasket and tightening plates.
- E. Transport and dispose of all excavated spoils in accordance with the Work Plan. No stockpiling shall be permitted at the launch pit sites. Only use the disposal sites identified in accepted submittals.
- F. In the event the Contractor encounters a problem during the Work and the situation is not covered by the Contractor's Contingency Plan, the Contractor shall propose alternative solutions for Owner's approval within 2 days.

3.03 PRE-RAMMING MEETING

- A. Before the Contractor starts any pipe ramming activities the Contractor shall hold a pre-pipe ramming meeting with the Superintendent, Pipe Ramming Operator, Public Works Inspector, and Engineer.
- B. The meeting shall be scheduled within seven (7) days of the planned start of ramming operations. The intent of the meeting is to review all elements of the proposed pipe ramming operation including:
 - 1. Verification that the Contractor has coordinated with BNSF and the BNSF observer will be on site at the start of the ram.
 - 2. Verification that the rails have been surveyed to the design elevation and slope, including survey information.
 - 3. Communication protocols between the pipe ramming operator, Contractor, and Engineer.
 - 4. Required entries to the daily log and updating the As Built Working Drawings.
 - 5. Pipe ramming within specified tolerances.
 - 6. Methods for confirming the As Built casing alignment and profile are within the tolerance of the design of the pipe ramming alignment and profile.
 - 7. All permit requirements

3.04 CONSTRUCTION

- A. Install casing between the limits indicated on the Plans.
- B. Locate launch and receiving pits within construction limits.
- C. Utilize methods that include due regard for safety of workers, adjacent structures and improvements, utilities, and the public.
- D. Perform all work in accordance with the requirements of Washington State, OSHA standards.
- E. Provide all necessary equipment, power, water, and utilities for excavation, pipe ramming, lubrication, removal and disposal of spoils, grouting, and other associated work consistent with the accepted Work Plan.

- F. Take measures to prevent surface runoff from entering the launch and receiving pits.
- G. Take necessary precautions to minimize groundwater inflow into the launch pit from within the pipe.
- H. Perform all work so as not to disturb adjacent structures, roadways, railroads, or existing utilities.
- I. Repair damage in a timely manner to the satisfaction of the agency or utility having jurisdiction.
- J. Handle and store casing pipe as required by the manufacture.
- K. Use a hammer cradle or approved equal to ensure that the angle of the hammer matches the design line and grade.
- L. Hammer shall not be suspended in the pit during ramming.
- M. A pipe support shall be placed within 2 feet of the launch wall if the rails do not extend to within 2 feet of the wall.
- N. CDF shall be designed and placed on the outside of the launch shaft wall to prevent soil inflows at the front of the Launch pit during the initiation of ramming.
- O. Water-tight seals shall be constructed at the launch and receiving pits.
 - 1. Pit seal shall include a rubber gasket that distends in the ramming direction and prevents soil and groundwater movement into the launch and reception pit.
 - 2. Seal shall include a sliding plates to tighten the rubber gasket.
- P. A launch plug shall be designed to control groundwater and soil inflows into the pipe first section of pipe at initiating of ramming. The plug shall prevent soil inflows into the launch pit during ramming.
 - 1. The plug shall be sufficient to prevent soil from entering the casing.

3.05 GROUNDWATER CONTROL

- A. Required for pipe ramming launch and receiving pits.
- B. Pipe ramming shall not advance if groundwater is causing soil to flow into the launch pit from the casing.

3.06 OBSTRUCTIONS DURING INSTALLATION

- A. Notify the Public Works Inspector immediately if an obstruction is encountered. Written notification is required to meet contract Specification Section 00 72 00.
- B. Diligently work to advance the casing per the contingency plans submitted in the Work Plan and Method's Statement.

- C. Allow Public Works Inspector visual access to verify object(s) including by real time sharing of live video, still photography shared in real time, and man entry to the point of obstruction, as requested by the Owner.
- D. Take all necessary steps to remove any obstruction or otherwise make it possible to continue casing installation.

3.07 CONTACT GROUTING

- A. Within one week of completion of Pipe Ramming operations, the Contractor shall fill the external void space with grout. Contact grout pressure shall be controlled to ensure that the casing pipe is not damaged, and grout is not forced to the ground surface. At the completion of grouting, all grout ports shall be sealed with plugs designed to prevent long-term infiltration of soil and water into the steel pipe. No leakage shall be allowed.

3.08 LAUNCH AND RECEIVING PITS

- A. The Contractor shall size and position the launch and reception pits as needed to comply with their means and methods.
- B. The Contractor shall determine the size and shape the pit for the pipe ramming.
- C. Upon completion of the pipe ramming and grouting operations, the Contractor shall remove all equipment and temporary shoring.
- D. Backfill the pit with imported fill, shall be in accordance with Specification Section 31 23 00 Excavation and Fill.
- E. Compaction of the backfill, shall be in accordance with Specification Section 31 23 00 Excavation and Fill.

3.09 FINISHING

- A. The Contractor shall remove all construction debris, spoil, water, oil, grease, and other materials from the installed casing.
- B. Cleanup will be incidental to the construction. No separate payment shall be made for the cleanup.
- C. Installed casing will be subject to visual inspection by the Public Works Inspector. Visual inspection will include real time sharing of live video, still photography shared in real time, and personnel entry to any point along the casing, as requested by the Public Works Inspector.
- D. Complete an As-Built survey of the casing invert. Survey casing invert at the face of the launch pit, the face of the receiving pit and on maximum 20' spacing in between.

END OF SECTION

SECTION 33 05 07.22

AUGER BORING

PART 1 GENERAL

1.01 SUMMARY

- A. The work specified in this section includes the requirements for steel casing installation using Auger Boring to install two 60-inch and one 36-inch steel casings at locations shown on the drawings.
- B. This Section defines in general terms the Work to be completed. The Contractor shall have sole responsibility for the means and methods utilized to install the casing to the line and grade shown on the Drawings and to prevent settlement, all within the tolerances specified herein and related Sections, and subject to review by the Engineer and Public Works Inspector.

1.02 QUALITY ASSURANCE

- A. The Contractor shall allow access to the Engineer and Public Works Inspector and shall furnish all necessary assistance and cooperation to aid the Engineer and Public Works Inspector in observations, measurements, data, and sample collection, including but not limited to access to the launch and receiving pits prior to, during, and following all Auger Boring operations. The Contractor shall provide safe access in accordance with all safety regulations.
- B. Qualifications:
 - 1. Auger Boring shall be provided by a Contractor regularly engaged in Auger Boring construction activities for at least five years.
 - 2. Auger Bore machine operator shall have completed a minimum four installations in the past five years using the equipment proposed for use to install casing with a diameter of 60-inch or greater and installation lengths of 140 feet or longer.
 - 3. Welder shall be AWS Certified.

1.03 DEFINITIONS

- A. Auger Boring: A technique of installing a casing from a Launch Pit to a Receiving Pit by means of a rotating cutter head with a helically wound auger flight within the Casing that also moves the excavated material to the launch pit for removal.
- B. Annular space: Volume between the outside diameter of the carrier pipe and the inside diameter of the casing pipe.
- C. Annular space grouting: Process of injecting a controlled grout mixture into the space between the exterior surface of a carrier pipe and the interior surface of a casing pipe.
- D. Break-ins and Break-outs: Area of the pit through which the pipe penetrations for connections into and out of pits.

- E. Casing Pipe: A pipe that houses a carrier pipe, conduit, or duct specifically designed to be installed using trenchless technology.
- F. Carrier Pipe: A pipe used to transmit a fluid, liquid, gas, or other non-static material and is installed within the casing pipe.
- G. Contact Grout: The grout injected into the external void space at the completion of the pipe jacking operation.
- H. Dewatering: The act of removing groundwater or lowering the groundwater elevation, using a system of wells and pumps.
- I. Annular Overcut: Volume between the outside diameter of the casing pipe and the excavated bore.
- J. Grout Port: A port within the casing pipe fitted with a one-way plug valve for injection of contact grout into the annular overcut.
- K. Launch Pit: An excavation from which Auger Boring initiates. Launch pit may incorporate a thrust wall to spread reaction loads to the ground.
- L. Receiving Pit: An excavation into which Auger Boring equipment is recovered following the installation of the casing.
- M. Lubrication: Bentonite or polymer mixture injected into the external annular overcut.
- N. Obstruction: An object or feature that stops forward progress of the steel casing.
- O. Grout port: A factory-installed port within the steel pipe fitted with a one-way valve for injection of grout into the external void space between the installed steel pipe and the ground.
- P. Physical Location: As it is related to existing underground facilities, the facility is located via potholing, or another means of excavation and the depth and location of the facility as shown on the contract plans or any other confirmed source.
- Q. Underground Utility: Existing pipelines, conduits, and cables.
- R. Underground Facility: All underground features including pipe networks, underground structures, piles, and footings.

1.04 DESIGN CRITERIA

- A. The Contractor shall use Auger Boring equipment specifically designed for installation through the ground conditions indicated in the Contract Documents referring to Specification Section 01 11 10.
- B. Install Casing to the line and grade shown on the Drawings within the following tolerances:
 - 1. Horizontal Casing Tolerance: Maximum one foot deviation from design.
 - 2. Vertical Casing Tolerance: Maximum one foot deviation from design.

- C. Allowable Ground Surface Movement and Allowable Utility Movement as provided in 31 09 11 – Geotechnical Instrumentation and Monitoring.
 - 1. Maximum settlement over the centerline of the bore shall not exceed 0.5 inches. If settlement reaches 0.25 inches, Public Works Inspector must be notified immediately.
- D. Conduct Auger Boring in a manner to prevent over-excavation above the pipeline, to prevent the formation of voids, and to prevent damage to existing utilities, railroads, highways, and structures.
- E. Carrier pipe must be installed to the design line and grade shown on the Drawings.

1.05 EQUIPMENT

- A. Provide Auger Boring machine, augers, bits, and supporting equipment capable of advancing through the ground conditions presented in the Contract Documents.
- B. Auger Boring machine shall include a water level manometer capable of continuously monitoring casing grade.
- C. Augers used for Auger Boring shall be at least 80% of the casing diameter. Undersized augers are precluded from use.
- D. Provide a jacking and thrust support system with a capacity sufficient for the maximum anticipated jacking loads with a safety factor of 2 or greater.
- E. Jacking system must be capable of continuously monitoring the jacking loads via gauges indicating the relative thrust and torque resistance encountered by the auger machine.
- F. Auger boring machine shall be capable of ingesting cobbles up to 1/3 the inner diameter of the casing pipe. Any cobble smaller than 1/3 of the inner diameter of the casing, measured in the longest direction, shall not be eligible for additional compensation.
- G. Contractor shall have the equipment and capacity to provide pipe lubrication during Auger Boring. Lubrication lines shall be protected from damage during jacking. Provide a suitable pressure gauge on the lubrication supply line.

1.06 SUBMITTALS

- A. Submit Working Drawings and design calculations in accordance with Specification Section 01 33 00 except as modified by this subsection to comply with Standard Specification. Edit Instructions to Bidders to coordinate with this Article. Instructions to Bidders should cross-reference this Section to establish product substitution procedures during Bidding period.
- B. Qualifications of Contractor and Auger Bore Machine Operator. Provide the name and resume meeting the qualifications specified herein. For each qualifying project provide the project name, date, location, owner, contact information, single installation length and installed diameter. Do not submit projects that do not meet the qualification requirements. General project lists that include the Auger Boring Contractor's work history will not be accepted.

- C. Submit a detailed Auger Boring Work Plan and Methods statement at least 30 days prior to starting any of the work specified herein. The detailed Work Plan shall contain the following elements:
1. Descriptions of the methods, equipment, and procedures to be utilized in completing the Work. Provide manufacturer's specifications for the auger boring machine intended for use on the project. Include descriptions and pictures of the augers and bits planned for use at each Auger Boring location.
 2. Provide the basis for the cutting head selection and acknowledgement that the cutting bits are suitable for the ground conditions as described in the Contract Documents.
 3. Describe measures for monitoring and controlling line and grade. Indicate how the water level manometer will be attached to the casing and the location of the water level within the pit for monitoring and recording grade.
 4. Scaled layout drawings showing the location of the launch and receiving pits and construction equipment and materials on the surface and within the launch and receiving pits.
 5. Provide the Auger bore machine thrust capacity and torque capacity, as well as a conversion chart for converting jacking pressure to jacking force and rotational pressure to rotational torque.
 6. Describe how a stable excavation face will be maintained during Auger Boring to prevent uncontrolled inflow of soil during Auger Boring.
 7. Schedule showing the Auger Boring work and identifying all major construction activities as independent items. Include any advance notifications required by BNSF as listed in the permit. Include the following major activities:
 - a. Notification of BNSF to coordinate BNSF representative on site.
 - b. Utility locates
 - c. Mobilization
 - d. Instrumentation and monitoring equipment installation for baseline reading
 - e. Pit excavation
 - f. Auger Boring
 - g. Contact Grouting
 - h. Carrier Pipe Installation
 - i. Annular Space Backfill
 - j. Site clean-up and demobilization.
 8. Indicate if lubrication will be used during jacking. Include details of the lubrication injection system. Include Material Data Sheets (MDS) for all lubricants.
 9. Provide a spoils removal plan, including all equipment necessary to remove the spoil from the pits for transportation. Provide the name of the disposal site location.
 10. Include calculations stamped and signed by a Professional Engineer licensed in the State of Washington, showing the selected Casing can withstand jacking forces, ground load, live load, and any other type of stresses imposed on the casing with a safety factor against overstress of 2.0 or greater. Indicate all assumptions used for the calculations and include the following:
 - a. Maximum estimated jacking load.

- b. Maximum stresses anticipated on the casing during installation including stress due to jacking, earth and water pressure, and live loads.
 - c. Show that the safety factor against exceeding the yield strength of the casing.
- 11. Provide samples of the jacking log and other record sheets to be used to create the daily records. Include all parameters that are specified herein.
- 12. Describe how the Casing line and grade will be surveyed after installation to confirm the carrier pipe will be installed to the line and grade shown on the drawings.
- 13. Provide contingency plans detailing the corrective action to be taken to address each scenario listed below. Include the observations and measurements required to identify the cause of the problem:
 - a. Settlement observed at the surface exceeding the allowable limits as noted in Section 1.4 Design Criteria, C.1. Settlement monitoring per 31 09 11.
 - b. Obstruction removal plan identifying the methods for removing obstructions at the face of the Casing during Auger Boring.
 - c. Deviation from planned alignment.
 - d. Excavated volumes of soil per Casing exceeding the Casing volume installed with a bulking factor of 1.2.

1.07 CONSTRUCTION REPORTING

- A. The Contractor shall submit daily records for each shift during Auger Boring operations. Reports shall be submitted on a daily basis by noon on the next working day following the shift for which the data or records were taken. At a minimum, log the following:
 - 1. Date, time, and name of operator.
 - 2. Installed casing pipe number, location as per stationing on plans and total installed length
 - 3. Time required to jack each pipe with a start and stop time
 - 4. Spoil volumes
 - 5. Jacking force and torque recorded at least once per Casing length installed and no less frequent than once per 20-ft of casing installed and when conditions change, or as directed by the Public Works Inspector.
 - 6. If used, volume, mix type, and locations of lubrication pumped.
 - 7. Problems encountered with Auger Boring; show durations and reasons for delay, corrective measures employed, and results.
 - 8. Soil conditions encountered.
- B. As-Built survey of Casing after completion of the Auger Boring. Provide survey of casing invert on maximum 20' spacing. The drawings shall be legibly marked with all field changes and information and shall be properly dated. This set of drawings shall be kept up to date.

1.08 NOTIFICATIONS

- A. Meeting requirements of BNSF permit.
- B. Minimum of 72-hour notification prior to the launch of the steel casing.
- C. Minimum of 48-hour notification prior to the beginning of contact grouting.

PART 2 PRODUCTS

2.01 CARRIER PIPE

- A. As shown on Plans.

2.02 STEEL CASING PIPE:

- A. The steel casing pipe shall have a minimum outer diameter of 60 inches, or 36 inches as shown on the Plans.
 - 1. Furnish size of casing to allow installation of the product pipe to the required line and grade indicated on the Plan.
 - 2. Minimum Yield Strength - 35,000 psi.
 - 3. Minimum wall thickness:
 - a. 60-inch shall be a minimum of 0.781 inch.
 - b. 36-inch casing shall be minimum of 0.469 inch.
 - 4. Shall have a thickness meeting the E-80 loading requirements
 - 5. Casing shall have the capacity to withstand the maximum anticipated jacking load with a safety factor of 2.0.

2.03 CASING DIMENSION TOLERANCE

- A. Roundness: Less than 1% difference in roundness between the major and minor outside diameter, or 1/4 inch, whichever is less.
- B. Circumference: Circumference shall be within 1% of the nominal circumference or 1/2 inch.
- C. Straightness: Maximum allowable straightness deviation: 1/8-inch in any 10-foot length.
- D. Pipe Ends: Perpendicular to the longitudinal axis of the pipe within 1/16 inch per foot of diameter with a maximum deviation of 1/4 inch measured with a straight edge and square across the end of the pipe.
- E. Square cut with beveled ends.
- F. Factory installed grout ports, flush with the inside and outside of casing, minimum of 3 grout ports per 10-foot of casing length.

2.04 CORROSION PROTECTION

- A. The corrosion protection on the steel casing shall be FBE with ARO overcoating, meeting the requirements of the BNSF permit, installed per the manufacturer's recommendation.

2.05 WELDS

- A. Full penetration butt welded joints or mechanical press-fit joints (Permalok or equal).
- B. Welding procedures must be consistent with the provisions of AWS and AWWA C2016 and the joints must be welded by an AWS certified welder.

2.06 CONTACT GROUT

- A. Within one week of completing each installation, contact grout the overcut space, completely filling the annulus in conformance with Specification Section 03 64 00..

2.07 LUBRICANT

- A. Lubricant shall consist of bentonite and/or polymers and potable water. Polymers shall be non-toxic.

2.08 ANNULAR SPACE GROUT

- A. Furnish grout for filling the annular space between the carrier pipe in conformance with Specification Section 03 60 00.

2.09 CASING SPACERS

- A. Casing Spacers shall be installed per the manufacturer's recommendations and conforming to the drawings.

PART 3 EXECUTION

3.01 GENERAL

- A. Install Casing pipe and Carrier pipe using Auger Boring in accordance with BNSF permit.
- B. Operations shall be in accordance with Auger Boring Work Plan prepared, submitted, and accepted by the Engineer.
- C. Contractor shall be responsible for locating any and all underground facilities regardless of Owner's previous efforts in this regard. Contractor shall be responsible for all losses and repairs caused by damage to underground facilities resulting from Auger Boring operations. Contractor shall undertake the following steps prior to commencing Auger Boring operations in a location which might contain underground facilities:
 - 1. Contact the utility location/notification service, for the construction area to mark the location of all utilities at the launch and receiving pit and along the pipe alignment.
 - 2. Contact all private utility owners to locate/identify any utilities in the planned boring location, including the launch and receiving pits.
 - 3. Physically locate and stake all existing lines, cables, or other underground facilities including exposing any facilities which are located within 10 feet of the proposed alignment or the launch and receiving pits.
 - 4. Modify Auger Boring practices as required to prevent damage to existing facilities.
 - 5. The Contractor shall compare the underground facility locations, depths, dimensions, and appurtenances as shown on the Plans with the actual facility locations, depths, and dimensions. Any deviations in utility location from those shown on the Plans shall be reported to the Public Works Inspector prior to the initiation of Auger Boring.

6. Conflicts between existing utilities and the Auger Boring path shall be resolved before Auger Boring can start.
 7. At any time during pipe jacking, if the Engineer or Public Works Inspector believes that there is over-excavation due to trenchless operations, at the sole discretion of the Public Works Inspector the Contractor shall install settlement monitoring points on all utilities prior to jacking beneath the utilities, at no additional charge to the Owner.
- D. Do not begin Auger Boring operations until the following conditions have been met:
1. Submittals have been made and accepted by the Engineer.
 2. Pit excavation and support has been completed in accordance with Section 31 50 00 – Excavation Support and Protection.
 3. All groundwater control has been established.
 4. All instrumentation has been installed, and baseline readings have been taken.
 5. Ensure that all work on the Launch and Receiving Pits, including any related ground improvements at the pits for break-in and break-out, has been completed prior to use of the Pits for Auger Boring. A final line and grade survey shall be conducted at the completion of the Auger Boring.
- E. Furnish all necessary equipment, power, water, and utilities for excavation, Jacked Steel Casing installation, lubrication mixing and pumping, removal and disposal of spoils, and other associated work consistent with the methods of construction.
- F. Provide a ventilation and air quality monitoring system which conforms to OSHA requirements for the duration of auger boring installation. If necessary to enter the pipeline, provide a lighting system to allow safe entry.
- G. Establish control points sufficiently far from the Auger Bore to ensure that they will not be affected by ground movement. Check the primary control for the Auger Bore system against an above ground undisturbed reference at least once every shift and any time the casing is moving out of tolerance.
- H. If a steel casing pipe section is damaged during the installation, the Contractor shall repair the steel pipe. All voids resulting from damaged steel pipe repair shall be filled to the satisfaction of the Engineer.
- I. Within one day of the completion of casing installation, completely fill the overcut space with grout

3.02 AUGER BORING

- A. Jack each pipe section forward as the excavation progresses in such a way to provide complete ground support at all times. Take special care when setting the Casing pipe on the guide rails in the pit to ensure the Casing pipe is aligned to the line and grade shown on the drawings.
- B. If the casing installation exceeds the specified tolerances, the Contractor is responsible for correcting the installation. All corrective Work shall be performed as described in the accepted Contingency Plan at no additional cost to the Owner.

- C. If the soil at the face of the machine is not stable and subject to flowing or fast raveling conditions, the Contractor shall recess their augers inside the Casing to control the face.
- D. Provide groundwater control at the pits and as required for execution of the Work.
- E. Provide Launch and Receiving Pits seals comprised of a rubber gasket and tightening plates.
- F. Transport and dispose of all excavated spoils in accordance with the Work Plan. No stockpiling shall be permitted at the launch pit sites. Only use the disposal sites identified in accepted submittals.
- G. In the event the Contractor encounters a problem during the Work and the situation is not covered by the Contractor's Contingency Plan, the Contractor shall propose alternative solutions for Owner's approval within two days of occurrence.
- H. Use CDF or grout on the outside of the exit pit wall to completely seal the exit/entrance face of the launch and receiving pit. Prevent soil inflows into the pits during launch and retrieval of the auger boring machine. No voids shall be present on the outside of the shoring. Any voids must be backfilled with CDF. Ensure that the strength of the CDF allows penetration of the Auger Boring machine.

3.03 PRE-AUGER BORING MEETING

- A. Before the Contractor starts any auger boring activities the Contractor shall hold a pre-Auger Boring meeting with the Superintendent, Auger Boring Operator, Public Works Inspector and Engineer.
- B. The meeting shall be scheduled within seven (7) days of the planned start of Auger Boring operations. The intent of the meeting is to review all elements of the proposed Auger Boring operation including:
- C. Verification that all submittals have been accepted by the City.
- D. Verification that the rails have been surveyed to the design elevation and slope, including survey information.
- E. Communication protocols between the Auger Boring operator, Contractor, and Public Works Inspector.
- F. Required entries to the daily log and updating the As Built Working Drawings.
- G. Auger Boring within specified tolerances.
- H. Methods for confirming the As Built casing alignment and profile are within the tolerance of the design of the auger boring alignment and profile.

3.04 CONSTRUCTION

- A. Do not begin construction until the BNSF representative is on site.
- B. Install casing between the limits indicated on the Plans.

- C. Locate launch and receiving pits within construction limits.
- D. Utilize methods that include due regard for safety of workers, adjacent structures and improvements, utilities, and the public.
- E. Perform all work in accordance with the requirements of Washington State, OSHA standards.
- F. Provide all necessary equipment, power, water, and utilities for excavation, auger boring, lubrication, removal and disposal of spoils, grouting, and other associated work consistent with the accepted Work Plan.
- G. Take measures to prevent surface runoff from entering the launch and receiving pits.
- H. Take necessary precautions to minimize groundwater inflow into the launch pit from within the pipe.
- I. Perform all work so as not to disturb adjacent structures, roadways, railroads, or existing utilities.
- J. Repair damage in a timely manner to the satisfaction of the agency or utility having jurisdiction.
- K. Handle and store casing pipe as required by the manufacture.
- L. Water-tight Seals shall be constructed at the launch and receiving pits.
 - 1. Pit seal shall be a rubber gasket attached to the Pit wall.
 - 2. Pit shall include sliding plates to tighten the rubber gasket.
- M. The outside of the pit at the location of launch shall be filled with CDF to prevent groundwater from entering the pit during launch.

3.05 GROUNDWATER CONTROL

- A. Required for Auger Boring launch and receiving pits.
- B. Auger Boring shall not advance if groundwater carrying soil is flowing into the launch pit from casing.

3.06 OBSTRUCTIONS DURING INSTALLATION

- A. Notify the Public Works Inspector immediately if an obstruction is encountered. Written notification is required to meet contract Specification Section 00 72 00.
- B. Diligently work to advance the casing per the contingency plans submitted in the Work Plan and Method's Statement.

- C. Allow Public Works Inspector visual access to verify object(s) including by real time sharing of live video, still photography shared in real time, and man entry to the point of obstruction, as requested by the Owner.
- D. Take all necessary steps to remove any obstruction or otherwise make it possible to continue casing installation.

3.07 CONTACT GROUTING

- A. Within one week of completion of Auger Boring operations, the Contractor shall fill the external void space with grout. Contact grout pressure shall be controlled to ensure that the casing pipe is not damaged, and grout is not forced to the ground surface. At the completion of grouting, all grout ports shall be sealed with plugs designed to prevent long-term infiltration of soil and water into the steel pipe. No leakage shall be allowed.

3.08 LAUNCH AND RECEIVING PITS

- A. The locations of the launch and receiving pits are shown in the Plans.
- B. The Contractor shall determine the size and shape the pit for the pipe jacking.
- C. Upon completion of the Auger Boring and grouting operations, the Contractor shall remove all equipment and temporary shoring.
- D. Backfill the pit with imported fill, shall be in accordance with Specification Section 31 23 00 Excavation and Fill.
- E. Compaction of the backfill, shall be in accordance with Specification Section 31 23 00 Excavation and Fill.

