Factoria Recycling and Transfer Station

Contract C00678C12

CONTRACT VOLUME 8 of 15

RFP Volume 4 of 7

Request for Proposal
Technical Specifications
Divisions 31 thru 40

June 2014

King County

Department of Natural Resources and Parks
Solid Waste Division

Factoria Recycling and Transfer Station Project

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Request for Proposal

Technical Specifications
Division 31 Thru 40

August, 2013

King County

Department of Natural Resources and Parks
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SECTION 31 10 00
SITE CLEARING

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. This work consists of site clearing, grubbing, protecting trees not subject to removal, stripping of topsoil, and demolition of structures and obstructions found within the limits of the project including work for loading, hauling, and disposing of non-salvageable materials obtained as part of the Contractors site clearing operation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 31 23 00 - Earthwork.
   4. Section 31 25 00 - Soil Erosion and Sediment Control.
   5. Section 32 91 05 - Topsoiling and Finished Grading.

1.02 REFERENCE STANDARDS

A. Comply with the requirements of Section 01 09 05 – Reference Standards and as listed herein. The following is a list of standards referenced in this Section.
   1. City of Bellevue:
      a. Clearing and Grading Development Standards – 2010.

PART 2 – PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 – EXECUTION

3.01 PREPARATION

A. Protect existing trees and other vegetation to remain against damage:
   1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
   2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
   3. Provide temporary protection as required.

B. Repair or replace trees and vegetation damaged by construction operations.
   1. Repair to be performed by a qualified tree surgeon.

2. Remove trees which cannot be repaired and restored to full-growth status.
3. Replace with new trees of minimum 4 IN caliper.

C. Owner will obtain authority for removal and alteration work on adjoining property.

3.02 SITE CLEARING

A. Topsoil Removal:
1. Strip topsoil to depths encountered.
   a. Remove heavy growths of grass before stripping.
   b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
   c. Separate from underlying subsoil or objectionable material.
2. Stockpile topsoil where directed by Project Representative.
   a. Construct storage piles to freely drain surface water.
   b. Seed or cover storage piles to prevent erosion.
3. Do not strip topsoil in wooded areas where no change in grade occurs.
4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.

B. Clearing and Grubbing:
1. Clear from within limits of construction all trees not marked to remain.
   a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
   a. Totally grub under areas to be paved and where structures will be constructed.
   b. Grubbing in lawn areas:
      1) In cut areas, totally grub.
      2) In fill areas, totally grub.

C. Disposal of Waste Materials:
1. Do not burn combustible materials on site.
2. Remove all waste materials from site.
3. Do not bury organic matter on site.

3.03 ACCEPTANCE

A. Upon completion of the site clearing, obtain Project Representative's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

SECTION 31 21 33
TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Excavation, trenching, backfilling and compacting for all underground utilities.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   4. Division 26 - Electrical.
   5. Section 31 23 00 - Earthwork.
   6. Section 31 23 19 – Temporary Dewatering.
   7. Section 31 69 00 – Foundation Subsurface Drain System.
   8. Section 33 05 16 - Precast Concrete Manhole Structures.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
      c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
      d. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
      e. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      f. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   2. City of Bellevue (COB):
      a. Sewer Engineering Standards, January 2012.
      b. Water Engineering Standards, January 2012.

1.03 DEFINITIONS

A. Excavation: All excavation will be defined as unclassified.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
   3. Trench shield (trench box) certification if employed:
      a. Specific to Project conditions.
      b. Project Representative is not responsible to, and will not, review and approve.
   4. Qualifications of testing laboratory for material testing as described in this Section.

C. Quality Assurance Submittals:
   1. Submit sieve analysis reports on all granular materials.
   2. Certification by Professional Structural Engineer, registered in Washington State.
   3. Trench shield (trench box) shall be re-certified if members become distressed.
   4. Submit field quality control test results.

1.05 PROJECT CONDITIONS

A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
   1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.

B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Project Representative to prevent serious interruption of travel.

C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Project Representative and controlling agency.

D. Verify location of existing underground utilities.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Bedding and Backfill Materials for Water and Sewer Utilities:
   1. Per COB Water Engineering Standards January 2012, Section W4-36.
   2. Per COB Sewer Engineering Standards January 2012, Section S4-24.

B. Bedding and Backfill Materials for Storm and Surface Water Utilities:
   1. Per COB Storm and Surface Water Engineering Standards - 2012.

C. Backfill Materials for finger drains per the requirements for Gravel Backfill in Section 31 69 00 – Foundation Subsurface Drain System.

D. Backfill material for Puget Sound Energy (PSE) natural gas service line shall meet PSE specifications.
   1. PSE approved sand bedding and shading material is commonly referred to as “builder’s sand” or “building sand” at supplier locations within the PSE service territory.
   2. The backfill layer above the sand shading shall be soil that is free from construction debris, glass, sharp rocks, frozen clods, and rocks larger than 8 IN DIA.

E. Backfill Material (other):
   1. As approved by Project Representative.
      a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
      b. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content as specified in accordance with ASTM D1557.
   2. Gravel trench backfill materials: In accordance with Gravel Backfill requirements provided in Section 31 69 00 - Foundation Subsurface Drain System.

F. Subgrade Stabilization Materials: Clean (less that 5 percent fines) compacted structural fill in accordance with Section 31 23 00 - Earthwork.

G. Bedding Materials:
   1. Granular bedding materials: In accordance with Gravel Backfill requirements provided in Section 31 69 00 - Foundation Subsurface Drain System.
   2. Flowable fill:
      a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.

b. Material characteristics:

1) The approximate quantities of each component per cubic yard of mixed material shall be as follows:

a) Cement (Type I or II): 50 LBS.

b) Fly ash: 200 LBS.

c) Fine sand: 2,700 LBS.

d) Water: 420 LBS.

e) Air content: 10 percent.

2) Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.

3) Approximate compressive strength should be 85 PSI to 175 PSI.

4) Fine sand shall be an evenly graded material having not less than 95 percent passing the No. 4 sieve and not more than 5 percent passing the No. 200 sieve.

5) Mixing and handling of the material shall be in accordance with Specification Section 03 31 31 – Concrete Mixing, Pacing, Jointing and Curing.

PART 3 – EXECUTION

3.01 GENERAL

A. Remove and dispose of unsuitable materials as directed by Project Representative to site provided by Contractor.

3.02 EXCAVATION

A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Project Representative.

B. Excavation for Appurtenances:
1. 12 IN (minimum) clear distance between outer surface and embankment.
2. See Section 31 23 00 - Earthwork for applicable requirements.
3. See Section 33 05 16 – Precast Concrete Manhole Structures for applicable requirements.

C. Groundwater Dewatering:
1. Refer to Section 31 23 19 – Temporary Dewatering.

D. Trench Excavation:
1. For Water and Sewer Utilities: Per COB Water Engineering Standards January 2012, Section W5-23 and COB Sewer Engineering Standards January 2012, Section S5-26.

a. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.

b. Support existing utility lines where proposed work crosses at a lower elevation.

1) Stabilize excavation to prevent undermining of existing utility.

2. Open trench outside buildings, units, and structures:

a. No more than the distance between two manholes, structures, units, or 300 LF, whichever is less.

b. Field adjust limitations as weather conditions dictate.

3. Trenching within buildings, units, or structures:

a. No more than 100 LF at any one time.

4. Any trench or portion of trench, which is opened and remains idle for seven (7) calendar days, or longer, as determined by the Project Representative, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.

a. Said trench may not be reopened until Project Representative is satisfied that work associated with trench will be prosecuted with dispatch.

5. Observe following trenching criteria:

a. Trench size:

1) Excavate width to accommodate free working space.

2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.

4) Shoring is required for all trench portions greater than 4 FT in depth. Trenches greater than 20 FT in depth require protection systems designed by Professional Engineer

5) Keep trenches free of surface water runoff.

a) Include cost in Bid.

b) No separate payment for surface water runoff pumping will be made.

E. Trenching for Electrical Installations:
1. Observe Paragraph 3.02D.

2. Modify for electrical installations as follows:
    a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
    b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
    c. Do not over excavate trench.
    d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
    e. See Division 26 for additional requirements.

F. Flowable Fill:
1. Flowable fill shall be:
    a. Discharged from a mixer by any means acceptable to the Project Representative into the area to be filled.
    b. Placed in 4 FT maximum lifts to the elevations indicated.
        1) Allow 12 HR set-up time before placing next lift or as approved by the Project Representative.
        2) Contractor shall place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Flowable fill shall not be placed on frozen ground.
3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
4. Conform to appropriate requirements of Specification Section 31 23 00 - Earthwork.
5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DegF and rising.
6. At the time of placement, flowable fill must have a temperature of at least 40 DegF.
7. Mixing and placing shall stop when the air temperature is 38 DegF or less and falling.
8. Each filling stage shall be as continuous an operation as is practicable.
9. Contractor shall prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
10. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of Section 31 23 19 – Temporary Dewatering.

3.03 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. For Water and Sewer Utilities:
   1. Per COB Water Engineering Standards January 2012, Section W5-26 and COB Sewer Engineering Standards January 2012, Section S5-30.

B. Over-Excavation:
   1. Backfill and compact to 90 percent of maximum dry density per ASTM D1557.
   2. Backfill with granular bedding material as option.

C. Rock Excavation:
   1. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
   2. Backfill to grade with suitable earth or granular material.
   3. Form bell holes in trench bottom.

D. Subgrade Stabilization:
   1. Stabilize the subgrade when directed by the Project Representative.
   2. Observe the following requirements when unstable trench bottom materials are encountered.
      a. Notify Project Representative when unstable materials are encountered.
         1) Define by drawing station locations and limits.
      b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
         1) Replace with subgrade stabilization with no additional compensation.

3.04 BACKFILLING METHODS

A. For Water and Sewer Utilities:
   1. Per COB Water Engineering Standards Chapter W5-26 and COB Sewer Engineering Standards Chapter S5-30.

B. Do not backfill until tests to be performed on system show system is in full compliance to specified requirements.

C. Carefully Compacted Backfill:
   1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
   2. Comply with the following:
      a. Place backfill in lifts not exceeding 8 IN (loose thickness).
      b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.

c. Observe specific manufacturer's recommendations regarding backfilling and compaction.

d. Compact each lift to specified requirements.

D. Common Trench Backfill:
1. Perform in accordance with the following:

a. Place backfill in lift thicknesses capable of being compacted to densities specified.

b. Observe specific manufacturer's recommendations regarding backfilling and compaction.

c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

E. Water flushing for consolidation is not permitted.

F. Backfilling for Electrical Installations:
1. Observe Paragraph 3.04.B. or C. or when approved by the Project Representative.

2. Modify for electrical installation as follows:

a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.05 COMPACTION

A. For Water and Sewer Utilities:
1. Per COB Water Engineering Standards Chapter W5-26 and COB Sewer Engineering Standards Chapter S5-30.

B. General:
1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.

2. In no case shall degree of compaction below minimum compactions specified be accepted.

C. Compaction Requirements:
1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.

a. Bedding material:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

b. Carefully compacted backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All applicable areas	Cohesive soils	95 percent of maximum dry density by ASTM D1557
	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

c. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	90 percent of maximum dry density by ASTM D1557
	Cohesionless soils	60 percent of relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded, plant seeded, non-traffic areas	Cohesive soils	85 percent of maximum dry density by ATM D1557
	Cohesionless soils	40 percent of relative density by ASTM D4253 and ASTM D4254

3.06 FIELD QUALITY CONTROL

A. Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section. Testing needs to be performed or overseen by a Professional Engineer licensed in the State of Washington.

B. Testing:
   1. Perform in-place moisture-density tests as directed by the Project Representative.
   2. Perform tests through recognized testing laboratory approved by Project Representative.
   3. Perform additional tests as directed until compaction meets or exceeds requirements.
   4. Assure Project Representative has immediate access for testing of all soils related work.
   5. Ensure excavations are safe for testing personnel.

END OF SECTION

SECTION 31 23 00
EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work described in this Section, regardless of the nature or type of the materials encountered, includes excavating and grading for site grades, building preparation, roadways, driveways, parking areas, excavating below grade, excavating channels and ditches, removing slide material, and disposing of all excavated material. These activities may be performed in making cuts, embankments, slopes, fills, roadways, drainage features, parking areas, completing finished grade, and in completing related Work where shown in the Plans or as designated by the Project Representative.
   2. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Division 02 - Existing Conditions.
   4. Section 07 26 00 - Under Slab Vapor Retarder.
   5. Section 31 10 00 - Site Clearing.
   6. Section 31 23 19 - Temporary Dewatering.
   7. Section 32 90 00 - Landscaping.

C. Related Available Information:
   1. Shannon & Wilson, Factoria Recycling and Transfer Station Geotechnical Report – June 2012.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. T90, Determining the Plastic Limit and Plasticity of Index Soils.
   2. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m)).

c. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

d. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

3. City of Bellevue (COB):

a. Bellevue City Code (BCC).

b. Clearing and Grading Development Standards – 2010.

c. Transportation Department Design Manual - 2011.

d. Utilities Department:

1) Storm and Surface Water Engineering Standards.

2) Sanitary Sewer Engineering Standards.

3) Water Engineering Standards.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

2. Samples:

a. Submit samples and source of fill and backfill materials proposed for use.

b. Submit samples and source of borrow materials proposed for use.

C. Quality Assurance Submittals:
1. Certifications.

2. Test reports: Soils inspection and testing results.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Fill and Backfill: Selected material approved by Project Representative from site excavation (suitable excavated material) or from off site borrow (import material).

B. Suitable Excavated Material: Onsite excavated material approved by the Project Representative that meets the following requirements for structural fill:
1. The soil is free from organics, debris, clay or other deleterious material.

2. The soil has less than 30 percent fines (material passing the No. 200 sieve based on wet-sieving the minus %-IN fraction).
3. The water content of the on-site soil at the time of compaction shall be close to its optimum for compaction as determined by a Modified Proctor Test (ASTM D 1557) performed by the Owners Geotechnical Representative.
4. On-site soils used for backfills that become wet and unstable after placement shall be removed and replaced with suitable excavated material or import material.

C. Excess Cut: Suitable Excavated Material beyond the quantity required for onsite fill. Excess cut will require offsite hauling and disposal by the Contractor.

D. Unsuitable Material: Onsite excavated material that does not meet the requirements of Suitable Excavated Material due to organic content (including peat), high moisture content, instability and pumping during compaction, presence of plastic fines or higher than 30 percent fines content.
1. Revised Geotechnical Report prepared by Shannon & Wilson dated June 11, 2012 is provided as Available Information only in accordance with Section 01 10 00 – Summary of Work.

E. Import Material: Borrow material from off-site as required to make-up soil balance beyond that fulfilled by suitable excavated material that is in compliance with the following requirements:
1. Material shall be granular soil and/or aggregate which is free of deleterious material, plastic fines and excessive fines.
    a. Deleterious material includes wood, organic waste, coal, charcoal, or any other extraneous or objectionable material.
    b. The percent by weight passing the No. 200 sieve does not exceed 15 percent based on wet-sieving the 3/4 IN minus fraction.
    c. During the wet season (October through April) and during wet weather conditions at any time of year the import material shall not contain more than 3 percent fines based on wet-sieving the 3/4 IN minus fraction.
2. The material shall not contain more than 3 percent organic material by weight.
3. Revised Geotechnical Report prepared by Shannon & Wilson dated June 11, 2012 is provided as Available Information only in accordance with Section 01 10 00 – Summary of Work.

F. Structural Fill: Densely compacted Import Material or approved onsite Suitable Excavated Material to be used under pavement, building foundations, slabs, and other structures or backfill against footings or utility vaults.

G. Granular Fill Under Building Floor Slabs-On-Grade: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No. 67, 3/4 IN to No. 4.

H. Granular Fill Under Base Slabs with Pressure Relief Valves:
   1. Drainage material: Conform to ASTM C33, Size No. 67.
   2. Filter material: Conform to ASTM C33 requirements for fine aggregate.

I. Gravel Backfill: Refer to Section 31 69 00 – Foundation Subsurface Drain System.

J. Pre-Load: 1 FT thick surcharge of import or clean fill (less than 5 percent fines) material to be placed in trailer yard area.

K. Vapor Barrier: Refer to Section 07 26 00 – Under Slab Vapor Retarder.

L. Quarry Spalls:
   1. Quarry Spalls shall consist of broken stone or broken concrete rubble and shall be free from segregation, seams, cracks, and other defects.
   2. Quarry Spalls shall meet the grading requirements in Table 1, below.

Table 1
Quarry Spalls Grading Requirements

Sieve Size	Percent Passing by Weight
6 IN Square	100%
3 IN Square	30 – 50%
3/4 IN Square	5 – 10%

M. Crushed Surfacing Base Course: Crushed surfacing base course shall be manufactured from ledge rock, talus, or gravel.
   1. The material shall be non-frost-susceptible and shall be uniform in quality and substantially free from wood, roots, bark, and other deleterious material, and shall meet the quality test requirements in Table 2, below.

Table 3
Crushed Surfacing Base Course Quality Test Requirements

Item	Requirement
Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor – Base Course	25 min.
Degradation Factor – Top Course	15 min.

   2. Crushed surfacing base course shall meet the gradation requirements indicated in Table 3, below.

Table 4
Crushed Surfacing Base Course Gradation Requirements

Sieve Size	Crushed Surfacing Base Course (CSBC) Percent Passing by Weight
1-1/4 IN Square	100 %
1 IN Square	80 – 100%
5/8 IN Square	50 – 80%
U.S. No. 4	25 – 45%
U.S. No. 40	2 – 18%
U.S. No. 200	7 % max.
% Fracture	75 % min.
Sand Equivalent	40 % min.

3. The fracture requirement shall be at least one (1) fractured face and shall apply to the combined aggregate retained on the U.S. No. 4 sieve in accordance with the field operating procedures for AASHTO TP 61.
4. The portion of crushed surfacing retained on a U.S. No. 4 sieve shall not contain more than fifteen-hundredths (0.15) percent wood waste.

2.02 TOLERANCES

A. Finish Grading Tolerance: 0.1 FT plus/minus from required elevations.

PART 3 – EXECUTION

3.01 PREPARATION

A. Correct, adjust and/or repair rough graded areas.
   1. Cut off mounds and ridges.
   2. Fill gullies and depressions.
   3. Perform other necessary repairs.
   4. Bring all sub-grades to specified contours, even and properly compacted.

B. Loosen surface to depth of 2 IN, minimum.

C. Remove all stones and debris over 2 IN in any dimension determined by visual inspection.

3.02 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.

2. Protect and maintain bench marks, monuments or other established reference points and property corners.
    a. If disturbed or destroyed, replace at own expense to full satisfaction of Project Representative and controlling agency.
3. Verify location of utilities.
    a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
    b. Secure and examine local utility records for location data.
    c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
    d. Repair damages to utility items at own expense.
    e. In case of damage, notify Project Representative at once so required protective measures may be taken.
4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
    a. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
    b. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Project Representative to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Any excavated material removed from the construction site and deposited on property within COB limits must be done in compliance with a valid clearing and grading permit. Locations for the mobilization area and stockpiled material must be approved by the Clearing and Grading Inspector at least 24 HRS in advance of any stockpiling.
8. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

B. Salvageable Items: Refer to Section 02 41 00 – Demolition.

C. Dispose of waste materials, legally, off site.
    1. Burning, as a means of waste disposal, is not permitted.

3.03 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. The work is subject to rainy season restrictions per BCC 23.76.093. Clearing and grading activities during rainy season require formal written request to be submitted and approved by the COB Development Services Department prior to work. Request to include augmented Construction Stormwater Pollution Prevention Plan (CSWPPP) including a narrative on erosion potential, construction sequence, and best management practices (BMP's) proposed in accordance with the code section. Approval is on a case by case basis.

C. Excavation and Grading:
   1. Perform as required by the Contract Drawings.
   2. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
      a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
      b. Perform other layout work required.
      c. Replace property corner markers to original location if disturbed or destroyed.
   3. Overexcavation:
      a. Building Foundations:
         1) All exposed subgrades should be evaluated by the project geotechnical engineer after site clearing and grubbing to evaluate if additional overexcavation is required prior to placing structural fill.
      b. Stormwater Detention Vault:
         1) Overexcavation of approximately 2 FT of unsuitable soils from 20 percent of the detention vault subgrade is estimated to be required.
            a) Refer to revised Geotechnical Report prepared by Shannon & Wilson dated June 11, 2012 provided as Available Information only in accordance with Section 01 10 00 – Summary of Work.
         2) Overexcavation shall be backfilled with quarry spalls per this section.
         3) Overexcavation shall be observed by the Project Representative.
   4. Preparation of ground surface for embankments or fills:
      a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
      b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
   5. Protection of finish grade:
      a. During construction, shape and drain embankment and excavations.
      b. Maintain ditches and drains to provide drainage at all times.

c. Protect graded areas against action of elements prior to acceptance of work.

d. Reestablish grade where settlement or erosion occurs.

D. Hauling and Disposal:
1. Contractor is responsible for hauling and disposal of unsuitable material and excess cut and potentially hazardous material encountered.
2. Unsuitable and excess material may be disposed of at Cedar Hills Regional Landfill (CHRLF).
    a. Disposal shall be as per Section 01 10 00 – Summary of Work and Section 01 14 00 – Work Restrictions.
    b. Coordinate with Project Representative at least three (3) days in advance of disposal of materials at CHRLF.
    c. Do not commingle materials being exported from the Project site with materials from another project or site.
3. Unsuitable and excess material may be disposed of at an approved off-site disposal site secured by the Contractor. Material must be disposed of in accordance with state, county, and municipal regulations protecting human health, safety, and the environment.
4. Dispose of potentially hazardous material in accordance with Specification Section 02 31 40 – Removal of Hazardous Materials and Dangerous Waste.

E. Borrow:
1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
2. Include cost of all borrow material in original proposal.
3. Fill material to be approved by Project Representative prior to placement.

F. Construct embankments and fills as required by the Contract Drawings:
1. Construct embankments and fills at locations and to lines of grade indicated.
    a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN.
    a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
    b. Do not place material in layers greater than 8 IN loose thickness.
    c. Place layers horizontally and compact each layer prior to placing additional fill.

3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
    a. Control moisture for each layer necessary to meet requirements of compaction.

3.04 ROUGH GRADE REVIEW

A. See Specification Section 31 10 00 – Site Clearing.

3.05 ROCK EXCAVATION

A. All rock excavation shall be under one classification.
    1. This classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling for its removal and also boulders that exceed 1/2 CY in volume.

B. When rock is encountered, strip free of earth.
    1. Employ an independent surveyor to determine rock quantities before removal operation begins.
    2. In computing the volumetric content of rock excavation for payment, the pay lines shall be taken as follows:
        a. For structures: 3 FT outside the exterior limits of foundations and from rock surface to 6 IN below bottom of foundations.
        b. For piping and utilities: A width 18 IN wider than the outside diameter of the pipe or conduit and from rock surface to 6 IN below bottom exterior surface of the pipe or conduit.
        c. For paving: 2 FT outside the exterior limits of paving and from rock surface to 6 IN below bottom of pavement subbase.

3.06 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.07 FIELD QUALITY CONTROL

A. Do not include in bid price the cost of inspection services indicated herein as being performed by the Project Representative.

B. Moisture density relations to be established by the Project Representative required for all materials to be compacted.

C. Extent of compaction testing will be as necessary to assure compliance with specifications.

D. Give minimum of one (1) Working Day advance notice to Project Representative when ready for compaction or subgrade testing and inspection.

E. Should any compaction density test or subgrade inspection fail to meet specification requirements, perform corrective work as necessary.

F. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

G. Testing Frequency:

Table 5
Testing Frequency Requirements

Material/Location	Test Type	Test Frequency	Notes
Granular Fill, Crushed Surfacing, Quarry Spalls	Gradation	Once/source	Or once/4,000 CY from same source
Embankment	Compaction	Once/10,000 SF per lift	One test per 100 feet for narrow (50 feet or less) strips
Trench Subgrade	Compaction	Once/100 FT	At least one test for shorter trenches
Trench Bedding/Backfill	Compaction	Once/100 FT per every second lift	At least one test per every second lift for shorter trenches
Subgrade for Structures	Compaction	One test every 5,000 square feet per lift	At least one test per lift for smaller structures
Fill/Backfill for Structures	Compaction	One test every 2,500 square feet per lift	Narrow backfill areas behind walls at every 20 lineal feet per every third lift
Subgrade	Compaction	One test every 100 feet	One additional test in poor subgrade areas
Base Course	Compaction	One test every 100 feet per lift	At least one test per lift for shorter roadways
Gravel Borrow	Compaction	One test every 50 feet of wall length per geogrid lift	At least one test per geogrid lift for shorter wall lengths
Preload Material	Compaction	One test every 10,000 square feet per lift	One test per 100 feet for narrow (50 feet or less) strips

3.08 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Project Representative with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Project Representative.

D. Stabilize subgrade with well graded granular materials as directed by Project Representative.

E. Assure by results of testing that compaction densities comply with the following requirements:
   1. Sitework:

Table 6
Compaction Requirements

LOCATION	COMPACTION DENSITY
Under Paved Areas, Sidewalks and Piping:	
Cohesive soils	95 percent per ASTM D1557
Cohesionless soils	75 percent relative density per ASTM D4253 and ASTM D4254
Base Course	98 percent per ASTM D1557
Unpaved Areas:	
Cohesive soils	90 percent of ASTM D1557
Cohesionless soils	60 percent relative density per ASTM D4253 and ASTM D4254
Pre-Load	95 percent of ASTM D1557

   2. Structures:

Table 7
Compaction Requirements

LOCATION	COMPACTION DENSITY
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	95 percent per ASTM D1557
Outside structures next to walls, piers, columns and any other structure exterior member	90 percent per ASTM D1557

   3. Specific areas:

Table 8
Compaction Requirements

LOCATION	COMPACTION DENSITY
Outside structures under equipment support foundations	95 percent per ASTM D1557
Under void	85 percent per ASTM D1557
Granular fill under base slabs with pressure relief valves, and under building floor slabs-on-grade	75 percent relative density per ASTM D4253 and ASTM D4254

   4. Frequency:
      a. Refer to this Specification Paragraph 3.07.

3.09 EXCAVATION, FILLING, AND BACKFILLING

A. General:
   1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction and other areas requiring excavation or fill.
   2. Obtain fill and backfill material necessary to produce grades required.
      a. Materials and source to be approved by Project Representative.
      b. Suitable excavated material approved by Project Representative may also be used for fill and backfill.
   3. In this Specification Section, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
   4. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General:
      a. Do not commence excavation for foundations for structures until Project Representative approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of Specifications.
         3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
         4) Surcharge or mass fill material has been removed from construction area or portions thereof.
      b. Project Representative grants approval to begin excavations.
   2. Dimensions:
      a. Excavate to elevations and dimensions indicated or specified.
      b. Allow additional space as required for construction operations and inspection of foundations.
   3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
      a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Project Representative.

4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
    a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
    b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
    c. Do not carry excavations lower than shown for foundations except as directed by Project Representative.
    d. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.
5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
6. Notify Project Representative as soon as excavation is completed in order that subgrades may be inspected.
    a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Project Representative as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.
    b. Project Representative shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
    c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
    d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Dewatering: See Section 31 23 19 – Temporary Dewatering.

8. Subgrade stabilization:
    a. After clearing and grubbing is performed, the subgrade of all areas to receive new pavement or floor slabs should be proof-rolled to identify any remaining soft or unsuitable soils in the subgrade. The proof-rolling operations should be conducted by a minimum 10-ton static weight, vibratory roller to compact the surface to a dense, unyielding condition.
    a. If unstable, frozen, loose, wet, or soft/spongy soil conditions and/or groundwater seepage are identified by the proof-rolling process, the soils should be overexcavated to 12 IN below final subgrade elevation and replaced with and replaced with clean (less that 5 percent fines) compacted structural fill as directed by the Project Representative.
    b. Provide compaction density of replacement material as stated in this Specification Section.
    c. Loose, wet, or soft materials, when approved by Project Representative, may be stabilized by a compacted working mat of crushed surfacing base course.
    d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
    e. Remove and replace frozen materials as directed by Project Representative.
    f. Method of stabilization shall be performed as directed by Project Representative.
    g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Project Representative.
9. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
    a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
10. Protection of structures:
    a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
    b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
11. Shoring:
    a. Shore, sheet pile, slope, or brace excavations as required to prevent them from collapsing.

b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.

12. Drainage:

a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.

b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.

c. Provide pumping required to keep excavated spaces clear of water during construction.

d. Should any water be encountered in the excavation, notify Project Representative.

e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.

13. Frost protection:

a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.

b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.

c. Protect excavation from frost if placing of concrete or fill is delayed.

d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Project Representative.

e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:

1. General:

a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Project Representative and scarified to a depth of 6 IN and compacted to density specified herein.

b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 percent.

c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Project Representative as being free of undesirable material and compacted to specified density.

2. Obtain approval of fill and backfill material and source from Project Representative prior to placing the material.
3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.
4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 – Under Slab Vapor Retarder and shown on Contract Drawings.
5. Fill and backfill placement:
    a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Project Representative.
    b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
    c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
    d. Use hand operated equipment for filling and backfilling next to walls.
    e. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
    f. Use vibratory equipment to compact granular material; do not use water.
6. Structural fill placement:
    a. Structural fill shall be placed in horizontal, uniform lifts and compacted per this Specification Section 3.08.
    b. Subgrades to receive structural fill should be dense and unyielding and should be evaluated by the geotechnical engineer prior to the placement of fill (see this Specification Section 3.09.B.8).
    c. The thickness of structural fill lifts before compaction should not exceed 10 IN for heavy equipment compactors or 6 IN for hand-operated mechanical compactors. The most appropriate lift thickness should be determined in the field using the Contractor's selected equipment and fill, and verified with in situ soil density testing.
    d. All compacted surfaces should be sloped to drain to prevent water ponding.
    e. Structural fill operations should be observed and evaluated by an experienced geotechnical engineer or technician.
7. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
    a. As required to provide fill material to indicated finished grade.
    b. 5 FT.

c. Distance equal to depth of compacted fill below bottom of foundations.

d. As directed by Project Representative.

D. Pre-Load:

1. Trailer yard area shall be pre-loaded with a 1 FT thick surcharge of additional fill. Pre-load shall be compacted and allowed to settle for up to three months prior to constructing pavement.

2. Pre-load material shall be graded to drain and protected from erosion.

3. Settlement monitoring using monitoring plates shall be set up at the beginning of the fill placement process. Plates should be placed 100 FT apart and should be surveyed by a Licensed Professional Surveyor every week after fill placement for a settlement period of up to 3 months.

4. Contractor to submit settlement monitoring data to Project Representative each week to determine when results indicate that settlement has stopped or slowed significantly. Pavement may be constructed only upon written approval of Project Representative.

5. Upon completion of pre-load period, trailer yard area shall be graded as required to bring to final elevations for placement of pavement subgrade per the Drawings.

E. Filling and Backfilling Outside of Structures:

1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.

2. Provide material as approved by Project Representative for filling and backfilling outside of structures.

3. Fill and backfill placement:

a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Project Representative.

b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.

c. Compact material with equipment of proper type and size to obtain density specified.

d. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.

e. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft.

f. Use vibratory equipment for compacting granular material; do not use water.

4. Backfilling against walls:

    a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.

    b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.

    c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.

    d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

F. Backfilling Outside of Structures Under Piping or Paving:
    1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Specification Section.

    2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.

    3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

G. Backfilling with Quarry Spalls:
    1. Quarry spalls shall be placed as directed by the Project Representative.

    2. Quarry spalls shall be placed in such a manner that all relatively large stones are essentially in contact with each other and voids are filled with the finer materials to provide a well graded compact mass. The finished surface shall be free from irregularities.

    3. Quarry spalls shall be dumped or placed in a manner that will ensure the placed material attains its specified thickness in one operation.

    4. When dumping or placing, care shall be used to avoid damaging the underlying material.

    5. The placement of quarry spalls shall start at the bottom of a slope and work toward the top. Quarry spalls shall not be placed at the top of a slope and allowed to roll down the surface of the geotextile. Material placement in ditches shall be started from the bottom of the ditch, and work toward the edges.

6. Quarry spalls shall not be dropped on geotextile from a height greater than 1 FT, unless approved by the Project Representative. If approved, the Contractor shall provide a cushioning layer of sand on top of geotextile before dumping of quarry spalls. The Contractor shall demonstrate to the satisfaction of the Project Representative that the proposed combination of drop height and sand thickness will prevent puncture or damage to the geotextile. No measurement or separate payment shall be made for a sand cushion layer placed for the purpose of allowing an increased drop height of stones.
7. Geotextile damaged during the placement of quarry spalls shall be repaired at the Contractor's expense.
8. Quarry spalls shall be underlain by Geotextile as per Section 31 25 00 – Soil Erosion and Sediment Control.

END OF SECTION

SECTION 31 23 19
TEMPORARY DEWATERING

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work described in this Section includes designing, furnishing, installing, operating, and maintaining dewatering systems and controls as required to manage water levels and hydrostatic pressure during demolition, excavation, and construction and removal of equipment and infrastructure when no longer needed.
   2. Dewatering systems include, but are not limited to, any pumped wells, wellpoints, pumps, vacuum lines, discharge lines, and other equipment, appurtenances, and related earthwork necessary to install, operate, and maintain these systems.
   3. Shallow aquifer dewatering and reduction of hydrostatic pressures in deeper aquifers may be required to prevent basal instability.
   4. This Section does not specify the control, removal, or disposal of surface water runoff, water generated by construction activities other than dewatering, water seeping through excavation support systems, or permanent (passive) site dewatering.
   5. The Contractor is solely responsible for the proper design, installation, operation, maintenance, performance, failure, or damage resulting from any component of the dewatering system for this Contract.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 31 23 00 – Earthwork.

C. Available Information:
   1. Shannon and Wilson:
      a. Factoria Recycling and Transfer Station Dewatering Report – October 2012.
      b. Factoria Recycling and Transfer Station Geotechnical Report – June 2012.

1.02 REFERENCE STANDARDS

A. City of Bellevue:
   1. Clearing and Grading Development Standards – 2010.
   2. Clearing and Grading Code, Chapter 23.76
   3. Storm and Surface Water Engineering Standards – 2012.

B. Washington Administrative Code (WAC):
   1. 173-160 Minimum Standards for Construction and Maintenance of Wells

C. American Water Works Association (AWWA):
   1. A100 - Standard for Water Wells.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Dewatering Plan, including:
      a. Drawings and description indicating the location and number, location, size, and depth of all deep wells, wellpoints, observation wells, location and dimensions of discharge piping, pumps, discharge points, valves, flow meters, settlement tanks, other dewatering equipment, and complete design data that have been stamped by a licensed Professional Engineer or Hydrogeologist in the State of Washington.
      b. Proposed methods, installation including detail of the dewatering system indicating number and type of equipment and pipelines including capacity(ies), and water discharge locations.
         1) Equipment for utilization in dewatering.
         2) Dewatering system and schedule including an estimate of the time required to dewater the excavation location prior to starting excavation work, and such other information to verify acceptable control and performance.
         3) Relief of hydrostatic head.
         4) Maintaining the excavation in a dewatered and in a hydrostatically stable condition.
         5) Contingency plan if operation of the dewatering system results in drawdown induced settlement in excess of allowable limits or less than necessary for construction purposes.
      c. Capacities of pumps and standby equipment.
      d. Design calculations proving adequacy of system and selected equipment.
      e. Description of primary and standby electrical services.
      f. Detailed description of the dewatering system installation, operation, maintenance, and abandonment procedures.
      g. Projected water level drawdown and elevation in all pumped wells, wellpoints, and observation wells.
      h. Plan view drawing showing the estimated zone of influence and resulting groundwater elevations during dewatering.
      i. Estimated dewatering system discharge flow rates and durations.

j. Monitoring program or plan that provides method and data showing that improved areas and existing facilities are not structurally affected by the dewatering system, and that the receiving systems are not affected by the flows.

k. Water quality and quantity monitoring program and records retention program that meets the requirements of applicable permits.

l. Drawing or description of well decommissioning and site restoration activities.

2. Submit Dewatering Plan within 30 days of the effective date of the Notice to Proceed 1.

C. Quality Assurance Submittals.
1. Qualifications of dewatering system designer and operator.
2. Name and qualifications of analytical laboratory that will analyze samples from pumped wells as required by the City of Bellevue.
3. Calibration documentation of flowmeters.

D. Closeout Submittals:
1. Documentation for all well installations and decommissioning, including:
a. Required notices and/or approvals.
b. Documentation in support of filter grain size determination.
c. A certificate of gravel pack's material quality and gradation.
d. All results of sand content measurements.
2. After decommissioning or abandonment, submit a sketch with site restoration details and restore each well site to match surrounding area including any site improvements made since the well was installed including landscape, pavement, or other to the satisfaction of the Project Representative.

1.04 DEFINITIONS

A. Annular Space (or Annulus): The space between the soil surface of the wall of the drilled hole and the outer surface of the well casing.

B. 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, wellpoints, and sumps.

C. Aquitard: A soil or rock unit of low permeability that stores groundwater and transmits it slowly from one aquifer to another.

D. Artesian: An aquifer bounded above and below by soil or rock layers of distinctly lower permeability than the aquifer itself; the groundwater level in an artesian aquifer rises above the bottom of the overlying confining layer.

E. Confined Aquifer: 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 permeable layers of soil, sediment, or rocks.

F. Depressurization: Reduction of the potentiometric Surface / hydrostatic pressure that exists due to the presence of water within a confined aquifer.

G. Depressurization Well: A 'Pumped Well' or vacuum wellpoint designed to reduce the hydrostatic pressure in a confined aquifer.

H. Dewatering: Removal and lowering of groundwater levels within the subsurface soil profile.

I. Dewatering System: A system of wells, wellpoints, and sumps that will lower the water table and a confined potentiometric surface adequately to permit safe and dry working conditions and excavation subgrade stability.

J. Dewatering Well: See 'Pumped Well'.

K. Energy Dissipation: Methods to dampen the erosive energy of discharging water exiting a pipe onto land or surface water discharge locations.

L. Excavation Drainage: Includes keeping excavations free of surface and seepage water and may be achieved by placement of drainage layer and sump pumping.

M. Filter Pack: Clean, well rounded, smooth, uniform, sand or gravel, which is placed in the Annulus of the well between the borehole wall and the outside surface of the well screen.

N. Flowing Artesian: A well that taps a confined aquifer that has a groundwater level above the ground surface.

O. Formation: An assemblage of earth materials grouped together into a unit that is convenient for description or mapping.

P. Groundwater: Water in a saturated zone or stratum beneath the surface of land or below a surface water body.

Q. Groundwater Control System: A system of pumped wells, wellpoints, and sumps that will lower the water table and a confined potentiometric surface adequately to permit safe and dry working conditions and excavation subgrade stability; monitoring of flow rates from system; measurement of lowering groundwater levels in observation wells.

R. Observation Well: A well designed to measure the depth to groundwater.

S. Open Sump Pumping: Pumping water directly from an excavation subgrade or hole in the ground without a perforated or slotted casing, or a sand or gravel filter pack to prevent the movement of formation material.

T. Perched Groundwater: Water in a stratum beneath the ground surface above the water table.

U. Potentiometric Surface or Level: An imaginary surface connecting points to which water would rise in tightly cased wells from a given point in an aquifer. The water table is a particular potentiometric surface for an unconfined aquifer.

V. 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.

W. Static Water Level: The vertical distance from the ground surface to the water level in a well when the water level is not affected by the withdrawal of groundwater.

X. Subgrade: The soil or rock surface at the bottom of an excavation (typically one to three feet below the pipe invert or bottom slab).

Y. Sump: Shallow hole in the ground adjacent to or in excavation trench with a slotted or perforated casing containing a pump and surrounded by filter pack to prevent the pumping of formation material.

Z. Surface Drainage: Includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.

AA. Target Drawdown: Unconfined groundwater or potentiometric levels 2 FT below subgrade.

BB. Turbidity: The clarity of water expressed as Nephelometric Turbidity Units (NTUs) as measured by a calibrated turbidimeter.

CC. Unconfined Groundwater: Water in an aquifer that has a potentiometric surface that is at atmospheric pressure.

DD. Wellpoint: A short slotted or perforated screen (usually steel or plastic and generally less than 4 IN in diameter and 5 FT long) attached to a 15 to 20 FT long riser pipe and typically jetted, driven or installed in a drilled hole; also 'vacuum wellpoint'.

EE. Wellpoint System: The system that consists of a number of well points placed at close intervals along and attached to a common header and a vacuum wellpoint system pump.

1.05 DESIGN REQUIREMENTS AND AVAILABLE DISCHARGE POINTS

A. Water discharge points shall comply with required permits from the City of Bellevue, other local jurisdictions, State and Federal agencies as appropriate. No water shall be discharged to City of Bellevue sewer system unless permitted by the Contractor. Dewatering discharge flows shall be directed to existing surface water systems near the site.

B. The primary surface water system for discharge of dewatering flow is East Creek Tributary 0263A which is capacity-limited during the rainy season as defined by Bellevue City Code Chapter 23.76. Tributary 0263A consists of Ditch A (along the west site property line and shown on the Contract Drawings) and enters existing CB105 and exits this pipe to become open creek flow in a green space (0236A). Tributary 0263A ends where it joins East Creek at a confluence point further north which then flows west and joins with Richards Creek. Dewatering discharge flows directed to Tributary 0263A shall not exceed 7 CFS (3140 GPM) between May 1st and September 30th (dry season). Comprehensive dewatering flow (temporary and permanent, as applicable) of 2.63 CFS is allowed in the Tributary 0263A between October 1st and April 30th (rainy season).

C. No channel capacity exists in East Creek (0263) upstream of the confluence with Tributary 0263A, and no dewatering flow can be placed in this reach.

D. Alternate locations and limits for dewatering discharge if needed are as follows:
   1. East Creek, below the confluence with East Creek Tributary 0263A. (Contractor to coordinate maximum discharge for approval by City of Bellevue).
   2. Sunset Creek culvert crossing under SE 30th Street, to the west of the site (Contractor to coordinate maximum discharge for approval by City of Bellevue).
   3. Alternate disposal options beyond discharge to surface waters, such as discharge to the sanitary sewer or hauling offsite, may be coordinated by the Contractor for approval by the Project Representative and City of Bellevue.

E. Dewatering flows shall be limited to the receiving capacities of each system. This shall be maintained by any combination of scheduling and sequencing of work to limit dewatering to the allowable release flows to the receiving systems. The Contractor may submit a formal written request to City of Bellevue for approval of larger discharge flows. The Contractor must show the discharge shall not cause a significant adverse impact to downstream receiving waters and downgradient properties and include a sequencing schedule for the work.

F. Dewatering plans will include a work schedule that shows compliance with the project schedule and dewatering restrictions, allowing time to complete all construction activities requiring dewatering within the allowed dewatering period.

G. Limit dewatering efforts to localized areas for work on specific structures or project areas. Phase dewatering approach is assumed for planned construction phases including the following construction activities that will require dewatering:
   1. Phase 1 – Preparation for Phase 2.
   2. Phase 2 – Overexcavation for and construction of stormwater vault, construction of temporary shoring wall.
   3. Phase 3 (including transition phase)– Maintenance of temporary shoring wall. Preparation for Phase 4.
   4. Phase 4 – Excavation of south hillside, construction of soldier pile Wall 4.Dewatering for Wall 4 construction may be required to be conducted in stages to meet discharge limitations.

H. Lower groundwater level to at least 2 FT below base of excavations.

I. Dewatering system including all wells, pumps, piping, and other appurtenances shall not interfere with ongoing transfer station operations. Work in active operating areas may be conducted during off-hours and must be approved by Project Representative in writing with at least 5 days advanced notice.

J. Project Representative shall approve all drawings and data submitted.

K. Dewatering can affect improvements in the work area. Take adequate precautions in the design and implementation of the Dewatering Plan to protect existing facilities and improvements, and avoid damage thereto.

L. Design the dewatering system using accepted and professional methods of design and engineering consistent with the best practice.

M. The dewatering system shall include, but not be limited to, any wells, pumps, and other equipment, appurtenances, and related earthwork necessary to perform the function as described in the Dewatering Report. If alternate dewatering system approach is proposed by Contractor it must be approved by Project Representative.

N. Reduce the hydrostatic pressure in the deep aquifers to prevent basal instability in excavations.

O. Provide suitable storage, settling tanks, filtration devices or discharge outlet structures necessary to remove and maintain settleable solid contents in compliance with permit requirements of the National Pollution Discharge Elimination System (NPDES) permit.

1.06 PERMIT REQUIREMENTS

A. Contractor responsible for meeting all permit conditions including discharge limitations, monitoring, testing, and reporting.

B. Contractor responsible for obtaining all permits.

PART 2 – PRODUCTS

2.01 SCHEDULE A, BASIC DEWATERING SYSTEM

A. The Contractor shall design dewatering systems, and provide bids for the Basic Dewatering System detailed below.

B. Two existing pumped wells, PW-1 and PW-2, shown on Drawing 00V104 and in the Dewatering Report, are available for use at the discretion of the Contractor.

C. Under Schedule A, Basic Dewatering System, for bidding purposes, the Contractor shall provide costs for the design, installation, operation and removal of a dewatering system consisting of 14 large-diameter pumped wells constructed on the site as follows: 6 at 40 FT deep, 2 at 60 FT deep, 3 at 70 FT deep, 2 at 80 FT deep, and 1 at 120 FT deep. Each well shall consist of:

1. Minimum 30 IN DIA borehole drilled with a bucket auger or cable tool.
2. Minimum 12 IN DIA PVC screen and casing.
3. Minimum 400 GPM pump with sufficient head to pump water to discharge point.
4. Fittings for monitoring sand content with a Rossum Sand Tester.
5. Any additional fittings necessary for a properly functioning pumped well.
6. All discharge piping necessary to handle design flow.

7. Fittings for collecting water quality samples at locations required by dewatering discharge permits.

D. For bidding purposes, the Contractor shall provide costs for the design, provision, installation, operation and removal of dewatering systems consisting of 430 FT of vacuum wellpoints with wellpoints spaced a maximum of 8 FT apart.

E. For bidding purposes, the Contractor shall provide and construct 4 2-IN DIA observation wells to monitor groundwater levels during construction and gauge the performance of the dewatering system(s). Wells shall be as follows:
   1. 1 at 120 FT deep.
   2. 3 at 60 FT deep.
   3. See this Specification Section 3.07B for observation well installation requirements.

2.02 SCHEDULE B, SUPPLEMENTAL PUMPED WELLS

A. If observation wells indicate Basic Dewatering System will not achieve target drawdowns, the Project Representative will direct the Contractor to provide an updated Dewatering Plan for approval to augment the Basic Dewatering System with additional pumped wells.

B. Contractor will be compensated for Schedule B, Supplemental Pumped Wells, if required, by identified allowance in accordance with Section 01 21 00 – Allowances.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide, install, operate, maintain, and remove any and all machinery, appliances and equipment necessary to keep excavations free from water during construction.

B. Maintain groundwater levels a minimum of 2 FT below the bottom of all excavations at all times and under all conditions.

C. Dewater 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.

D. At all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outage and flooding, and have available at all times for the continuous and successful operation of the dewatering and monitoring systems. These systems shall not be shut down between shifts, on holidays, or weekends, or during work stoppages, without written permission from the Project Representative.

E. The control of groundwater shall be such that softening of the sides or bottom of excavations, or formation of "quick" conditions or "boils" during excavation shall be prevented. Design and operate dewatering systems to prevent removal of the natural soils.

F. Excavations shall be kept free of water during excavation, construction of structures, installation of pipelines, placement of gravel working base, structure and trench backfill, and the placement and setting of concrete below grade.

G. Control surface runoff so as to prevent entry or collection of water in excavations or in other isolated areas of the site.

H. Employ the services of a contractor who is experienced in the field of dewatering design, installation, operation, and maintenance. Visit the site to determine the existing conditions thereof.

I. Do not use open and cased sumps for excavations deeper than three feet below the static water level.

J. Be solely responsible for proper design, installation, operation, maintenance, and any failure of any component of the dewatering system.

K. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

L. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.

M. Install groundwater observation wells as necessary.

N. Contractor is responsible for submitting Notice of Intent (NOI) to Department of Ecology and submitting the necessary fees at least 72 HRS in advance of any pumped or observation well construction or decommissioning work.

O. Contractor is responsible for filing pumped or observation well report with Ecology within 30 days of completion of construction or decommissioning each pumped well and tagging each pumped or observation well within 30 days of construction.

3.02 DISCHARGE POINTS AND WATER QUALITY

A. Discharge points are per this Specification Section 1.05.

B. All water discharged shall meet the applicable permit requirements.

3.03 ELECTRICAL SUPPLY FOR INSTALLATION OF DEWATERING SYSTEMS

A. Supply the electrical service used for dewatering separate from all other Contractor electrical requirements and dedicated solely to the operation of the dewatering systems.

3.04 DEWATERING SYSTEM PROTECTION

A. Take all reasonable precautions necessary to ensure continuous, successful operation of the system. This includes adequate marking of all well, pump and pipeline locations.

B. Wherever pumped wells, vacuum headers or discharge lines are to be crossed for access and egress, use steel ramps to protect the system from vehicular traffic. All ramps shall be capable of supporting the heaviest equipment on site and shall provide at least 1 FT of clearance between the dewatering system element and the underside of the ramp.

C. Clearly identify with brightly colored or flagged 8 FT high poles on each side of the access point, all vehicular access points across the dewatering system.

D. All ramped pipelines shall be valved on both sides of the ramp. Routings affecting normal site operations, including regular vehicular traffic patterns within, into and out of the site, shall be approved before installation.

E. Routings affecting normal dewatering operations, including regular vehicular traffic patterns within, into, and out of the site, shall be submitted per Section 01 55 00 – Traffic Controls.

3.05 FILTER MATERIAL

A. For pumped wells and wellpoints the filter material shall be clean, rounded, washed select gravel and sand, free from silt, clay and other deleterious material.

B. Filter pack:
   1. Determine the filter pack sizes per industry standards.
   2. The filter pack shall be designed to maximize the flow of water into the wells and minimize the amount of fine grained material removed from the formation.
   3. Provide sufficient filter material for initial filter packing of the well and such additional filter material as the well may take during development.
   4. Provide a certificate of filter pack material quality and gradation prior to having filter delivered to the site.

C. Utilize information from the soils investigations to determine the grain size of the filter pack; however, alter the sizes of filter pack material as necessary in accordance with the grain size distribution of the materials encountered during installation of the dewatering system.

D. Submit documentation in support of the filter grain size determination.

3.06 STANDBY EQUIPMENT

A. Maintain on site sufficient equipment and materials to insure continuous and successful operation of the dewatering, recharge and monitoring systems.

B. Immediate replace materials and equipment that are damaged or cease to operate. Notify the Project Representative of replacements made to the dewatering system.

C. If using electric pumps, provide 100 percent standby electrical generating capacity.

D. Manifold each diesel or electrically-powered centrifugal pump to a diesel pump of equal or greater performance capability.

E. Maintain standby pumps that are fueled and operational at all times.

F. Test daily all standby pumps and generators to insure their immediate availability.

G. The Contractor shall have on site, a backup pump for each type of pump in the dewatering system and sufficient pipe and fittings for any repair. The Contractor shall provide automatic switching system to activate backup generator in the event of failure of the primary generator, and automatically notify the Contractor.

H. Maintain on site a minimum of 60 FT of each size and type of header or discharge pipe used in the system.

I. Maintain on site a sufficient number of valves, tees, elbows, connections, tools, recorder charts and parts or other system hardware to insure immediate repair or modification of any part of the system as necessary.

3.07 MONITORING SYSTEM

A. The locations of existing wells at the Site are shown on the Drawings. Existing wells that will be impacted by construction activities shall be decommissioned in accordance with WAC 173-160 requirements.

B. Observation wells will consist of a minimum 6 IN DIA borehole advanced with a sonic drill (NO ALTERNATIVE WILL BE ACCEPTED) and will be logged by a Washington State Licensed Geologist. The Contractor shall provide plastic tubes and wooden or plastic core boxes for the samples with depths and boring numbers of the cores indicated on the boxes. The Contractor shall complete the observation wells with a 2 IN DIA PVC well screen extending from 5 FT below subgrade to 5 FT above subgrade. Well screens will have 0.010 IN slots surrounded by a 10 x 20 filter sand. The Contractor shall store the soil core in a location identified by the Project Representative and protected from rain, sun and wind.

C. The Contractor shall construct observation wells at least fourteen (14) days prior to excavation that is anticipated to intercept the groundwater level and modify the Dewatering Plan as necessary to reflect conditions indicated by the information obtained in the observation wells. The Contractor shall provide the Project Representative with drilling logs and construction records of the observation wells within 48 HRS of well completion.

D. The Contractor shall verify in writing to the Project Representative that groundwater levels in observation wells are 2 FT below subgrade 48 HRS prior to excavation.

E. The Contractor shall begin water level measurements within 24 HRS of any well completion and development and continue daily measurements until the well is properly abandoned or the Project Representative approves cessation of measurement.

F. The Contractor shall begin water flow measurements within 4 HRS of initiating pumping in any well and continue measurements until the Project Representative approves cessation of measurement. The Contractor shall report to the Project Representative any changes in dewatering discharge flow of 25 percent or more occurring within any 24 HR period within 4 HRS following such a change. The Contractor shall notify the Project Representative anytime a pump fails, or is turned off or on, for a period of more than 4 HRS. Additionally, the Contractor shall note and record when any well(s) or dewatering systems are turned off and back on. The Contractor shall provide water level and flow measurement records to the Project Representative daily in both hardcopy and digital form.

G. The Contractor will remove, replace or shorten the casings of observation wells as the work requires, and at the direction of the Project Representative.

H. The Contractor shall notify the Project Representative of drilling schedule at least one week prior to installation of any observation wells. The Contractor shall provide the Project Representative with driller's logs and formation samples at 5-FT intervals for each pumped well.

I. Monitor operations to verify that the system lowers groundwater piezometric levels at a rate required to maintain a dry excavation resulting in a stable subgrade for performance of subsequent operations. Submit to the Project Representative records of daily observation well measurements indicating groundwater levels are at least 2 FT below proposed excavation subgrade prior to excavation.