3.09 FINISHING

- A. The Contractor shall remove all construction debris, spoil, water, oil, grease, and other materials from the installed casing.
- B. Cleanup will be incidental to the construction. No separate payment shall be made for the cleanup.
- C. Installed casing will be subject to visual inspection by the Public Works Inspector. Visual inspection will include real time sharing of live video, still photography shared in real time, and personnel entry to any point along the casing, as requested by the Public Works Inspector.
- D. Complete an As-Built survey of the casing invert. Survey casing invert at the face of the launch pit, the face of the receiving pit and on maximum 20' spacing in between.

END OF SECTION

SECTION 33 05 13
MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies precast concrete manholes and appurtenant items for combined sewers, sanitary sewers and storm drains.
 - 1. Unless otherwise specified, precast manholes shall conform to City of Everett requirements, Section 6-6 Manholes and Standard Drawings 605 through 607 with the modifications specified by the Contract Documents.
 - 2. Access manway manholes for combined sewers, sanitary sewers and storm drain shall be provided in accordance with Detail 1, CD-2601 with manholes and structures as specified including modifications to the COE Standard Details.
 - 3. All precast manholes and structures must be submitted for review and acceptance including design calculations and working drawings referencing the manhole identifier, drawing number and Station.
 - 4. All Precast units must be designed and sealed by a Professional Engineer registered in the State of Washington. At a minimum, the structures shall conform to the requirements of City of Everett requirements, Section 6-6 Manholes and Standard Drawings 605 through 607.
 - 5. Manholes within the Port of Everett, Norton Terminal property shall be designed for additional live loads and surcharge loading including but not limited to live loads per drawing G-2013 or the weight of four stacked containers over the structure, whichever is greater. Max gross load per container shall be 67,200 lbfs. This requirement shall apply to the following minimum locations:
 - a. C-2107, SSMH 010
 - b. C-2207, SSMH 104
 - c. C-2307, SDMH 508
- B. Provide all materials, labor, services and ancillary elements required to complete the work as specified, including but not limited to the construction of the manholes and concrete structures, coordination with pipe fabricators, testing of pipe and manhole, and any flow diversions or bypass pumping required to complete the work.
- C. Cast in-place manhole component for sanitary sewers, combined sewers and/or stormwater sewer shall be provided in accordance with the City standards and the requirements of Division 03.

1.02 QUALITY ASSURANCE

A. REFERENCES

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
ASTM A48	Gray Iron Castings
ASTM C478	Precast - Reinforced Concrete Manhole Sections
ASTM C857	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
ASTM C891	Installation of Underground Precast Concrete Utility Structures
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

- B. Manufacturer shall be a PCI, NPCA, and/or WSDOT-certified plant for production of precast structures as specified herein.
- C. Where structures are installed within WSDOT Rights-of-way, aggregate used in producing concrete shall be from WSDOT-approved sources.
- D. Standardization:
 1. Materials, supplies and equipment provided shall be the standard products of manufacturers. The standard products of manufacturers, other than those specified, will be accepted when it is demonstrated to the Construction Manager that they are equal in composition, durability, quality and usefulness for the purposes intended. Requests for substitution may be submitted and shall be considered in accordance with Section 01 33 00, and shall include directions for applicable and descriptive literature on the safe storage, handling and disposal of the product.

E. Quality Control Inspection:

1. Inspect all sections for general appearance, dimensions, soundness, etc. The surface shall be dense, close-textured and free of honeycomb, cracks, roughness, exposure of reinforcement, damaged joints, or other irregularities.
2. All sections which have been damaged after delivery will be rejected, or if already installed, shall be repaired or removed and replaced entirely at Contractor's expense.
3. Rejected sections shall be tagged as such, segregated from other sections, and removed from the Site.
4. The quality of all materials, the process of manufacture and the finished sections shall be subject to inspection by the Construction Manager. Such inspection by the Construction Manager may be made at the place of manufacture and/or at the Site upon delivery.

1.03 SUBMITTALS

A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES.

B. Action Submittals

1. A copy of this specification section, with addendum updates included, and 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. A check mark 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 ENGINEER 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. Shop Drawings:
 - a. Product technical data including:
 - 1) Acknowledgement that products submitted meet requirements of standards referenced.
 - 2) Manufacturer's installation instructions.
 - b. Structural Calculations:
 - 1) Structural calculations shall be prepared and stamped by an engineer licensed in the State of Washington.
 - 2) Loadings shall be based on load cases defined in the 2021 International Building Code and the following:
 - a) Lateral earth pressures, as shown on the Drawings.
 - b) AASHTO HS25 wheel loading with applicable impact factors in accordance with ASTM C857.
 - c) Any loads imposed by the supported pipeline and appurtenances.

- 3) Calculations shall be detailed and include:
 - a) Concrete reinforcement in walls, base, and top slab or cone.
 - b) Picking points for lifting.
 - c) Buoyancy checks. Assume groundwater at existing surface grade.
- 4) Fabrication and/or layout drawings:
 - a) Fabrication drawings shall be prepared and stamped by an engineer licensed in the State of Washington.
 - b) Include detailed diagrams of manholes showing typical components and dimensions, reinforcements, cast iron frames and covers, joint details and seals, and other details.
 - c) Weights of all precast sections.
 - d) Itemize, on a separate schedule, a sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.
 - e) Indicate knockout size, elevation, and orientation for all piping entering each manhole.
 - f) Pipe penetration seal detail.
- C. Informational Submittals
 - 1. Manufacturers Submittals
 - a. Manufacturer's shop drawings and catalog data with sufficient detail to show compliance with specified requirements.
 - b. Details of materials, components, pipe connections, joint gasket (material, size and shape), their locations, and related appurtenances.
 - c. Pipe-to-structure connection detail with Manufacturer's product data, material properties with applicable ASTM references and technical installation requirements.
 - d. Instructions on storage, handling, transporting and installation.
- D. Construction Submittals
 - 1. Record copies of structure testing results
- E. Close out Submittals
 - 1. Per Section 01 78 39, PROJECT RECORD DOCUMENTS

PART 2 PRODUCTS

2.01 PRECAST MANHOLE SECTIONS

- A. Precast reinforced concrete manhole bases, risers and tops shall meet the requirements of ASTM C 478.
- B. Precast reinforced concrete manhole bases, risers and tops shall have a minimum wall thickness as shown in Standard Drawings 605 through 607. The required wall thicknesses shall be confirmed by the precaster for the installation conditions including determination of bottom section, wall sections, and top section thicknesses to resist buoyancy forces and soil pressures.

- C. Prior to the delivery, all precast manhole sections will be tested at the point of manufacture.
 - 1. All test specimens will be tested and shall meet the permeability test requirements of ASTM C14.
 - 2. Precast, reinforced, concrete manhole bases, risers and tops shall be tested in accordance with ASTM C 497 by an approved testing laboratory, for concrete compression tests on cores drilled from 5 percent of the lot.
 - 3. When manhole sections are made on a sewer pipe machine, the number of compression tests on cores may be reduced to 1 percent of the order with a minimum of two cores per lot.
 - 4. For manhole section testing frequency, a lot shall be defined as all manhole risers and tops manufactured by the same process in one plant over a period not to exceed 2 weeks.
 - 5. Each manufacturer shall provide a suitable core-drilling machine conforming to ASTM C497, on his premises, and an operator to take test cores as directed by the testing laboratory personnel.
- D. Precast, reinforced, concrete manhole bases, risers and tops shall be subject to rejection for failure to conform to any of the Specification requirements. In addition, individual sections of manhole risers and tops may be rejected for any of the following reasons:
 - 1. Fracture or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
 - 2. Defects that indicate imperfect proportioning, mixing, or molding.
 - 3. Surface defects indicating honeycombed or open texture.
 - 4. Damaged ends, where such damage would, in the Engineer's opinion, prevent making a satisfactory joint.
 - 5. Manhole steps out of line, or not properly spaced.
 - 6. The internal diameter of the manhole section varying more than 1 percent from the nominal diameter.
 - 7. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of the position in the section wall.

2.02 PRECAST MANHOLE JOINTS

- A. Precast, reinforced concrete manhole sections used for sewer manholes shall be jointed with rubber gaskets meeting the following requirements of ASTM.

Depth of Manhole	ASTM Standard
0 to 30 feet	C443

2.03 EXTERNAL JOINT WRAP

- A. An external joint wrap shall be installed on each joint to provide a permanent external seal against infiltration.
- B. External joint seals shall:
 - 1. meet, or exceed, the requirements of ASTM C-877, Type II.

2. consist of a collar a minimum of 12" wide with an outer layer of polyethylene, with a minimum tensile strength of 4000 psi and a minimum tear resistance of 1500 psi, and an under layer of rubberized mastic that is reinforced with a woven polypropylene fabric.
 3. Provide Two 5/8 inches steel straps with self-contained tensioning ratchets shall be located within the collar 3/4 inches from each edge. The straps shall be confined in tubes that isolate them from the mastic and allow them to slip freely when mechanically tightened and locked around the manhole.
 4. The collar shall be furnished with a minimum of 8 inches overlap and a closing flap to cover any remaining exposed strap.
- C. Approved External Wrap
1. Cretex Wrap External Joint Sealers as manufactured by Cretex Specialty Products.
 2. Or equal

2.04 MANHOLE TOPS

- A. Manhole cones, top slabs, and grade rings shall comply with City of Everett Standard Drawings based on specified Manhole Type.

2.05 GRADE RINGS

- A. Precast Concrete Grade Rings: Concrete used to fabricate grade rings shall contain a proportion of cement in the mixture not less than 564 pounds per cubic yard of concrete except that a maximum of 64 pounds of Portland cement may be replaced with a minimum of 100 pounds of fly ash. The mixture shall contain 6 percent (plus/minus 1.5 percent) entrained air. The minimum compressive strength shall be 5,500 psi at 28 days. the maximum water absorption shall not exceed 6 percent by weight. If the grade ring is steam cured, it shall not be reduced in temperature more than 40 degrees F per hour until it is within 20 degrees F of the outside temperature. The units shall be maintained at a temperature above 32 degrees F during the first 6 days after curing. The rings shall have an approved identification mark or color code.
- B. Expanded Polypropylene Foam (EPP) Grade Rings
1. EPP foam shall be manufactured from commercial grade black 5000 series polypropylene in accordance with ASTM D3575 and have a have a traffic rating
 2. compliant with AASTHO M-306 HS-25.
 3. Grade rings shall have shop manufactured upper and lower keyways (tongue and groove) for proper vertical alignment and sealing. Finishing grade rings shall have keyways on the lower surface only.
 4. Any adhesive or sealant used for watertight installation of the manhole grade adjustment rings shall be M-1 Structural Adhesive/Sealant or equal meeting the following specifications:
 - a. ASTM C-920, Type S, Grade NS, Class 25, Uses NT, T, M, G, A and O
 - b. Federal Specification TT-S-00230-C Type II, Class A
 - c. Corps of Engineers CRD-C-541, Type II, Class A

- d. Canadian Standards Board CAN 19, 13-M82
 - e. AAMA 802.3-08 Type II, AAMA 803.3-08 Type I, and AAMA 805.2-08 Group C
5. Acceptable Manufacturer – Pro-Ring™ by Cretex Specialty Products

2.06 MANHOLE EXTENSIONS AND MANHOLE HEADERS CONSTRUCTED FROM PRECAST CONCRETE ADJUSTING GRADE RINGS

- A. Precast concrete adjusting grade rings used for manhole headers shall meet the requirements of ASTM C 478. Precast concrete adjusting grade rings used for manhole headers shall comprise a total height of 6 inches when stacked vertically and shall contain a minimum of one No. 2 reinforcing rod centered within each ring. Where necessary, rings shall be grooved to receive manhole steps.
- B. In general, manhole extensions and headers will be used on all manholes in roads or streets or in other locations where a subsequent change in existing grade may be likely. Extensions and headers will be limited to a maximum combined height of 16 inches. Finish grade for manhole covers shall conform to finished ground or street surface unless otherwise directed by the Construction Manager.

2.07 OIL/WATER SEPARATOR STRUCTURE

- A. Oil/water separator shall be model 712-SA, manufactured by Oldcastle Infrastructure.

2.08 PIPE CONNECTIONS

- A. Provide resilient watertight connectors between the manhole and piping in accordance with ASTM C923. Boots shall consist of a chemically resistant, flexible neoprene EPDM, locking ring, and pipe clamp(s). Locking ring shall be stainless steel and shall lock the boot into the preformed opening in the manhole. The pipe clamp shall be stainless steel.
- B. Alignment at the manhole shall not exceed deflection allowable per the manufacturer or ASTM C923.
- C. Acceptable Manufacturers:
 - 1. Kor-N-Seal Toggle Style or approved equal

2.09 DROP CONNECTION PIPE AND FITTINGS

- A. Provide outside drop manhole connections where specified in accordance with Standard Drawing 612.
- B. Firmly support all drop pipe and fittings to prevent movement when concrete is being placed.

2.10 MANHOLE FRAMES AND COVERS

- A. Provide manhole frame and cover in accordance with COE Standard Specification and Drawings and as modified herein.
- B. Manhole frames and covers shall be of good quality, strong, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render

them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30, and City of Everett Standards.

- C. Manhole covers shall be designed for an HS-25 wheel load and suitable for heavy traffic conditions unless otherwise specified.
- D. 30" manhole covers and frames:
 - 1. Olympic Foundry Inc. Part No. MH69 WT Ring & Cover or approved equal. See Manhole Schedule for structures with a 30" manhole cover.
- E. 24" manhole covers and frames:
 - 1. follow standard detail 610 OR 611 as specified.
- F. All covers shall be bolted unless otherwise specified.
- G. Stamped "SEWER" or "DRAIN". Do not apply any other lettering.

2.11 MANHOLE STEPS AND LADDERS

- A. Provide manhole steps and ladders in accordance with Standard Drawing 609 and 608.

2.12 WATERPROOFING

- A. Elastomeric waterproofing membrane shall applied to all exterior surfaces.
- B. Elastomeric Waterproofing Sealer:
 - 1. Provide single component, cold applied rubberized asphalt emulsion which cures to provide heavy duty, rubber-like membrane for use in waterproofing and damp proofing concrete and masonry surfaces below grade
 - a. HE784-AQUA-BLOC WB as manufactured by Henry,
 - b. or approved equal.
 - 2. Surface preparation and material application shall follow all manufacturer's recommendations.

2.13 CORROSION PROTECTION

- A. All sanitary sewer manholes with exposed concrete subject to wastewater shall be provided with internal corrosion protection per Section 33 01 30.82, Epoxy Coating of Concrete Structures.
- B. Sanitary sewer manholes with access manways and blind flanges shall NOT require Epoxy coatings.

2.14 SETTLEMENT-SEISMIC PROVISIONS (NOT USED)

2.15 MASONRY ANCHORS

- A. Masonry anchors shall be snap-off type or flush type for use with cadmium plated bolts. Nondrilling anchors shall be flush type for use with a bolt or stud type with projecting

threaded stud as manufactured by ITT Phillips Drill Division, Michigan City, IN; Hilti HDI Drop-in anchors, Hilti, Inc., Stamford, CT; or equal.

PART 3 EXECUTION

3.01 SITE PREPARATION

- A. Site preparation shall conform to Section 31 10 00 SITE CLEARING.
- B. Contractor shall field verify the existing condition of manholes to be removed and replaced or where connecting to existing structures including but not limited to location, elevations, channel inverts, and pipe connections.

3.02 SHORING, SHEATHING AND BRACING OF EXCAVATIONS

- A. Shoring, sheathing and bracing required for the construction of manholes, cleanouts and concrete structures shall conform to those requirements as specified in Section 31 50 00 EXCAVATION SUPPORT AND PROTECTION.

3.03 EXCAVATION AND BACKFILL FOR MANHOLES

- A. Excavation and backfill for manholes and cleanouts on open-cut sewers shall conform to the applicable provisions of Section 31 23 00 EXCAVATION AND FILL.
- B. If the excavation for manholes base in stable soil has, without the concurrence of the Construction Manager, been carried below the required bottom of the manhole base, the excess depth shall be filled, at no additional cost to the Owner, with base material and compacted as specified.
- C. Place and compact to 95 percent of maximum density as determined by AASHTO T180, a minimum of 24 inches of bedding material. Thoroughly compact with a mechanical vibrating or power tamper.
- D. Backfill around manholes and cleanouts on open-cut sewers shall conform to the class specified for trench backfill, Section 31 23 00 EXCAVATION AND FILL.
- E. Should the contractor elect to use a sealing slab to prevent uplift due to external water pressure, the slab thickness shall be sufficient to withstand full external water pressure with the excavation dry. If a sealing slab is used, no mud slab will be required.

3.04 REMOVAL OF WATER

- A. Remove water from the excavation. Conform to Section 31 23 19 DEWATERING.

3.05 PRECAST MANHOLES

- A. Spacing shall be as specified and shown.
- B. Manhole Invert
 - 1. Construct manhole inverts in conformance with manhole details shown on the Plans, and with smooth transitions to insure an unobstructed flow through the manhole. Remove all sharp edges or rough sections which tend to obstruct flow. Where a full

section of pipe is laid through a manhole, break out the top section and cover exposed edge of pipe completely with mortar. Trowel all mortar surfaces smooth.

2. The trough of a manhole for pipe sewers shall be the same diameter as the larger of the adjoining sewers. The pipe may be laid through the manhole, and the upper half of the pipe shall be removed after the manhole is built. The pipe shall be supported on brick or solid concrete blocks for the placement of the concrete base. The concrete shall be extended under the pipe to the face of a pipe joint and where the pipe rests on undisturbed soil. This extended portion of the manhole base shall rest on undisturbed soil.

C. Precast Manhole Base:

1. Set precast manhole base unit level on compacted base material or concrete work slab as specified hereinbefore.

D. Placing Precast Manhole Riser Sections:

1. Conform to the requirements of jointing rubber gasketed concrete sewer pipe in Section 33 05 13.

3.06 MANHOLE RISER TOLERANCE

- A. Departure from and return to true vertical from the established manhole center shall not exceed 1/2 inch per 10 vertical feet or 2 inches for the total manhole depth, whichever is less.

3.07 PIPE TO MANHOLE CONNECTIONS

A. Precast manholes:

1. Provide watertight flexible pipe to manhole connectors per Paragraph 2.07

B. Cast-in-place bases:

1. Pipes entering and leaving the base of the manhole shall be sealed with non-shrink grout. Place a six inch thick envelope around pipes entering a manhole. The concrete collar shall extend 12 inches from the manhole wall all around the pipe
2. Grout around pipes in manhole walls or base to provide a watertight seal. Where flexible pipe is used, the annular space between the pipe and manhole wall shall be filled with a mastic sealant supplied by the pipe manufacturer.

3.08 MANHOLE FRAMES AND COVERS

- A. Adjusting Manholes and Catch Basins to Grade per Section 32 10 00 Surface Restoration.

- B. Install frames and covers on top of manholes grade rings to prevent all infiltration of surface or ground water into manholes. Frames shall be set in a bed of mortar with the mortar carried over the flange of the frame. Set frames so tops of covers are flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

3.09 ELASTOMERIC WATERPROOFING SEALER

- A. Provide waterproofing seal to all manholes.

- B. Thoroughly clean the section of the manhole frame over which the sealer is to be applied, the manhole header, extension and cone or top slab and the top 12 inches of the manhole riser.
 - 1. All surfaces shall be free of dust, oil, rust, loose materials and other contaminants. Take necessary precautions to prevent rebound from the sandblasting operation to enter the sewer system.
 - 2. All holes, cracks, and recessed joints in concrete must be filled with cement mortar for a smooth, clean surface without depressions or projections.
 - 3. All surface voids, holes and cracks must be completely coated to attain the damp proofing or waterproofing qualities.
 - 4. If the mortar between grade rings is removed to a depth greater than 1/4 inch by the sandblasting, the joints shall be refilled with mortar as specified herein.
- C. Apply and cure in accordance with the manufacturer's recommendations.
- D. Allow sealer to cure before backfilling. Drying times may vary depending on weather conditions. Allow sealer to cure 24 to 48 hours unless otherwise approved.
- E. After curing is complete and prior to backfilling, all manholes and vaults shall be draped with minimum 10-mil polyethylene sheeting wrapped on all sides from the bottom to 6-inches below finished grade. Adhesive tape shall wrap around at the bottom and top of the sheeting as well as every 6 vertical feet, or fraction thereof. The adhesive tape shall be continuous around the manhole or vault and be a minimum of two layers.

3.10 CONNECTION TO EXISTING SEWER

- A. Install manholes on the existing sewer main as specified
 - 1. Boot shall be installed only in accurately sized, field-cored holes.
 - 2. Acceptable Manufacturer:
 - a. Kor-N-Seal Toggle Style or approved equal.
 - 3. Provide bypass for the existing sewer where required to complete the Work. Flow shall be prevented from entering the sewer or structure until the Work has been accepted by the Construction Manager.
- B. Confirm the pipe and invert elevations shown on the Plans. Immediately notify the Construction Manager if invert elevations of the existing sewers vary from those shown

3.11 TESTING AND ACCEPTANCE

- A. HYDROSTATIC TESTING FOR SHALLOW MANHOLES (LESS THAN 20 FEET DEEP)
 - 1. When, in the Engineer's opinion, the groundwater table is too low to permit visual detection of leaks, up to 20 percent but in no case less than 10 percent of the total manholes shall be hydrostatically tested. The test shall consist of plugging all inlets and outlets and filling the manhole with water to a height determined by the Engineer. Leakage in each manhole shall not exceed 0.2 gallon per hour per foot of head above the invert. A manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into the pipe walls to take place. Repair all manholes that do not meet the leakage test, or are unsatisfactory from visual inspection, to conform to the requirements herein.

2. If more than 25 percent of the manholes tested fail the hydrostatic test, the Contractor will be required to test all or as many manholes as the Engineer may deem necessary.
- B. TEST REQUIREMENT FOR DEEP MANHOLES (20 FEET DEEP AND OVER)
1. All manholes will be visually inspected for leakage. No leakage will be permitted and the Contractor shall repair all leaks in a manner satisfactory to the Engineer. If the groundwater is too low, in the Engineer's opinion, to detect leaks in deep manholes, hydrostatic testing as described above for manholes up to 20 feet deep will be required.
- C. WATER FOR TESTING
1. Make all arrangements for furnishing water from the nearest hydrant or other suitable source for testing purposes. Provide all hoses, tank trucks, plugs, and other necessary equipment to complete the tests.

END OF SECTION

SECTION 33 05 26
BURIED UTILITY IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies warning tape, tracer wire, marker posts and tags for buried pipe, valves, appurtenances and for hazard and safety signs.
- B. Provide all necessary labor, materials, equipment, services, and incidentals required provide a complete, in-place identification and protection system for buried conveyance infrastructure.
- C. Provide detectable warning tape over all non-ferrous pipe and service laterals unless otherwise specified.
 - 1. Provide one layer of detectable warning tape 12-inches over the crown of pipe.
 - 2. Provide a second layer of detectable warning tape 18-inches below finished grade or the base of the aggregate base layer.
- D. Provide non-detectable warning tape over ductile iron pipe installed in West Marine View Drive (WMVD).

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 31 23 00 Excavation and Fill

1.03 REFERENCES

- A. 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.

Reference	Title
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D882	Standard Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D2103	Standard Specification for Polyethylene Film
ANSI Z535.1	APWA Uniform Color Code, ANSI Z535.1-2006, American National Standard For Safety Colors
OSHA	29 CFR 1910.145, Specification for Accident Presentation Signs and Tags
WSDOT Materials Manual	Washington State Department of Transportation (WSDOT), Materials Manual, latest edition
WSDOT Standard Specifications	Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge, and Municipal Construction, latest edition

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures.
- B. Action Submittals:
 - 1. A copy of this entire specification section, with addendum updates included, and 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. A check mark 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.
- C. Informational Submittals:
 - 1. Manufacturers Material Submittals
 - a. Manufacturer's product data including but not limited to:
 - 1) Product catalogue data with dimensions and materials,
 - 2) Working drawing of the exact legend to be provided for posts, markers and caps showing all information to be provided, text height and coloring for each identification device.
 - 3) Installation requirements and recommendations.
 - b. Acknowledgement that products provided are provided by a single manufacturer and meet requirements of referenced standards and requirements specified herein.
- D. Construction Submittals:
 - 1. Provide a schedule of identification devices to be installed including the device type, color, description, and location including coordinates, station and offset as applicable.
- E. Closeout Submittals:
 - 1. Per Section 01 78 39, Project Record Documents.
 - 2. Provide installed locations and device type on Record Drawings
 - 3. Provide a schedule of as-built identification devices including the device type, color, description, and location including coordinates, station and offset as applicable.

1.05 IDENTIFICATION COLOR

- A. Comply with APWA Uniform Color Code, ANSI Z535.1-2006, American National Standard For Safety Colors unless otherwise specified.

Utility Type	Color
Electric Power Lines, Cables, Conduit, and Lighting Cables	Red
Gas, Oil, Steam, Petroleum or Gaseous Materials	Yellow
Telephone, Communication, Alarm or Signal Lines, Cables, or Conduit	Orange
Cable TV and Fiber Optic	Black and Orange
Potable Water	Blue
Reclaimed Water, Irrigation and Slurry Lines	Purple
Sewers and Drain Lines	Green

PART 2 PRODUCTS

2.01 GENERAL

- A. All identification devices to be:
1. Supplied in accordance with APWA Color code with black ink legend against high intensity color coded background.
 2. Printed by mechanical process - hand printing is not acceptable.
 3. Lead free

2.02 NON-DETECTABLE WARNING TAPE

- A. Material: Polyethylene.
- B. Dimensions:
1. Width: 6-inch minimum
 2. Thickness: 4 mils minimum per ASTM D2103
- C. Legend: Preprinted and permanently embedded. 1-inch-high minimum
1. "CAUTION "XXX" PIPELINE BURIED BELOW" or as directed by the Owner's Representative.
- D. Color: Comply with APWA Uniform Color Code (ANSI Z535.1) for the pipeline service.
- E. Manufacturers:
1. Presco Non-Detectable Underground Warning Tape
 2. Harris Industries UT Series
 3. Or approved equal.

2.03 DETECTABLE WARNING TAPE

- A. Material: Polyethylene. Tape shall have non-ferrous metal foil conductor sandwiched in the tape for detection purposes.
 - 1. Tensile strength: 1750 psi minimum
 - 2. Elongation minimum: MD 80% TD 139% per ASTM D882
 - 3. Thickness Foil Core minimum: 0.35 mil per ASTM D2103
- B. Dimensions:
 - 1. Width: 6-inch minimum
 - 2. Thickness Overall: 4.5 mil foil minimum per ASTM D2103
- C. Legend: Preprinted and permanently embedded. 1-inch-high minimum
 - 1. "CAUTION "XXX" PIPELINE BURIED BELOW" or as directed by the Owner's Representative.
- D. Color: Comply with APWA Uniform Color Code (ANSI Z535.1) for the pipeline service.
- E. Manufacturers:
 - 1. Presco Detectable Underground Warning Tape
 - 2. Harris Industries DU Series
 - 3. Or approved equal.

2.04 DOME TOP MARKER POSTS (NOT USED)

- A. Material: Non-corrosive, impact resistant thermoplastic, easy to install, maintenance free, weather and vandal resistant.
- B. Dimensions:
 - 1. Dome Top posts: 72-inch long by 3.50-inch diameter post
 - 2. Enhancer length: 18 inches minimum
- C. Legend: "WARNING "XXX" Pipeline CALL-BEFORE YOU DIG 811" or as directed by the Owner's Representative.
- D. Color: Comply with APWA Uniform Color Code (ANSI Z535.1) for the pipeline service.
- E. Manufacturers:
 - 1. Model: Carsonite dome top LineMarker with visibility enhancer and T anchor.
 - 2. Or approved equal.

2.05 FLAT MARKER POSTS

- A. Material: Fiberglass composite.
- B. Dimensions: 66-inch long by 3.75 inches wide (CRM) or 4.00 inches wide (CFR).
- C. Legend: "WARNING: LOCATE TEST STATION – CALL BEFORE YOU DIG."

- D. Color: Comply with APWA Uniform Color Code (ANSI Z535.1) for the pipeline service.
- E. Manufacturer:
 - 1. Carsonite CRM RoadMarker or CFR Curv-Flex Marker, with anchor barb.
 - 2. Or approved equal.

2.06 BRASS CAP MARKER

- A. Materials: Brass Caps shall be a 3-inch diameter, flat brass cap with corrugated stem.
- B. Stamp cap with the information as specified.
 - 1. Provide cardinal direction using standard 8 cardinal compass points and offset.
- C. Manufacturer:
 - 1. SOKKIA 813408
 - 2. or approved equal.

2.07 STENCILING

- A. Materials: Exterior type stenciling enamel.
 - 1. Either brushing grade or pressurized spray can form and grade.
- B. Size: As specified
 - 1. 3.75-inch Min for pipe exposed in manholes, vaults or structures.
- C. Legend: As required by Owner.
- D. Color: Black or white for best contract.

PART 3 EXECUTION

3.01 GENERAL

- A. Install identification devices at specified locations. Provide installed locations and device type on Record Drawings
- B. Install identification devices in accordance with manufacturer recommendations unless otherwise specified.
- C. Lay warning tape and tracer wire over the pipe centerline. Warning tape must be continuous along the full length of the buried utility. Gaps will not be accepted.

3.02 INSTALLATION OF NON-DETECTABLE WARNING TAPE

- A. Place warning tape in trench as follows:
 - 1. Cover less than 5 feet: Place non-detectable warning tape 18-inches below finished grade.
 - 2. Cover greater than 5 feet: Place an additional layer of non-detectable warning tape 12-inches above the top of the utility.

3.03 INSTALLATION OF DETECTABLE WARNING TAPE

- A. Place warning tape in trench as follows:
 - 1. Cover less than 5 feet: Place detectable warning tape 18-inches below finished grade.
 - 2. Cover greater than 5 feet: Place an additional layer of detectable warning tape 12-inches above the top of the utility.
- B. Splicing of the tape shall be per the manufacturer's recommended materials and procedures
- C. Tracer wire shall be physically attached to buried pipes. Installed wire must be free of abrasions or cuts to the exterior jacket.
- D. Terminations
 - 1. Run wire up through valve stem assemblies and other surface appurtenances. Terminate tracer wire as recommended by the manufacturer.
 - 2. Extend detectable warning tape a minimum of 2-feet into manholes or structures.

3.04 INSTALLATION OF FLAT FACE AND DOME MARKER POSTS

- A. Provide marker posts as follows:
 - 1. For all buried utilities except straight gravity sewer lines or drain lines with a manhole on each end of a straight alignment.
 - 2. Do not install marker posts in paved areas or roadways.
 - a. Install marker posts either side of paved areas, roadway, easement boundaries and other linear improvements (e.g. Flood control channels)
- B. Location
 - 1. Install marker posts along the centerline of pipe.
 - 2. Provide posts at each straight-line maximum distance of 500 feet.
 - 3. Provide posts at horizontal changes in direction over fittings.
 - a. if structures are not present.
 - b. Provide one post above the fitting and one post in each direction from the bend. The two directional posts shall be a minimum of 1 foot and a maximum of 50 feet from the post that marks the bend location.
 - c. Provide posts at points of curvature and along the arc of the curve at a maximum of 25-foot intervals.
- C. Service stub outs or end points for future connections.

3.05 INSTALLATION OF BRASS CAP MARKERS

- A. Install brass cap markers into holes drilled into concrete curb, sidewalks, etc or provide concrete posts where concrete improvements do not exist.
 - 1. Concrete posts shall be Class B Concrete, 8-inch diameter min with marker set in the center of the post.

END OF SECTION

SECTION 33 05 31
DUCTILE IRON PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies ductile iron pipe (DIP), ductile fittings and gaskets.
1. Pipe and fittings for waterline relocations shall be provided in accordance with City of Everett requirements.
 2. Pipe and fittings for combined sewer, sanitary sewer and storm drain shall be provided in accordance with this Section.

1.02 REFERENCES

- A. 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.
- B. 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
ANSI A21.14	Ductile-Iron Fittings 3 In. Through 24 In., for Gas
ANSI A21.52	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand Lined Molds for Gas
ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A716	Ductile-Iron Culvert Pipe
ASTM C150	Portland Cement
AWWA C104 (ANSI A21.4)	Cement-Mortar Lining for Ductile- Iron and Gray-Iron Pipe and Fittings for Water
AWWA C110 (ANSI A21.10)	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111 (ANSI A21.11)	Rubber-Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115 (ANSI A21.15)	Flanged Ductile-Iron and Gray-Iron Pipe With Threaded Flanges
AWWA C150 (ANSI A21.50)	Thickness Design of Ductile-Iron Pipe

Reference	Title
AWWA C151 (ANSI A21.51)	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153 (ANSI A21.53)	Ductile-Iron Compact Fittings, 3 In. Through 12 In. for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Type Joints
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

1.03 SUBMITTALS

A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES.

B. Action Submittals

1. A copy of this specification section, with addendum updates included, and 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. A check mark 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 ENGINEER 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. Detail drawings which show the type and location of all pipe, fittings, joints, and connections to structures and manholes.
3. Submit design calculations for pipe substantiating suitability of pipe for design loads for trench and embedment provided.
 - a. Submitted calculations must be sealed by a registered professional engineer licensed in the State of Washington for the design of the pipe in accordance with these specifications
4. Submit insertion valve product data, location, shop drawings of all materials to be provided with installation procedure and schedule. Submit pothole data confirming depth of the existing 20" W.

C. Informational Submittals

1. Manufacturers Submittals

- a. Manufacturer's shop drawings and catalog data with sufficient detail to show compliance with specified requirements. Shop drawings shall illustrate pipe lengths, diameter control, wall thickness, and pipe class.

- b. Details of fittings, pipe joints, joint gasket (material, size and shape), service connections, taps, saddles, their locations, and related appurtenances with locations and complete service connection detail.
- c. Pipe lining product data including touch up and repair products, installation requirements and SDS.
- d. Pipe-to-structure connection detail with Manufacturer's product data, material properties with applicable ASTM references and technical installation requirements.
- e. Certifications specified in the following documents:
 - 1) ANSI A21.14, paragraph 14-4.2
 - 2) ANSI A21.52, paragraph 52-4.2
 - 3) ASTM A716, paragraph 4.2
 - 4) AWWA C110, paragraph 10-5.3
 - 5) AWWA C111, paragraph 11-7.1
 - 6) AWWA C115, paragraph 15-4.2
 - 7) AWWA C151, paragraph 51-5.2
 - 8) AWWA C153, paragraph 53-6.3
 - 9) AWWA C606, paragraph 4.1.1.1
- f. Instructions on storage, handling, transporting and installation.

D. Construction Submittals

- 1. Prior to delivery of the pipe from each manufacturing lot or run:
 - a. Provide an affidavit of compliance with this specification and standards referenced in this specification.
 - b. Submit certified laboratory testing results for provided pipe.
- 2. Cut sheets showing stationing, invert elevations, ground elevations, and cuts every 25 feet or at connection points to manhole and structures. Surveying shall be performed under the supervision of and certified by a licensed Professional Land Surveyor of the State of Washington.
- 3. Working drawings of the Contractor's trench section with all dimensions and materials (bedding, pipe zone backfill, geotextile, foundations stabilizations). Coordinate submittal with design calculations and requirements for installation per Section 31 23 00, EXCAVATION AND FILL.

E. Close out Submittals

- 1. Per Section 01 78 39, PROJECT RECORD DOCUMENTS
- 2. Submit location of all insertion valves where installed (N,E, Elevation of pipe)

PART 2 PRODUCTS

2.01 GENERAL

- A. Pipe design, materials and manufacture shall comply with the following documents:

Item	Document
Thickness design	AWWA C150

Item	Document
Manufacturing requirements	
• Water or other liquid	AWWA C151
• Gas	ANSI A21.52
Gravity service pipe	ASTM A716
Joints	
• Rubber gasket	AWWA C111
• Threaded flange	AWWA C115
Fittings	
• Water or other liquid	AWWA C110/AWWA C153
• Gas	ANSI A21.14
Cement mortar lining	AWWA C104

2.02 PIPE

- A. Unless otherwise specified, ductile iron pipe shall be Class 52 and have nominal laying lengths of 18 or 20 feet. For grooved-end pipe, wall thickness shall be minimum Class 52.

2.03 GASKETS

- A. Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50 percent by volume nitrile or neoprene and shall be free from factice, reclaimed rubber and other deleterious substances. Gaskets shall, in addition, comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

2.04 FITTINGS

- A. Unless otherwise specified, fittings shall conform to AWWA C110. Ends shall be flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified. The AWWA C153 compact ductile iron fittings in sizes 3 through 12 inches are an acceptable substitute for standard fittings unless otherwise specified. Long-radius elbows shall be provided where specified.

2.05 JOINTS

- A. Unrestrained Joints: NOT USED
- B. Restrained Joints:
- General: Unless otherwise specified, restrained joints are required for all exposed and buried piping. Unless otherwise specified, restrained joints shall be flanged or grooved end for exposed service and restrained push-on for buried service.
 - Push-On Joints: Restrained push-on joints may be used. Joints shall be the Flex-Ring or Lok-Ring Joint as manufactured by American Cast Iron Pipe Company, TR Flex Joint as manufactured by US Pipe, or equal. Restrained joints shall be capable of being deflected after full assembly. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations. No field cuts of restrained pipe are permitted without prior approval of the Construction Manager.

3. Flange Assemblies: Unless otherwise specified, flanges shall be ductile iron and shall be threaded-on flanges conforming to ANSI/AWWA A21.15/C115 or cast-on flanges conforming to ANSI/AWWA A21.10/C110. Flanges shall be adequate for 250 psi working pressure. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges. Where specified, flanges shall be threaded-on or cast-on flanges conforming to ANSI B16.1, Class 250.
 - a. Unless otherwise specified, bolts and nuts for flange assemblies shall be non-corrosive high-strength, Low-alloy steel, ASTM A449 Gr 3, Class C or Class D, with metallurgy specified in AWWA C111, regardless of any other protective coating.
 4. Mechanical Joints: Where specified, restrained mechanical joints shall be the positive restraint type. Mechanical joints with retainer glands are not acceptable.
 - a. Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.
- C. Ball And Socket Flexible Joint Pipe: Per Paragraph 2.08
- D. Bolts and Nuts: Corrosion-resistant bolts and nuts for use with ductile iron joints shall be high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.

2.06 PIPE COATING

- A. Buried pipe:
1. Unless otherwise specified, pipe and fittings shall be coated with asphaltic material as specified in AWWA C151.
- B. Exposed pipe:
1. Pipe and fittings shall be shop-coated with a polyamidoamine epoxy primer, and finish coated as specified in section 09 96 00.

2.07 PIPE LINING

- A. Water Service:
1. Cement Mortar Lining: Where specified, interior surfaces of pipe and fittings shall be cement mortar lined in accordance with AWWA C104. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalies.
- B. Sewer or Combined Sewer Service:
1. Amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Ceramic Epoxy: Factory applied, minimum of 40 mils.
 - a. Induron Protecto 401 or approved equal.
 2. Touch-Up and Repair
 - a. Protecto 401TM Joint Compound
 3. Provide the manufacturer's certification that the applicator met all inspection and testing requirement.

2.08 SETTLEMENT-SEISMIC PROVISIONS

- A. Where specified, provide settlement joints in accordance with Section 40 05 07.14. Settlement-Seismic Provisions for Yard Piping.

2.09 INSERTION VALVES

- A. Where specified, provide isolation valves on existing water lines.
 - 1. Pothole the installation location prior to procurement of the valve to confirm depth of cover is sufficient for the provided insertion valve.
- B. Insertion valve shall:
 - 1. Be Ductile iron body, bonnet and cartridge, resilient wedge gate valve designed for permanent use in potable water.
 - 2. Have a 150 psi or greater working pressure rating
 - 3. Provide a minimum 10 mill epoxy-coated exterior
 - 4. Have a non-rising, stainless steel stem and 2" square nut, open left (black) or open right (red).
 - 5. Be installed without requiring disruption of water service and shall maintain pressure during installation.
 - 6. All hardware shall be stainless steel
- C. Installation shall include line tapping methods to allow the removal of a single coupon. Reaming the pipe, complete removal of a section of pipe, or milling a slot in the pipe shall not be allowed.
- D. Acceptable manufacturer's
 - 1. Hydro-Stop Insta Valve
 - 2. Or accepted equal

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Piping runs specified on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01 33 00.
 - 2. Pipe shall be installed in accordance with AWWA C600.
 - 3. Connections to existing structures and manholes shall be made so that the finished work will conform as nearly as practicable to the requirements specified for the manholes, including necessary concrete work, cutting and shaping. Concrete mortar shaping within any structure and manhole shall be as specified.
- B. Insulating Sections: NOT USED
- C. Anchorage: NOT USED

3.02 ACCEPTANCE TESTING

A. HYDROSTATIC PRESSURE TEST

1. All pipe subject to internal pressure shall be hydrostatically tested as specified in Section 7-09.3(23) of the WSDOT/APWA Standard Specifications. The contractor shall provide all necessary equipment and shall perform all work connected with the tests. The contractor shall perform the test to assure that the equipment to be used for the test is adequate and in good operating condition and all air has been released prior to requesting the city inspector to witness the test. If the initial test is not successful for any reason, additional trips required for City staff to witness or perform subsequent tests shall be at the developer's expense.

- B. The Contractor shall conduct the tests in the presence of the Construction Manager.

3.03 INSERTION VALVES

- A. Install insertion valves in accordance with the manufacturer's requirements.

END OF SECTION

SECTION 33 05 31.11
PVC GRAVITY SEWER PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies gasketed smooth and solid wall polyvinyl chloride (PVC) gravity sewer pipe, fittings, joints and service connections for conveyance of domestic sanitary sewage or combined sewers.
- B. Provide all necessary labor, materials, equipment, services, and incidentals required to provide a complete, in-place gravity sewer and to accurately locate in the field service laterals along new or existing sanitary sewers.
- C. Pipe diameters specified represent nominal pipe diameter, unless otherwise specified.
- D. Provide all design, detailing and coordination to provide a gravity sewer, complete and in place per the Contract Documents. Design shall include confirmation of spool length, joint, fittings and all ancillary components required for successful installation, confirmation of external loads, required pipe stiffness (PS), wall thickness, and all other loads as determined by the CONTRACTOR's means and methods to install the pipe. Provided pipe and materials shall be supported by the required submittals and documentation as specified herein.
- E. Pipe shall be provided with the following minimum requirements:
 - 1. Open Cut Gravity Sewer Pipe: less than 18-inch nominal diameter, CIOD
 - a. Minimum Pipe Stiffness (PS) 46 psi.
 - b. Minimum Standard Dimension Ration (SDR) 35
 - 2. Pipe 30-inch or larger pipe shall be FRP per Section 33 05 36 FIBERGLASS REINFORCED UTILITY PIPE unless otherwise specified.
 - 3. C900 PVC shall be provided where specified. PVC gravity pipe shall not be provided in lieu of C900 pipe.
- F. PVC Pipe and PVC Fittings shall each be provided by a single manufacturer and be manufactured specifically for this project.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 60 00 - Materials and Equipment
 - 3. Section 01 78 39 - Project Record Documents
 - 4. Section 31 23 00 - Excavation and Fill
 - 5. Section 40 05 07.14 - Settlement Provisions for Yard Piping

1.03 QUALITY ASSURANCE

A. REFERENCES

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
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM C1173	Standard specification for flexible transition couplings for underground piping systems
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
ASTM D2444	Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
ASTM D5926	Standard specification for poly vinyl chloride (PVC) gaskets for drain, waste, and vent (DWV), sewer, sanitary, and storm plumbing systems
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
ASTM F1336	Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings
ASTM F1803	Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
PVC Pipe Association (UNI-BELL)	The Handbook of PVC Pipe Design and Installation by the Uni-Bell PVC Pipe Association. (latest edition)

Reference	Title
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

B. MANUFACTURER'S REQUIREMENTS AND QUALIFICATIONS

1. The Manufacturer shall:
 - a. Maintain a continuous Quality Control Program and hold current third-party ISO 9001 certification.
 - b. Have a minimum of five (5) years of continuous experience producing PVC pipe and fittings
 - c. Provide an authorized representative who is trained by the manufacturer and experienced in installation, inspection and testing of the pipe and ancillary components supplied. The representative shall be available to provide technical support, resolve requests for information and construction conflicts throughout the duration of the work. All costs associated with these requirements shall be included in the CONTRACTOR's bid price.
 - d. Unless otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable referenced standards. Perform said material tests at no additional cost to the OWNER. The Owner's Representative shall have the right to witness all testing.

C. FACILITY INSPECTION

1. The Owner's Representative shall be entitled to inspect materials and witness manufacturing and testing of pipes, fittings, elbows, and special pieces at the manufacturer's plant. Such inspection shall not relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications and does not replace the pipe manufacturer's own quality control procedures.
 - a. Provide adequate advance notice of where and when production will commence and provide free and unlimited access to all portions of manufacturer's plant that are necessary to verify compliance with this specification. This inspection shall not replace the pipe manufacturer's own quality control procedures.
 - b. Should the Owner elect not to inspect the manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES.

B. Action Submittals

1. A copy of this specification section, with addendum updates included, and 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. A check mark 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 ENGINEER 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. Detail drawings which show the type and location of all fittings, joints, and connections to structures and manholes.
3. Submit design calculations for pipe substantiating suitability of pipe for design loads for trench and embedment provided.
 - a. Submitted calculations must be sealed by a registered professional engineer licensed in the State of Washington for the design of the pipe in accordance with these specifications
4. Submit cleaning and testing plans including but not limited to schedule, testing sections, methods, and materials to be used.

C. Informational Submittals

1. Manufacturers Submittals
 - a. Manufacturer's shop drawings and catalog data with sufficient detail to show compliance with specified requirements. Shop drawings shall illustrate pipe lengths, diameter control, wall thickness, pipe class, and standard dimension ratios (SDR).
 - b. Details of fittings, pipe joints, joint gasket (material, size and shape), service connections, taps, saddles, their locations, and related appurtenances with locations and complete service connection detail.
 - c. Pipe-to-structure connection detail with Manufacturer's product data, material properties with applicable ASTM references and technical installation requirements.
 - d. Instructions on storage, handling, transporting and installation.

D. Construction Submittals

1. Prior to delivery of the pipe from each manufacturing lot or run:
 - a. Provide an affidavit of compliance with this specification and standards referenced in this specification.
 - b. Submit certified laboratory testing results for provided pipe.
 - 1) Testing per ASTM D3034, pipes 4 inches through 60 inches, ASTM D3212 and ASTM F477.
 - c. Certified original test reports on physical properties of pipe materials and gaskets.

2. Cut sheets showing stationing, invert elevations, ground elevations, and cuts every 25 feet or at connection points to manhole and structures. Surveying shall be performed under the supervision of and certified by a licensed Professional Land Surveyor of the State of Washington.
 3. Working drawings of the Contractor's trench section with all dimensions and materials (bedding, pipe zone backfill, geotextile, foundations stabilizations). Coordinate submittal with design calculations and requirements for installation per Section 31 23 00, Earthworks.
 4. Testing records and results.
- E. Close out Submittals
1. Per Section 01 78 39, PROJECT RECORD DOCUMENTS

1.05 DELIVERY, STORAGE AND HANDLING

- A. Equipment shipment, protection and storage shall conform to the requirements specified in Section 01 60 00 MATERIAL AND EQUIPMENT.
1. Packaging, handling and shipping shall be in accordance with the Handbook of PVC Pipe Design and Installation by the Uni-Bell PVC Pipe Association, and the manufacturer recommendations. In the case of conflict between the handbook and manufacturer's recommendations, the stricter requirement as determined by the Owner's Representative shall apply. Extra care shall be taken in cold weather as recommended by the Manufacturer.
 2. Keep pipe and gaskets free of dirt, foreign matter, and exposure to heat, sunlight, ozone, oil, and grease.
 3. Receiving, storage and handling shall be in accordance with the PVC Pipe Association and manufacturer's recommendations, whichever is more stringent.
 4. Pipe shall be protected from UV radiation by covering with opaque tarpaulins until immediately prior to installation. Remove from Site all PVC pipe showing signs of physical damage or ultraviolet exposure, as determined by ENGINEER.
- B. Inspect each pipe upon delivery and prior to installation. The pipe shall be free of cracks, crazing, holes, delamination, foreign inclusions, air bubbles, blisters, or other deleterious defects. Remove rejected, damaged or defective materials from Site.

1.06 WARRANTY

- A. Manufacturer shall warrant the product from manufacturing defects for a period of 5 years from acceptance by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified, provide pipe and fittings with a minimum cell classification of 12454 or 12364 as defined in ASTM D1784.

- B. Additives and fillers, including stabilizers, antioxidants, lubricants, colorants, etc., shall not exceed 10 parts by weight per 100 of PVC resin in the compound.
- C. Green in color.

2.02 PIPE-SOLID WALL PVC GRAVITY SEWER PIPE

- A. Pipe shall have a the minimum SDR and minimum pipe stiffness per Paragraph 1.01 D when tested in accordance with ASTM D 2412.
- B. Pipe 4 through 60 inches shall conform to ASTM D3034.
- C. Provide pipe in standard nominal laying lengths, 14-ft or 20-ft. Laying length shall be provided as required to accommodate curvature in the pipe alignment where specified.
- D. Markings: Meet the minimum requirements of ASTM. Minimum pipe markings shall be as follows:
 - 1. Manufacturer's Name or Trademark and production record.
 - 2. Nominal pipe size.
 - 3. ASTM Standard.
 - 4. Cell Classification.
 - 5. Seal of testing agency that verified the suitability of the pipe.
- E. Accepted pipe manufacturers:
 - 1. Diamond Plastics Corporation.
 - 2. North American Pipe Co (NAPCO).
 - 3. National Pipe and Plastics.
 - 4. JM Manufacturing Co., Inc.
 - 5. IPEX, Inc.

2.03 JOINTS

- A. Provide integral bell and spigot-type with solid cross section elastomeric or rubber gasket ring conforming to ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Use elastomeric factory installed gaskets to make joints flexible and watertight. Joints shall remain watertight at minimum deflection of 5 percent.
 - 1. Lubricant for rubber-gasketed joints shall be water soluble, non-toxic, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets. The manufacturer shall test a sample from each batch conforming to the requirements of ASTM D2444.

2.04 FITTINGS

- A. Fittings shall be manufactured and tested in accordance with ASTM D3212 and ASTM F1336 and installed with pipe, in accordance with Practice D2321.
- B. Fittings and accessories shall conform to the requirements of ASTM F1336 and ASTM D3034 and shall have bell and/or spigot compatible with pipe. The stiffness of the fittings shall not be less than the stiffness of the adjoining pipe.

- C. Accepted fittings manufacturers:
 - 1. GPK Products, Inc.
 - 2. North American Pipe Co (NAPCO)
 - 3. JM Manufacturing Co., Inc.
 - 4. MULTIFITTINGS, LTD./IPEX, INC.

2.05 DESIGN CRITERIA

- A. Calculations for the design of the pipe shall be submitted per this Section, and shall be sealed in accordance with [Paragraph 1.03-B.3 of this specification. Design calculations shall be performed and submitted for each individual sewer reach or segment and in no instance shall the pipe stiffness class or SDR be less than the minimum specified.
- B. Obtain the following information from the Contract Documents:
 - 1. Depth of cover, pipe invert to finished grade.
 - 2. Alignment of the pipeline.
 - 3. Nominal diameter.
 - 4. Outside Diameter Control CPS
 - 5. Minimum Pipe Stiffness (46 psi)
 - 6. Existing subsurface conditions per Geotechnical Report. See Attachment B.
 - 7. Dead load based on the greatest depth of bury for each segment
 - 8. Live load HS-25 as defined in AASHTO-SSHB. Live load shall be applied to all reaches and included construction live loads and surcharge.
 - 9. Live load Cooper E80 as defined in AREMA-MRE including impact factor where crossing or adjacent to railroad tracks.
 - 10. Groundwater above pipe shall be to grade.
 - 11. Maximum long-term Deflection per Paragraph 3.06.
 - 12. Maximum conveyed fluid temperature of 80. degrees F

2.06 DEBRIS TRAPS AND PLUGS

- A. A debris trap shall be provided to prevent debris from entering downstream sanitary sewers during construction. Traps shall remain in place until the sewer is tested and accepted by the OWNER.
- B. When pipe-laying is not in progress, open ends of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe.