J. Ensure that an accurate and continuous record of water level, quality and flow information is maintained. Consistency is an important factor in insuring that water level data is accurate; therefore, assign and make known to the Project Representative specific member(s) of its work force responsible for collecting and reporting the required information.

K. Monitoring wells within excavations:
   1. May be removed and replaced as the work requires.
   2. Mark all monitor wells by an adjacent minimum 6-FT orange pole or flag.

L. Additional observation wells:
   1. Install any additional observation wells deemed necessary by Contractor to adequately monitor groundwater levels.
   2. Number and obtain location coordinates and ground surface elevations for all observation wells.
   3. Measuring points on wells shall be permanently marked and elevations surveyed and tied to project's vertical and horizontal datums.

M. Flowmeters:
   1. Install flowmeters with accuracy greater than 5 percent on all dewatering system discharge pipes.
   2. Where diversions of discharge occur, install additional flowmeters to insure that all water pumped from excavations is metered.
   3. Meters shall show gallons per minute and total flow in gallons passing through the meter.

4. Install all meters to manufacturer's Specifications and submit calibration documentation.

5. Submit daily the location and number of pumped wells or wellpoints in operation, total flow indicated on the flow meters, and the rate of flow at the time of recording.

3.08 FORMATION PROTECTION AND WELL DEVELOPMENT

A. The Contractor shall construct, operate, and maintain the dewatering systems such that the fine fraction of the foundation soils will not be removed upon pumping.

B. The Contractor shall develop all wells to remove fines resulting from drilling and construction and to increase the yield and hydraulic connection with the aquifer. The Contractor shall discharge all development water to the sediment settling tanks or settling pond prior to discharge. The Contractor shall not discharge any development water directly to the ground surface or surface water body.

C. In the event the Contractor's wells do not achieve the target drawdown level of 2 FT below subgrade and the Owner's Licensed Hydrogeologist considers the wells insufficiently developed to achieve maximum drawdown, the Project Representative may direct the Contractor to conduct additional development at the Contractor's expense.
   1. If the redevelopment procedures fail to increase the yield of the well by at least 25 percent, the Owner shall reimburse the Contractor for the development costs. Contractor shall propose a plan for approval by the Owner's Licensed Hydrogeologist for replacement of the poorly performing well(s).

D. The Contractor shall develop individual pumped wells until the sand/silt content of the discharge water during surging is less than 20 parts per million (ppm) as determined by a centrifugal separating meter such as a Rossum Sand Tester (Journal AWWA, 46:123, February 1954).

E. The Contractor shall monitor discharge from all parts of the system to ensure that the sand/silt content of the discharge water does not exceed 20 ppm as determined by a Rossum Sand Tester. The Contractor shall provide all of the equipment and fittings for monitoring sand content. The Contractor shall monitor sand/silt content daily for one week after installing and developing any individual pumped well and the entire system weekly thereafter. The Contractor shall take sand/silt content measurements in the presence of the Project Representative. The Contractor shall notify the Project Representative of the time of measurement and provide 24 HR notice of planned measurements.

F. The Contractor shall replace any pumped well that produces more than 20 ppm sand/silt at the Contractor's own cost unless otherwise authorized by the Owner's Licensed Hydrogeologist.

3.09 DAMAGES

A. Repair any damage to work in place, existing structures and features, other contractor's equipment, and the excavation, including damage to the sides and bottom due to heave and removal of material and pumping out of the excavated area, that may result from negligence, inadequate or improper dewatering system installation, maintenance and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.

3.10 MAINTAINING EXCAVATION IN DEWATERED CONDITION

A. Maintain the dewatering systems in operation at all times.

B. At all times provide personnel skilled in the operation, maintenance, and replacement of system components; standby and spare equipment of the same capacity and quantity; and any other work required to maintain the systems.

C. Dewatering shall be a continuous operation and interruptions due to outages or any other reason will not be permitted.

D. Be responsible for all damages to the work in the excavation area and for damages and fines to any other areas caused by the failure to maintain and operate the dewatering system in proper operational order.

E. Dewater sufficiently to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.

3.11 AVAILABLE DATA

A. Geotechnical Data Report and Dewatering Report available for reference. These reports are provided as Available Information only in accordance with Section 01 10 00 – Summary of Work.

B. Use of available information in no way relieves the Contractor from its responsibility for design, installation, and operation of a properly functioning dewatering system. Perform all testing as required.

3.12 SYSTEM REMOVAL

A. Decommissioning and Abandonment:
   1. Decommission or abandon, as appropriate, all pumped wells and those observation wells that are within the limits of required construction activities per WAC Chapter 173-160 unless directed otherwise in writing by the Project Representative.
   2. Dispose of all dewatering pumps, pipes and other assorted system hardware.
   3. Employ the services of a State of Washington licensed water well Contractor for the well decommissioning or abandonment.
   4. During decommissioning or abandonment, do not interfere with site operations.

5. After decommissioning or abandonment, submit a sketch with site restoration details and restore each well site to match surrounding area including any site improvements made since the well was installed including landscape, pavement or other to the satisfaction of the Project Representative.
6. When complete, submit evidence of well decommissioning or abandonment including completed observation and pumping logs through closure.

END OF SECTION

SECTION 31 25 00
SOIL EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies construction and maintaining all construction stormwater pollution prevention features. The features or measures are for temporary sediment and erosion control during construction activities.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 01 33 00 – Submittal Procedures.
   4. Section 31 23 00 – Earthwork.
   5. Section 32 90 00 – Landscaping.
   6. Section 33 40 00 – Storm Drainage Utilities.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. Erosion control standards: "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas" by the United Sates Department of Agriculture (USDA), Soil Conservation Service, College Park, Maryland.
   2. ASTM International (ASTM):
      a. D 882-12: Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
      b. D 1004-09: Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
      c. D 1388-08(2012): Standard Test Method for Stiffness of Fabrics.
      d. D 1777-96(2011)e1: Standard Test Method for Thickness of Textile Materials.
      e. D 3776-09ae2: Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
      f. D 4355-07: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and heat in a Xenon Arc Type Apparatus.
      g. D 4397-10: Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
      h. D 4491-99a(2004)e1: Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

i. D 4533-04: Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

j. D 4632-08: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

k. D 4751-04: Standard Test Method for Determining Apparent Opening Size of a Geotextile.

l. D4992-07: Standard Practice for Evaluation of Rock to be Used for Erosion Control.

m. D 5519-07: Standard Test Method for Particle Size Analysis of Natural and Man-Made Riprap Materials.

n. D 5035 - 06(2008)e1: Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method).

o. D 6092-97(2008): Standard Practice for Specifying Standard Sizes of Stone for Erosion Control.

p. D 6241 - 04: Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

q. D 6475 - 06: Standard Test Method for Measuring Mass Per Unit Area of Erosion Control Blankets.

r. D 6818-02: Standard Test Method for Ultimate Tensile Properties of Turf Reinforcement Mats.

s. E 1745-11: Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

B. Comply with all applicable requirements of local, state, and federal agencies including:
   1. City of Bellevue (COB):
      a. City of Bellevue Municipal Code.
      b. City of Bellevue Utilities Department Storm and Surface Water Engineering Standards, January 2012.
      c. City of Bellevue Clearing & Grading Development Standards and Details (City Standards).
   2. King County Surface Water Design Manual. King County, Washington. 2009.
   3. State of Washington:
      a. State of Washington Department of Agriculture “Rules for Seed Certification”, latest edition.
      b. Washington Administrative Code (WAC): WAC-173A-201A, Water Quality Standards for Surface Waters of the State of Washington.
      c. Washington State Department of Ecology (Ecology). Construction Stormwater General Permit.

d. Ecology: Stormwater Management Manual for Western Washington, 2005.

4. Do not allow activities which lead to violations of local and State Water Quality Standards for stormwater discharge and local agency discharge permits if discharge is placed in sanitary sewer systems.

1.03 DEFINITIONS AND ACRONYMS

A. Best Management Practices (BMPs): BMPs are schedules of activities, prohibition of practices, maintenance procedures and other management practices. They include temporary or permanent structural and non-structural devices. BMPs, when used alone or in combination, minimize erosion and contain sediment within the project site, and prevent discharge of pollutants to water bodies and wetlands. Pollutant is defined in 40 CFR 122.2 (a partial listing of this definition includes solid waste, garbage, chemical wastes, dredged spoil, rock, and sand).

B. CESCL: Certified Erosion and Sediment Control Lead.

C. CESCP: Contractor's Erosion and Sediment Control Plan.

D. CHRLF: Cedar Hills Regional Landfill.

E. Clean Surface Water: Refer to Section 01 50 00 – Temporary Facilities and Controls.

F. City or COB: City of Bellevue.

G. Construction Runoff: That portion of the water from or flowing through areas disturbed by construction that is not Contaminated Surface and Ground Water.

H. Contaminated Sediment: Refer to Section 01 50 00 – Temporary Facilities and Controls.

I. Contaminated Surface and Ground Water: Refer to Section 01 50 00 – Temporary Facilities and Controls.

J. CPESC: Certified Professional in Erosion and Sediment Control.

K. Sediment Laden Surface Water: Refer to Section 01 50 00 – Temporary Facilities and Controls.

L. SCTP: Stormwater Chemical Treatment Plan.

M. CSWPPP: Construction Stormwater Pollution Prevention Plan.

N. Wastewater: Refer to Section 01 50 00 – Temporary Facilities and Controls.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Division 00 – General Terms and Conditions, Article 4.4 – Submittals, and Section 01 33 00 - Submittal Procedures.

B. LEED® Documentation Submittals: SS Prerequisite 1: Construction Activity Pollution Prevention Form.

C. Approval Submittals:
   1. Construction Stormwater Pollution Prevention Plan (CSWPPP), and updates as required, in compliance with City of Bellevue (COB) Standards and Ecology Standards, whichever is more stringent.
   2. Contractor's Erosion and Sediment Control Plan (CESCP) and all updates as required, in compliance with COB Standards.
   3. All submittals required to comply with the COB Standards for erosion and sediment control. Specifically, the CESCP shall be prepared to fulfill the requirements of a project-specific CSWPPP (as defined by the project's Construction Stormwater General Permit) and complying with a Construction Stormwater Pollution Prevention Plan as defined in Section 23.76.035 of the COB clearing and grading code.
   4. Construction Water Quality Monitoring Plan.
   5. Maintenance Plan for Owner's Tire Wash.

D. Quality Assurance Submittals:
   1. Registration of Professional Engineer who prepared and updates the CESCP.

1.05 QUALITY ASSURANCE

A. Comply with the requirements of this Section and any other applicable federal, state, and Owner permits, licenses, and authorizations including:
   1. Bellevue Municipal Code Chapter 24.06 – Stormwater Management.
   2. Bellevue Municipal Code Chapter 23.76 – Clearing and Grading.
   3. City of Bellevue Utilities Department Storm and Surface Water Engineering Standards.
   4. City of Bellevue Clearing & Grading Development Standards and Details.
   5. Chapter 2 and Appendix D of the 2009 King County Surface Water Design Manual.
   6. Ecology Construction Stormwater General Permit.
   7. Washington Administrative Code (WAC).

B. The Contractor shall be responsible for implementing the CESCP and for fulfilling the objectives stated in the City Standards and the Construction Stormwater General Permit issued by Ecology.

C. All Contractor changes to the temporary and/or permanent erosion and sediment control features shall be reviewed by the Project Representative prior to implementation, and must thereafter be reflected in the CESCP used for compliance on-site.

D. Substantial penalties may be levied by Ecology for failure by the Owner to implement the provision of Ecology Construction Stormwater General Permit.
   1. Fines up to $10,000.00 per day can be levied for infractions.
   2. Any such fines or penalties incurred by the Owner, as permitted, which are due to the actions or lack thereof by the Contractor, shall be deducted from the Contract payments.
   3. Any deductions from Contract payments will be made at the time of the next progress payment.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer requirements and City Standards.

B. All chemicals shall be stored and handled in accordance with manufacturer's recommendations, relevant material safety data sheets and requirements of Section 01 35 00 - Health and Safety.

C. Storage of chemicals used for erosion control or water treatment shall be provided within lockable covered containers unless authorized otherwise by the Project Representative.
   1. These chemicals include but are not limited to: Tire wash chemicals, polyacrylamide, coagulants for enhancing settlement, CO_2 for pH control, and soil stabilization chemicals.

1.07 SEQUENCING AND SCHEDULING

A. Submit a signed CESCP prior to commencement of work.

B. Construct all signed CESCP plan measures prior to commencing any work.

C. Provide signed CESCP update documents as required to maintain compliance at all times.

D. Refer to Drawing 00C101 for overall construction phasing. Develop CESCP according to approved construction phasing used.

E. Project is subject to rainy season restrictions per Bellevue City Code 23.76.093. Clearing during rainy season requires formal written request to be submitted and approved by the Development Services Department prior to work. Request to include an augmented CSWPPP including a narrative on erosion potential, construction sequence and BMPs proposed in accordance with the code section. Approval is on a case-by-case basis.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Comply with all City Standards for materials and products.

B. Orange Safety Fence:
   1. Fence: Fence material shall be Tenax Beacon Safety fence or approved equal.
   2. Posts: 2 IN x 2 IN wood posts, standard or better, or metal fence posts.

C. Stabilized Construction Entrance:
   1. Geotextile for shall meet the properties in Table 1, below.

Table1. Stabilized Construction Entrance Geotextile Property Requirements

Geotextile Property	ASTM Test Method	Geotextile Property Requirements			
		Separation		Soil Stabilization	
		Woven	Nonwoven	Woven	Nonwoven
Apparent Opening Size (AOS)	D 4751-04	U.S. No. 30 max.		U.S. No. 40 max.	
Water Permittivity	D 4491-99a(2004)e1	0.02 sec^2 min.		0.10 sec^2 min	
Grab Tensile Strength, in machine and x-machine direction	D 4632-08	250 lb min.	160 lb min.	315 lb min.	200 lb min.
Grab Failure Strain, in machine and x-machine direction	D 4632-08	< 50%	≥ 50%	< 50%	≥ 50%
Seam Breaking Strength	D 4632-08	220 lb min.	140 lb min.	270 lb min.	180 lb min.
Puncture Resistance	D 6241-04	495 lb min.	310 lb min.	620 lb min.	430 lb min.
Tear Strength, in machine and x-machine direction	D 4533-04	80 lb min.	50 lb min.	112 lb min.	79 lb min.
Ultraviolet (UV) Radiation Stability	D 4355-07	50% strength retained min., after 500 hours in xenon arc device			

   2. Bedding shall consist of crushed surfacing base course as specified in Section 31 23 00 – Earthwork.
   3. Top course shall consist of Rip Rap as specified in Section 31 37 00 – Stone Revetment.

D. Temporary Tire Wash:
   1. Operate and maintain the tire wash system for construction equipment, including providing temporary power and makeup water and removal of collected sludge. See Appendix C for information on construction tire wash.
      a. Contractor shall inspect and notify the Project Representative of any deficiencies in the condition or function of the temporary tire wash equipment. Submit Contractor's letter of acceptance to Project Represenative – provided tire wash or written notice of deficiencies prior to issuance of the Second Notice to Proceed.

b. The temporary tire wash shall be maintained in accordance with the operation and maintenance manual furnished by the Manufacturer.

1) At the completion of construction under this Contract, Contractor, manufacturer's representative, and the Project Representative will inspect the temporary tire wash and verify that it is in good working condition. Contractor shall pay for all services of manufacturer's representative.

2) Any repair or service required shall be made by the Contractor as a condition of Substantial Completion.

2. The temporary tire wash shall be relocated by Contractor as needed for traffic flow needs and site phasing requirements to facilitate progress of the Work.

a. The temporary tire wash system shall be reassembled, operated, and maintained as it was in the original location including providing temporary electrical power, makeup water and sludge removal.

E. Erosion Control Matting:

1. Erosion control matting shall consist of a 100 percent coconut fiber matrix covered on the top and bottom with 100 percent biodegradable woven, natural, organic fiber netting.

2. The blanket shall be sewn together on 1.50 IN centers with biodegradable material.

3. The mass per unit area of the matting shall be at least 8 OZ/SQ YD (ASTM D 6475-06).

4. The minimum tensile strength in the machine direction shall be 100 LB/FT based on the minimum average roll value (ASTM D 5035-06(2008)e1/ECTC).

5. The coconut fiber matting (coir) may be obtained from North American Green, 14649 Highway 41 North, Evansville, IN 47725, phone (800) 772-2040 or an Approved Equal.

6. Staples shall be used to secure the coconut fiber matting.

a. Staples shall be a minimum of 6 IN long biodegradable staples provided by the manufacturer, or 8 IN long wire staples. All staples shall have a U-shaped top.

b. Each overlap shall have a staple placed on both sides approximately 1/2 IN from the top or edge to secure matting.

F. Erosion Control Blanket:

1. Erosion control blanket shall consist of a 100 percent certified weed free straw matrix stitched on two inch centers with a biodegradable jute/scrim net.

2. Minimum roll width shall be 8 FT.

3. Erosion control blanket shall have properties meeting the values shown in Table 2.

Table 2. Erosion Control Blanket Required Properties

Tested Property	Test Method	Value
Tensile Strength (MD) x (TD)	ASTM D6818-02	9.0 x 6.3 LB/IN
Elongation (MD) x (TD)	ASTM D6818-02	20 x 20 percent
Mass Per Unit Area	ASTM D6818-02	8.0 OZ/YD^2
Thickness	ASTM D6818-02	0.28 IN
Light Penetration	ASTM D6818-02	22 percent open
Water Absorption	ASTM D1117-96(2011)e1	450 percent

4. Netting shall meet the following Specifications:

Top Net Type	Biodegradable, Jute Scrim Leno Weave
Top Net Opening Dimensions	0.5 x 1.0 IN

5. Install per COB Clearing and Grading Detail BMP C122.

G. Polyacrylamide (PAM) for Erosion Control:
   1. PAM products shall meet ANSI/NSF Standard 60 for drinking water treatment with an acrylamide (AMD) content not to exceed 0.05 percent.
   2. PAM shall be anionic and shall be linear, and not cross-linked. The minimum average molecular weight shall be greater than 5 Mg/mole.
   3. The product shall contain at least 80 percent active ingredients and have a moisture content not exceeding 10 percent by weight.
   4. Purchase drinking water grade PAM from reputable agricultural and drinking water chemical suppliers.
   5. Manufacturers:
      a. Applied Polymer Systems, Inc. – Woodstock, GA.
      b. Agrivestment, Ltd. – Tacoma, WA.
      c. Or Approved Equal.

H. Hydroseed and Mulch for Erosion Control:
   1. Grass seed for erosion control shall conform to the standards for "Certified" grade seed or better as outlined by the State of Washington Department of Agriculture "Rules for Seed Certification", latest edition. Seeds shall be certified "Weed Free", indicating there is no noxious or nuisance weed in the seed.

2. Seed of the following composition, proportion, and quality shall be applied at a rate of at least 80 LBS/ACRE on areas requiring seeding and mulching for erosion control:

Kind and Variety of Seed in Mixture	% By Weight	% Pure Seed	Minimum % Germination
Colonial Bentgrass (Agrotis tenuis)	10	9.80 (min)	85
Red Fescue (Festuca rubra)	40	39.20 (min)	80
Perennial Rye (Lolium perenne)	40	39.20 (min)	90
White Dutch Clover (Trifolium repens) (pre-inoculated)	10	9.80 (min)	85
Inert and Other	-	2.50 (max)	-
Total	-	100	-

3. Sufficient quantities of fertilizer shall be applied to supply the following amounts of nutrients to areas of erosion control grass seeding:
   a. Total Nitrogen as N – 135 LBS/ACRE.
   b. Available Phosphoric Acid as P2O5 – 60 LBS/ACRE.
   c. Soluble Potash as K2O – 60 LBS/ACRE.
4. At least 90 LBS of nitrogen applied per acre shall be derived from isobutylidene diurea (IBDU). IBDU shall be supplied in a coarse particle size ranging from 0.7 MM to 2.5 MM in diameter.
5. Fertilizer shall be standard commercial grade of organic or inorganic fertilizer. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients, and manufacturer's guaranteed statement of analysis clearly marked, all in accordance with State and Federal laws.
6. Mulch for hydroseeding shall be wood cellulose fiber or straw mulch.

I. Wood Cellulose Fiber Mulch:
   1. Fiber shall be produced from natural or recycled (pulp) fiber. The fibers shall not contain any rock, metal, or plastic. It shall be treated with a green dye non toxic to plants and animals to facilitate inspection after placement of material. When hydraulically sprayed on the ground, the material shall allow for the absorption and percolation of moisture.
   2. A letter of certification shall be provided during the submittal process which certifies that the product contains less than 250 parts per million (PPM) boron, and shall be otherwise non-toxic to plants and animals. The moisture content shall be no more than 15 percent as determined by oven dried weight.

J. Straw Mulch:
   1. Straw mulch shall be in an air-dried condition, free of noxious weeds, seeds, and other materials detrimental to plant life.
   2. Hay is not acceptable.

3. Straw mulch should be suitable for spreading with mulch blower equipment.

K. Plastic Sheeting:
   1. Plastic sheeting shall be minimum 6-mil thick, clear polyethylene sheeting and meet the requirements of the ASTM D 4397-10.
   2. Plastic sheeting shall be UV-stabilized.
   3. Plastic sheeting used for long-term soil cover (greater than one month) shall be minimum 8 mil, scrim reinforced low density polyethylene laminated film with polyester string reinforcement meeting ASTM E1745-11 Class C.
      a. Acceptable products:
         1) Tuff-Scrim Poly TS8 Americover, 2067 Wineridge Pl., #F, Escondido, CA 92029, phone (800) 747-6095.
         2) Dura-Skrim.
         3) Or Approved Equal.

L. Temporary Silt Fence:
   1. Temporary Silt Fence shall be in accordance with COB Clearing and Grading Standard Detail, BMP C233: Silt Fence.

M. Check Dams:
   1. Check dams shall be in accordance with COB Clearing and Grading Standard (Appendix A2) BMP C207: Check Dams.

N. Wattles:
   1. Wattles shall consist of cylinders of biodegradable plant material such as straw, coir, compost, or wood shavings encased in a biodegradable or photodegradable netting.
   2. Wattles shall be at least 5 IN DIA.
   3. Encasing material shall be clean, evenly woven, and free of encrusted concrete or other contaminating materials.
   4. Encasing material shall be free from cuts, tears, or weak places and shall have an installed lifespan of greater than six months.

O. Compost Socks:
   1. Compost socks shall be cylinders of compost encased in a biodegradable netting.
   2. Compost products shall be the result of the biological degradation and transformation of organic materials under controlled conditions designed to promote aerobic decomposition. Compost shall be mature with regard to its suitability for serving as a soil amendment or an erosion control BMP.
   3. The compost shall have a moisture content that has no visible free water or dust produced when handling the material.

4. Compost for compost socks shall be tested in accordance with U.S. Composting Council Testing Methods for the Examination of Compost and Composting (TMECC 02.02-B, “Sample sieving for Aggregate Size Classification”).
5. Compost for compost socks shall meet the following gradation:

Sieve Size	Minimum Percent Passing	Maximum Percent Passing
3 IN	100	100
1 IN	90	100
3/4 IN	70	100
1/4 IN	40	60

P. Catch Basin Inserts (Filters):
1. Catch basin inserts shall conform to COB Clearing and Grading Standard Detail, C220: Storm Drain Inlet protection.
2. Catch basin inserts shall be prefabricated units specifically designed for inlet protection and shall remain securely attached to the drainage structure when fully loaded with wet sediment and debris.
3. Acceptable catch basin inserts:
   a. Dandy-Bag by Ten Cate (Mirafi), Pendergrass, GA.
   b. StreamGuard by Bowhead Mfg, Seattle, WA.
   c. Gullywasher Filtersacks by Aqua Treatment Systems, Kent, WA.
   d. Exert or Exert II by Seacor Environmental Products LLC, Seattle, WA.
   e. Storm Sentinel 1341 by Enpac Corp., Auburn, WA.
   f. Or Approved Equal.

Q. Portable Storage Tanks:
1. Portable storage tanks shall be provided by:
   a. Baker Corp (branch office in Woodinville, Washington).
   b. Rain for Rent (branch office in Arlington, Washington).
   c. Or Approved Equal.

R. Temporary Conveyances:
1. Pipe and fittings for temporary storm drain shall meet the requirements of Section 33 40 00 – Storm Drainage Utilities unless approved otherwise by the Project Representative.

S. Sod for Drainage Ditches:
1. Prior to installation, sod shall be free of weeds and grass shall be of a uniform height (approximately 1 IN).

2. Sod shall be field-grown one calendar year or longer and have a well-developed root structure for strength.
3. The sod shall have been cut with a minimum of 1 IN of soil adhering.

T. Temporary Curbs:
1. Temporary extruded asphalt curb shall be installed in accordance with the Drawings.
2. Temporary extruded curb shall only be placed on pavement.
3. Temporary curbs, other than extruded curbs, may consist of asphalt, concrete, sand bags, compost socks, or geotextile/plastic encased berms of soil, sand, or gravel or as approved by the Project Representative.
4. Temporary curbs shall be at least 4 IN in height.

U. Temporary Plug Valves:
1. Temporary plug valves used for CESCP shall be selected for the anticipated head conditions and duration of the project.

2.02 TEMPORARY SURFACE WATER STORAGE FACILITIES

A. The sizing criteria for the temporary surface water storage facilities shall comply with the City Standards.
1. The required storage volume shall be not less than the runoff volume generated by the 10 year 24 HR storm event for the Project Site.
a. The required storage volume shall be adjusted as necessary to account for changes in area and surface conditions on the Project Site as the Work progresses.
b. The required storage volume may take into account the discharge rate from the water quality treatment system to the public storm drain system in SE 30th Street.
2. The Contractor is responsible for providing any additional storage to the new detention vault that is required to meet project requirements for water quality and release rates to the public storm drainage system in SE 30th Street.

B. The temporary surface water storage facilities shall include all the conveyances, piping, valves, connections, pumps, tanks, ponds, power supply, and controls required for the working system.
1. At a minimum, ponds shall meet the requirements for BMP C241 – Temporary Sediment Ponds.

C. Liners for Temporary Storage Ponds:
1. Liners for temporary storage ponds and pre-treatment cells shall meet the requirements of PVC Geomembrane for pond lining in the City of Bellevue Storm and Surface Water Engineering Standards.

D. All permanent facilities and conveyances that are used for management of Construction Runoff and that have collected debris or sediment shall be cleaned and restored to good working order prior to completion of work.

2.03 WATER QUALITY TREATMENT SYSTEM

A. If Contractor designed water quality treatment system is utilized it shall be designed and operated to treat turbidity and pH of Sediment Laden Surface Water.

B. Water leaving the system shall meet water quality standards of the Project's Construction Stormwater General Permit.

C. The system shall meet the following minimum requirements:
   1. Provides treatment of Sediment Laden Surface Water to allow direct discharge of Clean Surface Water to the public storm drain.
   2. Provides for recirculation of water and additional treatment until water meets discharge standards for turbidity and pH.
      a. The system shall include automatic sensors and controls that test water quality and recirculates water back to system for additional treatment if necessary.
      b. A visual and audible alarm shall be installed to warn system operator if water requires recirculation.