PART 3 EXECUTION

3.01 GENERAL

- A. Make connections to different pipe materials by means of flanges, specified adapters or transition fittings. Where sleeve type couplings are used, both shall be uniformly torqued in accordance with pipe and coupling manufacturer's recommendation. Foreign material shall be removed from the pipe interior prior to assembly.

- B. Do not change the type or class of pipeline material between manhole sections.
- C. Conduct tests required in ASTM D3034, ASTM D2412, D32124, and F477.

3.02 INSTALLATION

- A. Install sewer pipe in accordance with ASTM D2321, pipe manufacturer's recommendations, and as specified below.
- B. Provide survey cut sheets with invert elevations, ground elevations, and cuts every 25 feet and lateral locations. Cut sheets shall be provided by a surveyor working under the supervision of a registered professional surveyor in the state of Washington.
- C. Minimum bedding thickness shall be 6-inches unless otherwise specified or shown.
- D. Lay pipe without break, upgrade from structure to structure, with the bell ends of the pipe upgrade.
- E. Do not use the pipe as a drain for removing water from the trench.
- F. Bedding material shall be placed under the haunches of the pipe by "haunching" or "shovel slicing". Bedding material shall be imported, placed and compacted per Section 31 23 00 EXCAVATION AND FILL.
- G. Backfill remainder of trench per Section 31 23 00 EXCAVATION AND FILL.
 - 1. Do not use hydro hammers to compact bedding or backfill.
 - 2. Do not use flooding and jetting to compact bedding or backfill.

3.03 LINE AND GRADE

- A. Pipe shall not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.
- B. Corrections or changes in line or grade may not be made by pipe bending.
- C. When installed, established line shall not result in high points or bellies in the reach.

3.04 STRUCTURE CONNECTIONS

- A. Structures and manholes provided as part of the Work shall be provided with inlet and outlet openings. Field coring will not be allowed unless specified.
- B. Pipe connections shall be resilient watertight connectors in accordance with ASTM C923. Connections shall consist of a chemically resistant flexible boot, locking ring, and pipe clamp(s). The locking ring shall lock the boot into the preformed opening in the manhole base. The flexible boot shall be synthetic rubber meeting the requirements of ASTM C923, Hardware shall be 304 series stainless steel.
- C. Pipe connections to provided manholes shall be factory installed and shall be Z-Lok, Press-Seal PSX, or approved equal.

- D. Do not cast pipe bells into manholes or structures. Cut off the bell so that no recess or offset appears on the exposed face from the inside wall of the pipe to the outside wall of the pipe. Pipe shall have a plain end, flush with the inside wall of the manhole or structure, or as specified.
- E. For grouted in place connections, provide a pipe joint of the same inside diameter as the adjoining pipe at the inlet and outlet to each manhole or structure. The joint shall be a minimum of two-feet from the face of the manhole. Provide a non-shrink, H2S resistant grout suitable for wastewater service. See Section 03 60 00 for grout requirements.
- F. Connections to existing structures
 - 1. Pipe connections to existing manholes shall be installed in accurately-sized, field cored holes and shall be Kor-N-Seal or approved equal.
 - 2. All penetrations through existing manholes shall be sized to maximize the performance of the sealing product which will be used at that location.
 - 3. Deflection through Boot type connections shall not exceed the Manufacturer's recommended angular deflection for watertight service. Adjustment mechanisms shall be Toggle style unless otherwise approved. Manufacturer's documentation shall demonstrate the installation is within performance limits for deflection, depth of cover and watertight seal.
 - 4. Coring of the hole should be smooth, clean and void of defects prior to installation. Such that the seal makes good contact with the manhole for the entire circumference of the circle. Each manhole penetration will be inspected and approved by the Owner's Representative.

3.05 SEWER SERVICE CONNECTIONS

- A. Service connections shall be installed perpendicular to the sewer and shall be straight, without curves or horizontal bends unless otherwise approved by the Owner's Representative.
- B. Connections shall be made in such a manner to not damage existing facilities and service laterals. Such connections shall be made so that no projections or rough surfaces occur within the pipe.
- C. Service connections, couplings and fittings must be accepted prior to procurement or installation.
- D. No projections or rough surfaces shall enter the sewer pipe.
- E. Provide transition couplings in accordance with ASTM C1173 when connecting plain end pipe ends or existing service laterals.
 - 1. Non shear-type connectors with neoprene insert, SST shield and SST interlocked worm gear clamps, two (2) clamps each side of the coupling.
 - 2. Fernco shielded (Strong Back) RC Couplings or Equal
- F. Existing service connections
 - 1. Pothole and locate existing connections' horizontal and vertical alignments prior to installation of the sewer.

2. Confirm service connections can be installed in the specified location and maintain minimum grade requirements as the mainline is being installed.
 3. Provide pipe and fittings for reconnection matching the existing service diameter.
- G. Service Connections
1. Provide inserta-tee, accurately sized for the mainline, service connection diameter and material.
- H. Service saddles will not be permitted, unless approved by the Owner's Representative. Where permitted, provide one-piece prefabricated PVC saddle with neoprene gasket to accomplish complete seal. Use saddle fabricated to fit outside diameter of connecting pipe. Protruding lip of saddle must be at least 5/8-inch long with grooves or ridges to retain stainless steel band clamps.
1. Record service connections on record drawings with nominal diameter, material, fitting type or product name/model, invert at connection, installed sloped and distance to nearest downstream manhole.

3.06 INSPECTION AND TESTING

- A. All sewer pipes, service lateral connections, and other sanitary system appurtenances shall be cleaned, inspected and subject to acceptance tests prior to the introduction of flows.
1. Tests shall be performed in accordance with Section 7-17.3(4) of the WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction. Sewers and appurtenance shall be cleaned and tested after backfilling by either the exfiltration or low pressure air method at the option of the contractor, except where the ground water table is such that the City Engineer may require the infiltration test.
 2. Clean and flush, with an approved cleaning ball and clean water, all gravity sanitary sewer lines prior to testing. The cleaning ball shall be an inflatable diagonally ribbed rubber ball of a size that will inflate to fit snugly into the pipe to be tested. A rope or chord will fastened to the ball to enable total control of the ball at all times.
 3. CCTV Inspection: Conduct CCTV Inspection/televising in accordance with Section 33 01 30.16.
 4. Test for Alignment, grade, and deflection:
 - a. Maximum vertical deflection after 30 days shall not exceed 5% percent.

END OF SECTION

SECTION 33 05 31.13

PVC PRESSURE PIPE

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies gasketed, solid wall polyvinyl chloride (PVC) pressure pipe, fittings, joints, and service connections for conveyance of combined sewers, sanitary sewers, and storm water where watertight joints are required.
 - 1. If used for construction of potable water mains, pipe, fittings and all ancillary components shall:
 - a. Adhere to the standards described in the Washington State Department of Health Water System Design Manual.
 - b. be NSF-61 and Lead Free certified.
- B. Provide all necessary labor, materials, equipment, and services to provide a complete, in-place PVC pipeline and to accurately locate in the field service laterals.
- C. Pipe diameters specified represent nominal pipe diameter. Unless otherwise specified:
 - 1. Provide Cast Iron Pipe Sizes (CIOD) pipe meeting the specified pressure requirement.
- D. Pipe fittings shall be C900 PVC with pressure ratings meeting or exceeding the provided PVC pipe.
- E. Provide a minimum DR25 C900 pipe unless otherwise specified.
 - 1. C900 pipe shall not be provided in Lieu of Fiberglass Pipe unless otherwise specified. Pipe 30" or greater shall be FRP.
 - 2. C028 shall be C900 PVC. PVC Gravity sewer shall not be allowed in place of C900.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. 31 23 00 Excavation and Fill

1.03 REFERENCE STANDARDS

- A. 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.

- B. 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
ASTM D883	Definitions of Terms Relating to Plastics
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
ASTM D2122	Method of Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
ASTM D2444	Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
ASTM F1674	Standard Test Methods for Joint Restraint Products for Use with PVC Pipe
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	Disinfecting Water Mains
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 300 mm), for Water Distribution
AWWA C907	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 Mm Through 300 Mm), For Water, Wastewater, And Reclaimed Water Service
AWWA M23	PVC Pipe - Design and Installation
NSF/ANSI 61	Drinking Water System Components - Health Effects
PVC Pipe Association (UNI-BELL)	The Handbook of PVC Pipe Design and Installation by the Uni-Bell PVC Pipe Association. (latest edition)
PVC Pipe Association (UNI-BELL)	UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00, SUBMITTAL PROCEDURES.

B. Action Submittals

1. A copy of this entire specification section, with addendum updates included, and 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. A check mark 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 Construction Manager 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. Submit design calculations for pipe demonstrating pipe thickness, dimension ratio (DR) and/or standard dimension ratio (SDR) for the pressure requirements, installation method and in-service conditions. Provide all installation loads, design loads for trench (live and dead loads) and embedment provided in accordance with procedures provided in AWWA M-23.
 - a. Submitted calculations must be sealed by a Registered Professional Engineer licensed in the State of Washington for the design of the pipe in accordance with these specifications.
3. Lay drawings for each pipeline to be constructed including pipe layout diagrams and schedule. Drawings information shall include but not necessarily be limited to:
 - a. Piping layout to scale including location of pulled or beveled joints to be used to form curved sections of the pipe alignment and dimensions for any specialized fittings.
 - b. Pipe invert elevations.
 - c. Acknowledgment of installation type, geotechnical conditions, bury depth and bedding requirements.
 - d. Dimensional Details of joints, fittings, special elbows, and related appurtenances.
 - e. Pipe connection details with Manufacturer's product data, material properties with applicable ASTM references and technical installation requirements.

C. Informational Submittals

1. PVC Manufacturers Material Submittals
 - a. Manufacturer's shop drawings and catalog data with sufficient detail to show compliance with specified requirements.
 - b. Shop drawings shall illustrate pipe lengths, diameter control, wall thickness, pipe dimension ratio and pressure rating.
 - 1) Submit fully dimensioned cross-section of the bell and barrel of the pipe. Show the bell maximum outside diameter in the pressurized area and its minimum wall thickness at the same location.
 - c. Details of fittings, joints, joint gasket (material, size, and shape), service connections, taps, saddles, and related appurtenances. Provide locations by station for fabricated fittings, service connections, taps, and saddles.

- d. Instructions on storage, handling, transporting and installation.
 - e. Pipe-to-pipe/appurtenance connection details with Manufacturer's product data, material properties with applicable ASTM references and technical installation requirements.
 - 2. Service saddles, corporation stops and pipe plugs.
 - 3. Manufacturer's Shop drawings and catalog data with sufficient detail to show compliance with specified requirements for all service connection, saddles, corporation stops, and pipe plugs. Identify appurtenances by Station where they are to be installed.
 - 4. Restraint Systems
 - a. Manufacturer's shop drawings and catalog data with sufficient detail to show compliance with specified requirements for restrained joint systems provided. Identify restraint devices and lengths by Station.
 - b. Provide test results certified by an independent test laboratory demonstrating compliance for each size and pressure rating and
 - c. Installation instructions including bolt torque requirements, limitations and assembly tolerances.
 - 5. Manufacturer's Representative
 - a. Provide name, contact information and experience of representative.
 - 6. Warranty
 - a. Manufacturer's warranty
 - b. Record copies of all certified test reports for all pipe and materials manufactured for this project demonstrating the materials have met all the quality control requirements specified shall be enclosed with the warranty letter.
- D. Construction Submittals
- 1. Prior to delivery of the pipe from each manufacturing lot or run:
 - a. Provide an affidavit of compliance with AWWA C900 and this specification.
 - b. Submit certified laboratory testing results for provided pipe including manufacturer's conducted testing:
 - 1) Quick-burst strength of pipe and couplings.
 - 2) Flattening resistance of pipe.
 - 2. Cut sheets:
 - a. Cut sheet showing stationing, elevation invert, ground elevation, and cuts every 25-feet and at connection points to manholes, structures, and valves shall be prepared and provided.
 - b. Surveying shall be performed under the supervision of a licensed Professional Land Surveyor of the State of Washington.
 - 3. Hydrostatic Testing
 - a. Submit testing plan and Testing Reports.
 - 4. Disinfection and Bacteriological Testing results.
- E. Close-out Submittals
- 1. Per Section 01 78 39, PROJECT RECORD DOCUMENTS

1.05 QUALITY ASSURANCE

A. Manufacturer Certifications:

1. AWWA C900
2. Factory Mutual (FM) 1612 Approved
3. NSF Standard 14 and NSF Standard 61 listings
4. Certification under NSF/ANSI 327 Annex G "lead-free"
5. Underwriters Laboratories Inc. Standard UL 1285 mark of acceptance
6. Canadian Standards Association Standard B137.3 mark of acceptance

B. Manufacturer Qualifications and experience

1. Have a minimum of five (5) years of continuous experience producing PVC pipe and/or fittings.
2. Shall be able to show evidence of at least ten (10) installations in satisfactory service for at least five (5) years. All referenced experience shall be for projects completed within the United States or Canada.
3. Provide an authorized representative who is trained by the Manufacturer and experienced in installation, inspection and testing of the pipe and ancillary components supplied.
 - a. The representative shall be available to provide technical support, resolve requests for information and construction conflicts throughout the duration of the work.
 - b. All costs associated with these requirements shall be included in the Contractor's bid price.

C. SHOP INSPECTION

1. The Construction Manager may inspect materials production and witness testing pipes, fittings, elbows, and special pieces at the manufacturer's plant.
 - a. Provide two weeks written advance notice of where and when production will commence and provide free and unlimited access to all portions of the manufacturer's plant that are necessary to verify compliance with this specification. This inspection shall not replace the pipe manufacturer's own quality control procedures.
 - b. The Construction Manager shall have the right to witness all testing.

D. SHOP TESTING

1. Unless otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable referenced standards. Perform said material tests at no additional cost to the Owner.
 - a. Conduct tests required in ASTM D3034, ASTM D2412, D32124, and F477.
 - b. For pressure applications, each length of pipe must be hydrotested at twice the rating and a short-term pressure test must be conducted once per production run.

E. SUPPLIERS

1. Like items of pipe, joints and fittings shall be the end products of one manufacturer and shall be manufactured within an 18-month period prior to installation.
 - a. Pipe shall be date coded by manufacturer and the manufacturer's code provided on the pipe and delivery manifests.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Pipe shall be packaged, handled and stored in accordance with AWWA M-23 and the Manufacturer's recommendations.
- B. Inspect each pipe upon delivery and prior to installation. The pipe shall be free of cracks, crazing, holes, delamination, foreign inclusions, air bubbles, blisters, or other deleterious defects. Remove rejected, damaged or defective materials from Site.
 1. Pipe that has been gouged, scratched, or otherwise damaged shall be subject to rejection at the discretion of the Construction Manager.
 2. Pipe shall be protected from UV radiation by covering with opaque tarpaulins until immediately prior to installation.
- C. Keep pipe and gaskets free of dirt, foreign matter, and exposure to heat, sunlight, ozone, oil, and grease. Maintain covers on pipe ends.
 1. PVC pipe that has been contaminated in any way with petroleum products (on the inside or outside of the pipe) shall not be used.
- D. Remove all pipe showing physical damage, ultraviolet exposure or contamination from the site and replace at no additional cost to the Owner.

1.07 WARRANTY

- A. Per General Conditions reference or client requirement.
- B. Manufacturer shall warrant the product from manufacturing defects for a period of 5-years from acceptance by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide pipe and fittings manufactured from virgin PVC compound meeting or exceeding cell classification of 12454 as defined by ASTM D1784 and a hydrostatic design basis rating of 4000 psi for water at 73.4 Deg F.
- B. Additives and fillers, including stabilizers, antioxidants, lubricants, colorants, etc., shall not exceed 10 parts by weight per 100 of PVC resin in the compound.
- C. Color
 1. Per Pipe Color Codes - ANSI/ASME A13.1 Guidelines:
 - a. Potable Water: Blue (White not permitted)
 - b. Raw Water: Olive Green

- c. Recycled Water: Purple (Pantone 522)
- d. Sanitary Sewer, Combined Sewer or Sewer Force Main: Green

2.02 PVC PRESSURE PIPE

- A. Meet or exceed the minimum DR and pressure rating as specified and in accordance with AWWA C900.
- B. Provide standard nominal laying lengths, 10- or 20-ft unless otherwise specified or required to achieve the pipe alignment geometry. Pipe and fittings must be circular and concentric with the pipe barrel cut off on a plane at right angle to longitudinal axis of pipe.
- C. Markings: Meet the minimum requirements of AWWA C900. Markings shall include the following:
 - 1. Manufacturer's Name or Trademark and production/date code
 - 2. Certified Seals NSF-PW
 - 3. Nominal pipe size
 - 4. ASTM Standard
 - 5. Cell Classification
 - 6. "CAUTION: "NON-POTABLE" OR "RAW WATER" – DO NOT DRINK." for non-potable mains
 - a. Lettering shall be minimum 1-inch-high black letters and shall be repeated every 36 inches.
 - 7. Home mark on the spigot end to indicate proper penetration when the joint is made.
- D. Accepted pipe manufacturers:
 - 1. Diamond Plastics Corporation
 - 2. North American Pipe Co (NAPCO)
 - 3. JM Manufacturing Co., Inc.
 - 4. IPEX, Blue Brute,
 - 5. or equal

2.03 DESIGN CRITERIA

- A. Obtain the following information from the drawings:
 - 1. Elevation of the pipe invert and of the completed ground.
 - 2. Alignment of the pipeline.
 - 3. Nominal diameter.
 - 4. Outside Diameter Control
 - 5. Minimum Pressure Class
- B. ADDITIONAL CRITERIA:
 - 1. Live loads, H-25, or E80 as applicable
 - 2. Minimum Impact Factor live loads: 1.5.
 - 3. Minimum unit weight of soil: 120 pcf

4. Maximum Allowable Deflection: 3%
5. Maximum Allowable Long-Term deflection: 5%
6. Submit calculations substantiating suitability of provided pipe for installation conditions sealed by a Registered Professional Engineer Licensed in the State of Washington.

2.04 PVC JOINTS

A. Bell and Spigot Joints

1. Provide integral bell joint meeting the requirements of ASTM D3139 with an elastomeric seal meeting the specification defined in ASTM F477. Ends must have the same or greater thickness as of the pipe barrel.
2. Gaskets shall be factory-assembled and lock-in style to prevent displacement.
 - a. Provide SBR, EPDM, or NBR gaskets conforming to ASTM F477.
 - b. Gaskets must be NSF approved and comply with ASTM F477 requirements.
 - c. Where buried in soil with hydrocarbon contamination, provide nitrile (NBR) gaskets.
 - d. Lubricants shall be non-toxic, food grade and biodegradable as recommended by the manufacturer.

B. Restrained Joints

1. Provide internally restrained pipe joints where restrained joints are specified. Pipe joints may be internally restrained gasket joints or spline-lock gasketed joints. Pipe joints must be submitted for review and acceptance prior to procurement.
2. External joint restraint devices and flanges may only be used where shown and specified
 - a. Joint restraint systems shall be selected from the Owner's Approved Product List and shall be installed in accordance with the manufacturer's instructions.
 - b. Approved Products:
 - 1) EBAA Iron 1900 Split Serrated Restraint Harness, or approved equal
 - 2) EBAA Iron 2800 MEGALUG Restraint Harness, or approved equal
 - 3) EBAA Iron 1100HV Split Restraint Harness, or approved equal
 - 4) EBAA Iron 2500 Restraint Harness for C900 PVC Fittings, or approved equal

2.05 FITTINGS

- A. PVC Fitting shall be a one-piece injection molded or fabricated from PVC compounds meeting ASTM D1784 with an equal or greater pressure rating than the pipe to which the fitting is connected.
 1. Fabricated fittings shall conform to AWWA C900 PVC pipe.
- B. Accepted fittings manufacturers:
 1. GPK Products, Inc.
 2. North American Pipe Co (NAPCO)
 3. JM Manufacturing Co., Inc.
 4. IPEX, Blue Brute,

5. Multifittings, Ltd./Iplex, Inc.
6. or equal

2.06 COUPLINGS

- A. Couplings shall meet the requirements of AWWA C900 as applicable and have a minimum rated working pressure equal or greater than the PVC pressure pipe.
- B. Flange Adapters
 1. Provide flange adapter specifically designed for AWWA C900 PVC Pressure pipe when connecting PVC pressure pipe to flanged fittings or flanged valves.
- C. Transition and Sleeve Type Couplings
 1. Provide transition and sleeve-type couplings specifically designed for use with PVC pressure pipe. Devices must be restrained to prevent axial separation of connected plain end pipe or dissimilar materials.
- D. Bolts and nuts for mechanical joints, or flanged ends will be of a high strength corrosion resistant low-alloy steel and shall conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel. All fittings shall be fusion bonded epoxy lined and coated and lined unless stainless steel is used.

2.07 SERVICE SADDLES

- A. Provide service saddles in accordance with City requirements and in accordance with the Owner's Approved Materials List.

2.08 INTEGRAL JOINT RESTRAINT SYSTEMS

- A. Provide integral joint restraint systems meeting or exceeding the requirements of ASTM F1674. The restraint system shall be:
 1. Installed/fabricated during the PVC pipe belling process. The joint must provide full 360-degree restraint with evenly distributed loading.
 2. Provide elastomeric sealing gaskets meeting the requirements of ASTM F477
 3. Meet or exceed the maximum system pressure of the pipeline.
 4. Meet the zero leakage requirements of ASTM D3139
- B. Approved Products:
 1. EBAA Iron

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain inside of pipe free from foreign materials and in a clean and sanitary condition until final acceptance by Owner.

- B. Do not use the pipe as a drain for removing water from the trench.
- C. Do not change the type or class of PVC Pressure pipe unless otherwise specified.

3.02 INSTALLATION

- A. Install PVC pressure pipe in accordance with ASTM D2774, AWWA C605, AWWA M23, and the manufacturer's recommendations. In the case of conflict, the stricter requirement as determined by the Construction Manager shall apply.
 - 1. Foreign materials shall be removed from the pipe interior prior to assembly.
 - 2. Provide cutsheets ahead of trench excavation where required.
- B. Minimum bedding thickness shall be 6-inches unless otherwise specified. Bedding material shall be imported, placed, and compacted per Section 31 23 00 EARTHWORK.
- C. Lay pipe without break, upgrade from structure to structure, with the socket ends of the pipe upgrade.
- D. Use manufacturer's recommended pipe lubricant when assembling joints.
- E. Pipe shall not be over-homed.
 - 1. Pipe installed below the water table where the homing mark is not visible shall utilize an over-insertion prevention device; EBAA Iron Mega-Stop Series 500, S&B Technical Product, RIG, Resistance Insertion Grip, or equal.
- F. After joint assembly, bring the bedding material up to pipe spring line, taking care to uniformly support the pipe.
- G. Where ductile-iron fittings are provided, cut PVC pipe ends smooth and square. No Bevel.
- H. Backfill remainder of trench per Section 31 23 00 EARTHWORK.
 - 1. Do not use hydro hammers to compact bedding or backfill.
 - 2. Do not use flooding and jetting to compact bedding or backfill.
 - 3. Provide measures to prevent pipe from floating due to water entering the trench from any source or flowable backfill materials.
- I. Where specified, place a 2-foot section of pipe and joint at the inlet and outlet to each structure.

3.03 LINE AND GRADE

- A. Maintain minimum and maximum cover specified.
- B. Pipe shall not deviate more than 1 inch from line or 1/4 inch from grade as measured at the pipe invert in 100 ft.
 - 1. Corrections or changes in line or grade may not be made by pipe bending.
 - 2. When installed, established line shall not result in high points or bellies in the reach.

- C. PVC pressure pipe shall be deflected at the joints only. The maximum allowable joint deflection shall be limited to and shall not exceed 50% of the manufacturer's recommendation or 1 degree, whichever is less.
- D. High-deflection coupling may only be used where specified and as approved by the Construction Manager.
 - 1. High deflection coupling's pressure rating shall be equal or greater than the PVC pipe and system pressure.
 - 2. Deflection shall not exceed 4-degrees total deflection per coupling (2 degrees/each gasket).

3.04 PIPE CONNECTIONS

- A. Where connecting to existing mains, field verify in the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing main before proceeding with pipe procurement and installation. Field verification shall be performed in the presence of the Construction Manager. Adjust and align the pipe to be installed as necessary to meet the field conditions and provide all required material, labor, and equipment to make the connection.
- B. Make connections to different pipe materials by means of flanges, specified adapters or transition fittings.
- C. Where sleeve type couplings are used, both shall be uniformly torqued in accordance with pipe manufacturer's recommendation.
- D. Wherever valves are to be installed, the pipe slope shall not exceed 6% and valves shall be provided with the minimum cover per the manufacturer's requirements.

3.05 WATER SERVICE CONNECTIONS

- A. Provide service connection per Owner's Approved Materials List, latest edition.
- B. Record service connections on record drawings with nominal diameter, material, fitting type or product name/model, invert at connection, installed slope and distance to nearest downstream manhole.

3.06 SUPPORTS, THRUST AND ANCHOR BLOCKS

- A. Supports, thrust and anchor blocks shall be in accordance with COE standard specifications and drawings.
 - 1. Concrete support blocks shall be provided for all couplings, DIP fittings and valves to prevent the fitting or valve weight from being carried by the PVC pipe.
 - 2. Concrete thrust and anchor blocks shall be installed as specified. If the installation of concrete thrust blocks is not practical, the Contractor shall provide a joint restraint systems are approved by the Construction Manager. Where PVC pipe is to be installed with restrained joints, provide minimum Class 250 pipe. Contractor shall provide calculations indicating working pressure, surge pressure, joint restraint lengths required and manufacturer's product data. Calculations shall be provided by a Licensed Professional Engineer in the State of Washington.