D. Release rates from the water quality treatment system shall be managed such that overall releases to the public storm drain do not exceed the flow rates.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General:
   1. Comply with City Standards.
   2. During the construction period, do not disturb areas beyond the flagged construction limits.
   3. Maintain flagging for the duration of the construction.
   4. Construct the TESC facilities and features in the approved CESCP in conjunction with clearing and grading activities, and in such a manner as to ensure that Sediment Laden Surface Water does not enter the drainage system or violate water standards.
   5. Contractor to develop and update the CESCP so that construction runoff never enters the operational portion of the Recycling and Transfer Station.
   6. Follow the overall construction sequence shown on the Drawings or the Contractor developed construction sequence reviewed and approved on by the Project Representative.
   7. Temporary Cover Measures include but are not limited to plastic sheeting, hydroseeding, PAM, or straw mulch.
   8. Temporary Cover Measures shall be compatible with the water quality treatment system and earthwork operations.

9. Establish permanent vegetative cover in each area of Work at the earliest possible date in accordance with 32 90 00 – Landscaping.
10. Inspect the erosion and sedimentation control facilities per the CESCP and maintain as necessary to ensure their continued functioning.
11. Regularly inspect tanks and remove sediment to ensure that storage tank volume is not reduced due to sediment deposition.

B. Orange Safety Fence:
   1. Use wood or metal posts spaced at a maximum of 6 FT to support the fence.
   2. Leave the fence in place, fully functional until directed to remove it by the Project Representative.

C. Stabilized Construction Entrances:
   1. Stabilized Construction Entrances: Stabilized pads of quarry spalls at entrances to the Project Site shall be constructed and maintained to help eliminate transport of mud, dirt, and rocks onto public roads by construction traffic.
      a. Stabilized construction entrances shall be constructed in accordance with the CESCP, prior to beginning clearing, grubbing, earthwork, or excavation in the area to be served by the entrance.
      b. A Stabilized Construction Entrance shall be placed at all construction vehicular access points to the Project, for the duration of the Project.
      c. Maintain stabilized construction entrance pads at least 12 IN thick over crushed surfacing and geotextile, at least 100 FT in length (unless otherwise shown on the Drawings) and the full width of the vehicle ingress/egress, with a minimum width of 15 FT.
      d. The minimum length and width can be adjusted at the discretion of the Project Representative.
      e. Maintain proper function of the stabilized construction entrance pad by periodically adding quarry spalls, and crushed surfacing, as necessary.
      f. Remove construction entrance materials that are loosened from the pad and transported into the surrounding roads and streets.
      g. All dirt, mud and debris tracked or dropped onto the roadway shall immediately be swept and removed using vacuum-type street sweeper equipment. A vacuum-type street sweeper shall be maintained on the Project Site at all times.
      h. Sweeping dirt to the side of the road will not be an acceptable method of cleaning.

D. Temporary Tire Wash:
   1. Contractor is responsible for transport of the temporary tire wash system from CHRLF to the Project Site.

2. Contractor shall arrange and pay for tire wash system manufacturer's representative to be on-site for startup of existing tire wash system at the start of Milestone 2 Work.
3. Contractor shall arrange and pay for tire wash system manufacturer's representative to provide training for Contractor's site personnel for not less than 2 HRS after startup.
4. Operate and maintain temporary tire wash in accordance with operation and maintenance manual provided in Appendix C.
5. Periodically remove settled solids in accordance with manufacturer's or supplier's recommendations.
6. Contractor shall be fully responsible for modifying the flocculant dosage rate, tank sizing, and/or the frequency and method of settled solids removal if the system as installed does not eliminate track out beyond 100 FT from the temporary tire wash.
7. During transition from Milestone 2 to Milestone 3, relocate the existing temporary tire wash facility. The relocated temporary tire wash facility shall meet the following requirements:
    a. Exact reconfiguration of equipment will depend on the equipment used. Review proposed installation layout with the Project Representative before installation.
    b. Contractor is responsible for construction details of the temporary tire wash facility.
    c. The vehicular approach to and exit from the temporary tire wash shall either be sloped to drain into the temporary tire wash or the Contractor shall provide an alternative means of collecting wash water spray that does not drain back into the temporary tire wash system.
    d. Placement and operation of the temporary tire wash system shall not interfere with operation and public use of the existing transfer station. Any modifications to existing utilities that are required for the placement of the temporary tire wash shall be at the sole expense of the Contractor.
    e. Temporary tire wash system manufacturer's representative shall be on-site for startup of the relocated temporary tire wash system and review system for worn or damaged material and make recommendations for replacement or repairs.
8. Upon completion of Milestone 3, the temporary tire wash system shall be inspected by the Project Representative and the temporary tire wash system manufacturer's representative and demonstrated to be functioning properly. Contractor shall arrange and pay for tire wash system manufacturer's services. Following successful demonstration as approved by the Project Representative, disassemble and transport the equipment to, and off load at, King County's CHRLF. Temporary tire wash system components shall be stored at a location and in a manner as directed by the Project Representative.

9. Prior to storage at King County's CHRLF:
    a. System components shall be thoroughly cleaned.
    b. All damaged components that affect the proper function of the temporary tire wash system shall be repaired. Any repair or service required shall be made and paid for by the Contractor.

E. Construction Access Roads:
1. Contractor shall be responsible for controlling runoff from construction access roads to prevent both erosion and non-compliant runoff from leaving the Project Site.
2. Where new storm drains and inlets are available along construction access roads, temporary curbing and check dams shall be installed by Contractor to route construction runoff into the storm drain system for collection and treatment.

F. Hydroseed and Mulch for Erosion Control:
1. All erosion control grass seeding shall be by a hydro seeder unless approved otherwise by the Project Representative. The hydro seeder shall utilize water as the carrying agent, and maintain continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend, and mix into homogeneous slurry the specified amount of seed and water and other material. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles that will provide a uniform distribution of slurry.
2. A tracer shall be added to visibly aid uniform application. The tracer shall not be harmful to plants and animals. If wood cellulose fiber is used as a tracer only, the application rate shall not exceed 250 LBS/ACRE.
3. Fertilizer for erosion control seeding may be applied with hydro seeder provided the fertilizer is placed in the hydro seeder tank no more than one (1) HR prior to application.
4. When hand seeding is allowed by the Project Representative, seed and fertilizer shall be incorporated into the top 1/4 IN of soil by hand raking. Straw mulch cover shall be applied over the top of hand seeded areas.

G. Wood Cellulose Fiber:
1. Wood cellulose fiber shall be applied at a minimum rate of 1,200 LBS (dry) per acre when used as a mulch cover.

H. Straw Mulch:
1. Straw mulch may be used as a temporary measure to control erosion on exposed slopes.
2. The straw mulch shall be evenly spread a minimum of 2 IN thick; 4 IN thick during wet season construction (October 1 through April 30).
3. Hand methods may be used to place the straw mulch.

I. Plastic Cover:
   1. Use plastic sheeting to control erosion on exposed slopes as indicated in the Drawings or as directed by the Project Representative.
   2. Use scrim-reinforced plastic cover in any area where the cover will be in use for 30 days or more.
   3. Covering shall be installed and maintained tightly in place as shown on the Drawings.
   4. Secure the top edge of the top sheets along its full length in an anchor trench as shown on the Drawings.
   5. All seams shall be taped and weighted down full length and have at least a 5 FT overlap. Taped seams shall be weighted down along the entire seam length at a 10 FT maximum spacing.
   6. Equipment, tools, and materials shall not be stored on plastic covering slopes.
   7. Vehicles and workers shall remain off of plastic covering to the maximum extent possible.
   8. Sheeting applied over seeded slopes should be removed as soon as possible after vegetation is well grown to prevent burning the vegetation through the plastic sheeting.
   9. Check regularly for rips and places where the plastic may be dislodged. Maintain contact between the plastic and the ground. Air pockets under plastic should be removed immediately to prevent ripping during winds.
   10. Re-secure and replace plastic as necessary.
   11. Plastic covering that is removed to access underlying soils shall be restored to original condition unless approved otherwise by the Project Representative.

J. Temporary Silt Fence:
   1. Install temporary silt fences as indicated on the Drawings.
   2. Purchase filter fabric in continuous roll cut to the length of the barrier to avoid use of joints.
   3. When joints are necessary, splice filter fabric together only at a support post, with a minimum 6 IN overlap, and both ends securely fastened to the post.
   4. Install temporary silt fence to follow ground contours, where feasible.
   5. Do not place cast spoils on the downhill side of the fence.
   6. When standard strength filter fabric is used, provide a wire mesh support fence fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 IN long, tie wires, or hog rings.
   7. Extend wire into the trench a minimum of 4 IN and not more than 36 IN above the original ground surface.
   8. Do not staple filter fabric to existing trees.

9. When extra-strength filter fabric and 6 FT maximum fence post spacing are used, the wire mesh support fence may be eliminated, subject to the approval of the Project Representative. Staple or wire extra-strength filter fabric directly to the posts while complying with all other provisions of this Section.
10. Backfill the trench as indicated on the Drawings.
11. Inspect immediately after each rainfall and at least daily during prolonged rainfall and remove accumulated sediment.

K. Perimeter Berms:
1. Perimeter berms may be used to supplement or in lieu of silt fence or wattles if approved by the Project Representative to reduce sediment transport by sheet flows from disturbed ground.
2. The longest flow path length to perimeter berm shall not exceed 100 FT.
3. Perimeter berms shall be at least 18 IN high above adjacent, existing ground.
4. Perimeter berms shall consist of compost, ground brush, or earthen material.
5. Perimeter berms of earthen material shall be seeded with the erosion control grass seed mixture.

L. Check Dams: Check dams shall be installed according to COB BMP C207: Check Dams, Figure 4.13.

M. Wattles: If used, wattles shall be installed per the detail on the Drawings.

N. Compost Socks:
1. The Contractor shall exercise care when installing compost socks to ensure that the method of installation minimizes disturbance of waterways and prevents sediment or pollutant discharge into water bodies.
2. Compost socks shall be laced together end-to-end with coir rope to create a continuous length. Loose ends of the continuous length shall be buried 3 FT to 5 FT laterally into the bank slope. The upper surface of the compost sock shall be parallel to the slope. Finished grades shall be of a natural appearance with smooth transitions.
3. The compost sock shall be secured with wood stakes or live stake of species indicated on the Plans.
4. Wood stakes for compost socks shall be installed and driven into place centered on the top of the compost sock and spaced 3 FT OC throughout the length of the compost sock.

O. Catch Basin Inserts:
1. Install in accordance with manufacturer's recommendations.
2. Once insert fills with sediment remove, backflush, and re-install.
3. If insert is torn or damaged, replace with a new insert.

4. Install catch basin inserts in all catch basins and inlets (existing and new) within the Construction Limits and downstream of the Project Site that may receive Sediment Laden Surface Water from the Project Site.
5. Simply placing a piece of geotextile under the grate is not acceptable.
6. Inserts shall be removed after the site has been stabilized and before final acceptance.

P. Portable Storage Tanks:
1. Tanks shall be configured to maximize the potential for settling of suspended material within the tank and reduce the chance for re-suspension of settled material.

Q. Erosion Control Blanket:
1. Use erosion control blanket on exposed slopes where shown on the Drawings or required by Project Representative.
2. Unroll erosion control blanket for slope protection parallel to the flow of water.
3. Grade the surface smooth before placement of the erosion control blanket to allow soil contact.
4. Bury erosion control blanket at least 6 IN at the top and bottom ends of installation area. Overlap side edges of erosion control blanket a minimum of 4 IN.
5. Overlap ends of erosion control blanket a minimum of 6 IN.
6. Install fasteners per manufacturer's recommendations.
7. If hand seeding is to be used, apply seed and fertilizer before installing erosion control blanket.
8. If hydroseeding, apply hydroseed before installing the erosion control blanket.

R. PAM for Erosion Control:
1. The manufacturer or supplier shall provide written application methods for anionic PAM and anionic PAM mixtures based on site conditions.
2. Store, mix and apply PAM in accordance with requirements in Volume II of the Ecology's Stormwater Management Manual for Western Washington. These shall prevail over manufacturer's recommendations.
3. Keep granular PAM supply out of direct sunlight.
4. PAM shall be applied on bare soil completely dissolved and mixed in water or applied as a dry powder.
5. Dissolved PAM shall be applied at a rate of not more than 2/3 LB per 1,000 GAL of water per acre.
6. A minimum of 200 LBS/ACRE of cellulose fiber mulch treated with a non-toxic dye shall be applied with the dissolved PAM.
7. Dry powder applications may be at a rate of 5 LBS/ACRE using a hand-held fertilizer spreader or a tractor-mounted spreader.

8. PAM shall not be applied during rainfall or to saturated soils.
9. PAM shall be applied only to areas that drain to completed sedimentation control BMPs in accordance with the CESCP.
10. PAM shall not be applied to the same area more than once in a 48 HR period and no more than 7 times in a 30-day period.
11. Application rates may be adjusted based on observation of site-specific soil erosion patterns and approved by the Project Representative.
12. A trained person experienced in the use of PAM shall perform application. Notify Project Representative 48 HRS prior to first application.
13. Do not add PAM to water discharging from the Project Site.
14. Prior to applying PAM in any area draining to the water quality treatment system, consult with the operator of the water quality treatment system to ensure PAM application is compatible with system operation.

S. Temporary Plug Valves:
   1. Install per manufacturer's recommendations.
   2. Temporary plug valves shall be installed to allow their safe removal by workers under high head conditions in the storm drain system.
   3. Chains, ropes, or rods attached to plug valves should be clearly labeled for worker use under high head conditions.

T. Temporary Drainage Ditches:
   1. Sod temporary drainage ditches as called for in the notes on the Drawings to establish permanent turf for immediate erosion control and to stabilize drainage ways.
      a. Over excavate the drainage ditch 4 IN to 6 IN below the final elevation to allow room for placing soil amendment and sod.
      b. Amend 4 IN (minimum) of compost into the top 8 IN of the soil.
      c. Shape and smooth the surface of ditch.
      d. Fertilize according to Section 32 90 00 – Landscaping, using a non-phosphorous fertilizer.
      e. Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow.
      f. Wedge strips securely into place.
      g. Square the ends of each strip to provide for a close, tight fit.
      h. Stagger any joints at least 12 IN.
      i. Staple sod strips on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
      j. Inspect sodded ditches frequently.
      k. If the grass is unhealthy, the cause shall be determined and appropriate action taken to re-establish a healthy groundcover.

l. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with erosion control matting.

2. All temporary ditches will be repaired to original condition within 24 HRS of any damage.

U. Temporary Curb:
1. Where shown on the Drawings, temporary curbs shall be installed along pavement edges to prevent runoff from flowing onto erodible slopes.
2. The redirected water shall flow to a conveyance designed for concentrated flow. This requires having curb breaks and/or smooth transitions to allow gutter flow to enter storm drainage system.
3. If concentrated flows can continue past the end of curb run, runoff should enter a stabilized conveyance system via a smooth transition.
4. Curbing shall be placed and maintained as to not cause erosion or concentrated discharges across unstabilized work areas.

3.02 CONTROL OF STORMWATER RUNOFF FROM EXISTING TRANSFER FACILITY

A. Refer to notes on Drawing 01C105 for requirements for control of stormwater runoff from the outlets of the drainage system of the existing transfer facility the cost of which is to be borne by the Contractor.

3.03 WATER QUALITY TREATMENT SYSTEM

A. The filter cartridges in the permanent water quality treatment vault shall be protected or not installed until the vault is ready to be operated in final treatment condition. The vault shall be cleaned and filter cartridge system installed as needed once the vault is no longer used for construction stormwater control.

3.04 WATER QUALITY MONITORING

A. A construction water quality monitoring plan shall be prepared and implemented by the Contractor. The plan shall comply with the permit requirements and the following:
1. The quality of the surface water runoff as it exits the Project Site shall be monitored for pH and turbidity by the Contractor to ensure it is meeting the water quality performance requirements specified in the City Standards and this Section.
2. To monitor project discharges a portable turbidity meter and pH meter are required. The portable turbidity meter shall be calibrated and maintained in accordance with the manufacturer's recommendations and have a sealed optical chamber that is kept free of dust. Turbidity readings shall be reported in Nephelometric Turbidity Units (NTUs). The pH meter shall be calibrated and maintained in accordance with the manufacturer's recommendations.

3. Where water quality requirements are described in relation to receiving water quality, Contractor shall be responsible for collecting such data on receiving water quality, at no additional cost to Owner.
4. If at any time the sampled surface water runoff deviates from the water quality performance requirements specified in this Section, route flows back to the temporary storage system for additional treatment.

B. The Project Representative may also be monitoring the Project Site water quality to verify the water quality performance requirements are met.

C. Water quality for runoff leaving the site and discharged to the public drainage system or any natural receiving body shall meet the City Standards.

D. Water quality and flow monitoring shall occur at the following intervals unless approved otherwise by the Project Representative:
1. Every four (4) HRS when work is occurring on the Project Site and treated runoff discharges from the Project Site are occurring.
2. Monitoring shall occur every two (2) HRS when rainfall rates are intense (greater than 0.2 IN/HR) and treated runoff is being discharged.

E. The Contractor shall keep records of water quality and flow monitoring data in good order and retain on-site. Copies of monitoring data shall be submitted to the Project Representative on a weekly basis.

F. Any time the water quality exceeds permit requirements take corrective actions and monitor hourly until the water quality is in compliance with the permit requirements.

3.05 TEMPORARY CONVEYANCES

A. Temporary conveyances not shown on the Drawings shall be designed and installed as needed and according to the CESCP.

3.06 STREET CLEANING

A. Contractor shall use self-propelled vacuum street sweepers as needed to prevent the transport of sediment and other tracked-off debris tracked from the entire Project Site onto existing public roads and right-of-ways throughout the construction of the Project.

B. Street sweepers shall be designed and operated to meet applicable air quality standards.

C. Street washing will not be permitted unless wash water is collected for treatment to remove turbidity.

D. Paved roads that are actively used by construction equipment will be cleaned periodically to control dust and prevent sediment and debris track-out.

3.07 DUST CONTROL MEASURES

A. Comply with City Standards for dust control.

3.08 TEMPORARY SLOPE TREATMENT

A. Comply with City Standards for temporary slope treatment.

3.09 PROTECTION OF STOCKPILES AND PRELOAD

A. Stockpiles and preload shall be protected in accordance with City Standards and the notes on the Drawings.

B. Runoff from stockpiles and preload shall be conveyed to storage ponds, tanks, or permanent stormwater system for treatment.

END OF SECTION

SECTION 31 37 00
STONE REVETMENT (RIP RAP)

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. This Work shall consist of furnishing and placing stone revetment (rip rap) protection of the type specified at the locations and in conformity with the lines and dimensions shown in the Plans or established by the Project Representative including but not limited to the following:
      a. Drainage outflow area.
      b. Slope rip rap.
      c. Other areas indicated and shown on the Drawings.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 31 21 33 - Trenching, Backfilling, and Compacting for Utilities.
   4. Section 31 23 00 - Earthwork.
   5. Section 31 25 00 - Soil Erosion and Sediment Control.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. T103, Soundness of Aggregates by Freezing and Thawing.
   2. ASTM International (ASTM):
      a. C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
      b. C127, Standard Test Method for Density , Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
   3. Corps of Engineers (COE):
      a. CRD-C100, Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing.
   4. City of Bellevue:
      a. Clearing and Grading Development Standards – 2010.
      b. Transportation Department - Design Manual - 2011.

c. Utilities Department - Storm and Surface Water Engineering Standards – 2012.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Layout Drawings: Maximum scale: 1 IN = 30 FT.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.

C. Quality Assurance Submittals:
   1. Certifications.
   2. Test reports.
   3. Submit all tests and certification in a single coordinated submittal.
      a. Partial submittals will not be accepted.

D. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Overall O&M Manual will address rip rap protection maintenance needs, no separate manual required.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Stone:
   1. Durable broken quarry run stone.
   2. Does not disintegrate on exposure to water or weathering.
   3. Free from structural fractures and defects.
   4. Not containing shale, unsound sandstone, or other material which will disintegrate.
   5. Graded within limits specified.
   6. Breadth and thickness of any stone: Not less than one-third of its length.
   7. Ensure that dirt and fines accumulated from interledge layers or from blasting or handling operation is less than 2 percent by weight.
   8. Gradation of the material: Well-graded from 2 IN to 18 IN as indicated on the Drawings and Engineering Standards.

2.02 SOURCE QUALITY CONTROL

A. Perform all tests at an approved independent laboratory.

B. Obtain samples in conformance with COE CRD-C100.

C. Source Tests:
   1. Supply certified tests and service records to determine acceptability and application of stone materials.
   2. In event suitable test reports or a service record that is satisfactory are not available, as in case of newly operated sources, subject material to tests necessary to determine its acceptability for use.
   3. Tests to which materials to be subjected include:
      a. Specific gravity.
      b. Soundness in magnesium sulfate.
      c. Soundness in freezing and thawing.
      d. Adsorption.
      e. Wetting and Drying.

D. Material Acceptability Tests:
   1. Initial test:
      a. On material from each ledge sampled prior to start of construction.
      b. Specific gravity.
      c. Soundness in magnesium sulfate.
      d. Soundness in freezing and thawing.
   2. Control tests:
      a. Perform control tests including one specific gravity, one soundness in magnesium sulfate, and one soundness in freezing and thawing for each type of stone revetment material for every 5 TNS of material

E. Specific Gravity Test:
   1. Conform with ASTM C127.
   2. Not less than 2.40 minimum.

F. Soundness in Magnesium Sulfate:
   1. Conform with ASTM C88, except maintain samples immersed in solution at a temperature of 80 DegF +2 DegF.
   2. Not more than 12 percent loss at five cycles.

G. Soundness of Aggregates in Freezing and Thawing:
   1. Conform with AASHTO T103 method as modified herein.
   2. Ensure loss at 12 cycles of not more than 10 percent.
   3. Maintain temperature of cold liquid in range of -5 to 0 DegF.
   4. Maintain thaw fluid temperature in range of 45 to 50 DegF.
   5. Permit length of freezing and of thawing cycles of 2 HRS with 1 HR of freezing following by 1 HR of thawing.

6. Perform thawing by circulating thaw fluid around pan containing stone immersed in a depth of 1/4 IN rather than by total immersion.

PART 3 – EXECUTION

3.01 PREPARATION

A. Trim and dress all areas to required cross sections.

B. Bring areas that are below allowable minus tolerance limit to grade by filling with material similar to adjacent material.

C. Compact to density specified for backfill in accordance with Specification Section 31 23 00 - Earthwork.

D. Do not place any stone material on prepared base prior to inspection by Project Representative.

3.02 PLACING

A. Place stone revetment material on prepared foundation within limits indicated.

B. Place on prepared base to produce a well-graded mass of stone with minimum percentage of voids.

C. Place to required thickness and grades.

D. Place to full thickness in a single operation to avoid displacing the underlying material.

E. Distribute entire mass to conform to gradation specified.
   1. Do not place stone by dumping into chutes or by similar method likely to cause segregation.

F. Keep finished stone revetment free from objectionable pockets of small stones or clusters of larger stone.
   1. Hand place as necessary to obtain a well-graded distribution.

G. Ensure a final tolerance of within 3 IN from indicated slope and grade lines.

H. Place stone revetment in conjunction with embankment construction to prevent mixture of embankment and stone revetment materials.

I. Maintain stone revetment until accepted.

J. Replace any displaced material to lines and grades shown.

END OF SECTION

SECTION 31 50 00
TEMPORARY EARTH RETENTION SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, tools, equipment, and services for Temporary Earth Retention Systems, as indicated, in accordance with provisions of Contract Documents.

B. Subsurface soils investigations have been made at the Project Site.
   1. Soils information was obtained for use in preparing foundation design.
   2. Refer to Specifications Section 01 10 00 - Summary of Work for location of geotechnical information provided only as Available Information.
   3. Examine geotechnical report and determine character of materials to be encountered.

C. Definitions:
   1. Geotechnical Consultant: Owner's Representative, empowered to conduct inspections.
   2. Design Engineer: Structural or Civil Engineer licensed in the State of Washington responsible for design of the temporary earth retention systems.
   3. Temporary earth retention system: System required to function only during construction period, up until which time excavation can safely be backfilled and the temporary earth retention system is no longer required.

D. Completely coordinate with work of other trades.

1.02 QUALITY ASSURANCE

A. Assume complete responsibility for design, installation, maintenance as well as damage resulting from installation or performance of the temporary earth retention systems.

B. Carefully examine site and verify elevations of existing footings of adjacent buildings and invert elevations of underground utility lines.

C. Reference Standards:
   1. Post Tensioning Institute (PTI):
      a. Guide Specification for post tensioning materials.
      b. Recommendations for prestressed rock and soil anchors.
   2. American Institute of Steel Construction (AISC):
      a. Specifications for design, fabrication and erection of structural steel for buildings.
      b. Code of standard practice for steel buildings.

3. American Welding Society (AWS):
    a. AWS D1.1, structural welding code - steel.
4. American Society for Testing Materials Standards (ASTM): Standards indicated.
5. Structural Steel Painting Council (SSPC): Standards indicated.
6. American Wood Preservers Association (AWPA).

D. Design Criteria:
1. Provide temporary earth retention systems which will safely withstand earth pressures and limit settlement of surrounding structures to maximum 1/4 IN vertically and laterally.
2. Temporary earth retention systems shall utilize effectively prestressed tie backs or earth anchors to minimize lateral earth deflection.
3. Earth pressures used for the design of the temporary earth retention systems shall be determined by recognized principles of soils mechanics and shall be acceptable to the Geotechnical Consultant.
4. Design, installation and grouting of temporary earth retention systems to follow recommendations of Post Tensioning Institute's "Recommendations for Prestressed Rock and Soil Anchors".
5. Consider long term effects, including creep and relaxation in anchor design such that lateral movement of finished wall is less than 1/4 IN during service life of structure.
6. Consider the effects of impact on mounted or adjacent traffic barriers as well as vehicular live load surcharge.
7. Do not use driven piles or sheet piling.
8. Global Earth Stability:
    a. The temporary earth retention systems Design Engineer shall evaluate the excavation for global slope stability.
    b. Demonstrate by calculation that an appropriate factor of safety will exist or be provided by the temporary earth retention systems for all conditions or imposed loads.
    c. Appropriate soil properties to be used for the analysis shall be determined by the Geotechnical Consultant.
    d. Analysis shall conform the US Army Corps of Engineers Engineer Manual 1110-2-1902.

E. Qualifications:
1. Design Engineer:
    a. Temporary earth retention systems must be designed by a Civil or Structural Engineer registered in the State of Washington.
    b. Design Engineer must be knowledgeable in area of temporary earth retention systems with minimum 5 years experience in design of systems similar to that proposed for the Project.

2. Contractor:

   a. Temporary earth retention systems must be installed by a Contractor who specializes in installation of temporary earth retention systems such as that proposed.

   b. Contractor must have a minimum of 5 years experience with installations of temporary earth retention systems similar to that proposed for the Project.

F. Testing:
   1. Proof test tie-back anchors in accordance with Post Tensioning Institute's "Recommendations for Prestressed Rock and Soil Anchors" to verify their load carrying capabilities.

   2. Three temporary anchors shall be "verification or performance tested" to at least 2.0 times design working load; and all of the temporary anchors shall be tested to at least 1.35 times design working load in accordance with referenced PTI standards.