3.07 INSPECTION AND TESTING

- A. All piping shall be cleaned, inspected and subject to acceptance tests prior to the introduction of wastewater/ stormwater flows.
- B. CCTV Inspection: Conduct CCTV Inspection/televising in accordance with Section 33 01 30.16. CCTV Inspection of Pipelines.
- C. Test for Deflection:
 - 1. Pipe initial vertical deflection shall not exceed 5% of the original pipe diameter, verified by mandrel testing.
- D. Gravity Pipelines:
 - 1. Tests shall be performed in accordance with Section 7-17.3(4) of the WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction. Sewers and appurtenance shall be cleaned and tested after backfilling by either the exfiltration or low-pressure air method at the option of the contractor, except where the ground water table is such that the City Engineer may require the infiltration test.
 - 2. Clean and flush, with an approved cleaning ball and clean water, all gravity sanitary sewer lines prior to testing. The cleaning ball shall be an inflatable diagonally ribbed rubber ball of a size that will inflate to fit snugly into the pipe to be tested. A rope or chord will fastened to the ball to enable total control of the ball at all times.
- E. Hydrostatic Pressure Test
 - 1. All pipe subject to internal pressure shall be hydrostatically tested as specified in Section 7-09.3(23) of the WSDOT/APWA Standard Specifications. The contractor shall provide all necessary equipment and shall perform all work connected with the tests. The contractor shall perform the test to assure that the equipment to be used for the test is adequate and in good operating condition and all air has been released prior to requesting the city inspector to witness the test. If the initial test is not successful for any reason, additional trips required for City staff to witness or perform subsequent tests shall be at the developer's expense.

3.08 FLUSHING AND DISINFECTION

- A. Potable water pipe disinfection shall be in accordance with AWWA C651.
 - 1. Perform flushing and disinfection before making final connections to the existing system. at the same time or after the pipe has been pressure tested. Swab or spray a 1 percent minimum chlorine solution to the inside of the pipeline at the final connection point.

END OF SECTION

SECTION 33 05 32
STORMWATER CONVEYANCE

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies storm drainage including pipe, catch basins, and gratings.
1. Storm drain pipe shall be provided as specified.
 - a. FRP and PVC shall be provided in accordance with the pipe material requirements of DIV 33.

1.02 QUALITY ASSURANCE

- A. References:
1. This section contains references to the following standard specifications. They are 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 a 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
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M254	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
ASTM-A48	Standard Specification for Gray Iron Castings
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Material
ASTM D2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM F2306	Standard Specification for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
COE	City of Everett, Design and Construction Standards and Specifications for Development
WSDOT/APWA	WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction

1.03 QUALITY ASSURANCE

A. Standardization:

1. Materials, supplies and equipment provided by the Contractor shall be the standard products of manufacturers. The standard products of manufacturers, other than those specified, will be accepted when it is demonstrated to the Construction Manager that they are equal in composition, durability, quality and usefulness for the purposes intended. Requests for substitution shall be in accordance with Section 01 25 00, and shall include directions for applicable and descriptive literature on the safe storage, handling and disposal of the product.

1.04 SUBMITTALS DURING CONSTRUCTION

A. Submittals during construction shall be made in accordance with Section 01 33 00 in Division 1, General Requirements.

1. Shop drawings and catalog cuts for all required equipment.
2. Details of precast concrete units.

B. Product data and shop drawings for:

1. Pipe materials.
2. Catch basins.
3. Frames and grates.
4. Cleanouts
5. Manufacturer's affidavit certifying compliance of materials with specification.

PART 2 PRODUCTS

2.01 STORM DRAIN PIPE

A. High Density Polyethylene Pipe (HDPE):

1. Pipe shall be in accordance with ASTM F2619
2. Joints: soil-tight, gasketed bell & spigot joints meeting ASTM F2648
3. Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F2306.
4. Material for pipe production shall be an engineered compound of virgin and recycled high density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4-through 10-inch (100 to 25-mm) diameters, and 435420C (ESCR Test Condition B) for 12-through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%.
5. Manufacturer:
 - a. ADS, N-12 ST IB
 - b. JM Eagle, Corr PE Dual Wall
6. Pipe installed through valve vaults shall be steel in accordance with Section 40 05 33.13.

2.02 CATCH BASINS

- A. Unless otherwise indicated, pre-cast reinforced concrete catch basins, per City Standard Details.
- B. Frame and Grate: designed for HS-25 loading and per City Standard Details.

2.03 STORMWATER STEPS

- A. Steps shall be steel reinforced copolymer polypropylene plastic conforming to City Standard Detail.

2.04 CLEANOUT

- A. Cleanouts shall conform to COE Standard Detail 421.

2.05 GATE VALVE

- A. Size: Provide valves of the same size as upstream pipe as specified in the Drawings.
- B. Valve shall be as specified in Section 40 05 60
- C. Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body

2.06 VALVE BOX

- A. Valve box lid shall be H-20 Traffic Rated.
- B. Valve box shall be as specified in Section 40 05 60.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

- A. Excavation, backfilling, and compacting of trench per Section 31 23 00. Conduct backfill operations of open-cut trenching closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed.
- B. Pipe Installation:
 - 1. Install piping from materials as indicated on the Drawings and in accordance with manufacturer's recommendations.
 - 2. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
 - 3. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
 - 4. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
 - 5. Inspect piping to determine whether line displacement or other damage has occurred.

6. Make inspections after lines between manholes, catch basins, or area drains, have been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 7. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects, and re-inspect.
- C. Pipe connections to existing structures:
1. Core drill new connection in existing structure wall, ensuring minimum clearance of 6 inches from edge of structure.
 2. Install corrugated HDPE flexible boot connector with oversleeve adapter.
 3. Grout and seal connections per manufacturer recommendations.
- D. Line Markers: Install continuous line markers located directly over buried line at 5 to 8 inches below finished grade, during backfilling/top soil operation.
- E. Catch basins, frames, grates, and solid cover:
1. Construct catch basins to sizes and shapes indicated.
 2. Set frames, grates, and solid cover to elevations indicated on plans.

3.02 QUALITY CONTROL TESTING

- A. Perform leak testing of completed piping in accordance with COE Requirements.

3.03 SITE PREPARATION

- A. Site preparation required for the construction of manholes, cleanouts and concrete structures shall conform to Section 31 10 00.

3.04 CLEARING AND GRUBBING

- A. Clearing and grubbing required for the construction of manholes, cleanouts and concrete structures shall conform to Section 31 10 00.

3.05 SHORING, SHEATHING AND BRACING OF EXCAVATIONS

- A. Shoring, sheathing and bracing required for the construction of manholes, cleanouts and concrete structures shall conform to those requirements as specified in Section 31 23 00.

3.06 EXCAVATION AND BACKFILL FOR CATCH BASINS AND CLEANOUTS

- A. Excavation and backfill for cleanouts on open-cut sewers shall conform to the applicable provisions of Section 31 23 00.
- B. If the excavation for manholes base is stable soil and has, without the concurrence of the Engineer, been carried below the required bottom of the manhole base, the excess depth shall be filled, at no additional cost to the Owner, with base material as specified.

3.07 REMOVAL OF WATER

- A. Conform to Section 31 23 19.

3.08 BASE MATERIAL FOR CATCH BASINS, STORMWATER VAULT, AND CLEANOUTS

- A. Remove water from the excavation. Place and compact to 90 percent of maximum density as determined by AASHTO T180, a minimum of 6 inches of pipe bedding material, for manholes and structures on open-cut sewers. Thoroughly compact with a mechanical vibrating or power tamper.
- B. Backfill around cleanouts on open-cut sewers shall conform to the class specified for trench backfill, Section 31 23 00.

3.09 PRECAST CATCH BASIN

- A. Catch Basin Invert
 - 1. Construct manhole inverts in conformance with vault details shown on the Plans, and with smooth transitions to insure an unobstructed flow through the vault. Remove all sharp edges or rough sections which tend to obstruct flow. Where a full section of pipe is laid through a manhole, break out the top section and cover exposed edge of pipe completely with mortar. Trowel all mortar surfaces smooth.
 - 2. The trough of a manhole for pipe sewers shall be the same diameter as the larger of the adjoining sewers. The pipe may be laid through the manhole, and the upper half of the pipe shall be removed after the manhole is built. The pipe shall be supported on brick or solid concrete blocks for the placement of the concrete base. The concrete shall be extended under the pipe to the face of a pipe joint and where the pipe rests on undisturbed soil. This extended portion of the manhole base shall rest on undisturbed soil.
- B. Catch Basin Base
 - 1. Set precast manhole base unit level on compacted base material or concrete work slab as specified hereinbefore.

3.10 PIPE CONNECTION TO CATCH BASINS

- A. Provide joints in flexible pipe sewers within 1 to 3 feet from structure walls. Pipes entering and leaving the base of the structure shall be laid on concrete backfill. Place 2,000 psi concrete from the manhole base to the spring line of the pipe, from the manhole wall to undisturbed earth.
- B. Grout around pipes in manhole walls or base to provide a watertight seal. Where flexible pipe is used, the annular space between the pipe and manhole wall shall be filled with a mastic sealant supplied by the pipe manufacturer.

3.11 STEPS FOR STORMWATER MANHOLES

- A. Conform to Section 33 05 13.

3.12 STEP TESTING

- A. Test all steps for a horizontal pullout load of 400 pounds with the load applied over a width of 3-1/2 inches and centered on the rung. The load shall be applied at a uniform rate until the required test load is reached. The steps will be considered acceptable if they remain solidly embedded after application of the test load and if no cracking or fracture of the step nor spalling of the concrete, masonry or mortar is evident. Provide suitable hydraulic jacks and gauges to perform the test. All steps failing to meet the required load shall be replaced or reset and retested.

3.13 GROUT

- A. Conform to Section 03 60 00.

3.14 GROUNDWATER TEST CONNECTION

- A. Install a 3/4-inch Schedule 80 PVC pipe nipple with a 4-inch diameter seep ring through all manhole walls and miscellaneous concrete structures not more than 9 inches above the incoming pipe crown and in line with the entering or effluent pipe. Locate to clear manhole steps. Provide a threaded end on the inside of the structure suitable for connection to a 3/4-inch garden hose. Provide a PVC cap.

3.15 HYDROSTATIC TESTING FOR SHALLOW MANHOLES (LESS THAN 20 FEET DEEP)

- A. When, in the Engineer's opinion, the groundwater table is too low to permit visual detection of leaks, manholes shall be hydrostatically tested. The test shall consist of plugging all inlets and outlets and filling the manhole with water to a height determined by the Engineer. Leakage in each manhole shall not exceed 0.2 gallon per hour per foot of head above the invert. A manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into the pipe walls to take place. Repair all manholes that do not meet the leakage test, or are unsatisfactory from visual inspection, to conform to the requirements herein.

3.16 WATER FOR TESTING

- A. Make all arrangements for furnishing water from the nearest hydrant or other suitable source for testing purposes. Provide all hoses, tank trucks, plugs, and other necessary equipment to complete the tests.

END OF SECTION

SECTION 33 05 33.23
HIGH DENSITY POLYETHYLENE PIPE - SOLID WALL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Heat fusible, uniform thickness, solid wall, constant outside diameter, high-density polyethylene (HDPE) pressure pipe, fittings, and appurtenances.
 2. This Section does not specify HDPE pipe with a corrugated, tubular, or structured wall profile.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 31 23 00 – Excavation and Fill
 2. Section 40 05 07.14 – Settlement Provisions for Yard Piping

1.03 REFERENCES

- A. 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 prevail.
1. ANSI/AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution
 2. AWWA M-55 - PE Pipe – Design and Installation
 3. ASTM D2321 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 4. ASTM D2513 - Polyethylene Gas Pressure Pipe, Tubing, and Fittings
 5. ASTM D2657 - Heat Joining Polyolefin Pipe and Fittings
 6. ASTM D2774 - Underground Installation of Thermoplastic Pressure Piping
 7. ASTM D3035 – Polyethylene Plastic Pipe Based on Controlled Outside Diameter
 8. ASTM D3261 - Butt Heat Fusion Polyethylene Plastic Fittings for PE Plastic Pipe and Tubing
 9. ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials
 10. ASTM F1055 - Electrofusion Type Polyethylene Fittings for OD Controlled PE Pipe and Fittings
 11. ASTM F1668 - Construction Procedures for Buried Plastic Pipe
 12. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure.
 13. ASTM F2206 - Fabricated Fittings of Butt-Fused Polyethylene
 14. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

- 15. ASTM F714 - Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
- 16. PPI TR 31 - Underground Installation of Polyolefin Piping

1.04 SUBMITTALS

- A. Procedures: Section 01 33 00
- B. Action Submittals:
 - 1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations.
 - 2. Qualifications of the certified fusion technician.
 - 3. Manufacturers' product data, catalog cuts, typical installation details, and dimensions. Indicate each piping system where the product will be used on the submittal.
 - 4. Pipe Manufacturer's joint assembly procedure.
- C. Informational Submittals:
 - 1. Procedures: Section 01 33 00.
 - 2. Records of each field butt-fusion joint installation, as specified in this specification.
 - 3. Manufacturer's affidavit affirming that the materials furnished for the project comply with the specifications of this section.
 - 4. Product Data as specified in paragraph 2.02 of this Section.

1.05 QUALITY ASSURANCE

- A. Qualifications: Field welding by butt fusion and/or electrofusion performed by a factory trained and certified fusion technician. Training and/or certification by fusion equipment manufacturer or pipe manufacturer.
- B. Certifications: Furnish affidavit (as specified in AWWA C906) documenting compliance with AWWA C906, as appropriate for the pipe material specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, stack in accordance with the pipe manufacturer's recommendations.
- B. Prevent damage to pipe from dragging over sharp objects or cutting by chokers or lifting equipment while handling pipe.
- C. Handle pipe in accordance with pipe manufacturer's recommendations.
- D. Pipe with gouges, cuts, or scratches deeper than 10% of the pipe wall thickness will be rejected.
- E. Pipe with cuts, gouges, and/or scratches of the pipe interior will be rejected.
- F. Store pipe in accordance with pipe manufacturer's recommendations until installation.

- G. Store pipe at ambient outdoor temperature.
- H. Provide temporary shading.
- I. Avoid coverings that will raise pipe temperature over ambient temperature.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All pipe system materials to be new, free from defects and conforming to the requirements and standards specified in this section. Sizes shall be as specified in the Drawings.
 - 1. The polyethylene base resin shall meet the requirements of ASTM D3350 and F714 for Grade PE4710. The polyethylene resin shall contain antioxidants and be stabilized with a minimum of 2 percent carbon black, well dispersed, for protection against ultra-violet degradation. Pipe and fittings produced from this resin shall have a cell classification of PE 445474C in accordance with ASTM D3350 and shall meet or exceed all the requirements of this specification. All pipe and fittings shall be made from virgin material. No rework compound, except that obtained from the manufacturer's own production of the same formulation, shall be used. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
- B. Physical Properties
 - 1. The pipe, welded joints, and fittings shall all meet or exceed the following physical properties:

Property	Test value (73.4 degrees F)	ASTM Method
Density (pipe)	0.955 gr/cc	D1505
Density (natural base resin)	0.943 gr/cc	D1505
Melt index (pipe-condition E)	0.1 to 0.2 gr/10 minutes	D1238
Melt index (resin-condition E)	0.1 to 0.2 gr/10 minutes	D1238
Tensile strength (yield, 2 ipm)	3200 psi	D638
Tensile strength (ultimate, 2 ipm)	>5000 psi	D638
Elongation (2 ipm)	>500 percent	D638
Modulus of elasticity	113,000 psi	D638
Flexural modulus	136,000 psi	D3350
Environmental stress cracking resistance (Condition C, f20)	1500 hours	D1693

- C. Fittings:
 - 1. Provide ARC™ sweep bends manufactured by Pipestar International, or approved equal, for 2-inch through 14-inch long radius bends. Bend radius 3 times the nominal pipe size, measured to the centerline of the bend.

2. Increase wall thickness to next nominal pressure rating (next lower SDR) for mitered bends and fabricated fittings. 2 miter segments, minimum for deflections of 45 degrees or less. 4 miter segments, minimum for deflections greater than 45 degrees.
 3. Non-standard bends shall be custom fabricated.
- D. Flange Ends:
1. HDPE stub end flange adapter and back up ring.
 2. Furnish beveled flange adapters for disk clearance on flanged connections to butterfly valves.
 3. Furnish stub end flange adapters with radius or chamfered outer diameter transition from pipe wall to stub end.
 4. Chamfer or radius flange ring bore to match transition on stub end flange adapter.
 5. Ductile iron back up rings encapsulated in polypropylene or CF8 (304) Stainless Steel back up rings: Improved Piping products – PPDI, Improved Piping Products - SS-SDR, or approved equal.
- E. Couplings:
1. HGRV – HDPE Groove Coupling
 - a. HGRV couplings consist of two coupling halves and gasket. Designed to join double-grooved HDPE pipe ends.
 - b. HGRV (HDPE Grooved Coupling): Victaulic Style 908 or Approved Equal.
 2. HPEG – HDPE Plain End with Gripping Teeth
 - a. HPEG couplings consist of two coupling halves, gasket, and gripping teeth that engage and grip the exterior of plain end HDPE pipe segments.
 - b. HPEG (HDPE Plain End with Gripping Teeth): Victaulic Style 995N, Victaulic Style 905, or Approved Equal.
 3. HXGT – HDPE by Grooved End Transition
 - a. HDPE by Grooved End Transitions consist of a carbon steel grooved end pressed onto a plain end HDPE pipe stub. Join HDPE by Grooved End Transitions with Flexible Grooved End Coupling.
 - b. Carbon steel grooved end transition furnished with cut grooves and fitted with multiple rows of integral circumferential barbs on the inside diameter.
 - c. Coat carbon steel components with NSF 61 compliant epoxy prior to pressing onto HDPE pipe.
 - d. HDPE by Grooved End Transition: Poly-Cam Series 701 or Approved Equal.
 - e. Flexible Grooved End Couplings: Victaulic Style 77, Anvil Gruvlok Figure 7001 or Approved Equal.

2.02 PRODUCT DATA

- A. Contractor shall provide the following information in accordance with Section 01 33 00:
1. Test results indicating that polyethylene pipe and fittings meet or exceed the physical properties specified in paragraph 2.01 Materials.
 2. Training certification for project personnel.

3. Grout testing reports for slip lining installations.
4. TV inspection reports in accordance with Section 33 01 30.16.

PART 3 EXECUTION

3.01 INSTALLATION, BURIED

- A. Install piping system in accordance with ASTM D2321, AWWA C901 or AWWA C906 and the pipe manufacturer's recommendations.
- B. Joining:
 1. Join pipes and fittings above grade, out of the trench.
 2. Butt fusion welds in accordance with the pipe manufacturer's recommendations and ASTM D2657
 3. Obtain optimum fusion parameters from the pipe manufacturer, with regard to fusion temperature, interface pressure, and cooling time.
 4. Follow the manufacturer's recommendations with regard to the optimum fusion parameters and use proper equipment for the fusion process.
 5. Provide record of each butt fusion joint using McElroy Datalogger, or equal. Record date, time, joint number, operator identification, fusion machine make and model, pipe size and SDR, interfacial pressure during fusion and cooling, and fusion temperature.
 6. Butt fusion joint strength exceeds tensile strength of pipe.
 7. Extrusion welding and hot gas welding is not permitted.
 8. Pipe joints completed by factory trained and certified fusion technicians.
 9. Provide flange joints for connections to different pipe materials, equipment, valves, and other appurtenances unless otherwise specified on the Drawings.
 10. Install electrofusion welds where required for closures and joining HDPE to fixed/installed HDPE pipe or where specified on the drawings. Electrofusion welds installed in accordance with manufacturer's instructions and ASTM F1055.
- C. Trench Excavation: per Section 31 23 00 and 31 50 00.
- D. Location and Alignment: Place pipe and fittings in the trench with the invert conforming to the elevations, slopes, and alignments specified on the Drawings.
- E. Bedding and Backfill:
 1. Bedding and backfill per Section 31 23 00 and as specified on the Drawings.
 2. Place materials by methods that will not disturb or damage the pipe.
 3. Adjust temperature of HDPE pipe to the temperature of the surrounding soil at the time it is backfilled and compacted.
 4. Work in and tamp the bedding material in the area under the pipe and up to the spring line before placing and compacting the remainder of the embedment.
 5. Blocking under the pipe is not permitted.

6. Place sufficient backfill to prevent damage, excessive deflections, or other disturbances of the pipe before using heavy compaction or construction equipment directly over the pipe.
7. Control flotation of pipe when backfilling with flowable materials. Provide sufficient pipe weight, anchor blocks, fill with water, or backfill in lifts.

3.02 INSTALLATION, EXPOSED AND SUBMERGED

- A. Install piping system in accordance with Chapter 8 of the Plastic Pipe Institute *PE Handbook*, ASTM F2620, AWWA C901 or AWWA C906, and the manufacturer's recommendations.
- B. Joining:
 1. Butt fusion welds in accordance with the pipe manufacturer's recommendations and ASTM D2657
 2. Obtain optimum fusion parameters from the pipe manufacturer, with regard to fusion temperature, interface pressure, and cooling time.
 3. Follow the manufacturer's recommendations with regard to the optimum fusion parameters, and use proper equipment for the fusion process
 4. Butt fusion joint strength exceeds tensile strength of pipe.
 5. Extrusion welding and hot gas welding is not permitted.
 6. Pipe joints completed by factory trained and certified fusion technicians.
 7. Provide flange joints for connections to different pipe materials, equipment, valves, and other appurtenances unless otherwise specified on the Drawings.
 8. Install electrofusion welds where required for closures and joining HDPE to fixed/installed HDPE pipe or where specified on the drawings. Install electrofusion welds per the manufacturer's instructions and ASTM-F1055.
- C. Pipe Support:
 1. Conform to the plans.
 2. Accommodate thermal expansion and contraction movement.
 3. Support pipe at intervals of 8 feet or less.
 4. Provide pipe cradles supporting the bottom 120 degrees of pipe circumference.
 5. Cradle length (measured parallel to pipe axis) not less than half of the pipe's outside diameter.
 6. Edges of pipe cradles rounded or rolled to prevent cutting or gouging pipe.

3.03 INSTALLATION - SLIP LINING

- A. Refer to Section 33 31 20.23.

3.04 FIELD TESTING

- A. Deflection Testing (Proofing) for Buried Pipe:
 1. Perform deflection testing for the entire length of buried pipe.
 2. Deflection testing performed not less than 30 days after completion of any work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads.

3. Maximum permissible pipe deflection: 4.0 percent of the average inside diameter of the pipe.
4. Deflection testing device capable of detecting pipe internal dimensions to within 1 percent of the average internal diameter of the specified pipe dimensions.
5. Remove, replace, and retest pipe sections that fail the deflection testing.

B. Leak Testing

1. Following proofing of the installed direct buried pipe or liner, the Contractor shall conduct a leak test using air or water.
2. An exfiltration test shall be made by plugging the downstream end of the pipe test section and installing a standpipe to the pipe's upstream end using appropriately sized 90-degree elbow fittings, plastic standpipe and flexible watertight couplings. The standpipe shall be temporarily secured within the manhole and shall extend up to or above the roadway elevation. The Contractor shall fill the standpipe and test section with water so that a head of at least 4 feet is provided above both the water table and the crown of the pipe at the upstream manhole. Contractor shall extend the standpipe height as necessary where the water table elevation is within 4 feet of the roadway elevation. The filled test section shall be allowed to stand for a 2-hour test period. The water level during the test period shall remain unchanged for the test section to be accepted as watertight.
3. Alternately, the Contractor may use low pressure air to test the installed pipe. Contractor shall plug and brace the ends of the test section and provide a means to introduce test air to the sealed pipe. The test section shall be pressurized with air to 4.0 psi plus 0.5 psi for each foot the groundwater table is above the minimum invert elevation of the pipe. The maximum test pressure shall be 10 psi. The Contractor may delay the start of the test until the test pressure has stabilized. The pipe shall be accepted as watertight where the pressure within the sealed pipe remains constant for 5 minutes after the air supply has been disconnected. The Contractor shall exercise due caution when air testing. Plugs shall be adequately braced against the forces developed during testing. All test pressure shall be removed from the pipe prior to removal of test plugs. All personnel shall be isolated from the area under test while the test section is pressurized. The test pressure gage shall have a maximum reading of 15 psi and shall be calibrated prior to testing.
4. Where the test section fails the leak test, the Contractor shall continue to test smaller segments of the pipeline in like manner and fix all leaks. The method of fix shall not diminish the pipe dimensions. All costs incurred in providing a successful test shall be borne by the Contractor.

END OF SECTION

SECTION 33 05 36
FIBERGLASS REINFORCED UTILITY PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies fiberglass reinforced pipe (FRP) and fittings suitable for low pressure (due to surcharge) for gravity combined sewer or storm water service.
- B. Provide all necessary labor, materials, equipment, services, and incidentals required provide a complete, in-place gravity sewer and to accurately locate in the field service laterals along new or existing sanitary sewers.
- C. Provide all design, detailing and coordination to provide a complete and in place pipeline per the Contract Documents. Design shall include confirmation of spool length, joint, shop fabricated fittings and all ancillary components required for successful installation, confirmation of external loads, required pipe stiffness (SN), Pressure Class (PN), and all other loads as determined by the Contractor's means and methods to install the pipe. Provided pipe and materials shall be supported by the required submittals and documentation as specified herein.
- D. Pipe shall be provided in the diameters specified. Diameters specified represent nominal pipe diameter, unless otherwise specified.
 - 1. Minimum Pipe Stiffness (SN): As specified.
 - 2. Minimum Pressure Class (PN) As specified.
 - 3. All pipe fittings and joints shall be designed and rated for the minimum internal operating pressure specified.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 1 33 00 - Submittal Procedures
 - 2. Section 01 60 00 - Materials and Equipment
 - 3. Section 01 78 39 - Project Record Documents
 - 4. Section 31 23 00 - Excavation and Fill
 - 5. Section 40 05 07.14 - Settlement Provisions for Yard Piping

1.03 REFERENCE STANDARDS

- A. 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.

Reference	Title
ASTM D638	Standard Test Method for Tensile Properties of Plastics

Reference	Title
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D2992	Standard practice for obtaining hydrostatic or pressure design basis for "Fiberglass" (Fiber Reinforced Thermosetting - Resin) pipe and fittings. (Hydrostatic Design Basic (HDB)).
ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
ASTM D3567	Standard Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings.
ASTM D3681	Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.
ASTM D3754	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
ASTM D3839	Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D4161	Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D5421	Standard Specification for Contact Molded "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ISO 9001	Quality Management Systems
AWWA C950	Fiberglass Pressure Pipe
AWWA M45	Fiberglass Pipe Design
COE	City of Everett Design and Construction Standards & Specifications for Development. Current edition
WSDOT	Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, current edition.
WSDOT	Washington State Department of Transportation, Standard Plan Manual, Current edition.

1.04 SUBMITTALS

A. Procedures: Section 01 33 00, Submittal Procedures.

B. Action Submittals:

1. A copy of this entire specification section, with addendum updates included, and 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. A check mark 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. Submit design calculations for pipe demonstrating:
 - a. Pipe thickness, stiffness number (SN) and pressure class (PN) for installation method and in-service conditions. Provide all internal pressures, installation loads, design loads for trench (live and dead loads) and embedment provided in accordance with procedures provided in AWWA M-45.
 - b. Thrust restraint calculations for all fittings, deflections, and valves including the minimum restraint length required and details of the restraint method provided.
3. Fabrication and lay drawings for each pipeline to be constructed including pipe layout diagrams and schedule. Drawings information shall include but not necessarily be limited to:
 - a. Piping layout to scale including location of flush or non-flush joints, fabricated fittings or beveled joints to be used to form curved sections of the pipe alignment and dimensions for any specialized fittings. Specialized fittings shall include but not be limited to:
 - 1) Working drawings for Accessways and adjacent fittings per paragraph 2.03 A. 3
 - 2) Working drawings for Drop Structures and adjacent fittings per paragraph 2.03 A. 4.
 - 3) Working drawings for connection to settlement joints per paragraph 2.08.
 - b. Pipe invert elevations.
 - c. Acknowledgment of, installation type, geotechnical conditions, bury depth and bedding requirements.
 - d. Dimensional Details of beveled fittings, joints, special elbows, and related appurtenances.
 - e. Pipe-to-structure connection detail with Manufacturer's product data, material properties with applicable ASTM references and technical installation requirements.
 - f. Details, locations, and pipe restraint and all proposed methods required to prevent pipe movement and excessive pipe wall stresses for hydrostatic joint testing of pipeline.
 - g. Details and location of grouting ports including port closure

4. Submitted fabrication, lay drawings and design calculations must be sealed by a Registered Professional Engineer licensed in the State of Washington
5. Submit cleaning and testing plans including but not limited to schedule, testing sections, methods, and materials to be used.

C. Informational Submittals:

1. Manufacturers Material Submittals

- a. Manufacturer's shop drawings and catalog data with sufficient detail to show compliance with specified requirements.
- b. Shop drawings shall illustrate pipe lengths, diameter control, wall thickness, pipe stiffness class (SN) class, pipe pressure class (PN).
- c. Details of fabricated fittings, pipe joints, joint gasket (material, size, and shape), service connections, taps, saddles, and related appurtenances. Provide locations by station for fabricated fittings, service connections, taps, and saddles.
- d. Instructions on storage, handling, transporting, and installation including number, and position of slings, strutting, and other methods for pipe handling during manufacturing, transport, and installation.

2. Manufacturer's Experience

- a. Provide a Certificate confirming required experience levels for years of production, diameters, and footages with a reference list of projects in the United States or Canada.

3. Manufacturer's Certificates & Affidavits

- a. Copy of Manufacturer's current ISO 9001 certification.
- b. Affidavit of Compliance to these specifications referencing the project name, location and the diameter of pipe and fittings provided including a statement of the pressure rating of the provided pipe and anticipated pressures.
- c. Provide the gasket manufacturer's material certification for the gasket in accordance with ASTM F477 and an affidavit of compliance for gasket tests per ASTM F477.
- d. A copy of the full ASTM D 3681 Strain Corrosion test report verifying that the provided pipe meets the long-term corrosion resistance required for Sanitary Sewer service when tested using 1N Sulfuric Acid.
- e. The test report and all data shall be from sample production pipe from the plant which will be supplying pipe to this project.
- f. Data from other manufacturing sites, or report with mix data are subject to rejection by the Owner.

4. Manufacturer's Representative

- a. Provide name, contact information and experience of representative.

5. Warranty

- a. Record copies of certified test reports that all pipe and materials manufactured for this project have met all the quality control requirements specified shall be enclosed with the warranty letter.

D. Construction Submittals:

1. Prior to delivery of the pipe from each manufacturing lot or run
 - a. Submit certified laboratory testing results for provided pipe.

2. Cut sheets showing stationing, invert elevations, ground elevations, and cuts every 25 feet and at connection points to manhole and structures. Surveying shall be performed under the supervision of and certified by a licensed Professional Land Surveyor of the State of Washington.
 3. Working drawings of the Contractor's trench section with all dimensions and materials (bedding, pipe zone backfill, geotextile, foundations stabilizations). Coordinate submittal with design calculations and requirements for installation per Section 31 23 00, Excavation and Fill.
 4. Testing records and results.
- E. Closeout Submittals:
1. Per Section 01 78 39, Project Record Documents.
 2. Record Drawings provided by the Contractor must provide the field installed Station, elevation, northing and easting.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Requirements and Qualifications:
1. Maintain a continuous Quality Control Program and hold current third-party ISO 9001 certification.
 2. Have a minimum of five (5) years of continuous experience producing FRP pipe and fittings and shall be able to show evidence of at least ten (10) installations in satisfactory service for at least five (5) years totaling 50,000 linear feet of pipe greater than or equal to 48-inches in diameter. All referenced experience shall be for projects completed within the United States or Canada.
 3. Provide services of an authorized representative who is trained by the Manufacturer and experienced in installation, inspection and testing of the pipe and ancillary components supplied. The representative shall be available to provide technical support, resolve requests for information and construction conflicts throughout the duration of the work. All costs associated with these requirements shall be included in the Contractor's bid price.
 4. Perform shop tests and provide certified test reports and an affidavit that all provided materials have been tested and meet or exceed the performance requirements specified.
 5. Pipe and fittings shall be tested and meet or exceed the performance requirements of ASTM D2412, ASTM D3262, ASTM D4161 and ASTM D3681. For pipe provided for the project, specified production testing shall be completed and certified results provided prior to delivery.
 6. Pipe shall meet or exceed the minimum strain corrosion limits shown in Table 4 of ASTM D3262.
 7. Submit current ASTM D3681 long-term strain corrosion test reports verifying the pipe meets long term corrosion resistance requirements when tested using 1N sulfuric acid. Chemical resistance of the pipe shall be demonstrated as no loss of tensile or impact strength after four (4) months of continuous immersion for the following solutions:
 - a. 20% sulfuric acid
 - b. 1% ferric chloride
 - c. 1% nitric acid

- d. 0.1% soap
- e. 0.1% commercial detergent as linear alkylbenzyl sulfonate
- f. 700 ppm biological oxygen demand (BOD).

B. Facility Inspection:

1. The Owner's Representative shall be entitled to inspect materials and witness manufacturing and testing of pipes, fittings, elbows, and special pieces at the Manufacturer's plant. Such inspection shall not relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications and does not replace the Manufacturer's own quality control procedures.
2. Provide advanced notice of where and when production will commence and provide free and unlimited access to all portions of Manufacturer's plant that are necessary to verify compliance with this specification.
3. Should the Owner elect not to inspect the manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Equipment shipment, protection and storage shall conform to the requirements specified in Section 01 60 00.
- B. Packaging, handling, and shipping shall be in accordance with the Manufacturer's recommendations, and requirements of ASTM D3262.
 1. Use unloading and installation procedures that avoid cracking of the resin lining. Use textile slings, or other suitable materials or a forklift for pipe handling. Use of chains or cables is not permitted.
 2. Extra care shall be taken in cold weather as recommended by the Manufacturer.
 3. Do not move the pipe by inserting any devices or pieces of equipment into the pipe barrel. Secure pipe from rolling.
 4. Slings shall be made of non-metallic webbing such as nylon or textile material that will not damage the pipe.
 5. Store pipe in accordance with the requirements of AWWA M45 and the Manufacturers recommendations. Support stored pipe on dunnage away from contact with vegetation or soil.
- C. Inspect each pipe upon delivery and prior to installation. The pipe shall be free of cracks, crazing, holes, delamination, foreign inclusions, air bubbles, blisters, or other deleterious defects. Remove rejected, damaged or defective materials from Site.

1.07 WARRANTY

- A. Manufacturer shall warrant the product from manufacturing defects for a period of 5 years from acceptance by the Owner.
- B. Manufacturer shall certify the pipe is suitable for 100-year service in sanitary sewers based on a minimum 50-year extrapolated strain level of 0.90% when tested per ASTM D3681 AND ASTM D3262 as specified.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Unless otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable referenced standards. Perform said material tests at no additional cost to the Owner. The Owner's Representative shall have the right to witness all testing.

B. Resin Systems:

1. Provide polyester resin systems with a proven history of performance for the intended service. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.

C. Glass Reinforcements:

1. Provide commercial grade E-CR glass (corrosion resistant and boron free E glass) with binder and sizing compatible with impregnating resins.

D. Silica Sand:

1. Provide Silica sand with a minimum 98 percent silica with a maximum moisture content of 0.2 percent.

E. Additives:

1. Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.

F. Gaskets:

1. Gaskets must meet the requirements of ASTM F477, must be supplied by qualified gasket manufacturers, and must be suitable for the service intended.
2. Gaskets shall either be affixed to the pipe by means of a suitable adhesive or shall be installed in such a manner to prevent the gasket from rolling out of the pre-cut groove.

2.02 PIPE FABRICATION

- A. Pipe for gravity service shall be manufactured and tested in accordance with ASTM D3262.

- B. Manufacture may utilize either the centrifugal casting process or the filament winding process to combine the resins, reinforcements, colorants, fillers, and other materials into a dense, nonporous, corrosion-resistant, consistent composite structure.

- C. Pipe shall meet or exceed the performance requirements for ASTM D3262 for Type 1, Liner 1 or 2, Grade 1 or 3 per ASTM D3262. Minimum wall thickness shall be in accordance with D3262.

D. Pipe Stiffness:

1. Pipe stiffness must be measured in accordance with ASTM D2412 and shall meet or exceed the specified stiffness. The corrosion liner must not be considered as contributing to the structural strength of the pipe. Specified pipe stiffness class requirements by depth of cover will apply, even if the manufacturer's calculations indicate a lower SN class pipe would suffice for a given depth of cover. Design basis must be clearly identified by the manufacturer in support of the pipe design provided.

E. Tensile Strength:

1. Pipe hoop tensile strength for pipe subject to internal pressure shall be verified as specified in applicable standard (ASTM D3754, D3517 or AWWA C950) or by random burst testing at the same sampling frequency.
2. All pipes shall be capable of withstanding a test pressure of two (2) times the maximum sustained operating pressure of the line without leaking or cracking.

F. Pipe Dimensions:

1. Outside Diameter:
 - a. The actual outside diameter shall be in accordance with ASTM D3262, unlisted diameters larger than 60 inches shall be per Manufacturer's literature.
 - b. Pipe shall be round and the diameter shall not vary at any point in excess of 0.5% measured at any point along the length of pipe.
2. Pipe Length:
 - a. Provide pipe in nominal lengths of 19- to 40-feet. Actual laying length shall be nominal +1 to-4 inches.
 - b. Pipe shall be straight such that a 10-foot straightedge laid longitudinally against the O.D. or I.D. of the pipe shall not deviate from the pipe by more than 0.06 inch.
 - c. At least 90 percent of the total footage of each size and class of pipe, shall be furnished in nominal lengths.
 - d. When required by curves along the horizontal or vertical alignments, access pits or closure requirements, shorter lengths shall be provided as recommended by the manufacturer.
3. End Squareness:
 - a. Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8-inch.

G. Inner Liner Resin or Corrosion Barrier:

1. The interior surface of the pipes exposed to sewer flow shall provide chemical, crack and abrasion resistance. The interior liner shall be manufactured using a resin with a 50% elongation (minimum) when tested in accordance with ASTM D638, or a glass reinforced resin liner system.

H. Exterior Liner:

1. The exterior surface of the pipes shall be comprised of a sand and resin layer or a glass reinforced resin layer which provides UV protection to the exterior.

- I. Pipe Markings:
 - 1. Plainly mark the exterior of each length of straight pipe and each fitting in accordance with ASTM D3262 and/or ASTM D3754 to identify:
 - a. Nominal pipe size
 - b. Minimum Pipe Stiffness (SN) and Pressure Class (PN)
 - c. Sequence number in accordance with piping layout
 - d. ASTM or AWWA designation
 - e. Date of manufacture
 - f. Name of the Manufacturer and plant location where pipe was fabricated.
- J. Ports: Provide ports at location and spacing indicated on the Drawings for pipe installed in tunneled casing.
 - 1. Provide three (3) inch pressure grout plug; PVC that threads an SST mating port; thread dimensions per ANSI/ASME B1.20.1 unless otherwise approved.

2.03 FITTINGS

- A. Fittings and specials (flanges, “branch fittings” including elbows, reducers, tees, wyes, laterals or other fittings) shall be contact molded or shop fabricated mitered sections with structural fiberglass reinforce overlays or laminations. Pipe for fittings, specials and mitered sections shall meet or exceed the requirements of the pipe section to which they are connected, exceed all operating conditions and capable of withstanding service conditions where installed.
 - 1. The tolerance of the angle of an elbow and the angle between the main and leg of a wye or tee shall be plus or minus 2 degrees. The tolerance on the laying length of a fitting shall be plus or minus 2 inches.
 - 2. Thrust at valves, bends, tees, or other fittings shall be resisted by restrained joints. Minimum restraint length shall be in accordance with AWWA M-45 and to include the nearest, next joint.
 - a. Restraint methods shall be in accordance with the manufacturer’s recommended restrained joint system for the required minimum length including bell and spigot with a locking key or one or more gaskets.
 - b. Concrete thrust blocks shall not be used for restraint. Reinforced concrete encasements may be used where specified.
 - c. Laminated joints (butt-wrap factory or field lay-up) may be used for restraint. The length and thickness of the lay-up depends on the diameter of the pipe and operating pressure. Where used, the pipe fabricator shall provide design and detail requirements for lay-up wraps as part of the fabrication and lay drawings.
 - d. The Contractor shall provide restrained joints at all bends where the required restraint length exceeds the available pipe length before a joint. At a minimum all upstream and downstream piping joints of bends shall be provided with restrained connections unless otherwise demonstrated to not be required by submitted and accepted calculations. See Key maps for minimum required internal pressures.

3. Accessways

a. The Contractor shall provide accessways as specified.

- 1) Accessways may be provided in accordance with Detail 1, Option A or Option B. Where specified, the concrete encasement must be provided.
- 2) Where accessways are adjacent to other fabricated bends or fittings, at the fabricators' option:
 - a) the accessway and fitting may be combined and provided at the bend or point of inflection (PI). Any additional pipe spool required shall be included in the Contractor's bid price for the accessway.
 - b) Where two fittings are provided,
 - (1) the station/location of the accessway maybe adjusted by the fabricator to accommodate fabrication.
 - (2) the joint between the fitting and accessway shall be restrained.
- 3) Accessways shall be designed to allow up to 4-inch of settlement and provided with a minimum of two couplings either side of the access way. The Contractor's accessway submittal shall provide the location and length of spool pieces required based on the outlet design. Spool pieces shall not be less than 5-feet in length.
- 4) Submit fabricator's working drawings, restraint methods, installation procedures and all appurtenance components. Working Drawings shall include as a minimum:
 - a) Field verified invert elevations of adjacent pipes, casings
 - b) Accessway station, pipe dimensions, stiffness, pressure class, invert and top of outlet elevations.
 - c) Where connected to adjacent fittings or bends, provide working drawings for adjacent fabricated fittings.
 - d) Layout drawings for installation with stations and elevations of all couplings, fittings and spool pieces.

4. Drop Structures

a. The Contractor shall provide custom drop structures as specified.

- 1) See Drawings 3815-02-CD-2612, 3815-02-C-2107, 3815-02-C-2207, and 3815-02-C-2307.
- 2) Prior to procurement, confirm the installed elevation of the adjacent casing, vertical alignment of the pipe and structure and clearances for installation of the carrier pipe and adjacent fittings.
- 3) Submit fabricator's working drawings, restraint methods installation procedures and all appurtenance components. Working Drawings shall include as a minimum:
 - a) Field verified invert elevations of adjacent pipes, casings
 - b) Structure station, pipe dimensions, stiffness, pressure class, invert and top or bottom elevations.
 - c) top and base elevations of the structures.
 - d) b) Where connected to adjacent fittings or bends, Working drawings for adjacent fabricated fittings
 - e) Layout drawings for installation with stations and elevations

2.04 JOINTS

- A. Unless otherwise specified, the pipe shall be field connected with fiberglass reinforced sleeve coupling, utilizing an elastomeric sealing gasket as the sole means to maintain joint watertightness and soundness.
 - 1. Joint assemblies shall be so formed and accurately manufactured such that when the pipes are drawn together, the pipe shall form a continuous watertight conduit with smooth and uniform interior surface and shall provide for slight movements of any pipe in the pipeline due to expansion, contraction, settlement, or lateral displacement.
 - 2. Pipe must be shipped with one bell and spigot, or filament wound coupling sleeve mounted on one of the pipe ends prior to leaving the manufacturing warehouse unless otherwise specified.
 - 3. The maximum allowable deflection at the joint shall be 50% of the manufacturer's recommended allowable deflection.
 - 4. Pipe joints shall be flush or non-flush as required by the installation.
- B. Filament Wound Coupling Sleeve:
 - 1. Couplings shall consist of a structural filament wound sleeve coupling overwrapped and mechanically locked to an integral full-face EDPM elastomeric gasket or a recessed elastomeric gasket which is affixed in place to maintain position during shipping and installation. Sleeves shall be shipped fully assembled with gaskets affixed as complete unit.
- C. Flanges:
 - 1. Per AWWA C207. Minimum pressure rating per Paragraph 1.01 D.
 - 2. Match pipe flanges to valve flanges.
 - 3. Flange Gasket to be EPDM, epoxied to the flange surface unless otherwise accepted.
 - 4. Hardware (nuts, bolts, etc.) shall be Type 316 stainless steel unless otherwise accepted.
- D. Gaskets:
 - 1. Gaskets must
 - a. meet the requirements of ASTM F477, must be supplied by qualified gasket manufacturers, and must be suitable for the service intended.
 - b. either be affixed to the pipe by means of a suitable adhesive or shall be installed in such a manner to prevent the gasket from rolling out of the pre-cut groove.
 - c. Be suitable where potentially contaminated soils or groundwater are present:
 - 1) Provide manufacturer's recommended gaskets for contaminants.

2.05 MANUFACTURERS

- A. FRP Pipe, and fittings shall be provided by a single manufacturer unless otherwise specified or accepted by the Owner.
- B. Accepted Manufacturer's include:
 - 1. Hobas Pipe USA,

2. Thompson Pipe Group,
3. Approved equal.

2.06 DESIGN CRITERIA

- A. Calculations for the design of the pipe shall be submitted per this Section and shall be sealed in accordance with Article 1.04 B.2.
 1. Pipe design calculations in accordance with AWWA M45 standards shall be performed and submitted for each individual sewer reach or segment included in the alignment, and in no instance shall the pipe stiffness or pressure class be less than the specified minimum stiffness or pressure class per Article 1.01 D.
- B. Obtain the following information from the Contract Documents:
 1. Depth of cover, pipe invert to finished grade.
 2. Alignment of the pipeline.
 3. Nominal diameter.
 4. Minimum Pipe Stiffness (SN) and Pressure Class (PN).
 5. Design Working/Operating pressure per Paragraph 1.01 D.
 6. Dead load based on the greatest depth of bury for each segment and the Unit weight of backfill material.
 7. Live load HS-25 as defined in AASHTO-SSHB. Live load shall be applied to all reaches and included construction live loads and surcharge.
 - a. Pipe installed within the Port of Everett, Norton Terminal property shall be designed for additional live loads and surcharge loading including but not limited to live loads per drawing G-2013 or the weight of four stacked containers over the structure, whichever is greater. Max gross load per container shall be 67,200 lbfs.
 8. Groundwater to grade.
 9. Flange Requirements.
 10. Long-term Deflection Lag Factor 1.5. Maximum long-term deflection shall be 5%.
 11. Thrust restraint:
 - a. Working/Operating pressure shall be per Paragraph 1.01 D plus an allowance for testing pressure.
 - b. Weight of soil shall be the projected soil prism above the pipe. Soil density shall be based on the backfill material provided. In locations where ground water is present, soil density shall be reduced to the buoyant weight.
 - c. The coefficient of friction shall be a maximum of 0.20 for unsaturated soils. In locations where ground water is present, the coefficient of friction shall be reduced to a maximum of 0.15.

2.07 CLOSURE COUPLINGS

- A. Closure coupling components shall be ANSI 316 SST with elastomeric gaskets suitable for the service .
- B. Couplings shall be recommended by the Manufacturer and suitable for the operating pressures, , equal or greater than the pipe being joined, required thrust restraint and installed conditions.

- C. Approved Coupling:
 - 1. Teekay,
 - 2. Straub-Flex, Straub open flex couplings or
 - 3. Approved equal.

2.08 SETTLEMENT-SEISMIC PROVISIONS

- A. Where specified, provide settlement joints in accordance with Section 40 05 07.14. Settlement-Seismic Provisions for Yard Piping.
 - a. The Contractor shall coordinate FRP pipe, fittings, and appurtenances required to make connections to settlement-seismic joints and piping at the PGSF site.
 - b. Prior to procurement, confirm the installed location and elevation of the PGSF connection points.
 - 1) Submit fabricator's working drawings, restraint methods installation procedures and all appurtenance components. Working Drawings shall include as a minimum:
 - a) Field verified locations and invert elevations of adjacent pipe and couplings
 - b) Pipe dimensions, stiffness, pressure class, invert and top or bottom elevations.
 - c) Layout drawings for installation with Stations and elevations

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall be responsible for the correct fitting of all pipe sections, branch fittings and components, ancillary items, appurtenances, and structures in accordance with the intent of the Contract Documents as accepted by the Owner's Representative and as necessary to complete the work.
- B. Inspect each pipe prior to installation. The pipe shall be free of cracks, crazing, holes, delamination's, foreign inclusions, air bubbles, blisters, or other deleterious defects. Remove rejected, damaged or defective materials from the site.
- C. Pipe and fittings that are damaged before or during installation may be repaired as recommended by the Manufacturer. Repair details shall be submitted for acceptance by the Owner's Representative. The Contractor shall repair or replace damaged pipe in kind at no additional cost to the Owner.
- D. The Contractor shall arrange to have the Manufacturer supply a suitable, qualified field service representative to be present during the initial installation of the pipe and as needed to advise the Contractor regarding proper installation methods.

3.02 INSTALLATION

- A. Install pipe by open cut consistent with the provisions of ASTM D3839 and Section 31 23 00 - Trenching, Excavation, Backfilling, And Compacting.

- B. Pipe Bedding, Cover and Backfill: Conform to requirements of 31 23 00.
 - 1. Lay pipe with uniform bedding under the full length of the barrel of the pipe.
 - 2. Lay pipe upgrade with bell / attached filament sleeve coupling ends pointing in direction of laying.
 - 3. The interior of the pipeline shall be cleaned as the work progresses.
- C. Jointing Pipe:
 - 1. Check pipe ends and couplings for damage. Correct any damage found.
 - 2. Clean ends of pipe, gaskets and coupling in accordance with the Manufacturer's requirements. Coupling grooves must be completely free of dirt or backfill material.
 - 3. Apply joint lubricant to pipe ends and rubber seals of coupling. Use only lubricants approved by the Manufacturer.
 - 4. Use suitable auxiliary equipment and end protection to pull pipe joints together.
 - 5. Check completed jointing with feeler gauge to make sure the gasket is completely seated around the circumference of the pipe.
 - 6. Do not exceed forces recommended by the manufacturer for coupling pipe. If excessive force is required, remove coupling, determine source of problem, and correct it.
 - 7. In the process of jointing the pipe, do not allow the deflection angle to exceed 50% of the deflection angle permitted by the Manufacturer without prior approval of the Owner's Representative.
 - 8. Adjust homing of pipe joints to provide longitudinal flexibility were required for seismic resiliency.

3.03 LINE AND GRADE

- A. Pipe shall not deviate more than 1 inch from line or 1/4 inch from grade as measured at the pipe invert.
- B. When installed, established line shall not result in high points or bellies in the reach and meet the specified line and grade within the specified tolerances.

3.04 MANHOLES AND STRUCTURES

- A. Connect to Manholes as shown on the drawings.
- B. Connect to existing pipe utilizing a butt wrap joint or standard sleeve coupling as recommended by the pipe manufacturer.

3.05 CUTTING OF PIPE

- A. Pipe sections will be shipped in the Manufacturer's standard lengths. Minimize field cutting of the pipe and include locations of field cuts in the submitted lay drawings for review and acceptance.

- B. Field cuts must be accepted by the Owner's Representative prior to cutting. Accepted field cutting shall be performed in accordance with the accepted plan and Manufacturer's recommendations. Cut ends shall be ground smooth and beveled in accordance with the Manufacturer's instructions. Field cut pipe ends shall be square to the pipe axis and shall not exceed the manufacturing tolerance.
- C. Mitered joints shall be fabricated by the Manufacturer and shall not be field cut.
- D. Recoat the interior lining at the cut with a resin rich material approved by the Pipe Manufacturer.

3.06 FIELD BONDING/LAY-UPS

- A. Bonding or welding shall be performed in accordance with the FRP supplier. Surface to be welded must be completely sanded and roughened. Roughed surface should extend at least 1-inch (25mm) beyond the area where the glass/resin will be applied. Glass resin shall overlap joints a minimum of 4-inches.
- B. Thoroughly clean areas to remove surface contamination. This includes dirt, dust, moisture, and all other foreign materials that negatively impact bonding.
- C. The bonding should be performed as immediately following grinding and cleaning of surfaces. Under no circumstances shall the bonding be performed if the area has been contaminated or the grinded surface is older than 4 hours.
- D. All roughened surfaces shall be recoated with resin after all lamination layers are installed.

3.07 INSPECTION AND TESTING

- A. All piping shall be cleaned, inspected and subject to acceptance tests prior to the introduction of wastewater/ stormwater flows.
- B. CCTV Inspection: Conduct CCTV Inspection/televising in accordance with Section 33 01 30.16. CCTV Inspection of Pipelines.
- C. Test for Deflection:
 - 1. Pipe initial vertical deflection shall not exceed 3% of the original pipe diameter, verified by mandrel testing.
- D. GRAVITY PIPELINES:
 - 1. Tests shall be performed in accordance with Section 7-17.3(4) of the WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction. Sewers and appurtenance shall be cleaned and tested after backfilling by either the exfiltration or low pressure air method at the option of the contractor, except where the ground water table is such that the City Engineer may require the infiltration test.
 - 2. Clean and flush, with an approved cleaning ball and clean water, all gravity sanitary sewer lines prior to testing. The cleaning ball shall be an inflatable diagonally ribbed rubber ball of a size that will inflate to fit snugly into the pipe to be tested. A rope or chord will fastened to the ball to enable total control of the ball at all times.