G. Monitoring:
   1. The Owner shall employ a Geotechnical Consultant familiar with the soil conditions at the Project Site who shall install 3-dimensional survey monitoring instrumentation as required to observe the movement of the temporary earth retention systems and adjacent structures.

   2. The Geotechnical Consultant shall report the measured movements of the temporary earth retention systems and adjacent structures to the Contractor and Project Representative on a weekly basis until such time that the temporary earth retention systems are no longer necessary as deemed acceptable by the Geotechnical Consultant.

   3. If movements are recorded that are larger than anticipated or projected, or greater than 1/2 IN, the Contractor shall stop all excavation work adjacent to the earth retention system and provide necessary support and/or redesign of the earth retention system so as to reduce the movements to an acceptable level.

H. Inspection:
   1. The Design Engineer shall observe work in progress to see that design is being followed and design criteria are being met.

   2. Upon construction completion of temporary earth retention systems, the Design Engineer shall verify correctness of installation and inform the Project Representative in writing within 10 days after completion of construction.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Project Information:
      a. Temporary earth retention system design indicating approval of the Office of State Architect. Allow 4 to 6 weeks for State Review.
      b. Shop Drawings and Specifications including the following:
         1) Description of system proposed.
         2) Plan layout of proposed system including dimensions, section cuts and details for stage of construction.
         3) Coordinate plan layout and details with existing facilities that are to remain open and operational as well as Building Construction Drawings to insure no conflicts will arise.
         4) Shop Drawings shall be in sufficient detail to permit installation without reference to Contract Documents.
         5) Include specific descriptions of required field quality control.
         6) Anchor (tiebacks), Lagging, and Internal Bracing.
            a) Type.
            b) Corrosion protection.
            c) Stressing procedure.
            d) Grout and grouting method.
         7) Proposed method of providing for utility penetrations.
      c. Crack survey of existing structures protected by earth retention system.
      d. Design calculations signed and sealed by the Design Engineer, who shall be licensed in State of Washington.

C. Quality Assurance Submittals: Tie-back proof test results.

1.04 JOB CONDITIONS

A. Carefully maintain bench marks, monuments, and other reference points.

B. Replace if disturbed or destroyed.

C. Protect active utilities from damage.

D. Provide protective barriers around excavation as required by governing agencies.

E. Maintain minimum 12 FT access drive width and do not hinder the operation of existing facilities that are to remain open during construction.

F. Provide temporary guardrail or other barrier along traffic side of temporary earth retention systems meeting applicable safety requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Anchor materials:
   1. Either single or multiple elements of wires conforming to ASTM-A421; or strands conforming to ASTM-A416; or steel bars conforming to ASTM-A722.
   2. Minimum protective coating (except over bond length): Double corrosion protection system consisting of a plastic sheathing and grease over tendon in addition to grouting.
   3. Take extra care to ensure complete and uninterrupted continuity of protective coating.

B. Structural steel:
   1. New rolled shapes or plates of structural grade steel conforming to ASTM-A36, ASTM-A572 Grade-50, or ASTM-A992, Grade-50.
   2. Deformations, imperfections, camber and sweep of piles not more than allowed by ASTM-A6.
   3. Pile lengths necessary to reach required depths shall be determined by Contractor.
   4. Soldier pile: Coated with coal tar epoxy, with predrilled holes to prevent damage to corrosion protection system.

C. Protective coatings:
   1. Corrosion protection material which is not detrimental to prestressing steel, with following properties:
      a. Free from cracks and not brittle or fluid over entire anticipated range of temperatures.
      b. Chemically stable for life of tendon.
      c. Non-reactive with surrounding materials such as concrete, tendons or sheathing.
      d. Corrosion inhibiting.
      e. Impervious to moisture.
   2. Coal tar epoxy: Tnemec Tneme-Tar 46-413, minimum 8 mils.
   3. Grease: Specially compounded for post tensioning.

D. Timber Lagging: Of sufficient size and strength to support loads imposed on it; pressure treated in accordance with AWPA standards to preserve capacity of element for service life of structure.

PART 3 – EXECUTION

3.01 PREPARATION

A. Do not start work nor purchase materials required until submittals approved for proposed temporary earth retention systems.

3.02 EXCAVATION

A. Install temporary earth retention systems to dimensions and elevations indicated, allowing additional space as required for construction operations and inspection of foundations.

B. Excavate and remove existing concrete encountered.

C. Do not perform blasting.

D. Remove old foundations, building construction, and other materials concealed beneath present grade, as required to execute work, and as indicated.

E. Properly level off bottoms of excavations.

F. Control grading around building.

G. Pitch earth to prevent water from running into excavated areas or damaging structure.

H. Provide pumping and designed dewatering system required to keep excavated spaces clear of water.

I. When springs or running water are encountered, notify the Project Representative. Drain dewatering system discharge to appropriate point of disposal as indicated in the Project Drawings and Specifications.

J. Maintain temporary earth retention systems from time of installation until no longer required.

END OF SECTION

SECTION 31 51 00
PERMANENT GROUND ANCHORS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Permanent Ground Anchors; also known as Tiebacks or Soil Anchors.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 32 32 43 – Soldier Pile and Soldier Pile Tieback Walls.
   4. Section 31 23 00 - Earthwork.

C. All anchors indicated on the Drawings or specified to be Permanent Ground Anchors obtaining their required tension load carrying capacity from embedment into cohesive and/or granular soils.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC):
      a. 325, Manual of Steel Construction.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength.
      c. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
      d. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      e. A722, Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete.
      f. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
      g. C33, Standard Specification for Concrete Aggregates.
      h. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      i. C150, Standard Specification for Portland Cement.

3. Post-Tensioning Institute (PTI):

a. Post-Tensioning Manual:

1) Chapter 4, Recommendations for Prestressed Rock and Soil Anchors.

B. Qualifications:

1. Anchor installer to have a minimum of five (5) years of experience in the installation and construction of the type of anchors shown on the Drawings and required by the Specification Sections.

a. Prior to the beginning of construction, the Contractor shall submit a list containing at least five projects on which the Contractor has installed permanent ground anchors. A brief description of each project and a reference shall be included for each project listed. As a minimum, the reference shall include an individual's name and current phone number.

2. The Contractor shall assign an engineer to supervise the Work with at least 3 years of experience in the design and construction of permanently anchored Structures. The Contractor shall not use A/E Representative or manufacturer's representatives in order to meet the requirements of this Section. Drill operators and on-site supervisors shall have a minimum of 1 year experience installing permanent ground anchors.

a. Contractors or Subcontractors that are specifically prequalified in Class 36 Work will be considered to have met the above experience requirements.

1.03 DEFINITIONS

A. Anchor Bond Length: That length of anchor which is bonded to a passive subgrade zone and which transmits the required anchor tension load to subgrade.

B. Anchor Embedment Length: That portion of the total length of anchor extending into and surrounded by subgrade material.

C. Permanent Ground Anchor System: A structural system used to transfer tensile loads to soil or rock. A permanent ground anchor system may also be specified in the Plans as an anchor, a ground anchor, or a tieback. A permanent ground anchor system includes all prestressing steel, anchorage devices, grout, coatings, sheathings and couplers if used.

D. Production Anchors: Anchors indicated on Drawings or otherwise required for support of structural members.

E. Soils Engineer: Geotechnical Engineer licensed in the State of Washington retained by the Owner to perform observation and evaluation services during permanent ground anchor installation and testing.

F. Installer or Applicator:

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. See Specification Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:

1. Working Drawings and structural design calculations for the ground anchor system or systems intended for use.
2. Detailed description of the construction procedure proposed for use to the Project Representative for approval.
3. Ground anchor schedule giving:
    a. Ground anchor number.
    b. Ground anchor design load.
    c. Type and size of tendon.
    d. Minimum total bond length.
    e. Minimum anchor length.
    f. Minimum tendon bond length.
    g. Minimum unbonded length.
4. Working Drawings of the ground anchor tendon and the corrosion protection system. Include details of the following:
    a. Spacers and their location.
    b. Centralizers and their location.
    c. Unbonded length corrosion protection system, including the permanent rubber seal between the trumpet and the tendon unbonded length corrosion protection.
    d. Bond length corrosion protection system.
    e. Tendon size, number, and arrangement, anchorage and trumpet.
    f. Anchorage corrosion protection system.
    g. Anchors using non-restressable anchorage devices.
5. Shop plans for all structural steel, including the permanent ground anchors to the Project Representative for review and approval.
6. Mix designs for the grout and the procedures for placing the grout to the Project Representative for approval and methods and materials used in filling the annulus over the unbonded length of the anchor.
7. Detailed Working Drawings for the method proposed to be followed for the permanent ground anchor testing to the Project Representative for approval prior to the tests. This shall include all necessary Drawings and details to clearly describe the method proposed.
8. The Contractor shall submit product technical data including acknowledgement that products submitted meet requirements of standards referenced.

9. Catalogue cuts or Manufacturer's Certificates of Compliance for anchorage covers, bond breaker, centralizers, corrosion inhibiting grease, end caps, grout admixtures, and strand tendon spacers.

10. Manufacturer's Certificates of Compliance for anchor heads, anchor head wedges, bar tendon nuts, bar tendon couplers, tendon encapsulation tubing, trumpet assemblies, and bar tendons or strand tendons. The Manufacturer's Certificates of Compliance for the anchor head wedges (grippers), and bar tendon nuts and couplers, shall confirm compliance with the specified strength requirements.

C. Quality Assurance Submittals:

1. Calibration data for each load cell, test jack, pressure gage and master pressure gage to be used. The calibration tests shall have been performed by an independent testing Laboratory and tests shall have been performed within 60 calendar days of the date submitted. The Project Representative shall approve or reject the calibration data after receipt of the data. Testing shall not commence until the Project Representative has approved the load cell, jack, pressure gage and master pressure gage calibrations.

2. Results of all anchor load tests.

3. Strength test results of concrete grout placed in the field.

4. Anchor report for all in place production anchors:

   a. Submittal is for information only.

1.05 PRE-INSTALLATION MEETING

A. A permanent ground anchor preconstruction conference shall be held at least 5 working days prior to the Contractor beginning any permanent ground anchor Work at the site to discuss construction procedures, personnel, and equipment to be used. The materials specified for this item of Work will also be discussed. Those attending shall include:

1. (Representing the Contractor) The superintendent, on site supervisors, and all foremen in charge of drilling the ground anchor hole, placing the permanent ground anchor and grout, and tensioning and testing the permanent ground anchor.

2. (Representing the Owner) The Project Representative, the Geotechnical Engineer, key inspection personnel, and other representatives from the Owner as required.

B. If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved permanent ground anchor installation plan, an additional conference shall be held before any additional permanent ground anchor operations are performed.

1.06 PROJECT CONDITIONS

A. Do not begin anchor installation until the earthwork in the area where anchors are to be installed has been completed as shown on the Drawings and indicated in this Specification Section.

1.07 TENDON STORAGE AND HANDLING

A. Tendons shall be handled and stored in such a manner as to avoid damage or corrosion. Damage to the prestressing steel as a result of abrasions, cut, nicks, welds and weld splatter will be cause for rejection by the Project Representative. The prestressing steel shall be protected if welding is to be performed in the vicinity. Grounding of welding leads to the prestressing steel is forbidden. Prestressing steel shall be protected from dirt, rust, and deleterious substances. A light coating of rust on the steel is acceptable. If heavy corrosion or pitting is noted, the Project Representative will reject the affected tendons.

B. The Contractor shall use care in handling and storing the tendons at the site. Prior to inserting a tendon in the drill hole, the Contractor and the Project Representative will examine the tendon for damage to the encapsulation and the sheathing. If, in the opinion of the Project Representative, the encapsulation is damaged, the Contractor shall repair the encapsulation in accordance with the tendon supplier's recommendations and as approved by the Project Representative. If, in the opinion of the Project Representative, the smooth sheathing has been damaged, the Contractor shall repair it with ultra high molecular weight polyethylene (PE) tape. The tape shall be spiral wound around the tendon so as to completely seal the damaged area. The pitch of the spiral shall ensure a double thickness at all points.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS AND PRODUCTS

A. Subject to compliance with the Contract Documents, the following manufacturers and Permanent Ground Anchor Systems are acceptable:
   1. Permanent Ground Anchor Strand Tendon:
      a. Permanent Ground Anchors System (Strand Tendon) as manufactured by Dywidag Systems International, USA, inc., Long Beach, CA.
      b. Permanent Ground Anchors System (Bar Tendon) as manufactured by Dywidag Systems International, USA, inc., Long Beach, CA.
      c. Permanent Ground Anchors as manufactured by Con-Tech Systems, Ltd., British Columbia, Canada.
      d. Permanent Ground Anchors as manufactured by Williams Form Engineering, Corp., Portland.
      e. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 COMPONENT MATERIAL SPECIFICATIONS

A. Anchorage covers shall have a minimum thickness of 0.20 IN and shall conform to either ASTM A 53 for pipe, or ASTM A 500 for tubing, or ASTM A 36, ASTM A 529, ASTM A 572, ASTM A 588, or AASHTO M 270 for fabricated steel.

B. Anchor heads shall conform to either ASTM A 36, AASHTO M 169 Grades 1040 or 1045, ASTM A 521 Grade 1045, ASTM A 576 Grade 1045, or ASTM A 536 Grade 80-55-06.

C. Bearing plates shall conform to either ASTM A 36, ASTM A 572, ASTM A 588, AASHTO M 270, ASTM A 529, or ASTM A 536.

D. Anchor head wedges (grippers) shall conform to AASHTO M 169 Grade 12L14, case hardened 0.012 to 0.015 inches deep to Rockwell C 59 to 65.

E. Bar tendon nuts shall conform to either ASTM A 29 Grade C1045, ASTM A 521 Class CF, AASHTO M 169 Grades 1117 or 1144, or ASTM A 536 Grade 100-70-03, and shall be capable of developing 100 percent of the GUTS of the bar tendon.

F. Bondbreaker shall conform to the requirements of Section 4.7 of the Post-Tensioning Institute “Recommendations for Prestressed Rock and Soil Anchors”, Fourth Edition - 2004, and shall be fabricated from a smooth plastic tube or pipe having the following properties:

1. Resistant to chemical attack from aggressive environments, grout or grease.
2. Resistant to aging by ultra-violet light.
3. Fabricated from material nondetrimental to the tendon.
4. Capable of withstanding abrasion, impact, and bending during handling and installation.
5. Enable the tendon to elongate during testing and stressing.
6. Allow the tendon to remain unbonded after lock-off.

G. Centralizers shall be fabricated from plastic, steel, or material which is non-detrimental to the prestressing steel. Wood shall not be used.

H. Corrosion inhibiting grease shall conform to the requirements of Section 3.2.5 of the Post-Tensioning Institute, "Specification for Unbonded Single Strand Tendons".

I. Couplers for bar tendons, if required, shall be furnished by the manufacturer of the bar tendons and shall be AASHTO M 169 Grades 1045, 1117 or 1144, ASTM A 519 Grade 1026, or equivalent steel developing 100 percent of the GUTS of the bar tendon without evidence of any failure. Couplers shall be placed in the bond zone. Couplers for strand tendons will not be allowed.

J. End caps shall conform to ASTM D 3350 Class PE324420C, Class PE334410C, or Class PE335400C, ASTM D 1248, and AASHTO M 252, ASTM D 1784 Class 1346B, ASTM A 653, or ASTM A 36.

K. Grout shall be a neat cement grout or a sand-cement grout. The compressive strength for the grout shall be as required by the tieback manufacturer and as approved by the Project Representative. Grout components shall be as follows:
   1. Admixtures shall conform to the requirements of Section 03 09 00 - Concrete. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations, trumpets and anchorage covers. Accelerators will not be permitted. Admixtures shall be compatible with prestressing steels and mixed in accordance with the manufacturer's recommendations.
   2. Aggregates shall conform to the requirements of Section 03 09 00 - Concrete.
   3. Cement shall conform to the requirements of Section 03 09 00 - Concrete and shall not contain lumps or other indications of hydration.

L. Prestressing steel shall consist of either bar tendons with an ultimate tensile strength of 150 KSI conforming to AASHTO M 275 Type II, or strand tendons with an ultimate tensile strength of 270 KSI conforming to AASHTO M 203. The Contractor shall submit certified mill test results and typical stress-strain curves along with samples from each heat, properly marked, for the prestressing steel to the Project Representative. The typical stress-strain curve shall be obtained by approved standard practices. The guaranteed ultimate strength, yield strength, elongation, and composition shall be specified.

M. Strand tendon spacers shall be fabricated from plastic, steel, or material which is non-detrimental to the prestressing steel. Wood shall not be used.

N. Tendon encapsulation, when specified in the Plans to provide additional corrosion protection, shall be fabricated from one of the following:
   1. High density corrugated polyethylene (PE) tubing conforming to the requirements of ASTM D 3350 Class PE334410C, Class PE335520C or Class PE335400C, ASTM D 1248, and AASHTO M 252 and having a nominal wall thickness of 40 mils or greater.
   2. Corrugated, polyvinyl chloride (PVC) tubing conforming to ASTM D 1784, Class 13464-B, and having a nominal wall thickness of 40 mils or greater.

O. Trumpet providing the transition from the bearing plate to the unbonded length corrosion protection shall be fabricated from a steel pipe or tube conforming to the requirements of ASTM A 53 for pipe or ASTM A 500 for tubing. The trumpet shall have a minimum wall thickness of 0.20 IN, and shall be seal welded to the bearing plate. The seal weld shall be visually inspected.

P. The trumpet shall have an inside diameter equal to or larger than the hole in the bearing plate. The trumpet shall be long enough to accommodate movements of the wall during testing and stressing. For strand tendons with encapsulation over the unbonded length, the trumpet shall be long enough to enable the tendon to make a transition from the diameter or the tendon in the unbonded length to the diameter of the tendon at the anchor head without damaging the encapsulation. Trumpets filled with corrosion-inhibiting grease shall have a permanent rubber seal, as approved by the Project Representative, provided between the trumpet and the tendon unbonded length corrosion protection. Trumpets filled with grout shall have a temporary seal provided between the trumpet and the tendon unbonded length corrosion protection or the trumpet shall overlap the tendon unbonded length corrosion protection.

PART 3 – EXECUTION

3.01 INSPECTION

A. Owner shall provide independent inspection services indicated herein to be performed by a Geotechnical Engineer licensed in the State of Washington.

3.02 LINES AND LEVELS

A. Complete necessary excavation and furnish all lines and levels necessary for completion of anchor installation.

3.03 DETERMINATION OF ANCHOR LENGTH(S) TO BE INSTALLED

A. Perform no less than three (3) load verification tests on anchors to determine required anchor bond length and embedment length into subgrade necessary to provide required allowable working tension load carrying capacity.
   1. Perform load verification tests prior to installing production anchors.
      a. Install verifications test anchors at locations indicated in the Plans with anchor bond length and embedment length into subgrade all as determined and directed by Soils Engineer.
   2. All components and details of the test anchors to be the same as proposed and required for use in production anchors.
   3. Load verification test anchors shall be sacrificial and not used as permanent production anchors.

B. Entire anchor load testing program to be under the observation of the Soils Engineer:
   1. When establishing anchor bond length and anchor embedment length into subgrade for test anchors, take into account the reduced tension capacity of an anchor due to "group action" caused by the close proximity of the locations of adjacent production anchors, if applicable.
   2. Apparatus for load testing anchors to be of such design that not only is the anchor tested for its capability of supporting the required loading but also that the subgrade material surrounding the anchor is tested for its capability of supporting the required loading.

3. Contractor to design test anchor setup.

    a. Entire apparatus for load testing anchors to be supplied by Contractor.

C. Load test anchors in accordance with the PTI's "Recommendations for Prestressed Rock and Soil Anchors."
   1. Provide a calibration chart not more than 20 days old for hydraulic jack and pressure gage used for the load tests.
   2. Entire load test setup to have adequate capacity for testing anchors to twice their specified allowable working tension load carrying capacity.
   3. Provide a dial gage to measure anchor movement during load testing.
      a. All readings, taken by Soils Engineer, to be verified and signed by Contractor, and a copy sent to Project Representative for information.
   4. Do not begin load tests until material used to bond anchors to subgrade has cured sufficiently to be capable of transferring the required test loads from the anchor to the subgrade.

D. Load test anchors to a minimum of twice the specified allowable working tension load carrying capacity shown in the Plans or as stated in this Specification Section.

E. Criteria for establishing failure of test anchors will be as determined by Soils Engineer.

F. In the event of failure of test anchor apparatus setup, repeat load test at no additional expense to Owner.

G. Based on the results of the anchor load verification tests, the anchor bond length and anchor embedment length into subgrade for production anchors to be installed at required locations to be as recommended by the Soils Engineer to the Owner.

H. Send anchor load test results to Project Representative for information.

I. If, during the installation of the production anchors, subgrade conditions are found to be different from those encountered during installation of the test anchors, or if production anchors are not capable of being post tensioned to the required loads as specified herein, revise the anchor bond length and/or the anchor embedment length into subgrade for the anchor being installed as directed by the Soils Engineer.
   1. If anchor is found to be not capable of being post tensioned to the required loads, install additional anchor or anchors as directed by Project Representative with anchor bond length and embedment length as directed by Soils Engineer.
   2. Install additional structural members required by placement of additional anchor or anchors as directed by Project Representative.
      a. Allow Soils Engineer to witness installation of all production anchors.

3.04 ADDITIONAL ANCHOR LOAD TESTS

A. In addition to anchor load verification test requirements for Base Bid, Soils Engineer may require installation and testing of additional test anchors loaded and tested in accordance with requirements of this Specification Section.

3.05 TENDON FABRICATION

A. The tendons may be either shop or field fabricated. The tendon shall be fabricated as shown in the approved shop plans.

B. The Contractor shall select the type of tendon to be used. The tendon shall be sized so the factored design load does not exceed 80 percent of the minimum guaranteed ultimate tensile strength of the tendon. In addition, the tendon shall be sized so the maximum test load does not exceed 80 percent of the minimum guaranteed ultimate tensile strength of the tendon.

C. The Contractor shall be responsible for determining the bond length and tendon bond length necessary to develop the design load indicated in the Plans in accordance with testing requirements herein. The minimum bond length shall be 15 FT in soil.

D. When the Plans require the tendon bond length to be encapsulated, the tendon bond length portion of the tendon shall be corrosion protected by encapsulating the tendon in a grout-filled PE or PVC tube. The tendons can be grouted inside the encapsulation prior to inserting the tendon in the drill hole or after the tendon has been placed in the drill hole. Expansive admixtures can be mixed with the encapsulation grout if the tendon is grouted inside the encapsulation while outside the drill hole. The tendon shall be centralized within the bond length encapsulation with a minimum of 0.20 IN of grout cover. Spacers shall be used along the tendon bond length of multi-element tendons to separate the elements of the tendon so the prestressing steel will bond to the encapsulation grout.

E. Centralizers shall be used to provide a minimum of 0.5 IN of grout cover over the tendon bond length encapsulation. Centralizers shall be securely attached to the encapsulation and the center-to-center spacing shall not exceed 10 FT. In addition, the upper centralizer shall be located a maximum of 5 FT from the top of the tendon bond length and the lower centralizer shall be located a maximum of 1 FT from the bottom of the tendon bond length.

F. The centralizer shall be able to support the tendon in the drill hole and position the tendon so a minimum of 0.5 IN of grout cover is provided and shall permit free flow of grout.

G. Centralizers are not required on encapsulated, pressure-injected ground anchor tendons if the ground anchor is installed in coarse grained soils (more than 50 percent of the soil larger than the number 200 sieve) using grouting pressures greater than 150 psi.

H. Centralizers are not required on encapsulated, hollow stem-augered ground anchor tendons if the ground anchor is grouted through and the hole is maintained full of a stiff grout (8 IN slump or less) during extraction of the auger.

I. The minimum unbonded length of the tendon shall be the greater of 15 FT or that indicated in the Plans.

J. Corrosion protection of the unbonded length shall be provided by a sheath completely filled with corrosion inhibiting grease or grout. If grease is used under the sheath, provisions shall be made to prevent the grease from escaping at the ends of the sheath. The grease shall completely coat the tendon and fill the voids between the tendon and the sheath. The Working Drawings shall show how the Contractor will provide a transition between the tendon bond length and the unbonded tendon length corrosion protection.

K. If the sheath is not fabricated from a smooth tube, a separate bond breaker shall be provided. The bond breaker shall prevent the tendon from bonding to the anchor grout surrounding the tendon unbonded length.

L. The total anchor length shall not be less than that indicated in the Plans or the approved Working Drawings.

M. Anchorage devices shall be capable of developing 95 percent of the minimum guaranteed ultimate tensile strength of the prestressing steel tendon. The anchorage devices shall conform for Unbonded Single Strand Tendons, First Edition – 1993.

N. Non-restressable anchorage devices may be used except where indicated in the Plans.

O. Restressable anchorages shall be provided on those ground anchors that require reloading. The post-tensioning supplier shall provide a restressable anchorage compatible with the post-tensioning system provided.

P. The bearing plates shall be sized so the bending stresses in the plate do not exceed the yield strength of the steel when a load equal to 95 percent of the minimum guaranteed ultimate tensile strength of the tendon is applied, and the average bearing stress on the concrete does not exceed that recommended in Section 3.1.3 of the Post Tensioning Institute Specification for Unbonded Single Strand Tendons, First Edition – 1993.

3.06 ANCHOR INSTALLATION AND DETAIL REQUIREMENTS

A. The Contractor shall select the drilling method, the grouting procedure, and the grouting pressure used for the installation of the ground anchor.

B. When caving conditions are encountered, no further drilling will be allowed until the Contractor selects a method to prevent caving and void formation around the drill hole. The Contractor may use a temporary casing. The Contractor's method to prevent caving shall be approved by the Soils Engineer. The casings for the anchor holes, if used, shall be removed. The drill hole shall be located so the longitudinal axis of the drill hole and the longitudinal axis of the tendon are parallel. The ground anchor shall not be drilled in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supported Structure. At the point of entry the ground anchor shall be installed within plus or minus 3 degrees of the inclination from horizontal shown in the Plans or the approved Working Drawings.

C. The tendon shall be inserted into the drill hole to the desired depth. When the tendon cannot be completely inserted without difficulty, the Contractor shall remove the tendon from the drill hole and clean or redrill the hole to permit insertion. Partially inserted tendons shall not be driven or forced into the hole.

D. The grout equipment shall produce a grout free of lumps and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gage near the discharge end to monitor grout pressures. The pressure gage shall be capable of measuring pressures of at least 150 PSI or twice the actual grout pressures used by the Contractor, whichever is greater. 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.

E. The grout shall be injected from the lowest point of the drill hole. The grout may be pumped through grout tubes, casing, or drill rods. The grout can be placed before or after insertion of the tendon. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave in soils, fracturing of rock formations, or loss of grout into adjacent drill holes.

F. After grouting, the tendon shall not be loaded for a minimum of 3 days.

G. No grout shall be placed above the top of the bond length during the time the bond length grout is placed. The grout at the top of the drill hole shall not contact the back of the Structure or the bottom of the trumpet. Except as otherwise noted, only nonstructural filler shall be placed above the bond length grout prior to testing and acceptance of the anchor. The Contractor may place structural grout above the bond length grout prior to testing and acceptance of the anchor subject to the following conditions:
   1. A bond-breaker sleeve is employed around the tendon to prevent load transfer into soils within the no-load zone.

H. The corrosion protection surrounding the unbonded length of the tendon shall extend up beyond the bottom seal of the trumpet or 1 FT into the trumpet if no trumpet seal is provided. If the protection does not extend beyond the seal or sufficiently far enough into the trumpet, the Contractor shall extend the corrosion protection or lengthen the trumpet.

I. The corrosion protection surrounding the no load zone length of the tendon shown in the Plans shall not contact the bearing plate or the anchor head during testing and stressing. If the protection is too long, the Contractor shall trim the corrosion protection to prevent contact.

J. The bearing plate and anchor head shall be placed so the axis of the tendon and the drill hole are both perpendicular to the bearing plate within plus or minus 3 degrees and the axis of the tendon passes through the center of the bearing plate at the intersection of the trumpet and the bearing plate when fully seated with the alignment load.

K. The trumpet shall be completely filled with corrosion inhibiting grease or grout. Trumpet grease can be placed anytime during construction. Trumpet grout shall be placed after the ground anchor has been tested. The Contractor shall demonstrate to the Project Representative that the procedure selected by the Contractor for placement of either grease or grout produces a completely filled trumpet.

L. All anchorages permanently exposed to the atmosphere shall be covered with a corrosion inhibiting grease-filled or grout-filled cover. The Contractor shall demonstrate to the Project Representative that the procedures selected by the Contractor for placement of either grease or grout produces a completely filled cover. If the Plans require restressable anchorages, corrosion inhibiting grease shall be used to fill the anchorage cover and trumpet.

M. Application, Measurement, and Magnitude of Post Tensioning Forces Required for Production Anchors:

1. All production anchors indicated on Drawings or specified (except load test anchors) to be post tensioned to 150 percent of the required allowable working tension load carrying capacity indicated for each production anchor as stated in this Specification Section.

2. Maintain this 150 percent load on each production anchor for a minimum period of 5 minutes.

   a. Measure anchor movement by dial gage during the application of the 150 percent load and while maintaining this load for the minimum 5 minute period.

   b. If during the 5 minute period, the anchor movement is less than 0.03 IN, the 150 percent load can be lowered and locked at the required post tensioning load stated below.

   c. If the anchor movement is greater than 0.03 IN during the 5 minute period, then the 150 percent load to be maintained until the anchor movement decreases to an acceptable value as determined by the Soils Engineer.

3. When approval to do so is obtained from the Soils Engineer, reduce the 150 percent load at each production anchor to a post tension force which will remain permanently in each production anchor equal to 110 percent of the required allowable working tension load carrying capacity giving full consideration to all possible losses of the applied post tensioning force.

4. Allow the installation and post tensioning of all production anchors to be witnessed and approved by the Soils Engineer.

5. All anchors to be post tensioned by means of a hydraulic jack.

   a. Post tensioning forces to be determined by both of the following methods:

   b. Measurement of anchor elongation.

      1) Required elongation to be determined from average load elongation curves for type and size of anchors being installed.

c. Observation of post tensioning force indicated on a calibrated gage attached to the hydraulic jack applying the post tensioning force.

1) Discrepancies of more than 5 percent between elongation and gage reading to be investigated and remedied.

2) Movement of the structural system during the application of the post tensioning forces to be taken into account.

3.07 ANCHOR REPORT

A. During the installation of the production anchors, provide an anchor report for each production anchor installed recording for each anchor the following information:

1. Anchor type, manufacturer, diameter and length.
2. Total anchor embedment length into soil and rock, if applicable.
3. Anchor bore hole diameter.
4. Whether or not consolidation grouting or steel casing was required for bore hole.
5. Anchor bond length.
6. Quantity of concrete grout placed in bore hole.
7. Hydraulic jacking force reading at 150 percent of required allowable working tension load carrying capacity with all accompanying anchor movement measurements.
8. Hydraulic jacking force reading at 110 percent of required allowable working tension load carrying capacity.

B. The anchor report to be signed by the Contractor with copies sent to Project Representative.

END OF SECTION

SECTION 31 69 00
FOUNDATION SUBSURFACE DRAIN SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work shall consist of installing foundation subsurface drains where shown in the Plans or where designated by the Project Representative.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 31 21 33- Trenching, Backfilling, and Compacting for Utilities.
   4. Section 31 23 00 - Earthwork.
   5. Section 33 40 00 - Storm Drainage Utilities.
   6. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Clearing and Grading Development Standards – 2010.
      b. Transportation Department - Design Manual - 2011.
      c. Utilities Department - Storm and Surface Water Engineering Standards - 2012.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. M278, Standard Specification for Class PS46 Polyvinyl Chloride (PVC) Pipe.
   3. ASTM International (ASTM):
      a. D3034, Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
      b. ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   4. City of Bellevue:
      a. Clearing and Grading Development Standards – 2010.
      b. Transportation Department - Design Manual - 2011.
      c. Utilities Department - Storm and Surface Water Engineering Standards – 2012.

1.03 SYSTEM DESCRIPTION

A. Recycling and Transfer Station Building Foundation Drainage System:
   1. System of drain pipes adjacent to lower level of Recycling and Transfer Station building with drainage by gravity connecting to into surface water conveyance ditch as shown on Drawings.

B. Wall/Vault Foundation Drainage System:
   1. System which drains by gravity, connects to and drains into surface water conveyance ditch as shown on Drawings.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 - Submittal for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Fabrication and/or layout Drawings:
      a. Layout diagram of drainage system(s).
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Type, size and manufacturer of drain pipe.
      d. Type, size and gradation of filter material.
      e. Type and manufacturer of filter fabric.

C. Quality Assurance Submittals.
   1. Certifications.
   2. Test reports.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Filter fabric:
      a. Mirafi 140N by Mirafi Inc.
      b. Propex 4545 by Amoco Fabrics Co.
      c. Or Approved Equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 UNDERDRAIN PIPE

A. Underdrain Pipe:
   1. Inside diameter: 6 IN and 12 IN as indicated on the Drawings.
   2. Provide fittings so that thickness, weight, material and quality correspond to that of the drain pipe approved for use.
      a. PVC pipe:
         1) ASTM D3034, SDR 35.
         2) Perforations in accordance with AASHTO M278, except perforations not to be greater than 5/16 IN DIA.

B. Gravel Backfill (Filter Material): Graded gravel or crushed stone meeting the following sieve analysis:

SIEVE SIZE	PERCENT PASSING
1 IN	95 - 100
3/8 IN	20 - 85
No.10	0 - 10
No.200	0 - 3

C. Filter Fabric:
   1. Nonwoven polypropylene fabric.
   2. Not less than 4 OZ/SY.
   3. Resistant to the chemical actions of the soil and water and non-biodegradable.
   4. Fabric to prevent the migration of soil particles into the filter material while allowing the free flow of water from the subsoil to the drain pipe.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Lay filter fabric with 12 IN minimum laps at splices.

B. Spread filter material in same direction as fabric overlap.

C. Patch tears and holes in fabric with piece of same fabric material large enough to cover the tear or hole plus a 12 IN overlap.

D. Lay drain pipe lines firmly bedded in filter material to true grades and alignment with invert elevation shown on Drawings.
   1. Unless indicated otherwise on Drawings, install pipes level to point of discharge with perforations down and joints closed.
   2. Make joints with sleeve type couplings or tapered couplings.
   3. Provide couplings suitable for holding pipe firmly in alignment without use of sealing compounds or gaskets.

4. Face bells upgradient away from point of discharge.
5. Use 1/8 bends for change in direction; use Y fittings at intersections.

E. Test drain lines with water to assure free flow before covering.
   1. Remove obstructions and retest until satisfactory.

F. Provide filter material around drain pipes to depths and thicknesses shown on Drawings.
   1. Compact filter material with vibrator tamper to density required to preclude settlement and to avoid damage to drain pipe and to filter fabric.
   2. Prevent damage to foundation.

G. Install standard pipe (non-perforated) to conveyance ditch in accordance with requirements of Specification Section 33 40 00 – Storm Drain Utilities.

END OF SECTION

SECTION 32 12 16
ASPHALTIC CONCRETE VEHICULAR PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work consists of providing and placing asphaltic concrete paving in one or more layers of plant-mixed hot mixed asphalt (HMA) on prepared foundation or base to the lines, grades, thicknesses, and typical cross-sections where shown in the Plans. The manufacture of HMA may include warm mix asphalt (WMA) processes that include organic additives, chemical additives and foaming. HMA shall be composed of asphalt binder and mineral materials as may be required, mixed in the proportions specified to provide a homogeneous, stable, and workable mixture.
   2. Recycled Asphalt Shingles (RAS).

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Transportation Department - Design Manual – January 9, 2013.
   2. King County:
      a. RAS Specification Guidelines - 2010.
      b. King County Roads Design and Construction Standards - 2007.
   3. Washington Department of Transportation (WSDOT):
      a. Standard Operating Procedure (SOP) T 729.
      b. SOP 731.
      c. Test Method T 718.
      d. Test Method 716.
   4. Federal Specifications (FS):
      a. AASHTO R-2005A TS-2c – Standard Recommended Practice for Design Considerations when using Recycled Asphalt Shingles in New Hot Mix Asphalt.
      b. AASHTO M-320 – Standard Specification for Performance Graded Asphalt Binder.

B. Miscellaneous:
   1. Should conflicts arise between standard specifications of government agencies mentioned herein and Contract Documents, Contract Documents shall govern.

1.03 DEFINITIONS

A. Manufactured Shingle Waste: Rejected asphalt shingles or shingle tabs that are discarded in the manufacturing process of new asphalt shingles.

B. Post-Consumer Asphalt Shingle: Asphalt shingles that are removed from the roofs of exiting structures when the new roofs are being installed. Post-consumer asphalt shingle is often called “Tear – Off” shingle.

C. Recycled Asphalt Shingles: Either manufactured shingle waste or post-consumer asphalt shingle that has been processed into a product that meets the requirements of this standard.

D. Shingle Asphalt Binder: The asphalt binder that is present in the recycled asphalt shingle.

E. Shingle Aggregate: Mineral granules, sand, or other mineral matter present in the recycled asphalt shingle, excluding the shingle fiber content.

F. Shingle Fiber: Glass felt, paper felt, foil, fabrics or films used as the structural basis of asphalt shingle and other asphalt roofing products.

G. Virgin asphalt binder: New performance graded asphalt binder to be used in the new hot mix asphalt.

H. Final Blended Binder: The mixture of virgin asphalt binder and shingle asphalt binder.

I. Virgin Aggregate: Coarse and fine aggregate introduced into new hot mix asphalt that is exclusive of the shingle aggregate.

J. New Hot Mix Asphalt: Hot mix asphalt manufactured using aggregates, recycled asphalt pavement, virgin asphalt binder, and recycled asphalt shingle.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. HMA mix design:
      a. The design shall be prepared by the asphalt producer’s laboratory and shall conform to the requirements of this Section.

b. The design shall include test results of the aggregates and proposed batch plant weight and shall be within the specified limits.

3. RAS product test results as specified in Section 3.4 of the 2010 RAS Specification Guidelines:

   a. Include a description of methodology used to determine asphalt content of the RAS.

4. RAS documentation, testing results, reports, and notifications that are generated to verify RAS is free of asbestos containing material (ACM) as specified in section 3.2 of the 2010 RAS Specification Guidelines.

   a. Asbestos survey documentation for each incoming load of roofing material used to produce RAS product.

   b. Load Inspection Forms (Appendix G of 2010 RAS Specification Guidelines) filled out be an Asbestos Hazard Emergency Response Act (AHERA) accredited staff.

   c. Independent accredited asbestos testing laboratory (IAATL) original lab data reports for each load tested.

   d. Notification, if potential ACM has been identified.

C. Quality Assurance Submittals:

1. Material certificates signed by material producer certifying that each material complies with specified requirements.

2. Mix design certification by WSDOT.

3. Paving Contractor:

   a. HMA plant control process plan for incorporation of recycled asphalt pavement (RAP) and RAS into the HMA mix.

   b. Documentation of past experience incorporating RAP and/or RAS into HMA paving.

   c. Documentation demonstrating past experience researching the use of RAS in HMA paving.

   d. A list of key paving personnel and their applicable work experience.

4. Shingle Recycling Operator and its Recycling Facilities:

   a. Shingle Recycling Operator Certification Form (Appendix C of 2010 RAS Specification Guidelines).

   b. Solid Waste Handling Facility Permit or documented exemption.

   c. Verification of AHERA-accredited builder inspector trained staff.

   d. Workplace Accident Prevention Plan.

   e. Detailed Process Report and any supplemental materials as specified in Section 4.3 of the 2010 RAS Specification Guidelines.

   f. Materials Sampling Plan for RAS product.

   g. IAATL certification, sampling and testing instructions, and documentation of the sampling and testing methods.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with Section 01 43 00 – Quality Assurance and Control.

B. Paving Contractor shall demonstrate to the satisfaction of the Project Representative that the Shingle Recycling Operator, Paving Contractor, and designated key personnel have an appropriate level of experience and technical competence to work with RAS material in the production of HMA.

C. Demonstrate the following:
   1. The ability and capacity of the HMA plant proposed for use on this Project to precisely control:
      a. The relative ratio of the RAP percentage by weight.
      b. The relative ratio of the RAS percentage by weight, as these two materials are incorporated into the HMA mix.
   2. Success paving a minimum of 10,000 tons of HMA (either new construction or maintenance overlay), incorporating a minimum of 1,000 tons of Rap, and/or RAS, in the HMA mix, within the last two years.
   3. Experience researching, experimenting, testing, producing, and evaluating each of the following:
      a. RAS Material.
      b. RAS incorporated into HMA mix for paving.
   4. A brief description of the applicable work experience with the elements identified, above, for the following key paving project team members:
      a. Project Manager.
      b. Project Representative, if different than the Project Manager.
      c. Designated HMA Plant Operator.
      d. Designated Asphalt Shingle Recycling Facility Operator.
      e. Paving Lead.

D. Shingle Recycling Operator and Recycling Facility shall meet the requirements and standards of Section 4 of the 2010 RAS Specification Guidelines.

E. RAS Quality Control and Verification Testing:
   1. Quality control and verification testing shall be conducted in accordance with the requirements and standards of Section 3 of the 2010 RAS Specification Guidelines.

PART 2 – PRODUCTS

2.01 MATERIALS

A. HMA:
   1. Aggregate:
      a. General Requirements:
      b. Test Requirements: Aggregate for HMA shall meet the following test requirements.
      c. Grading:
         1) Gradation:
            a) Contractor may furnish aggregates from multiple stockpiles.
            b) Gradation of the aggregates shall be such that the completed mixture complies in all respects of the pertinent requirements of this Section.
            c) Acceptance of aggregate gradation shall be based on samples taken from the final mixture.
         2) Recycled Asphalt Pavement and Mineral Aggregate:
            a) Asphalt concrete planning's or old asphalt concrete utilized in the production of HMA shall be sized prior to entering the mixer so that a uniform and thoroughly mixed HMA is produced in the mixer.
            b) If there is evidence of the old asphalt concrete not breaking down during the heating and mixing of the HMA, the Project Representative may elect to modify the maximum size entering the mixer.
            c) No contamination by deleterious materials will be allowed in the old asphalt concrete used.
         3) The gradation for the new aggregate used in the production of the HMA shall be the responsibility of the Contractor, and when combined with recycled material, the combined material shall meet the requirements of this Section.
      d. Blending Sand:
         1) Blending sand shall be clean, hard, sound material, either naturally occurring sand or crushed fines, and must be material which will readily accept an asphalt coating.
         2) The exact grading requirements for the blending sand shall be such that, when it is mixed with an aggregate, the combined product shall meet the requirements of this Section.
         3) Blending sand shall have a minimum sand equivalent of thirty (30).

e. Mineral Filler:

1) Mineral filler, when used in HMA mix, shall conform to the requirements of AASHTO M 17.

f. HMA Proportions of Materials.

2. Asphalt Binder:

a. Performance grade asphalt binder (PGAB) shall meet the requirements of AASHTO M 320, Table 1 for grade of PG 64-22.

3. Recycled Material:

a. The Contractor shall utilize RAP and RAS in the production of HMA.

b. The RAP content shall be fifteen (15) percent (plus or minus one-half of one percent) of the total aggregate weight, and the amount of the RAS shall be three (3) percent (plus or minus one-half of one percent) of the total weight of the aggregate in the mix.

4. RAS:

a. RAS material shall comply with the requirements and standards of Section 3 of the 2010 RAS Specification Guidelines, including inspection and testing to ensure RAS does not contain ACM.

b. Gradation of Recycled Asphalt Shingle:

1) See Section 3.3.1 of the 2010 RAS Specification Guidelines:

a) Note 3: The hot mix asphalt supplier may wish to uniformly blend fine aggregate with the recycled asphalt shingle as a method of preventing the agglomeration of recycled asphalt shingle particles. The fine aggregate so added must be considered in the final gradation of the new hot mix asphalt.

B. Tack Coat:

1. Tack coat shall be Cationic Emulsified Asphalt, CSS-1 in accordance with the requirements in Table 1.

Table 1
Cationic Emulsified Asphalt, CSS-1 Requirements

Grade	Test Method	Requirements	
		Minimum	Maximum
Viscosity Saybolt Furol S @ 77°F (25°C)	AASHTO T 59	20	100
Storage Stability Test 1 Day %	AASHTO T 59		1
Particle Charge Test	AASHTO T 59	Pos (if inconclusive, material shall have a maximum pH value of 6.7)	
Sieve Test, %	AASHTO T 59		0.10
Cement Mixing Test, %	AASHTO T 59		2.0
Residue, %	AASHTO T 59	57	
Penetration, 77°F (25°C)	AASHTO T 49	100	250

Ductility, 77°F (25°C) 5 cm/min., cm	AASHTO T 51	40	
Solubility in trichloroethylene, %	AASHTO T 44	97.5	

C. Line Paint:
   1. Nonreflective.
   2. White.
   3. FS TT-P-115F.

2.02 MIXES

A. Comply with mix design requirements in this Specification Section.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Construct to lines, grades and sections as shown on Drawings and in accordance with referenced State Specifications.

B. Southeast 30th Street Installation:
   1. Install a 6 IN compacted layer of crushed surfacing base course in accordance with Section 31 23 00 - Earthwork.

   2. Install a 4IN layer of HMA Class 1/2 IN PG 64-22, in accordance City of Bellevue Standard Detail Dev-9.

   3. Install a 6 IN layer of HMA Class 1 IN PG 64-22, in accordance with City of Bellevue Standard Detail Dev-9.

   4. Contractor shall grind and provide minimum 1 IN depth HMA overlay as required to provide smooth road grade.

C. Onsite Installation:
   1. Install a 6 IN compacted layer of crushed surfacing base course in accordance with Section 31 23 00 - Earthwork.

D. Spread a prime coat uniformly on compacted aggregate base course at rate of 0.05 to 0.10 GAL per square yard in accordance with this Specification.

E. Install a 5 IN surface course, in accordance with this Specification.

F. Tolerance of Finished Grade: +0.10 FT from required elevations.

G. Line Painting:
   1. Thoroughly clean surfaces which are to receive paint.
   2. Make completely dry before paint is applied.
   3. Do not paint until minimum of five (5) days has elapsed from time surface is completed.
      a. A longer period may be required if directed by Project Representative.

4. Do not apply paint over wet surfaces, during wet or damp weather, or when temperature is below 40 DegF.
5. Lay out markings and striping in accordance with Drawings.
    a. Width of painted lines: 4 IN.

H. Tack Coat: Apply between binder and surface courses of all asphalt driveways and parking lots.
1. Distribute at rate of one-tenth (0.1) to eighteen hundredths (0.18) gallon per square yard of surface.
2. Allow to dry until at proper condition to receive paving.

3.02 HMA INSTALLATION

A. General Requirements.
1. Construction shall conform to the details, dimensions and grades specified and shown on the Drawings.
2. HMA mixing plants shall be those having established accurate quality control procedures to ensure that the production of mixes conform to the Specifications consistently throughout the job, and meeting the following requirements.
3. Equipment for Preparation of Asphalt Binder:
    a. Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures.
    b. Heating shall be accomplished by steam coils, electricity, or other approved means.
    c. No flame shall be permitted to come in contact with the storage tanks.
    d. The circulating system for the asphalt binder shall be designed to ensure proper and continuous circulation.
    e. An asphalt binder sampling valve shall be located on the storage tank or on the supply line to the mixer.
4. Thermometric Equipment:
        1) An armored thermometer, capable of detecting temperature ranges expected in the HMA mix, shall be fixed in the asphalt binder feed line at a location near the charging valve of the mixer unit.
        2) The thermometer location shall be convenient and safe for access by the Project Representative.
        3) The plant shall be equipped with an approved dial-scale thermometer, a mercury actuated thermometer, an electric pyrometer, or another approved thermometric instrument, placed at the discharge chute of the drier, to automatically register or indicate the temperature of the heated aggregates.
        4) The instrument shall be in full view of the plant operator.

5. Sampling and Testing Mineral Materials:
    a. The HMA plant shall be equipped with a mechanical sampler for the sampling of mineral materials.
    b. The mechanical sampler shall:
        1) Be automatic or semi-automatic.
        2) Be able to safely and easily obtain representative samples.
        3) Be able to convey the samples to ground level.
        4) Move at an even rate through the full width of the materials stream falling from the discharge end of the belt, gate, or chute.
        5) Be power driven during material intercept cycle.
        6) Be adjustable to take samples of approximately one hundred (100) LBS.
    c. Contractor shall provide sufficient space for the setup and operation of the field testing facilities.
6. Sampling HMA:
    a. The HMA plant shall provide for sampling of HMA by one of the following methods:
        1) A mechanical sampling device attached to the HMA plant.
        2) Platforms or devices to enable sampling from the hauling vehicle without entering the hauling vehicle.
7. Hauling Equipment:
    a. Trucks used for hauling HMA shall have tight, clean, smooth metal beds and shall have a cover of canvas or other suitable material of sufficient size to protect the mixture from adverse weather.
    b. Whenever the weather conditions during the workshift include, or are forecasted to include, precipitation or an air temperature less that forty-five (45) DegF, the cover shall be securely attached to protect the HMA.
    c. To prevent HMA adhering to hauling equipment, truck beds shall be sprayed with an environmentally benign release agent.
        1) Excess release agent shall be drained prior to filling the hauling equipment with HMA.
        2) Petroleum derivatives, or other coating material, that contaminate or alter the characteristics of the HMA shall not be used.
        3) For hopper trucks, the conveyer shall be in operation during the process of applying the release agent.

8. HMA Pavers:

    a. HMA pavers shall be self-contained, power-propelled units, provided with an internally heated vibratory screed and shall be capable of spreading and finishing courses of HMA plant mix material in lane widths applicable to the specified typical section and thicknesses shown in the Drawings.

    b. The screed shall be operated in accordance with the manufacturer's recommendations and shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the mixture.

        1) A copy of the paver manufacturer's recommendations shall be provided upon request be the Project Representative.

        2) Extensions shall be allowed provided they produce the same results, including ride, density, and surface texture as obtained by the primary screed.

        3) Extensions without augers and an internally heated vibratory screed shall not be used in the traveled way.

    c. When laying HMA, the paver shall be operated at a uniform forward speed consistent with the plant production rate and roller train capacity to result in a continuous operation.

        1) The auger speed and flight gate opening shall be adjusted to coordinate with the operation.

    d. The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver.

        1) The controls shall be capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals which operate the screed to maintain the desired grade and transverse slope.

        2) The sensor shall be constructed so it will operate from a reference line or a mat referencing device.

    e. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus one tenth (0.1) percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

    f. Manual operation shall be permitted in the construction of irregularly shaped and minor areas.

    g. The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment.

9. Rollers:

    a. Rollers shall be of the steel wheel, vibratory, and/or pneumatic tire type, in good condition, capable of reversing without backlash.

b. Operation of the roller shall be in accordance with manufacturer's recommendations.

c. The number and weight of rollers shall be sufficient to compact the mixture as required in this Section.

d. The use of equipment which results in crushing of the aggregate shall not be permitted.

e. Rollers producing pickup, washboard, uneven compaction of the surface, displacement of the mixture, or other undesirable results shall not be used.

B. Conditioning of Existing Surface:

1. When the surface of the existing pavement is irregular, the Contractor shall bring it to a uniform grade and cross-section as shown on the Drawings or approved by the Project Representative.

2. Pre-leveling of uneven or broken surfaces over which HMA is to be placed may be accomplished by using an asphalt paver, a motor patrol grader, or by hand raking, as approved by the Project Representative

C. Preparation of Existing Surfaces:

1. Before construction of HMA on an existing paved surface:

a. The entire surface of the pavement shall be clean.

b. All fatty asphalt patches, grease drippings, and other objectionable matter shall be entirely removed from the existing pavement.

c. All pavements or bituminous surfaces shall be thoroughly cleaned of dust, soil, pavement grindings, and other foreign matter.

d. All holes and small depressions shall be filled with an appropriate class of HMA.

e. The surface of the patched area shall be leveled and compacted thoroughly.

2. A tack coat of asphalt shall be applied between binder and surface courses of all asphalt driveways and parking lots.

a. Tack coat shall be uniformly applied to cover the existing pavement with a thin film of residual asphalt free of streaks and bare spots.

b. The spreading equipment shall be equipped with a thermometer to indicate the temperature of the tack coat material.

3. Equipment shall not operate on tacked surfaces until the tack has broken and cured.

a. If the Contractor's operation damages the tack coat it shall be repaired prior to placement of the HMA.

4. Unless otherwise approved by the Project Representative, the tack coat shall be CSS-1 emulsified asphalt.

a. The CSS-1 emulsified asphalt may be diluted with water at a rate not to exceed 1-part water to 1-part emulsified asphalt.

b. The tack coat shall not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.

D. Preparation of CSBC Subgrade Surface:
   1. The roadway surface shall be shaped to a uniform grade and cross-section as shown in the Drawings.
      a. The roadway shall be dampened, bladed and rolled until the entire roadway surface shows a uniform grading and conforms to the line, grade, and cross-section shown in the Drawings, or as staked.
      b. During the operation of blading and rolling, water shall be applied, if necessary, in the amount and at the locations designated by the Project Representative.
      c. The entire surface shall be rolled with a smooth-wheeled or pneumatic-tired roller, or both, except that the final rolling shall be accomplished with a smooth-wheeled roller. Rolling shall continue until the entire roadway presents a firm, damp and unyielding surface.

E. Crack Sealing:
   1. All cracks and joints 1/4 IN and greater in width shall be cleaned with a stiff-bristled broom and compressed air and then shall be filled completely with sand slurry.
   2. The sand slurry shall consist of:
      a. Approximately 20-percent CSS-1 emulsified asphalt.
      b. Approximately 2-percent Portland cement.
      c. Water (if required).
      d. The remainder clean U.S. No. 4-0 paving sand.
   3. The sand slurry components shall be thoroughly mixed and then poured into the cracks and joints until full.
   4. The following day, any cracks or joints that are not completely filled shall be topped off with additional sand slurry.
   5. After the sand slurry is placed, the filler shall be struck off flush with the existing pavement surface and allowed to cure.
   6. The HMA overlay shall not be placed until the slurry has fully cured.