E. HYDROSTATIC PRESSURE TEST

1. All pipe subject to internal pressure shall be hydrostatically tested as specified in Section 7-09.3(23) of the WSDOT/APWA Standard Specifications. The contractor shall provide all necessary equipment and shall perform all work connected with the tests. The contractor shall perform the test to assure that the equipment to be used for the test is adequate and in good operating condition and all air has been released prior to requesting the city inspector to witness the test. If the initial test is not successful for any reason, additional trips required for City staff to witness or perform subsequent tests shall be at the contractor's expense.
2. Pipe Joint Pressure Test:
 - a. Pressure test each pipe joint using portable pipe joint tester.
 - 1) Test joint prior to final restoration of street grade or prior to placement of CDF.
 - 2) Test Medium: water.
 - 3) Test pressure: maximum pressure of 1.5 times the operating pressure but not to exceed $1.5 \times PN$ or 5 psi for PN 0 rated pipe.
 - b. Pipe joint tester:
 - 1) Pressure cylinder, which fits inside pipe, straddles pipe joint and isolates and pressurizes a section of pipe.
 - 2) Elastomeric sealing elements encircle the joint tester body so when inflated or deformed they affect seal between the joint tester body and the interior surface of the pipe.
 - 3) Data plate: References pipe diameter, rated test pressure, inflation pressure and any torque requirements for threaded fasteners.
 - c. Joint pressure test procedure:
 - 1) Gasketed joint:
 - a) Maintain test pressure for a minimum two minutes.
 - b) Visually inspect and mark any leaks indicated by escaping gas bubbles or water.
 - c) Leakage criteria: One psi pressure drop in two minutes allowed.
 - d) Repair joint leaks, which do not meet the leakage criteria.

END OF SECTION

SECTION 33 14 12
HIGHLINING FOR WATER MAINS

PART 1 GENERAL

1.01 GENERAL

- A. This section specifies highlining requirements for the existing potable water transmission and distribution system with a temporary water supply conveyance pipeline (highline system). Highlining shall be provided as specified herein and in accordance with City of Everett Water Distribution Design and Construction Specifications.
- B. The Contractor shall provide the materials, equipment, labor, and services necessary to maintain potable water service at all times.

1.02 DESIGN REQUIREMENTS

- A. The means and methods of providing and maintaining uninterrupted service shall be the sole responsibility of the Contractor. A Highlining Plan shall be submitted for each highline operation.
- B. The highline system shall provide continuous service until water mains are constructed, tested, and commissioned or the Work is accepted by the Owner. Installation and removal shall be organized, scheduled, and performed to provide minimum disruption of water services.
- C. Coordinate with Owner Water Operations on the pressure, flow requirements and connection to existing distribution systems for the highline system.
- D. Contractor shall ensure that fire flow is maintained including the existing fire hydrants along the existing Strand Pipeline.
- E. All materials shall be NSF 61 certified and used exclusively for water service.
- F. Highlines may be provided above-grade. Portions of the highline will be trenched and buried to protect pipes and to avoid interference with vehicular or pedestrian travel or access.

1.03 SUBMITTALS

- A. Working Drawings of Highlining Systems: Working drawings shall provide a detailed description and staging of highline systems to be provided. The plans must include the detailed locations of each connection and location of highline piping.
- B. Schedule: Submit a highlining schedule prior to the start of fabrication or assembly of any part of the highline system.

- C. Project Specific Highline Plan: The Contractor shall submit a separate plan for each separate set-up required. Plans shall be prepared and stamped by a Registered Professional Engineer in the State of Washington. Submit Working drawings, materials, staging and design calculations with supporting documentation and details for buried highline piping subject to live and dead loads.

PART 2 PRODUCTS

2.01 MATERIALS

A. Highline Systems

1. The Contractor shall provide all pipe, valves, fittings, couplings, adapters and ancillary materials required for a complete and operable highline system. Joints for all pipe shall be watertight.
 - a. The Contractor shall provide only products and materials which meet the specified requirements.
 - b. Products and materials shall be suitable for the intended purpose, free of defects, and recommended by the Manufacturer for the application intended.
 - c. At the Contractor's option, highlining products and materials shall either be: a) New products and materials purchased for this Work, or b) Previously used and refurbished products and materials that have been used only in potable water service. Contractor shall submit a Letter of Certification as to the material use for potable water service only.
 - d. Products and materials provided shall be of current manufacture and shall be shop fabricated. Field fabrication of fittings shall not be permitted.
 - e. Provide bolted sleeve type transition coupling suitable for the pipe materials and diameters at connections to existing potable water mains. The coupling must be braced or restrained.
 - f. Isolation valves shall be installed on the temporary piping at connection points with the existing system.

B. Highline Alignment

1. The actual design of the highline system shall be prepared by the Contractor. The Contractor shall be responsible for routing piping and locating fittings and appurtenances. In general, piping shall be laid adjacent to the roadway along the curb gutter line.
2. Contractor shall maintain pedestrian and vehicular access as part of the design requirement for the highline system. Design shall include ADA standards for accessibility design if piping, fittings, and appurtenances crosses or parallels on top of sidewalk.

2.02 SAFETY BARRICADES

- A. Traffic safety barricades shall be provided in accordance with MUTCD where necessary to protect the public or pedestrian and vehicular traffic.

2.03 TEMPORARY PAVEMENT

- A. Provide a temporary pavement patch to re-open the paved travel lanes when constructing buried Highlines. Provide a minimum of 4-inch hot mix bituminous temporary pavement. Cold mix temporary pavement shall not be used for temporary pavement.

2.04 TEMPORARY FLUSHING ASSEMBLIES

- A. Provide temporary flushing assemblies where specified.
 - 1. Assemblies shall be installed in accordance with City of Everett Standard Detail 511

PART 3 EXECUTION

3.01 GENERAL

- A. The highline system shall be flushed, hydrostatic tested for leaks, disinfected, and shall pass required bacteriological tests prior to being placed in service in accordance with ANSI/AWWA C651-14 Disinfecting Water Mains. All water sampling and bacteriological testing samples shall be taken by the City Utilities Department and testing shall be performed by a certified laboratory.
- B. The Contractor shall have a dedicated personal to inspect and maintain the highline system during operation.
- C. The materials selected shall be adequate to operate at the specified pressure and adequate to withstand imposed forces, such as traffic loading or unbalanced thrust.

3.02 INSTALLATION

- A. The Contractor shall not commence installation of any part of the highline system without review of submittals and written authorization by the Owner.
- B. The Contractor shall notify the Owner, a minimum of 2 working days prior to commencing Work on highline set-up.
- C. Highline piping systems shall be installed and maintained such that they are neat, orderly, and leak-free, and shall be arranged to minimize interference with, or present a hazard to, normal usage of roads, shoulders, driveways, storm drains, drainage, and other affected facilities.
- D. Excess materials shall be removed from the Project Site daily.

3.03 ROADWAY CROSSING AND TRENCHING

- A. Trenching and backfill shall be performed in accordance with Section 31 23 00 Excavation and Fill and applicable AWWA standards for the piping materials provided. Trench backfill and temporary asphalt surface shall be tamped and compacted to provide a smooth, safe surface for the duration of the highlining installation.

3.04 RESTRAINT AND ROUTING

- A. Highline systems shall be restrained to prevent movement including, but not limited to, providing anchors, tethers and thrust blocks.

3.05 REMOVAL

- A. On completion of the Work, the Contractor shall:
 - 1. Drain the Highline in accordance with AWWA C655 and applicable sections of these Specifications.
 - 2. Dismantle the highline system by removing all pipe and appurtenances. Connections to existing potable water pipe shall be removed and pipes to be abandoned capped. Pipes installed in trenches shall be removed and trenches backfilled per Section 31 23 00 Excavation and Fill.
 - 3. Restore streets, curbs and gutters, cross gutters, landscape, irrigation, and other disturbed facilities.

END OF SECTION

SECTION 33 31 20.23

SEWER SLIP LINING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies properties of polyethylene pipe and fittings, joining tools and procedures for sliplining of existing sanitary sewers with solid-wall HDPE pipe.

B. Requirements:

1. Contractor shall provide a leakproof liner in all sewers identified for sliplining. Individual pipe lengths shall be assembled by butt-fusion welding unless otherwise specified. Connecting fittings shall be fused or mechanically joined to the liner as specified. Contractor shall also be responsible for cleaning and television inspection of the sewer, bypassing and dewatering sewer flow around his work, leak testing the liner and liner fittings, grouting the annular space between the liner and existing sewer, temporarily suspending and restoring sanitary and water service to all facilities affected by the Contractor's work, and performing a grout pumping demonstration.

1.02 QUALITY ASSURANCE

A. References:

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
ASTM C31	Standard Method of Making and Curing Concrete Test Specimens in the Field
ASTM C39	Standard Test for Compressive Strength of Cylinder Concrete Specimens
ASTM C172	Standard Practice for Sampling Fresh Concrete
ASTM C425	Compressive Joints for Vitrified Clay Pipe and Fittings
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastomer

Reference	Title
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1505	Standard Test Method for the Density of Plastics by the Density-Gradient Technique
ASTM D1693	Standard Test Method for Environmental Stress Cracking of Ethylene Plastics
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM F585	Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

B. Certification:

1. All pipe welding personnel shall receive training in the proper use of joint fusion equipment and recommended methods for liner connections. All personnel directly involved with installing the liner shall receive training in the proper methods for handling, inserting, trimming and finishing the liner. Training shall be performed by a representative of the pipe manufacturer.
2. The Contractor may satisfy this requirement by providing one day on-site training for his crew by the pipe supplier in the presence of the Construction Manager. Where the training is not witnessed by the Construction Manager, the Contractor shall provide a certification of training for each crew member in accordance with paragraph 1.04.

1.03 SUBMITTALS

A. The Contractor shall submit the following information in accordance with Section 01 33 00.

B. Action Submittals:

1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations.
2. Qualifications of the certified fusion technician.
3. Manufacturers' product data, catalog cuts, typical installation details, and dimensions. Indicate each piping system where the product will be used on the submittal.
4. Pipe Manufacturer's joint assembly procedure.
5. Shop drawings which include a complete materials list showing liner and fittings dimensions and construction details. Shop drawings shall also include for each liner installation all excavation locations, interfering utilities, excavation dimensions, flow bypass and traffic control schematics.
6. At least 2 weeks prior to the start of work, the Contractor shall submit his sliplining schedule identifying daily work hours and working dates for each installation. For each installation, the total time connecting house laterals will be out of service shall be 8 hours. When the Contractor intends to perform night work, the noise level for all equipment to be used, measured in accordance with local noise ordinances, shall be submitted.

- C. Informational Submittals:
1. Records of each field butt-fusion joint installation, as specified in this specification.
 2. Manufacturer's affidavit affirming that the materials furnished for the project comply with the specifications of this section.
 3. Grout design mixes and grout testing reports.

1.04 QUALITY ASSURANCE

- A. Qualifications: Field welding by butt fusion and/or electrofusion performed by a factory trained and certified fusion technician. Training and/or certification by fusion equipment manufacturer or pipe manufacturer.
- B. Certifications: Furnish affidavit (as specified in AWWA C906) documenting compliance AWWA C906, as appropriate for the pipe material specified in this section.

PART 2 PRODUCTS

2.01 POLYETHYLENE PIPE LINER

- A. The slip liner shall meet the requirements of Section 33 05 33.23 paragraph 2.01.
- B. Dimensions:
1. The outside diameter and wall thickness shall be as follows when measured in accordance with ASTM D2122:

Inside diameter of existing sewer, inches	Liner outside diameter, inches	Liner minimum wall thickness, SDR-17, inches
30.9	19.5	1.147

2.02 PIPE JOINING

- A. Unless otherwise specified, liner lengths shall be assembled in the field with butt-fused joints in accordance with ASTM D2657. Where this reference is nonspecific, the Contractor shall follow the pipe manufacturer's written instructions. Butt-fused joints shall have internal bead projections 1/8 inch or less. Joint strength shall be equal to or greater than pipe, and joints shall indicate a ductile rather than brittle fracture when tested. Threaded or solvent-cement joints and connections shall not be permitted.
- B. Where excavations for liner insertion are made between manholes, or at transitions between direct buried pipe and slip liner, the liner ends shall be joined together by butt fused joints, with couplings as described in Section 33 05 33.23 paragraph 2.01.E, or with a full circle seal clamp with stainless steel hardware and with a rubber sleeve. Seal clamps shall be by Rockwell, Dresser, or equal. The minimum clamp length shall conform to the following dimensions:

Outside diameter of the liner pipe, inches	Minimum length of clamp, inches
19.5	30

2.03 GROUT

- A. The Contractor shall submit grout design mixes capable of meeting or exceeding 200 psi compressive strength at 28 days. Testing requirements shall be in accordance with paragraph 3.07. Contractor may incorporate grout additives to improve its flow properties, provided that the minimum compressive strength requirements are met. Grout design mixes with their test results shall be submitted prior to the grouting demonstration specified in paragraph 3.07.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Sewer Bypassing And Dewatering:
 - 1. Contractor shall be responsible for bypassing sewer flow around his work and dewatering of sewer lines in accordance with the requirements of Section 33 01 30.50. During installation and testing of the liner, the Contractor shall provide sewer plugs in upstream sewers to prevent flow from entering his work.
- B. Sewer Proofing:
 - 1. Prior to slip lining, the Contractor shall clean and TV inspect the sewer line in accordance with Sections 33 01 30.53 and 33 01 30.16, respectively. If TV inspection shows a major obstruction that would prohibit or otherwise damage the liner during installation, the Contractor may be directed by the Construction Manager to conduct a spot repair.
 - 2. Following TV inspection, the Contractor shall verify that the sewer is free of obstructions (proof the line) by pulling a 4-foot piece of liner through the existing sewer line. The proofing liner shall be assembled with at least one field made fusion joint. The proofing liner shall have the same diameter dimensions as the intended slipliner and shall be fitted with a pulling head and cable on both ends. Pull heads shall be made of material which will not damage the sewer and shall have a outside diameter within 0.5 inch of the sewer inside diameter. The winch used to pull the proofing liner shall be equipped with a load gage which measures the developed winching force. The maximum allowable pulling force shall be 700 pounds per inch-diameter of the liner. During proofing, the Contractor shall document all portions of the existing sewer where the pulling force exceeds 50 percent of the maximum allowed. Proofing shall be stopped if the winching force reaches the maximum allowed pull force and the proofing section removed by reversing the pull or by excavation. The Contractor shall be responsible for all costs incurred in retrieving the proofing section. Where the outside surface of the proofing liner is damaged, the Contractor may be directed by the Construction Manager to prepare a new proofing liner. The sewer shall be considered ready for sliplining where, after proofing the sewer, the proofing liner shows no evidence of cuts, kinks, gouges, or other damage.
 - 3. No sliplining shall be performed until the sewer has been successfully proofed. Where the sewer is unacceptable for sliplining, the Contractor shall review the TV inspection report and determine the location(s) where spot repair(s) or additional cleaning is required. Spot repairs shall be authorized by the Construction Manager.

C. Sequence Of Work:

1. The Contractor shall perform the work in the following sequence:
 - a. Clean the sewer.
 - b. TV inspect the sewer.
 - c. Spot repairs as required.
 - d. Proof the sewer.
 - e. Install the liner.
 - f. Proof the liner.
 - g. Leak test the liner.
 - h. Grout annular space.
 - i. Internal television inspection.

3.02 EXCAVATION

- A. Excavation shall be in accordance with Section 31 23 00 and ASTM F585. Access pit length shall be such that a minimum bending radius of 33 times the liner outside diameter is maintained. Sheet piling, shoring and bracing requirements shall be in accordance with Section 31 50 00.
- B. Access pit excavations shall be performed at all points where the liner pipe will be inserted into the existing sewer. When possible, access pit excavations shall coincide with service lateral connection points or changes in the sewer line or grade.

3.03 LINER INSERTION

- A. The liner shall be continuously supported above ground on rollers during joining and insertion. The liner shall be inserted into the existing sewer pipe in accordance with the requirements of ASTM F585. Within the dimensions of the access pit, the existing sewer pipeline above the springline shall be cut and removed as necessary for the insertion of the liner. Contractor shall not disturb the existing pipeline below the springline. The point of insertion shall be at a joint in the existing sewer which shall be protected by some means to prevent damage to the liner during insertion. The Construction Manager may direct the Contractor to retrieve the installed liner for inspection and possible rejection where damage is evident from contact of the liner and the point of insertion.
- B. A power winch cable shall then be connected to the end of the liner via a pulling head approved by the pipe supplier so that the liner can be fed into the existing sewer. The winch shall be equipped with a load gage to read the developing winching force directly. The force shall be recorded regularly during winching and at every start and restart. The maximum pulling tension on the liner shall not exceed 700 pounds per inch-diameter.
- C. Where the winching pulling force reaches the allowed maximum, the Contractor shall stop liner insertion and excavate a new insertion pit. The location of the pit shall coincide with the position of installed end of the liner and shall be of sufficient dimensions for liner insertion and joining, and such that the Contractor will not need to extend the excavation due to liner contraction. The cost for the access pit shall be borne by the Contractor.

- D. The liner shall be handled with care to minimize the possibility of it being cut, kinked, or gouged, or otherwise damaged. The use of cables or hooks will not be permitted. Sections of the liner damaged, cut, or gouged shall be repaired by cutting out the section of damaged pipe and the rejoining the liner.
- E. If the liner is pulled through a manhole, that portion within the manhole shall be removed and the annular space around the liner grouted in accordance with paragraph 3.07.

3.04 LINER RELAXATION

- A. The Contractor shall allow time for the liner to relax by natural contraction to its final installed length. The relaxation period shall be determined by the Construction Manager by measuring the distance by which the liner contracts over time. When the rate of change in the liner length is within 5 percent of the rate of change measured in the initial time interval immediately following insertion, the liner will be considered substantially relaxed and ready for subsequent operations.
- B. The Contractor may elect to plug and fill the liner with cold water to speed up the relaxation period and may also perform an exfiltration leak test at this time in accordance with paragraph 3.06.

3.05 LINER PROOFING

- A. Proofing shall consist of pulling a 4-foot section of liner with pulling heads on both ends through the entire length of the liner. The pulling heads shall be made of a material that will not damage the liner. The outside diameter of the pulling heads shall not exceed that of the proofing liner. The proofing liner shall be within 1/2 inch of the inside diameter of the installed liner.
- B. The winch used to pull the proofing liner shall be equipped with a load gage which measure the developed winching force. Points where the load gage reads 50 percent or more of the maximum allowable pulling force specified in paragraph 3.01.B Sewer Proofing shall be excavated, and the installed liner repaired or replaced at the Contractor's expense. The proofing liner shall be assembled in accordance with paragraph 3.01.B Sewer Proofing. Where the outside surface of the proofing liner is cut or scraped, the Contractor may be directed by the Construction Manager to prepare and use a new proofing liner.

3.06 LINER LEAK TEST

- A. Comply with the requirements of Section 33 05 33.23 paragraph 3.04.C.

3.07 GROUTING OF ANNULAR SPACE

- A. The annular space between the outside of the liner and the inside of the existing sewer shall be grouted. For each mix submitted, the Contractor shall demonstrate that he can adequately pump the grout mixture within the annular space for a minimum length of 30 feet. The Contractor shall demonstrate this capability during the first sliplining installation by excavating one point along the existing sewer 30 feet from the upstream manhole. Contractor shall then inject grout from this access point to the referenced manhole. The demonstration will be considered satisfactory where the grout is observed at the referenced manhole.

- B. Samples of grout shall be obtained in accordance with ASTM C172. One set of four standard cylinders shall be cast for each batch in accordance with ASTM C31. Testing of the specimens for compressive strength shall be in accordance with ASTM C39. One test shall be made 3 days from the time of casting, one test at 7 days, and two tests shall be made 28 days from the time of casting. The average of the 28-day strength tests shall be equal to or greater than 200 psi.
- C. Grouting of the annular space shall be done in such a manner as to prevent damage or collapse of the liner. Grout shall be pumped into the annular space at the manholes, service connections, and wherever the liner is exposed. At manholes, the Contractor shall trowel the grout to form a smooth transition between the manhole base and the liner. The Contractor shall ensure that the manholes are not damaged during grouting.
- D. The Contractor shall prevent the liner from floating or collapsing during grouting by filling the liner with water or some other positive method, as approved by the Construction Manager.

3.08 TV INSPECTION

- A. After the annular space has been grouted, the liner shall be TV inspected in accordance with Section 33 01 30.16. Where the TV inspection indicates the liner wall is damaged or forced out of round through grouting, the affected portion(s) of the liner shall be replaced at no additional cost to the Owner.

3.09 CONCRETE ANCHORS

- A. At all points where the liner has been exposed as in access pits, service connections, and other locations, the Contractor shall remove all debris and create a void along each side of the existing sewer pipe at the springline to undisturbed soil. The total width of the void shall not exceed the sum of either the sewer O.D. plus 2 feet or service lateral O.D. plus 2 feet. Contractor shall encase the exposed liner and fittings in a minimum of 6 inches of 2000 psi concrete followed by backfill requirements in accordance with Section 31 23 00. Contractor shall not encase flexible couplings in concrete.

3.10 CLEANUP

- A. After the work has been completed, the Contractor shall clean up the entire project area. All excess material and debris not incorporated into the permanent installation shall be disposed of off site in a lawful manner by the Contractor.

END OF SECTION

SECTION 33 46 59
STORMWATER TREATMENT EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers the furnishing and installation of the stormwater treatment system at Port Gardner Storage Facility (PGSF).
- B. Stormwater mitigation best management practice (BMP) shown on the drawings consists of the following:
 - 1. Stormwater Treatment System structure as shown on plans
 - 2. Stormwater Treatment System: Filterra Bioscape Bioretention System (Bioscape) by Contech Engineered Solution LLC (Contech).
- C. The Stormwater treatment system shall be installed in the location indicated on the drawings and shall meet the performance standards identified in the Washington State Department of Ecology (DOE) Technology Assessment Protocol – Ecology program (TAPE), the City of Everett (COE) Stormwater Management Manual of Western Washington (SWMMWW), and COE Design and Construction Standards and Specifications (DCSS). The specific performance standards applicable to the treatment system are:
 - 1. Phosphorus Treatment
- D. Contractor is allowed to propose an alternative equivalent Stormwater treatment system to that noted in paragraph 1.01.B.2 above, provided the treatment system meets or exceeds the minimum DOE General Use Level Designation (GULD) treatment design rates and performance criteria.
 - 1. The specifications for the proprietary Stormwater treatment system components are not in this specification. Stormwater treatment shall be Bioscape by Contech or approved equal.

1.02 RELATED SECTIONS

- A. Section 33 05 32 Stormwater Conveyance

1.03 SUBMITTALS

- A. Complete drawings, details, product data, testing results, and specifications, covering the Stormwater treatment system and their appurtenances shall be submitted in accordance with the Submittals section.
 - 1. Manufacturer shall provide certification product compliance of GULD approval requirements.
 - 2. Manufacturer's activation report and 6-12 month monitoring/maintenance assurance to list of submittals.

PART 2 PRODUCTS

2.01 PERFORMANCE

- A. Treatment shall remove phosphorous meeting general use level designation through DOE's TAPE program.

2.02 MATERIALS

- A. Internal components including engineered biofiltration media, underdrain stone, PVC underdrain piping, and mulch must be included as part of the bioretention system and shall be provided by the manufacturer. Note that vegetation is an essential component of bioretention systems and shall be provided at time of Activation by contractor.
 - 1. Engineered biofiltration media shall consist of both organic and inorganic components. Stormwater shall be directed to flow vertically through the media profile, saturating the full media profile without downstream flow control.
 - 2. Underdrain stone shall be of size and shape to provide adequate bridging between the media and stone for the prevention or migration of fine particles. Underdrain stone must also be able to convey the design flow rate of the system without restriction and be approved for use in the bioretention system by the manufacturer.
 - 3. PVC Underdrain Piping shall be SDR35 with perforation pattern designed to convey system design flow rate without restriction.
 - 4. Mulch shall be double shredded wood or bark mulch approved for use with the bioretention system by the manufacturer.
- B. Containment Structure
 - 1. Stormwater BMP containment structures shall be provided by the contractor in accordance with the Engineer of Record site plans. Plans show how containment structure is to be connected to stormwater inlet and outlet and how the treatment units will be configured.
- C. Emergency overflow
 - 1. 6" diameter pipe and beehive grate by Trench Drain Supply or approved equal.
- D. Dissipation Rock
 - 1. Dissipation Rock shall be placed in areas where higher flow facilities are anticipated as noted in Drawings. Rock shall be 1- to 1.5-inch gravel and shall be washed and free of fines.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Set up and attend a preconstruction meeting with manufacturer prior to installation of product.
- B. Stormwater treatment system is to be installed in strict accordance with the manufacturer's instructions, in accordance with the State of Washington (WA) Department of Ecology (DOE) specifications as well as the following:
 - 1. Verify BSM meets specification prior to delivery and placement in the facility.

2. Contractor to coordinate with Manufacturer on delivery of engineered biofiltration media. Contractor shall take appropriate action to protect the media from sediment and debris during construction. The method ultimately selected shall be at Contractor's discretion and Contractor's risk.
 - a. Manufacturer or a Manufacturer's certified representative shall install media into the vault or be present to supervise installation to ensure proper installation.
 3. Delineate the facility area and keep construction traffic off. Protect soils with fencing, plywood, etc.
 4. Provide erosion control in the contributing drainage areas of the facility. Stabilize upslope areas.
 5. Surface drainage should be directed away from biofiltration facilities. Site surface stormwater will be directed to area drains and catch basins conveying drainage to Lift Station 46.
 6. Verify installation of underdrain is correct prior to placing soil per Manufacturer's Underdrain Design Plan.
 7. Install overflow system. Place grate at overflow elevation as specified on Drawings.
 8. The bioretention system shall not be placed in operation (activated) until the project site is clean and stabilized (construction erosion control measures no longer required). The project site includes any surface that contributes storm drainage to the system. All permeable surfaces shall be clean and free of dirt and debris. All catch basins, manholes, and pipes shall be free of dirt and sediment. Activation shall be provided by Manufacturer or authorized.
 9. All throat and grate protection covers shall remain in place until the system is activated.
 - a. Vehicular traffic and construction equipment shall not drive on, move onto, or disturb the BSM once placed, and water compacted.
 - b. Rake biofiltration soil as needed to level out. Verify BSM elevations before applying mulch.
- C. Inspection and Maintenance
1. Each correctly installed system shall include a Final Inspection performed by Manufacturer or authorized supplier upon request between 6-12 months after Activation. The cost of this service shall be included in the price of the system and include the following:
 - a. System inspection to help Owner establish proper routine maintenance intervals.
 - b. Routine maintenance; removal of foreign debris silt, and trash; mulch removal; engineered biofiltration media evaluation; replacement of mulch; disposal of all maintenance refuse items and updating of maintenance records.