F. Heating of Asphalt Binder:
   1. The temperature of the asphalt binder shall not exceed the maximum recommended by the manufacturer.
   2. The asphalt binder shall be heated in a manner that shall avoid local variations in heating.
   3. The heating method shall provide a continuous supply of asphalt binder to the mixer at a uniform temperature plus or minus twenty-five (25) DegF.

G. Preparation of Aggregate:

1. The aggregate shall be removed from stockpile(s) in a manner to ensure a minimum of segregation when being moved to the HMA plant for processing into the final mixture.

2. Mix Design:

   a. The mix design shall be certified by WSDOT.

   b. Prior to production of HMA, the Contractor shall determine a design aggregate structure and asphalt binder content including RAP and RAS in accordance with this Section.

      1) Refer to AASHTO R-2005A TS-2c “Standard Recommended Practice for Design Considerations when using Recycled Asphalt Shingles in New Hot Mix Asphalt” for information on design, determining shingle aggregate gradation and binder considerations.

   c. The Contractor’s mix design shall include 3 percent RAS and 15 percent RAP.

      1) The total asphalt binder contribution from the RAP and RAS shall not exceed 30 percent by mass of the total binder.

      2) If a reduction of RAP, or RAS, is required to remain within the 30 percent requirement, RAP shall be reduced in consultation with the Project Representative.

   d. Once the design aggregate structure and asphalt binder content have been determined, the Contractor shall submit the HMA mix design, demonstrating that the design meets the requirements of this Section.

   e. In no case shall paving begin before the determination of anti-strip requirements has been made.

   f. Changes to the aggregate and asphalt binder require approval from the Project Representative and may require a new mix design submittal from the Contractor.

   g. For aggregate, this shall include changes in the source of material or in a change in the percentage of material from a stockpile greater than five (5) percent.

   h. Asphalt binder changes include the source of the crude petroleum supplied to the refinery, the refining process and additives or modifiers in the asphalt binder.

3. Non-statistical Evaluation:

   b. The Contractor shall submit representative samples of the mineral materials that are to be used in the HMA production.

c. The Owner shall use these samples to determine anti-strip requirements, if any, in accordance with WSDOT Test Method T 718 and will also conduct verification testing of the mix design.

1) Verification testing of HMA mix designs proposed by the Contractor that include RAP will be completed without the inclusion of the RAP. Submittal of RAP samples is not required.

2) A mix design verification report will be provided within twenty-five (25) calendar days after a mix design submittal has been received in the Owner's testing agency.

3) If the results of the verification testing of the mix design by the Owner are within the tolerances in Table 2 the mix design will be considered verified.

Table 2
Job Mix Formula (JMF) Tolerances

Aggregate (Percent Passing)	Nonstatistical Evaluation (%)
1 IN Square, 3/4 IN Square, 1/2 IN Square, and 3/8 IN Square Sieves	± 6
U.S. No. 4 Sieve	± 6
U.S. No. 8 Sieve	± 6
U.S. No. 200 Sieve	± 2.0
Asphalt Binder	± 0.5

VMA: 1.5% below minimum value in Table 4.
VFA: Minimum and Maximum as listed in Table 4.
Va: 2.5% minimum and 5.5% maximum.

d. HMA must have a verified mix design before paving will be allowed.

1) Where HMA mix design did not meet the required tolerances, the Contractor shall have the option to either resubmit a new mix design or proceed to paving an HMA mixture test section.

e. The mix design will be the initial JMF for the class of mix. Any additional adjustments to the JMF will require the approval of the Project Representative and may be made per the following.

1) Aggregates: The maximum adjustment from the approved mix design shall be: two (2) percent for the aggregate passing the 1-1/2 IN Square, 1 IN Square, 3/4 IN Square, 1/2 IN Square, 3/8 IN Square, and U.S No. 4 sieves; one (1) percent for the aggregate passing the U.S No. 8 sieve; and one half (0.5) percent for the aggregate passing the U.S No. 200 sieve.

2) Asphalt Binder Content: The Project Representative may order or approve changes to asphalt binder content. The maximum adjustment from the approved mix design for the asphalt binder content shall be three tenths (0.3) percent.

H. Mixing:

1. After the required amounts of mineral materials and asphalt binder have been introduced into the mixer, the HMA shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the mineral materials is ensured.

2. When discharged, the temperature of the mix shall not exceed the maximum temperature recommended by the asphalt binder manufacturer. A maximum water content of two (2) percent in the mix, at discharge, shall be allowed providing the water causes no problems with handling, stripping, or flushing. If the water in the HMA causes any of these problems, the moisture content shall be reduced as directed by the Project Representative.

3. Storing or holding of the HMA in approved storage facilities shall be permitted during the daily operation, but in no event shall the HMA be held for more than twenty-four (24) HRS. HMA held for more than twenty-four (24) HRS after mixing shall be rejected and disposed of by the Contractor at no expense to Owner. The storage facility shall have an accessible device located at the top of the cone or about the third point to indicate the amount of material in storage. No HMA shall be accepted from the storage facility when the HMA in storage is below the top of the cone of the storage facility, except at the end of the workshift.

4. Acceptance Sampling and Testing:

   a. Acceptance of HMA shall be as provided under non-statistical evaluation.

   b. Samples for acceptance testing shall be obtained by the Contractor as directed by the Project Representative. The Contractor shall sample the HMA mixture in the presence of the Project Representative in accordance with AASHTO T 168.

   c. Definition of Sampling Lot and Sub-lot.

      3) For the purpose of acceptance sampling and testing, a lot is defined as the total quantity of material produced for each JMF placed and represented by randomly selected samples tested for acceptance. All of the test results obtained from the acceptance samples shall be evaluated collectively. Only one lot per JMF will be expected to occur.

      4) The Contractor may request a change in the JMF. If the request is approved, all of the material produced up to the time of the change shall be evaluated on the basis of tests on samples taken from that material and a new lot will begin.

      5) Sampling and testing for non-statistical evaluation shall be performed on the frequency of one (1) sample per sub-lot. Sub-lots shall be approximately uniform in size with a maximum sub-lot size of eight hundred (800) tons.

      6) The quantity of material represented by the final sub-lot may be increased to a maximum of two (2) times the sub-lot quantity calculated.

d. Test Results: The Project Representative shall furnish the Contractor with a copy of the results of all acceptance testing performed in the field at the beginning of the next paving shift.

e. Test Methods: Testing of HMA for compliance of volumetric properties (VMA, VFA, and Va) Shall be by WSDOT SOP 731. Testing for compliance of asphalt binder content shall be by AASHTO T 308. Testing for Compliance of gradation shall be by AASHTO T 27/T 11.

5. The supplier should provide methods to ensure accurate mixing and proportioning of the RAS and RAP into the mix.

6. Addition Rates of Recycled Asphalt Shingle:

a. The addition rate of recycled asphalt shingle shall be such that the gradation of the new hot mix asphalt shall comply with the gradation requirements of this Specification.

1) The gradation of the new hot mix asphalt shall account for the shingle aggregate as well as the virgin aggregate. The shingle aggregate gradation shall be determined in accordance with the procedures outlined in AASHTO M-2005A TS-2c Section 5 or an equivalent method approved by the Project Representative.

b. The addition rate of recycled asphalt shingle shall be such that the new hot mix asphalt shall comply with the volumetric mix design requirements of the specifying jurisdiction.

c. If the total available shingle asphalt binder content expressed as a fraction or percentage of the new hot mix asphalt content is greater than 0.75 percent (see Note 5), the virgin asphalt binder and shingle binder combination shall be further evaluated to ensure that the performance grade of the final blended binder complies with the performance grade requirements of AASHTO M 320, Table 1 for a grade of PG 64-22.

1) The total available shingle asphalt binder content, expressed as a fraction or percentage of the new hot mix asphalt, is the product of the percentage of recycled asphalt shingle introduced into the new hot mix asphalt (P_s) and the percentage of shingle asphalt binder present in the recycled asphalt shingle (P_{sab}).

2) The performance grade and percentage of virgin asphalt binder introduced into the new mix asphalt shall be determined in accordance with the procedures outlined in AASHTO M-2005A TS-2c section 6 of the Specification or an equivalent method approved by the Project Representative.

I. Spreading and Finishing:

1. The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. HMA pavers complying with this Section shall be used to distribute the mixture.

2. Unless otherwise directed by the Project Representative, the nominal compacted depth of any layer of any course shall not exceed:

   a. Three-tenths (0.30) FT for HMA Class1/2 IN.

   b. Thirty five hundredths (0.35) FT for HMA Class 1 IN.

2. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other equipment or by hand.

3. When more than one (1) JMF is being utilized to produce HMA, the material produced for each JMF shall be placed by separate spreading and compacting equipment. Intermingling of HMA produced from more than one (1) JMF is prohibited.

J. Compaction:

1. Immediately after the HMA has been spread and struck off, and surface irregularities have been adjusted, the mix shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, or irregularities and shall conform to the line, grade, and cross-section shown in the Drawings. If necessary, the JMF may be altered to achieve desired results.

2. Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. Areas inaccessible to large compaction equipment shall be compacted by mechanical and hand tampers. Any HMA that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective shall be removed and replaced with new HMA which shall be immediately compacted to conform with the surrounding area.

3. The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided specified densities are attained. An exception shall be that the pneumatic tired roller shall be used between October 1 and April 1. Coverages with a vibratory or steel wheel roller may precede pneumatic tired rolling.

4. Vibratory rollers shall not be operated in the vibratory mode when the internal temperature of the mix is less than one hundred seventy-five (175) degrees F without permission from the Project Representative. In no case shall a vibratory roller be operated in a vibratory mode when checking or cracking of the mat occurs.

K. Compaction Control:

1. HMA used in traffic lanes, including lanes for ramps, truck climbing, weaving, and speed change, and having a specified compacted course thickness greater than one-tenth (0.10) FT, shall be compacted to a specified level of relative density.

2. The specified level of relative density shall be a minimum ninety-one (91.0) percent of the reference maximum density as determined by AASHTO T 209.

3. The specified level of density attained shall be by statistical evaluation of the tests taken in accordance with WAQTC TM 8 and WSDOT SOP T 729 on the day the mix is placed (after compaction of the finish rolling).
4. Each lot shall be divided into five (5) sub-lots. The sub-lot locations shall be determined by the stratified random sampling procedure conforming to WSDOT Test Method Number 716. The quantity represented by each density lot shall be no greater than a single day's production or approximately four hundred (400) tons, whichever is less, except the final lot each day may be increased to a maximum of six hundred (600) tons.
5. The Project Representative shall furnish the Contractor with a copy of the results of all compaction acceptance testing within three (3) working days. Acceptance of HMA compaction shall be based on the statistical evaluation.
6. When cores are taken by the Project Representative at the request of the Contractor, they shall be requested by noon of the next workday after receiving test results. The cores shall be taken at approximately the same locations as the nuclear density gauge tests in the compaction lot being challenged. The cost for the coring expenses, when the core results indicate the specified level of relative density within a lot has not been achieved, shall be deducted from any monies due or that may become due the Contractor under the contract at the rate of one hundred twenty-five dollars ($125) per core.
7. HMA constructed under conditions other than listed above shall be compacted on the basis of a test point evaluation of the compaction train. The test point evaluation shall be performed in accordance with instructions from the Project Representative. The number of passes with an approved compaction train, required to attain the maximum test point density, shall be used on all subsequent paving.
8. HMA for pre-leveling shall be compacted. HMA that is used for pre-leveling wheel rutting shall be compacted with a pneumatic tire roller unless otherwise approved by the Project Representative.

L. Reject HMA:
   1. Rejection Without Testing: The Project Representative may, without sampling, reject any batch, load, or section of roadway that appears defective in gradation or asphalt binder content. Material rejected before placement shall not be incorporated into the pavement. Any rejected section of roadway shall be removed. No payment shall be made for the rejected materials or the removal of the materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected material tested, a minimum of three (3) representative samples shall be obtained and tested. Acceptance of rejected material shall be based on conformance with this Section.

M. Joints:

1. Transverse joints:

    a. The Contractor shall conduct operations such that the placing of top or wearing course is a continuous operation or as close to continuous as possible. Unscheduled transverse joints shall be allowed and the roller may pass over the unprotected end of the freshly laid mixture only when the placement of the course must be discontinued for such a length of time that the mixture will cool below compaction temperature. When the paving is resumed, the previously compacted mixture shall be cut back to produce a slightly beveled edge for the full thickness of the course.

    b. A temporary wedge of HMA constructed on a fifty (50) horizontal to one (1) vertical shall be constructed where a transverse joint is open to traffic. The HMA in the temporary wedge shall be separated from the permanent HMA by strips of heavy wrapping paper. The wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the course prior to resumption of paving.

    c. The material that is cut away shall be waste and new mix shall be laid against the cut. Rollers or tamping irons shall be used to seal the joint.

2. Longitudinal Joints:

    d. The longitudinal joint in any one (1) course shall be offset from the course immediately below by not more than six (6) IN nor less than two (2) IN.

    e. All longitudinal joints constructed in the wearing course shall be located at a lane line or edge line of the traveled way.

N. Surface Smoothness:

1. The completed surface of all courses shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds.

2. The completed surface of the wearing course shall not vary more than one-eighth (1/8) IN from the lower edge of a ten (10) FT straightedge placed on the surface parallel to the centerline.

3. The transverse slope of the completed surface of the wearing course shall vary not more than one-quarter (1/4) IN in ten (10) FT from the rate of transverse slope shown on the Drawings.

4. When deviations in excess of the above tolerances are found that result from a high place in the HMA, the pavement surface shall be corrected by one of the following methods.

    a. Removal of material from high places by grinding with an approved grinding machine.

    b. Removal and replacement of the wearing course of HMA.

    c. By other means as approved by the Project Representative.

5. Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

6. Deviations in excess of the above tolerances that result from a low place in the HMA and deviations resulting from a high place where corrective action, in the opinion of the Project Representative, will not produce satisfactory results may be accepted with a price adjustment.
7. When utility appurtenances such as manhole covers and valve boxes are located in the traveled way, the roadway shall be paved before the utility appurtenances are adjusted to the finished grade.

O. Planing Bituminous Pavement:
1. Planing shall be performed in such a manner that the underlying pavement is not torn, broken, or otherwise damaged by the planning operation. Delamination or raveling of the underlying pavement will not be construed as damage due to the Contractor's operations. Pavement outside the limits shown in the Drawings that is damaged by the Contractor's operations shall be repaired to the satisfaction of the Project Representative, at the Contractor's expense.
2. For mainline planing operations, the equipment shall have automatic controls, with sensors for either or both sides of the equipment. The controls shall be capable of sensing the grade from an outside reference line or a mat-referencing device. The automatic controls shall have a transverse slope controller capable of maintaining the mandrel at the desired transverse slope (expressed as a percentage) within plus or minus 0.1-percent.
3. The planings and other debris resulting from the planning operation shall become the property of the Contractor and be disposed of off-site at no cost to the Owner. The planings may be utilized as RAP, within the requirements of this Section.

P. HMA Road Approaches.
1. HMA approaches shall be constructed at the locations shown in the Drawings, or where staked by the Project Representative. The Work shall be performed in accordance with this Section.

Q. Weather Limitations.
1. Asphalt for prime coat shall not be applied when the ground temperature is lower than fifty (50) degrees F, without written approval of the Project Representative.

2. HMA shall not be placed on any wet surface, or when the average surface temperatures are less than those specified in Table 3, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures.

Table 3
Surface Temperature Limitations

Compacted Thickness (FT)	Wearing Course (DegF)	Other Course (DegF)
Less than 0.10	55	45
0.10 to 0.20	45	35
0.21 to 0.35	35	35
More than 0.35	Not Applicable	25

3. Only on dry Subgrade, not frozen and when air temperature is rising.
4. Weather limitations may be modified as approved by the Project Representative.
5. Tack Coat:
   a. Apply tack coat when ambient temperature is above 50 DegF (10 DegC).
   b. Apply Tack coat when temperature has not been below 35 DegF (1 DegC) for 12 HRS immediately prior to application.
   c. Do not apply tack coat when base is wet or contains an excess of moisture.

3.03 REPAIR

A. The Contractor shall excavate pavement repair areas and shall backfill these areas with HMA.

B. The Project Representative shall determine the excavation depth, which may vary to a maximum depth of one (1) FT. The determination shall depend on the location of material suitable for support of the pavement.

C. The minimum width of any pavement repair area shall be three (3) FT. Before excavation, the existing pavement shall be sawcut or shall be removed by a pavement grinder.

D. Asphalt for tack coat shall be required as specified in this Section. A heavy application of tack coat shall be applied to all surfaces of existing pavement in the pavement repair area.

E. Excavated materials shall become the property of the Contractor for disposal.

F. The Contractor shall conduct the excavation operations in a manner that shall protect the pavement that is to remain. Pavement not designated to be removed that is damaged as a result of the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Project Representative at no cost to the Owner.

G. Placement of HMA backfill shall be accomplished in lifts not to exceed thirty-five-hundredths (0.35) FT compacted depth. Each lift shall be compacted by mechanical tamper or a roller to ninety-one (91) percent of the reference maximum density as determined by AAHTO T209.

3.04 FIELD QUALITY CONTROL

A. General: Testing in-place HMA paving courses for compliance with requirements for compaction, thickness and surface smoothness shall be performed by the Owner's testing laboratory. Repair or remove and replace unacceptable paving as directed by the Project Representative.

B. Thickness: In-place compacted thickness tested in accordance with ASTM D 3549 shall not be acceptable if variations are greater than plus or minus one-quarter (1/4) IN.

C. Surface Smoothness: Test finished surface of each HMA paving course for smoothness, in accordance with this Section.

D. Check surface areas at intervals as directed by the Project Representative.

3.05 PROTECTION

A. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

B. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVEMENT, SIDEWALK AND STEPS

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work consists of constructing concrete pavement, cement concrete driveway entrances, , sidewalk, and steps where shown in the Plans or where designated by the Project Representative.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Testing.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   6. Section 31 23 00 – Earthwork.

C. Payment Adjustment for Deficient Thickness of Concrete Pavement:
   1. A deduction in price shall be made for each lane of concrete pavement 1 block (400 FT) or more in length, or for any lane less than 1 block (400 FT) in total length, if the average concrete pavement thickness, when determined as provided herein, is within 1 IN tolerance but not within the 1/4 IN tolerance permitted.
      a. Payment reduction formula:

Payment = (Contract Price) [-2x(d/ts)x(Contract Price)]

Where d = thickness deficiency determined by coring = ts - ta, but less than 1 IN
ts = design thickness
ta = actual thickness determined by coring

   2. When any core shows a deficiency of more than 1 IN, the length of adjacent pavement deducted, and for which payment shall be withheld, shall be the sum of the distance, measured parallel to the centerline, from the deficient boring to the nearest borings, in both directions, which show a thickness not more than 1 IN deficient.
   3. Deductions in all cases shall be for the full width of the lane which the borings represent.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Transportation Department - Design Manual - 2011.
      b. Utilities Department - Storm and Surface Water Engineering Standards - 2012.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752).
      b. M171, Sheet Materials for Curing Concrete (ASTM C1271).
      c. M182, Burlap Cloth Made from Jute or Kenaf.
      d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) (ASTM D1751).
      e. M224, Use of Protective Sealers for Portland Cement Concrete.
      f. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   3. American Concrete Institute (ACI):
      a. 305R, Hot Weather Concreting.
      b. 306R, Cold Weather Concreting.
   4. ASTM International (ASTM):
      a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
      b. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      c. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
      d. C33, Standard Specification for Concrete Aggregates.
      e. C150, Standard Specification for Portland Cement.
      f. C174, Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
      g. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      h. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
      i. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

j. D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

k. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

l. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

5. Washington State Department of Transportation (WSDOT):

   a. WSDOT Field Operating Procedure (FOP) for WAQTC TM 2 – Sampling Freshly Mixed Concrete.

6. Federal Specification (FS):

   a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.

   b. TT-S 00227 E, Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Mix design(s) in accordance with Specification Section 03 31 30 – Concrete, Materials, and Proportioning and Specification Section 03 05 05 - Testing.
   3. Drawings detailing all reinforcing.
   4. Scaled cross section detail of crown template with dimensions showing off sets from level line.
   5. Concrete pavement joint pattern for paved areas.
   6. Samples: Samples of fabricated jointing materials and devices.

C. Quality Assurance Submittals: Qualifications of concrete installer.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type I or II.

B. Aggregates:
   1. ASTM C33, gradation size #67, 3/4 IN to #4.
   2. Clean, crushed gravel.

C. Water: Potable quality.

D. Admixtures: Comply with Specification Section 03 31 30 - Concrete Mixing, Placing, Jointing, and Curing.

E. Reinforcing Bars: ASTM A615, Grade 60.

F. Welded Wire Reinforcement:
   1. ASTM A185 or ASTM A1064.
   2. Flat.
   3. Clean, free from dirt, scale, rust.

G. Preformed Joint Filler:
   1. Non-extruding cork, self-expanding cork, sponge rubber or cork rubber.
   2. AASHTO M153 or AASHTO M213.

H. Hot-Poured Joint Sealing Material: FS SS-S-1614.

I. Sidewalk Joint Sealant:
   1. Two (2) compound polyurethane.
   2. Class A, Type 1.
   3. Self-leveling.
   4. Non-tracking.
   5. FS TT-S 00227 E(3).

J. Membrane Curing Compound: ASTM C309.

K. Cover Materials for Curing:
   1. Burlap:
      a. AASHTO M182.
      b. Minimum Class 2, 8 0Z material (1 YD x 42 IN).
   2. Polyethylene film, AASHTO M171.

L. Paper Subgrade Cover: Polyethylene film, AASHTO M171.

M. Concrete Treatment:
   1. Boiled linseed oil mixture.
   2. AASHTO M233.

N. Traffic Paint:
   1. Low VOC solvent based paint material requirements are as follows:
      a. Bleeding over asphalt in accordance with ASTM D 969, modified as follows:
         1) The reflectance measurement of the paint over asphalt paper shall be at least ninety (90) percent of the reflectance measurement of the paint over a taped (non-bleeding) surface.
      b. Chromium Content shall be less than fifty (50) parts per million (ppm) in accordance with ASTM D 3718.
      c. Yellow Color paint draw-downs shall be prepared in accordance with ASTM D 823 and the following.
         1) The paint shall match Federal Standard 595a color number 33538 and the tolerance of color variation shall match that shown in the FHWA “Highway Yellow Color Tolerance Chart (PR Color #1)”.
      d. Directional Reflectance in accordance with WSDOT Test Method 314.
         1) White paint shall have a minimum reflectance of eighty (80) percent.
      e. Density shall be eleven and eight tenths (11.8) LBS/GAL minimum in accordance with ASTM D 1475, at seventy (70) degrees
      f. Flexibility shall be in accordance with ASTM D 522 and the following.
         1) The paint shall be applied at a wet film thickness of six (6) mils to a three (3) IN by five (5) IN panel that has been solvent cleaned and lightly buffed with steel wool.
         2) With the panel kept in a horizontal position, the paint shall be allowed to dry for eighteen (18) HRS at seventy-five (75) DegF (plus or minus five (5) DegF) then baked for three (3) HRS at one hundred and forty (140) DegF (plus or minus four (4) DegF).
         3) The panel shall be cooled to seventy-five (75) DegF (plus or minus five (5) DegF) for at least 30 minutes, bent over a one quarter (0.25) IN mandrel and then examined without magnification.
         4) The paint shall show no cracking, flaking, or loss of adhesion.
      g. No Track Time (Dry to No-Pick-Up Time):
         1) The paint, when applied in a line at a rate of fifteen (15) mils wet film thickness with seven (7) LBS of glass beads per gallon of paint added to the paint surface shall “dry to no-pick-up” in ninety (90) seconds maximum.
         2) The test line shall be applied over a thirty (30) day old (approximate), non-beaded state standard paint line.
         3) The test line shall be applied using a striper capable of maintaining the fifteen (15) mil wet film thickness specified.

4) The glass beads shall be blown onto the line during paint application.

5) The test shall be conducted on dry pavement when the pavement temperature is between fifty (50) and one hundred (100) DegF and the relative humidity is less than eighty-five (85) percent.

6) The “dry to no-pick-up” tests shall be performed by having a standard size sedan or equivalent test vehicle coast across the paint line with no turning or accelerating at a speed of approximately forty (40) mph, no more than ninety (90) seconds after the test line is applied to the pavement.

7) A successful test shall be considered one in which at least three (3) out of four (4) line crossings show no visible paint from the line tracked onto the adjacent pavement when viewed standing fifty (50) FT from the point where the test vehicle crossed the line.

h. Lead Content shall be six hundredths (0.06) percent maximum in accordance with ASTM D 3335.

i. Nonvolatile Content shall be sixty-five (65) percent minimum in accordance with ASTM D 2369.

j. Package Stability shall be a six (6) rating minimum for all criteria in accordance with ASTM D 1849.

k. Pigment Content shall be fifty-three (53) percent maximum in accordance with ASTM D 2371.

l. Re-dissolve:

1) A fifteen (15) mil wet film thickness of paint shall be applied to a glass panel.

2) The paint shall be air dried for sixteen (16) HRS at seventy-seven (77) DegF then baked for four (4) HRS at one hundred and forty (140) DegF.

3) The panel shall be cooled to room temperature and placed in a quart container that is half filled with the same paint being tested.

4) The container shall be sealed and left undisturbed for eighteen (18) HRS.

5) After removing the panel from the container, a wooden spatula shall be drawn lightly over the painted surface.

6) The immersed portion of the paint film shall be completely dissolved with no evidence of dried paint remaining on the panel.

m. Retroreflectance:

1) Newly applied pavement markings shall have a minimum initial coefficient of retroreflective luminance of two hundred and fifty (250) mcd/m_2/lux for white and one hundred and seventy-five (175) mcd/m_2/lux for yellow in accordance with ASTM D 6359 when measured with a thirty (30) meter retroreflectometer.

n. Skinning:

1) The paint shall not skin within forty-eight (48) HRS in a three quarter (3/4) filled tightly closed container.

o. Settling properties during storage shall be in accordance with ASTM D 1309 and the following:

1) The sample shall show no more than one half (0.5) IN of clear material over the opaque portion of the paint and there shall be no settling below a rating of seven (7).

p. Titanium Dioxide (Rutile Type II) in accordance with ASTM D 476 and the following:

1) White – 1.0 LBS/GAL minimum (ASTM D 4563).

2) Yellow – 0.2 LBS/GAL maximum (ASTM D 4563).

q. Viscosity in accordance with ASTM D 562 and the following.

1) One hundred and five (105) Krebs units maximum at fifty (50) DegF.

2) Seventy-five (75) to eighty-five (85) Krebs units at seventy (70) DegF.

3) Sixty-five (65) Krebs units minimum at one hundred and twenty (120) DegF.

r. Volatile Organic Compound Content shall be one and one quarter (1.25) LBS/GAL maximum in accordance with ASTM D 3960.

O. Forms:

1. Steel or wood.
2. Size and strength to resist movement during concrete placement and able to retain horizontal and vertical alignment.
3. Free of distortion and defects.
4. Full depth.
5. Metal side forms:

a. Minimum 7/32 IN thick.

b. Depth equal to edge thickness of concrete.

c. Flat or rounded top minimum 1-3/4 IN wide.

d. Base 8 IN wide or equal to height, whichever is less.

e. Maximum deflection 1/8 IN under center load of 1,700 LBS.

f. Use flexible spring steel forms or laminated boards to form radius bends.