END OF SECTION

SECTION 40 05 07.14
SETTLEMENT/SEISMIC PROVISIONS FOR YARD PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies settlement and seismic provisions for buried piping at conveyance connections to the Port Gardner storage facility influent piping as specified.
- B. Provide professional engineering services for a piping settlement coupling system design by the manufacturer's engineer (hereinafter the "Design Professional") as specified herein and related sections.
- C. DEFINITIONS
 - 1. Terminology used in this Section conforms to the following definitions:
 - a. Longitudinal direction: direction parallel to the pipe axis.
 - b. Lateral direction: direction perpendicular to the pipe axis.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 01 60 00 – Materials and Equipment
 - 3. Section 33 05 36 – Fiberglass Reinforced Utility Pipe
 - 4. Section 33 05 31 – Ductile Iron Pipe
 - 5. Section 33 05 33.23 – High Density Polyethylene Pipe Solid Wall

1.03 REFERENCES

- A. 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.
- B. 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
AWWA C200	Steel Water Pipe, 6 In. (150 mm) and Larger
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Type Joints
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C116	Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C150	Thickness Design of Ductile Iron Pipe
AWWA C151	Ductile Iron Pipe, Centrifugally Cast
AWWA C153	Ductile Iron Compact Fittings
AWWA C210	Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
AWWA C213	Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
AWWA M11	Steel Pipe - A Guide for Design and Installation
NSF-61	Drinking Water System Components - Health Effects

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordination required with the design of piping settlement coupling systems, expansion joints, pipe joints, and expansion control as specified.
2. Refer to paragraph 1.08 Settlement Provisions Design for additional coordination requirements.

1.05 SUBMITTALS

A. Procedures: Section 01 33 00.

B. Action Submittals:

1. Settlement provisions system drawings and calculations as specified in paragraph 1.08 Settlement Provisions Design.
2. Settlement accommodating coupling locations and legend as specified in paragraph 3.01.
3. Manufacturer documentation that verifies project requirements relative to:
 - a. Design Pressure
 - b. Movement
 - c. Activation Moment

C. Informational Submittals:

1. The Design Professional's reports and certification of final installation as specified in paragraph 3.03.

D. Closeout Submittals

1. In accordance with Section 01 78 39 Project Record Documents

1.06 QUALITY ASSURANCE

- A. Refer to paragraph 1.08 Settlement Provisions Design for additional quality assurance requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Procedures: Section 01 60 00.

1.08 SETTLEMENT PROVISIONS DESIGN

- A. Design Professional:

1. The settlement provisions/dynamic movement system shall be designed by the Design Professional required by paragraph 1.01.B. Settlement provisions details shall be designed in conjunction with preparation of pipe joint and coupling system required to accommodate settlement and longitudinal displacement due to settlement and liquefaction in the event of a seismic event. Design shall include selection of all adapters, transition couplings, deflection and expansion coupling/joints necessary for pipe type and sizes shown on the drawings at the locations indicated on the drawings. Joints shall provide restraint from pulling apart during settlement or lateral movement from seismic activity.
2. All drawings and work product for the settlement provisions system shall bear the manufacturer's design professional's registration seal certified in the state of Washington and signature. The requirement, however, shall not be construed as relieving the Contractor of responsibility for this portion of the work.

- B. Pipe Joint/Coupling Placement Selection:

1. The Contractor shall select, locate and provide necessary joints and couplings to accommodate settlement due to consolidation of pipe supporting materials and settlement due to potential liquefaction due to seismic activity for piping in accordance with this section. As required by paragraph 1.01.B, this work shall be coordinated with the Design Professional to accommodate the settlement.
2. The Contractor shall review the piping layout in relation to the adjacent structures and connecting piping to design and select the pipe joints and couplings to withstand anticipated settlement at each location as specified.
 - a. Settlement provisions shall be capable of longitudinal movement of the pipe, lateral movement of the pipe, vertical settlement of the pipe, and cyclic movements in these directions.
 - b. One and one-half-inch diameter water pipes and four-inch diameter sewer service pipes outside of buildings do not require provisions for settlement.

PART 2 PRODUCTS

2.01 PERFORMANCE/ DESIGN REQUIREMENTS

- A. Settlement/Seismic restraining coupling joints shall meet the following requirements.
 1. Joints/coupling shall be joined in pairs or series of pairs. Single joints are not permitted.

2. Restraint
 - a. Settlement joints/couplings shall provide restraint to prevent the pipe joints/couplings from pulling apart from settlement or seismic movement.
 - b. The joint shall be flexible self-restraining. Restraint shall be integral with the joint/coupling.
 - c. Secondary or external devices to provide restraint and not permitted.
3. Pressure
 - a. The joints/couplings shall be capable of withstanding the full end thrust load at 50 psi operating pressure and test pressure as specified for the associated conveyance or plant piping.
 - b. Seals shall also be able to perform under vacuum.
4. Movement
 - a. Joints/coupling shall:
 - 1) Handle all in-service dynamic movement (lateral, vertical, axial)
 - 2) Provide full sealing under full in-service movement limits. Secondary sealing systems are not acceptable. In-service fastener re-tightening is not permitted.
 - 3) Transmit bending forces across the joint.
 - b. Movement shall be accommodated by utilizing a pair or series of pairs of self-restraining joints. A single joint is not permitted.
5. Joining
 - a. For HDPE pipe, each differential settlement joint shall be connected to the pipeline by the means of grooved ends for joining to the mating pipe that are compliant with AWWA C606, C200, in accordance with the coupling/joint manufacturer, or other alternative proposed by the manufacturer and approved by the Construction Manager.
 - b. For DI pipe, each differential settlement joint shall provide an access point to the pipeline by the means of flanged or grooved mechanical couplings for joining to the mating pipe that are compliant with AWWA C606, in accordance with the coupling/joint manufacturer. For the EPS discharges, the joints shall be EBAA Iron Flex-Tend.
 - c. For Steel pipe, each differential settlement joint shall provide an access point to the pipeline by the means of grooved ends for joining to the mating pipe that are compliant with AWWA C606, C200, in accordance with the coupling/joint manufacturer.
 - d. Transition Couplings:
 - 1) Transition couplings shall be provided to connect the differential settlement coupling to the pipe.
 - 2) Design and selection shall be specific for the type and size of pipe.
 - a) Mechanical grooved type is permissible for HDPE pipe.
 - b) The means to transition to FRP shall be proposed and designed by the coupling manufacturer, concurred by the FRP pipe manufacturer, and approved by the Construction Manager.

2.02 MANUFACTURERS

- A. Acceptable Settlement joints/couplings
 - 1. Victaulic Style W257B, W257, 257, or 257C, as per pipe type and size,
 - 2. or approved equal.
- B. Acceptable Double Ball Flexible expansion joints
 - 1. FLEX-TEND as manufactured by EBAA Iron, INC. Eastland, TX., U.S.A.
 - 2. or approved equal.
- C. Manufacturer shall provide on-site services during installation including but not limited to:
 - 1. In-person training of coupling and dynamic movement joint installation.
 - 2. Training on-site construction personnel to support installation crew.
 - 3. Presence during receipt and installation of the dynamic movement coupling system to ensure installation procedure is proper and adhere to Quality Assurance processes.

2.03 MATERIALS

- A. Settlement/Seismic restraining coupling joints shall meet the following requirements.
 - 1. Housings:
 - a. Ductile Iron to ASTM A-536, grade 65-45-12.
 - b. Couplings shall be groove and retaining ring style, designed to meet the requirements of AWWA M11 for differential settlement, or approve equal.
 - 2. Seals:
 - a. The joint sealing material must suit the media of the application and be produced by the same manufacturer as the joining and movement devices.
 - b. Have NSF-61 certification on potable water systems.
 - c. Must handle movement and sealing at full operating pressures and temperatures.
 - 3. Fasteners:
 - a. Stainless Steel, meeting the mechanical property requirements of ASTM A193 Grade B8M, Class 2 (316 stainless).
 - 4. Pipe Spools:
 - a. For HDPE pipe - Meet the physical and mechanical requirements of ASTM A-53, API 5L, or AWWA C200.
 - b. For DI pipe - Meet the physical and mechanical properties of AWWA C151/A21.51 centrifugally cast ductile iron pipe and minimum wall thickness of class 53 DIP per AWWA C150/A21.50
 - 5. Forgings/Rings (when applicable):
 - a. Shall be carbon steel, ASTM A105 or equivalent.
 - 6. Coupling Coating and Lining:
 - a. Coat and line couplings in accordance with AWWA C210 liquid epoxy coating systems.

- B. Double-ball Flexible Expansion Joints shall meet the following requirements.
 - 1. Shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
 - 2. Pressure tested prior to shipment to a minimum of 250 psi. Minimum 2:1 safety factor.
 - 3. Shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of 15° and 4-inches minimum expansion. Flange end connections.
 - 4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
 - 5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
 - 6. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be installed on the full length of the joint, including the flanged ends.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide settlement/seismic coupling joints as specified and in accordance with approved design submittals.
- B. Indicate settlement provision locations and components on the piping layout drawings. The drawings shall bear a legend giving settlement information and restraint component selection at each restraint location and shall be sealed and signed by the manufacturer's Design Professional registered in the State of Washington for design of the coupling and transition joints.

3.02 INSTALLATION

- A. Joints and flexible connections shall be installed centered with no angular deflection unless otherwise indicated on the Drawings.
- B. Install end couplings centered on pipe gap if applicable.
- C. Inspect each coupling to ensure that there are no damaged portions. Pay particular attention to the gasket area.
- D. Before installation, thoroughly clean each coupling of any foreign substance which may have collected thereon and install in clean condition.
- E. Conform to manufacturer instructions.
- F. Bolts and studs shall be tightened to secure a uniform gasket compression between the coupling and the body of the pipe with all bolts or studs tightened approximately the same amount.
- G. Ends of piping where couplings are installed shall be smooth and free of defects.

- H. Remove weld splatter and grind smooth.
- I. Grind pipe seam welds flush with pipe wall and smooth.
- J. Wrap entire coupling/joint/adapters with polyethylene encasement meeting ANSI/AWWA C105/A21.5. and install in accordance with manufacturers recommendations. Secure ends of encasement with tie straps and tape ends to pipe with a continuous band of adhesive tape a minimum of 8 inches wide with a minimum of 3-inches fully on the sheeting and a minimum of 3-inches on the pipe on both ends.
- K. Backfill entire coupling/joint/adapters with pea gravel or similar low-friction embedment.

3.03 INSPECTION AND CERTIFICATION

- A. In-person training of coupling and dynamic movement joint installation by the coupling manufacturer shall be provided in advance of, and during, installation to ensure proper handling, installation, and testing of joints.
- B. The Design Professional and manufacturer's representative shall inspect the completed settlement provision system before backfilling and provide written certification that installation complies with manufacturers procedures.

3.04 SETTLEMENT/SEISMIC JOINT SCHEDULE

SETTLEMENT/SEISMIC JOINT SCHEDULE							
Structure JOINT	TYPE	NOMINAL DIAMETER	+/- Y MOVEMENT	PIPE MATERIAL FROM STRUCTURE/Plant Site	YARD PIPE MATERIAL	TRANSITION METHOD FROM STRUCTURE	TRANSITION METHOD TO YARD PIPE
C-2309 STA 40+48.07	W257B	48"	8"	SP – GROOVED END FOR W257B (BY OTHERS)	FRP	STEEL SPOOL	FLANGED FOR FRP
CO02 STAND PIPE	FLEX-TEND (2 REQ'D)	36"	20"	DI	DI	FLANGED	FLANGED

END OF SECTION

SECTION 40 05 57.13

MANUAL ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies manual operators for valves and gates, and operator appurtenances.

1.02 REFERENCES

- A. 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.
- B. 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
AWWA C500	Gate Valves 3 through 48 inch NPS, for Water and Sewage Systems

PART 2 PRODUCTS

2.01 GENERAL

- A. Except as specified in valve and gate specification sections, manual operators shall be as specified herein. Operators shall be mounted on the valve or gate and provided as a unit. Each valve body or operator shall have cast thereon the word "OPEN," an arrow indicating the direction to open, and flow direction arrows.

2.02 OPERATORS

- A. General:
1. Manual operators shall have operating torques less than 80 foot-pounds.
- B. Wrench Nuts:
1. Wrench nuts shall comply with Section 3.15 of AWWA C500. A minimum of two operating keys, but no less than one key per every ten valves, shall be provided for operation of the wrench nut operated valves.

2.03 OPERATOR APPURTENANCES

A. Valve Boxes:

1. Valve boxes shall be cast iron and shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers. Covers shall be hot-dip galvanized.

B. Floor Boxes:

1. Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be bronze bushed. Where the operating nut is below slab, the opening in the bottom of the box shall be sufficient for passage of the operating key.

C. Adjustable Shaft Valve Boxes:

1. Adjustable shaft valve boxes shall be concrete or cast iron Brooks No. 3RT, Christie G5, Empire 7-1/2 valve extension box, or equal. Box covers on water lines shall be impressed with the letter "W." Gas line covers shall be impressed with the letter "G." Sewer line covers shall be impressed with the letter "S."

2.04 PRODUCT DATA

- A. Manufacturer's catalog information and other data confirming conformance to design and material requirements shall be provided in accordance with Section 01 33 00.

PART 3 EXECUTION

3.01 GENERAL

- A. Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.02 OPERATORS

A. General:

1. Valves and gates shall be provided with manual operators, unless specified otherwise. Where possible, manual operators shall be located between 48 inches and 60 inches above the floor or a permanent work platform.

B. Wrench Nuts:

1. Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6 inches of the valve box cover.

3.03 OPERATOR APPURTENANCES

A. Valve Boxes:

1. Valve boxes extending to finished surfaces shall be provided for buried valves.

B. Floor Boxes:

1. Floor boxes shall be provided for wrench operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.

END OF SECTION

SECTION 40 05 60

VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the supply, installation and testing of valves. Materials and performance requirements for valves are specified in Detailed Valve Specifications. Detailed Valve Specifications are provided in Sections 40 05 61.09.
- B. Determining Valve Type:
 - 1. Drawings specify valve types (gate, plug, butterfly, check, globe, knife, etc.) used in each pipeline. Process fluids that will be conveyed in pipelines are identified on the Drawings.
 - 2. Piping system size, materials and classifications, and required valve types are indicated on the Drawings.
 - 3. Provide valves conforming to the provisions of this section and Detailed Valve Specifications

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 40 05 57.13 Manual Actuators

1.03 REFERENCES

- A. 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.
- B. 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
ASME 16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B1.20.1	Pipe Threads, General Purpose
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
ASME B16.5	Pipe Flanges and Flanged Fittings

Reference	Title
ASME B16.34	Valves—Flanged, Threaded, and Welding End
API 607	Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats
ASTM A48	Gray Iron Castings
ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A216/A216M	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A276	Stainless and Heat Resisting Steel Bars and Shapes
ASTM A351	Castings, Austenitic, for Pressure-Containing Parts
ASTM A516	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A536	Ductile Iron Castings
ASTM A571	Austenitic Ductile Iron Castings
ASTM A995/A995M-13	Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM B124	Copper and Copper Alloy Forging Rod, Bar, and Shapes
ASTM B148	Aluminum-Bronze Sand Castings
ASTM C283	Resistance of Porcelain Enameled Utensils to Boiling Acid
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D5162	Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C504	Rubber-Seated Butterfly Valves
AWWA C507	Standard for Ball Valves
AWWA C509	Resilient-Seated Gate Valves
AWWA C508	Swing Check Valves for Waterworks Service, 2 - 24 Inches NPS
AWWA C517	Resilient-Seated Cast Iron Eccentric Plug Valves
AWWA C550	Protective Interior Coatings for Valves and Hydrants
MSS SP-70	Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves
MSS SP-81	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
MSS SP-110	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
NSF 61	Drinking Water System Components - Health Effects
UL 429	Electrically Operated Valves
UL 1002	Electrically Operated Valves for Use in Hazardous Locations, Class I, Groups A, B, C, and D, and Class II, Groups E, F, and G

1.04 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00

2. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from specification requirements. Check-marks (✓) denote full compliance with a paragraph as a whole. Underline deviations and denote with a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. 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 will be sufficient cause for rejection of the entire submittal with no further consideration.
 3. Catalog cuts and/or shop drawings for each type of valve indicating the valve type (Detailed Valve Specification Section Number), materials of construction, dimensions, operating torque, valve end connection configuration, pressure rating, and operating temperature range.
 4. An amended Detailed Valve Specification for all valve types provided for this contract. Indicate with check marks where the valve supplied meets the requirements specified and with written amendments where the product differs from the specification.
 5. Factory Acceptance Test results and/or Certified Statement of Proof-of-Design testing results when specified in Detailed Valve Specifications.
 6. Action Submittal Items listed on Detailed Valve Specifications
- B. Informational Submittals:
1. Affidavits and registration numbers as specified.
 2. Operating and Maintenance data for incorporation in operation and maintenance manual, as specified in Section 01 78 23. Include complete description of operation together with detailed drawings, a complete list of replacement and repair parts, and parts manufacturer's identifying numbers.
 3. Informational Submittal Items listed on Detailed Valve Specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Procedures: Section 01 60 00.
- B. Deliver valves to site in accordance with Section 01 60 00 and using loading methods which do not damage any valve components or coatings.
- C. Tag loose valves as specified in Section 01 60 00, stating size, type, coatings and mating parts shipped loose or separate.
- D. Store on site until ready for incorporation in the work using methods recommended by the manufacturer to prevent damage, undue stresses, or weathering.

1.06 WARRANTY

- A. Procedures: Section 01 78 36 Warranties and Bonds.
- B. Where a warranty duration is specified by the Detailed Valve Specification, provide a special warranty valid for the specified duration.

- C. Where no special warranty requirements are specified in the Detailed Valve Specification, provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 VALVE CONFIGURATION REQUIREMENTS

A. General

1. Provide valves of the same type, size range and service from a single manufacturer.
2. Provide new, unused valves for the work.
3. Provide valve materials free from defects or flaws, with true alignment and bores.
4. Provide valves that open by turning the valve shaft to rotate counterclockwise unless otherwise specified in the Detailed Valve Specification Section.

B. Provide pad-lockable lockout feature on all valves where noted.

C. Manual Operators

1. Provide valves with manual operators as specified in the Detailed Valve Specification, unless specified otherwise in Section 40 05 57.13.
2. For hand wheels, clearly show the direction of opening in raised lettering and symbols.
3. The maximum rim pull on a hand wheel or key handle is not to exceed 65 lb. when one side of the valve is at test pressure and the other side is at atmospheric pressure. Where a shaft mounted hand wheel would require greater force to operate, provide a torque reduction gearbox operator. Unless different operators are scheduled or specified on the Drawings, conform to the following minimum requirements.
4. Provide grease lubricated, worm gear type operators for torque reduction gearbox operators. Provide gear operators with adjustable mechanical stop-limiting devices to prevent over travel of the disc/ball/plug in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Where gearbox operators are intended for direct bury or submergence, seal units with long life lubricant.

D. Valve Stem Extensions, Operating Keys and Wrench Nuts

1. Provide valve stem extensions where additional clearance is required for pipe insulation or where valve operation without the extension is difficult; and in manholes.
2. Where angle valve stem extensions are employed, they will be angle geared. Universal joint types are not permitted.
3. Wrench nuts shall comply with AWWA C500. A minimum of two T-handle operating keys, but no less than one key per every ten valves, shall be provided for operation of wrench nut operated valves.

E. Operator Appurtenances

1. Valve Boxes: Valve boxes shall be cast iron and shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers. Covers shall be hot-dip galvanized. Valve boxes extending to finished surfaces shall be provided for buried valves.

2. Floor Boxes: Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be bronze bushed. Where the operating nut is below slab, the opening in the bottom of the box shall be sufficient for passage of the operating key. Floor boxes shall be provided for wrench operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.
3. Adjustable Shaft Valve Boxes: Adjustable shaft valve boxes shall be concrete or cast iron Brooks No. 3RT, Christie G5, Empire 7-1/2 valve extension box, or equal. Box covers on water lines shall be impressed with the letter "W." Gas line covers shall be impressed with the letter "G."

2.02 VALVE IDENTIFICATION TAGS

- A. Provide valve identification tags for all valves showing the name of the manufacturer, valve model and serial number.
- B. Type 316 stainless steel tags, minimum 2.5-inches x 0.75 inches, with 0.1875 inch numbers and letters. Tags shall be permanently attached to the valve body.

PART 3 EXECUTION

3.01 PREPARATION

- A. The valve and piping arrangement indicated on the Drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in the piping to allow for discrepancies between the valve dimensions shown and those supplied for the Work.
- B. Prior to installation of valves, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that the valve location and orientation provide suitable access to manual operators.
- C. Where conflicts are identified, inform the Construction Manager.

3.02 INSTALLATION

- A. In horizontal pipe runs, other than in locations where space does not permit, install all valves (except for butterfly valves, eccentric plug valves, and trunnion ball valves) with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator below the valve.
- B. When joining valves to pipe or fittings, do not over torque bolts to correct for misalignment.
- C. Support valves in position using temporary supports until valves are fixed in place.
- D. Permanently support valves to prevent transmission of loads to adjacent pipework and/or equipment.

- E. Where valves are installed in plastic pipelines (PVC, CPVC, HDPE, polypropylene etc.) greater than 4-inch diameter, support valves independent of the piping and brace valves against operating loads and torque to prevent transmission of stresses to the adjacent pipework.
- F. Install gate valves in the closed position.
- G. Install valves which are bubble tight in one direction to provide bubble tight seal of flow in normal direction of flow unless otherwise noted or directed by the Construction Manager.
- H. Unless otherwise specified, install single seated valves with the seat downstream. Install valves at tank connections with seat away from tank. Install valves on pump discharge and suction lines with seat end towards the pump.
- I. Install all valves in accordance with the manufacturer's recommendations.
- J. Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tape wrap.
- K. Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6 inches of the valve box cover.

3.03 FIELD QUALITY CONTROL

- A. Perform Field or Site Tests and Inspections per Detailed Valve Specifications.
- B. Pressure test all valves in conjunction with the pipes in which the valves are installed at test pressures specified in the applicable pipe specification.

END OF SECTION

40 05 61.09

GATE VALVE, 14 TO 48 INCH, RESILIENT WEDGE

GENERAL
1. Line Size: 14 through 48 inches 2. Rated Limits: Pressure 250 psi; Temperature 100 °F
VALVE MATERIALS
1. Body: Ductile Iron with epoxy coating interior and exterior 2. Disc: Ductile Iron fully encapsulated with molded rubber per ASTM D429, no exposed iron 3. Disc Trim: Buna N, SBR or Urethane Rubber 4. Stem: Bronze with O-ring seals at all pressure retaining joints
VALVE CONFIGURATION
1. Valve End/Connections: Flanged, ANSI B16.1 Class 125; Mechanical Joint ANSI C111 2. Type of Disc: Vulcanized Resilient Wedge 3. Operator: 2 inch square nut 6 to 12 inches below surface grade; non-rising stem; spur or bevel gear reducer as needed; valve bonnet, riser and box at surface grade per Section 40 05 60
SUBMITTALS
1. Action Submittals: a. Manufacturer's catalog information b. List of valves to be provided 2. Information Submittals: a. O&M manual for review 3. Closeout Submittals: a. Final O&M manual
CANDIDATE MANUFACTURERS
1. Mueller A-2361 2. Clow 2638

END OF SECTION

SECTION 40 05 62.01
PLUG VALVE, AWWA C517 STANDARD PORT

GENERAL
1. Line Size: 3 through 12 inches 2. Rated Limits: Pressure 175 psi; Temperature 125 °F 1. Line Size: 14 through 72 inches 2. Rated Limits: Pressure 150 psi; Temperature 125 °F
VALVE MATERIALS
1. Body: Cast Iron 2. Plug: Cast Iron or Ductile Iron 3. Plug Facing: Neoprene or Buna-N 4. Seatings: Ni or Stainless Steel 5. Packing: Buna V-flex or TFE 6. Bearings: Stainless Steel 7. Grit Excluder: PTFE or Buna-N
VALVE CONFIGURATION
1. Valve End/Connections: ASME B16.1 Class 125# Flange 2. Pattern: One-piece, Standard Port; provide 100% minimum port area of adjacent pipe for valves 4 inches and less, provide 80 to 85% port area of adjacent pipe for valves 6 to 24 inches, provide 75% minimum port area of adjacent pipe for valves 30 inches and larger 3. Reference Standard: AWWA C517 4. Installation: install with shaft in horizontal position, valve seat located upstream 5. Operator: Handwheel, or lever if noted on drawings 6. Special: upper and lower journal bearings shall be replaceable, sleeve-type, corrosion resistant, and permanently lubricated; packing shall be self-adjusting chevron type replaceable without disassembling the valve
SUBMITTALS
1. As required in Section 40 05 60 – Valves. 2. Action Submittals: a. Furnish three certified copies of a report from an independent testing laboratory certifying successful completion of proof-of-design testing conducted in accordance with AWWA C517, Section 5.2. In lieu of testing the valves at an independent testing laboratory, proof-of-design testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory, and all test reports must be certified by the laboratory representative. Proof-of-design testing shall have been performed on not less than three 6-inch diameter valves, with all three test units demonstrating full compliance with the test standards. Failure to satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's model number.
CANDIDATE MANUFACTURERS
1. Val-Matic Cam Centric 2. DeZurik PEC 3. Or Approved Equal

END OF SECTION