2.02 MIXES

A. Mix design to provide 4,000 psi 28-day compressive strength, 1-1/2 IN plus 1 IN slump, 6 percent air.

B. Comply with Specification Section 03 31 30 – Concrete, Materials, and Proportioning and Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.

PART 3 – EXECUTION

3.01 PREPARATION

A. Subgrade Preparation:
   1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
   2. Scarify and recompact top 6 IN of fills and embankments which will be under paved areas.
   3. Remove soft or spongy areas.
   4. Replace with aggregate material.
   5. Compact to the densities identified in Section 31 23 00 - Earthwork.
   6. Assure moisture content is within limits prescribed to achieve required compaction density.
   7. Following compaction, trim and roll to exact cross section.
      a. Check with approved grading template.
   8. Perform density tests on subgrade to determine that subgrade complies with the specification.

B. Aggregate Course:
   1. Place material in not more than 6 IN thick layers.
   2. Spread, shape, and compact all material deposited on the subgrade during the same day.
   3. Compact to 75 percent relative per ASTM D4253 and ASTM D4254.

C. Loose and Foreign Material: Remove loose and foreign material immediately before application of paving.

D. Appurtenance Preparation:
   1. Block out or box out curb inlets and curb returns.
   2. Provide for joint construction as detailed and dimensioned on Drawings.
   3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
      a. Secure to elevation with concrete.
      b. Place concrete up to 5 IN below design grade.

4. Headers:
    a. Construct at open ends of pavements.
    b. Use same concrete to construct headers as that used in the abutting structure.
    c. Extend header full width of pavement and crown same as pavement.
5. Clean and oil forms.

3.02 INSTALLATION

A. Concrete Production: Comply with Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing and Curing.

B. Forms:
1. Form support:
    a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
    b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
    c. Do not use earth pedestals.
2. Staking forms:
    a. Joint forms neatly and tightly.
    b. Stake and pin securely with at least three (3) pins for each 10 FT section.
3. Clean and oil forms prior to placement of concrete.
4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
5. Previously finished concrete pavement, curb or sidewalk contiguous with new work may serve as side form when specifically approved.

C. Reinforcing:
1. Locate longitudinal edge bars between 3 IN and 6 IN from edge of slab.
2. Lap mats one (1) full space.
3. Tie end transverse member of upper mat securely to prevent curving.
4. Lap nonwelded bars 12 IN minimum.
5. Support:
    a. Place bars and heavy mats securely on chairs at called-for height.
    b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Project Representative.

D. Joints:
1. Hold joint location and alignment to within +1/4 IN.

2. Finish concrete surface adjacent to previously placed slab to within +1/8 IN, with tooled radius of 1/4 IN.
3. Metal keyway joints:
    a. Form by installing metal joint strip left in place.
    b. Stake and support like side form.
    c. Provide dowels or tie bars.
4. Weakened plane joints:
    a. Tooled joints:
        1) Form groove in freshly placed concrete with tooling device.
        2) Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
    b. Sawed joints:
        1) Saw 1/4 IN groove in green concrete.
        2) Commence sawing as soon as concrete is hard enough to withstand operation without chipping, spalling or tearing, regardless of nighttime or weather.
        3) Thoroughly wet surface to protect membrane cure and recoat afterward.
        4) Complete saw cutting before shrinkage stresses cause cracking.
    c. Locate at 6 FT intervals.
5. Stake in place load transfer device for expansion joints consisting of dowels:
    a. Supporting and spacing means and premolded joint filler as per Drawing details.
    b. Located at 48 FT intervals and at all intersection curb returns.
    c. Provide preformed joint filler at all junctions with existing curb, sidewalk, steps, or other structures.
6. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
7. Thoroughly clean and fill joints with joint sealing material as specified.
8. Fill joints without overflowing onto pavement surface.
9. Upper surface of filled joint to be flush to 1/8 IN below finish surface.

E. Place Concrete:
1. Comply with Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.
2. Construct driveway openings, ramps, and other features as per Drawing details.

F. Cold and Hot Weather Concreting:
   1. Cold weather:
      a. Cease concrete placing when descending air temperature in shade falls below 40 DegF.
      b. Do not resume until ambient temperature rises to minimum 40 DegF.
      c. If placing below 40 DegF is authorized by Project Representative, maintain temperature of mix between 60 and 80 DegF.
      d. Heat aggregates or water or both.
      e. Water temperature may not exceed 175 DegF.
      f. Aggregate temperature may not exceed 150 DegF.
      g. Remove and replace frost damaged concrete.
      h. Salt or other antifreeze is not permitted.
      i. Comply with ACI 306R.
   2. Hot weather:
      a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DegF.
      b. Aggregates or water or both may be cooled.
      c. Cool water with crushed ice.
      d. Cool aggregates by evaporation of water spray.
      e. Never batch cement hotter than 160 DegF.
      f. Comply with ACI 305R.

G. Finishing:
   1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
   2. Maintain uniform ridge full width with first pass of first screed.
   3. Pavement and similar surfaces:
      a. Float by longitudinally reciprocating float, passing gradually from edge to edge.
      b. Assure successive advances do not exceed half the length of the float.
      c. Test level of slab with minimum 10 FT straightedge.
      d. Fill depressions with fresh material, consolidate and refinish.
      e. Cut down high areas and retest.
      f. Belt surface with two-ply canvas belt, using transverse strokes while advancing along center line.
      g. Provide final finish by full width burlap or carpet drag, drawn longitudinally.

h. Keep drag clean to avoid build up and consequent scarring.

i. Tool pavement edges with suitable edger.

j. Retest with straightedge and if pavement shows deviation of more than 1/8 IN in 10 FT, remove and replace.

4. Sidewalk, steps, ramps, and similar surfaces:

a. Test with 6 FT straightedges equipped with long handles and operated from off the sidewalk.

b. Draw excess water and laitance off from surface.

c. Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.

d. Broom finish after floating.

e. Tool pavement edges with suitable edger.

f. Provide exposed aggregate surfaces in areas indicated on the Drawings.

g. Provide method such as abrasive blasting, bush hammering, or surface retarder acceptable to the Project Representative.

H. Curing:

1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SF per gallon.

2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.

3. Cure for minimum of seven (7) days.

4. When average daily temperature is below 50 DegF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.

5. Linseed oil sealant:

a. For concrete pavement or sidewalk, seal surface with linseed oil.

b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for one (1) month.

c. Apply first application at minimum rate of 67 SY per gallon.

d. Apply second application to a dry surface at minimum rate of 40 SY per gallon.

I. Protection of Concrete:

1. Protect concrete surfaces and appurtenances from traffic for minimum of 14 days.

2. Erect and maintain warning signs, lights, watchmen to direct traffic.

3. Repair or replace parts of concrete surfaces damaged by traffic, or other causes, occurring prior to final acceptance.

4. Protect concrete pavement against public traffic, construction traffic and traffic caused by employees and agents.
5. No equipment shall be driven or moved across concrete surfaces unless such equipment is rubber-tired and only if concrete is designed for and capable of sustaining loads to be imposed by the equipment.
6. Do not drive over new or existing concrete with tracked vehicles and equipment.

J. Painting and Striping:
1. Stripe and mark pavement per the Drawings following sufficient cure time for pavement.
2. Lay out markings with guidelines, templates, and forms.
3. Apply 6 IN wide stripe with self-contained striping machine to a clean and dry pavement surface.
4. Temperature must be above 40 DegF and precipitation should not be expected during drying period.
5. Use yellow or white paint as approved complying with low VOC solvent based paint or low VOC waterborne paint of this Section.
6. Apply at 1 GAL per 105 SF.

K. Opening to Traffic:
1. After 14 days, pavement may, at Project Representative's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 PSI when tested in accordance with ASTM standard methods.
2. Prior to opening to traffic, clean and refill joints as required with the specified filler material.

L. Handrails:
1. Provide handrails where required and as per Drawing details.

M. Clean Up:
1. Assure clean up work is completed within two (2) weeks after pavement has been opened to traffic.
2. No new work will begin until clean up work has been completed, or is maintained within two (2) weeks after pavement has been opened to traffic.

N. Pavement Patching:
1. Comply with material and density requirements as mentioned elsewhere in this Specification except provide minimum 6 IN aggregate immediately below the patch.
2. Place pavement patch providing a thickened edge.
3. Assure that patch in plane of "cold" joint has a thickness 6 IN greater than that of the existing pavement.

4. Extend patch under existing pavement for a distance of 6 IN minimum.
5. Fill void under existing pavement with concrete.
6. Undercut existing pavement 6 IN all around patch and to a depth of 6 IN.
7. Prior to placing patch, sawcut edge of existing concrete to 1/4 depth and remove to provide a vertical face for a straight and true joint.

3.03 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 - Testing and WSDOT FOP for WAQTC TM 2.

B. Pavement Thickness Testing:
   1. General:
      a. Core pavement to determine the actual thickness as directed by Project Representative.
      b. Determine thickness by ASTM C174.
      c. Fill holes from removal of cores with concrete of the same mixture as specified.
      d. Cost incidental to coring of cores showing a deficiency greater than 1/4 IN shall be paid by the Contractor.
      e. Cost of cores showing a deficiency of 1/4 IN or less shall be paid by the Owner.
      f. If average pavement thickness, as directed by core measurement, is outside specified tolerances, payment will be reduced per PART 1 of this Specification Section.
      g. If deficiency in pavement thickness is 1 IN or more, remove and replace pavement at Contractor's expense.
   2. Core categories:
      a. In determining the average thickness of acceptable pavement for which payment will be made, utilize the following core categories:

CATEGORY NUMBER	CORE THICKNESS IN RELATION TO DESIGN	CORE LENGTH USED IN CALCULATING
1	1 IN or more deficiency	NOT USED
2	Less than 1 IN deficiency through 1/2 IN excess	Actual Core Thickness
3	More than 1/2 IN excess	Design Thickness plus 1/2 IN

      b. Core sampling:
         1) Take cores in each lane in each block.
      c. Take cores at locations where the cement content was found to be low when checking the quantities of cement used during the progress of the work.

d. Each separately poured lane of the pavement to be considered as a unit.

e. A lane shall be considered to be the pavement surface between longitudinal construction joints, between a longitudinal construction joint and the edge, or between two (2) pavement edges in cases where the entire width of the pavement is poured in one (1) operation.

f. Should any core show a deficiency in thickness in excess of 1 IN, check cores shall be taken 5 FT on either side of this location parallel to the centerline of the pavement.

g. If both of these cores are within the 1 IN tolerance, no further special borings for this individual zone of deficiency will be made.

h. If either one (1) or both of these cores are not within the 1 IN tolerance, the procedure will be to cut cores in the following order on either side of the original short core parallel to the centerline of the pavement:

    1) 25 FT, the same to be measured from the location of original core found to be deficient in thickness, then at 50 FT intervals until a thickness within the 1 IN tolerance is found in both directions.

    2) On either side of the original deficient core, the procedure will then be to make a coring approximately half the distance within the first core which comes within the 1 IN tolerance.

    3) Repeat the above procedure until the station (+5 FT), at which the pavement comes within the 1 IN tolerance is located.

    4) If for some reason two (2) or more cores are taken at the same station and at least one (1) of them is beyond the 1 IN tolerance, the section of pavement at the station shall be considered as unacceptable.

END OF SECTION

SECTION 32 16 13
CONCRETE CURB AND GUTTER

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work consists of constructing cement concrete curbs, precast wheel stops, curbs and gutters, and gutters of the kind and design specified at the locations where shown in the Drawings or where designated by the Project Representative.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.
   4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   5. Section 03 05 05 - Testing.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Transportation Department - Design Manual - 2011.
      b. Utilities Department - Storm and Surface Water Engineering Standards - 2012.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153,Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
      b. M171, Standard Specification for Sheet Materials for Curing Concrete.
      c. M182, Burlap Cloth Made from Jute or Kenef.
      d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Non-extruding and Resilient Bituminous Types).
      e. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   3. American Concrete Institute (ACI):
      a. 305R, Hot Weather Concreting.
      b. 306R, Cold Weather Concreting.

4. ASTM International (ASTM):
    a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    b. C33, Standard Specification for Concrete Aggregates.
    c. C150, Standard Specification for Portland Cement.
    d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    e. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
    f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
    g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
5. Precast/Prestressed Concrete Institute (PCI):
    a. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
    b. PCI Design Handbook - Precast and Prestressed Concrete.
6. Washington State Department of Transportation (WSDOT):
    a. WSDOT Field Operating Procedure (FOP) for WAQTC TM 2 – Sampling Freshly Mixed Concrete.
7. Federal Specification (FS):
    a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
1. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
2. Mix design(s) in accordance with Specification Section 03 31 30 – Concrete, Materials, and Proportioning and Specification Section 03 05 05 - Testing.
3. Drawings detailing all reinforcing.
4. Shop Drawings and erection plans for precast units, their connections and supports showing:
    a. Member size and location.

b. Size, configuration, location and quantity of reinforcing bars and prestressing strands.

c. Initial prestress forces.

d. Size and location of openings verified by Contractor.

e. Size, number, and locations of embedded metal items and connections.

f. Required concrete strengths.

g. Identification of each unit using same standard marking numbers as used to mark actual units.

5. Test reports:

a. Concrete cylinder test results from field quality control.

6. Samples:

a. Samples of fabricated jointing materials and devices.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Chemical admixtures:

a. Sika Chemical Corporation.

b. BASF Admixtures, Inc.

c. Protex Industries.

d. W. R. Grace and Company.

e. Or Approved Equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 MATERIALS

A. Portland Cement: ASTM C150, Type I or II.

B. Aggregates: ASTM C33, gradation size #67, 3/4 IN to #4.

C. Water: Potable quality.

D. Admixtures: Comply with Specification Section 03 31 30 – Concrete, Materials, and Proportioning.

E. Reinforcing Bars: ASTM A615, Grade 60.

F. Preformed Joint Filler:
1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.

2. AASHTO M153 or AASHTO M213.

G. Hot-Poured Joint Sealing Material: FS SS-S-1614.

H. Membrane Curing Compound: ASTM C309.

I. Cover Materials for Curing:
   1. Burlap:
      a. AASHTO M182.
      b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
   2. Polyethylene film, AASHTO M171.

J. Paper Subgrade Cover: Polyethylene film, AASHTO M171.

K. Concrete Treatment:
   1. Boiled linseed oil mixture.
   2. AASHTO M233.

L. Forms:
   1. Steel or wood.
   2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
   3. Free of distortion and defects.
   4. Full depth.
   5. Metal side forms:
      a. Minimum 7/32 IN thick.
      b. Depth equal to edge thickness of concrete.
      c. Flat or rounded top minimum 1-3/4 IN wide.
      d. Base 8 IN wide or equal to height, whichever is less.
      e. Maximum deflection 1/8 IN under center load of 1,700 LBS.
      f. Use flexible spring steel forms or laminated boards to form radius bends.

2.03 MIXES

A. Mix design to provide 4,000 psi 28-day compressive strength, 1-1/2 IN +1 IN slump, 6 percent air.

B. Comply with Specification Section 03 31 30 – Concrete, Materials, and Proportioning and Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.

2.04 FABRICATION

A. Do not fabricate units until Shop Drawings have been approved by Project Representative and returned to Contractor and support locations have been field verified by Contractor.

B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with both PCI MNL 116 and PCI Design Handbook - Precast and Prestressed Concrete.

C. Cast all members in smooth rigid forms which will provide straight, true members of uniform thickness and uniform color and finish.

D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.

E. Finish all repairs smooth and to match adjacent surface texture and color.

PART 3 – EXECUTION

3.01 PREPARATION

A. Subgrade Preparation:
   1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
   2. Scarify and recompact top 6 IN of fills and embankments which will be under concrete curb and gutters.
   3. Remove soft or spongy areas.
      a. Replace with aggregate material.
      b. Compact to the following densities:
         1) Cohesive soils: 95 percent per ASTM D698.
         2) Noncohesive soils: 75 percent relative per ASTM D4253 and ASTM D4254.
   4. Assure moisture content is within limits prescribed to achieve required compaction density.
   5. Following compaction, trim and roll to exact cross section.
   6. Check with approved grading template.
   7. Perform density tests on subgrade to determine that subgrade complies with the Specification.

B. Aggregate Course:
   1. Place material in not more than 6 IN thick layers.
   2. Spread, shape, and compact all material deposited on the subgrade during the same day.
   3. Compact to 75 percent relative per ASTM D4253 and ASTM D4254.

C. Loose and Foreign Material:
   1. Remove loose and foreign material immediately before application of paving.

D. Appurtenance Preparation:
   1. Block out or box out curb inlets and curb returns.

2. Provide for joint construction as detailed and dimensioned on Drawings.
3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
    a. Secure to elevation with concrete.
    b. Place concrete up to 5 IN below design grade.
4. Clean and oil forms.

3.02 INSTALLATION

A. Comply with Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.

3.03 FORMS

A. Form support:
    1. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
    2. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
    3. Do not use earth pedestals.

B. Staking Forms:
    1. Joint forms neatly and tightly.
    2. Stake and pin securely with at least three (3) pins for each 10 FT section.

C. Clean and oil forms prior to placement of concrete.

D. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.

E. Previously finished pavement or sidewalk contiguous with new work may serve as side form when specifically approved.

F. Reinforcing:
    1. Lap nonwelded bars 12 IN minimum.
    2. Support: Place bars securely on chairs at called-for height.

G. Joints:
    1. Hold locations and alignment to within +1/4 IN.
    2. Finish concrete surface adjacent to previous section to within +1/8 IN, with tooled radius of 1/4 IN.
    3. Expansion joints:
        a. Locate at 48 FT intervals and at all intersection curb returns.
        b. Stake in place load transfer device consisting of dowels.
        c. Supporting and spacing means and premolded joint filler as per Drawing details.

d. Provide preformed joint filler at all junctions with existing curb and gutter or other structures.

4. Contraction joints:
   a. Locate at 6 FT intervals.
   b. Use steel template at least 1/4 IN thick, conforming to cross section of curb and gutter.
   c. Remove template where concrete has set sufficiently to prevent spalling or adhesion of concrete.
   d. If machine placed, use tooled joint formed in freshly placed concrete.
   e. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
6. Thoroughly clean and fill joints with joint sealing material as specified.
7. Upper surface of filled joint to be flush to 1/8 IN below finished surface.

H. Place Concrete:
   1. Comply with Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.
   2. Construct driveway openings, ramps, and other features as per Drawing details.

I. Cold and Hot Weather Concreting:
   1. Cold weather:
      a. Cease concrete placing when descending air temperature in shade falls below 40 DegF.
      b. Do not resume until ambient temperature has risen to 40 DegF.
      c. If placing is authorized below 40 DegF by Project Representative, maintain temperature of mix between 60 and 80 DegF.
      d. Heat aggregates or water or both.
      e. Water temperature may not exceed 175 DegF.
      f. Aggregate temperature may not exceed 150 DegF.
      g. Remove and replace frost-damaged concrete.
      h. Salt or other antifreeze is not permitted.
      i. Comply with ACI 306R.
   2. Hot weather:
      a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DegF.
      b. Aggregates or water or both may be cooled.
      c. Cool water with crushed ice.

d. Cool aggregates by evaporation of water spray.

e. Never batch cement hotter than 160 DegF.

f. Comply with ACI 305R.

J. Finishing:
1. Bring combination curb and gutter to grade by running straightedge over steel templates with sawing motion.
2. Float surface with a wood float to draw cement to surface.
3. Broom finish after floating.
4. Tool edges with suitable edger.
5. Upon removal of forms, fill honeycombed or unevenly filled sections immediately with cement mortar.
6. Precast wheel stops shall be placed on the finished grade surface of cement concrete pavement surface and anchored in place using a rebar pins as shown in the Drawing details or otherwise approved by the Project Representative.
7. Assure that expansion joints are cleared of concrete, both at bottom of gutter and back of curb.

K. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SF per gallon.
2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
3. Cure for 7 days.
4. When average daily temperature is below 50 DegF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.

L. Protection of Concrete:
1. Protect new curb and gutter and its appurtenances from traffic for minimum of 14 days.
2. Repair or replace parts of curb and gutter damaged by traffic, or other causes, occurring prior to final acceptance.

M. Opening to Traffic:
1. After 14 days, area may, at Project Representative's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 LBS/SQ IN when tested in accordance with ASTM standard methods.
2. Prior to opening to traffic, clean and refill joints as required with specified filler material.

N. Clean Up:
   1. Assure clean up work is completed within two (2) weeks after work has been opened to traffic.
   2. No new work will begin until clean up work has been completed, or is maintained within two (2) weeks after work has been opened to traffic.

3.04 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 - Testing and WSDOT FOP for WAQTC TM 2.

B. Causes for rejection of precast units include, but are not necessarily limited to the following:
   1. Cracked units.
   2. Chipped, broken, or spalled edges.
   3. Units not within allowable casting tolerances.
   4. Voids or air pockets which, in opinion of Project Representative, are too numerous or too large.
   5. Non-uniform finish or appearance.
   6. Low concrete strength.
   7. Improperly placed embedded items and/or openings.
   8. Exposed wire mesh, reinforcing or prestressing strands.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCE AND AUTOMATED GATES

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work consists of:
      a. Furnishing and constructing various types of chain link fence and gates of the type specified in the Plans to the lines as staked.
      b. Providing automated North Entrance Road Truck Gate system controlled by automatic vehicle identification (AVI, aka long range RFID) system specified in this Section and controlled by King County access control card reader as per Section 28 34 00 – Electronic Detection, Alarm and Access Control.
      c. Providing automated South Entrance Road gates controlled by King County access control card reader as per Section 28 34 00 – Electronic Detection, Alarm and Access Control.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 09 00 - Concrete.
   4. Division 26 - Electrical.
   5. Division 28 – Electronic Safety and Security.
   6. Section 31 23 00 - Earthwork.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Transportation Department - Design Manual – January 9, 2013.
   2. ASTM International (ASTM):
      a. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
      c. A824, Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain-Link Fence.
      d. F552, Standard Terminology Relating to Chain Link Fencing.
      e. F567, Standard Practice for Installation of Chain-Link Fence.

f. F626, Standard Specification for Fence Fittings.

g. F668, Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.

h. F900, Standard Specification for Industrial and Commercial Swing Gates.

i. F934, Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.

j. F1043, Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.

k. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

3. American Welding Society (AWS).

4. National Fire Protection Association (NFPA):

   a. 70, National Electrical Code (NEC).

5. Underwriters Laboratories, Inc. (UL).

   1) UL 325; Standard for Safety: Door, Drapery, Gate, Louver, and Window Operators and Systems.

   2) UL 991; Tests for Safety-Related Controls Employing Solid-State Devices.

6. Washington Administrative Code.

7. FCC part 15.245, ETS 300 440.

8. Wiegand Interface 37-bit protocol access control.

B. Qualifications:

1. Installer bonded and licensed in the State of Washington.

2. Installer shall have a minimum two (2) years experience installing similar fencing.

3. Utilize only AWS certified welders.

4. Electric gate operators to be UL listed and manufactured by a company specializing in the manufacture of gate operators of the type specified, with a minimum of ten (10) years experience.

5. Grounding by an electrician licensed in the State of Washington.

6. Automatic Vehicle Identification (AVI) (aka long range RFID) and gate access card reader to be installed by certified Software House dealer Simplex Grinnell as per Section 28 34 00 – Electronic Detection, Alarm and Access Control.

1.03 DEFINITIONS

A. See ASTM F552.

B. NPS: Nominal pipe size, in inches.

C. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project Site.
   2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Scaled plan layout showing spacing of components, accessories, fittings, and post anchorage.
   3. For all products in this section, provide installation manual, identify parts of the equipment for future procurement.
   4. Automatic gate system:
      a. Electrical circuitry and control wiring.
      b. Card Access reader at South Entrance Road Gate and North Entrance Road Truck Gate.
      c. Vehicle Detector loops.
      d. Locking plan.
      e. Method of installation of detector loop.
      f. Sealant material for detector loops.
      g. Automatic Vehicle Identification (aka. long range RFID) system for North Entrance Road Gate (Vehicles, North Entrance Road Truck Gate Only).
   5. Underground electrical runs and inductive vehicle obstruction loop locations.
   6. Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator. All underground runs of electrical lines and inductive vehicle obstruction loop locations shall be indicated on drawings. Drawings shall also show the size and location of the concrete mounting pad.
   7. Installation instructions: Submit two copies of manufacturer's installation instructions for this specific project.
   8. Manufacturer’s completed warranty registration.

C. Quality Control Submittals:
   1. Mill certificates.

2. Source quality control test results.

D. Closeout Submittals:
   1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.
   2. Extended Warranty: Provide two (2) executed copies of the Extended Warranties required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.05 COMMISSIONING

A. The Work of this Section shall include the Contractor's labor and materials for participation in the Commissioning Activities (CX) as a Commissioning Team Member (CxT) as required by Section 01 95 00 – Commissioning Requirements.

1.06 EXTENDED WARRANTY

A. In accordance with the provisions of Section 01 78 00 – Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. Chain Link Fence and Gates:
      1) Twenty-five (25) year limited warranty against either color fading or breakage of privacy slats and locking-channel used under normal climactic extremes experienced In the United States.
      2) Fifteen (15) year limited warranty on PVC fence fabric coating against defects in material or workmanship including peeling, blistering, rust, or corrosion.
   2. Gate Operators:
      1) Provide warranty against defects in material and workmanship for a period of five (5) years commencing on the date of Substantial Completion.
      2) Defective materials shall be replaced, including all freight, labor and other incidental costs, with new materials furnished by the manufacturer, at no cost to the Owner.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Fence systems:
      a. Pacific Fence & Wire Co.
      b. Boundary Fence Systems.
      c. Master Halco, Inc.
      d. Or approved equal.

2. Swing Gate:
    a. Pacific Fence & Wire Co.
    b. Master Halco, Inc.
    c. Tymetal Corp.
    d. Or approved equal.
3. Electric gate operators:
    a. Chamberlain Group Inc.
    b. Liftmaster Division.
    c. HySecurity.
    d. Tymetal Corp.
    e. Elite.
    f. Or approved equal.
4. Long Range Radio Frequency Identification (RFID) System:
    1) Tyco Security, Software House, Nedap®Automatic Vehicle Identification System.
    2) No substitutions permitted.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 COMPONENTS

A. Chain Link Fabric:
1. Fabric type:
    a. ASTM A392 zinc-coated steel:
        1) Coated before weaving, 2.0 OZ/SF.
2. Wire gage: 9.
3. Mesh size: 2 IN.
4. Selvage treatment:
    a. Top: Knuckled.
    b. Bottom: Knuckled.

B. Slats:
1. Privacy Slats: Self-locking using horizontal top or bottom channel system.
2. All slats are manufactured from a combination of color pigments, quality high density virgin polyethylene an ultraviolet inhibitors.
3. Color: Forest Green.

C. PVC Coated Fabric:
   1. PVC coated, 6 mil to 10 mil thickness, thermally fused to zinc-coated steel core wire: Per ASTM F668 Class 2b. Core wire tensile strength 75,000 psi.
   2. Color: Black.

D. Concrete: See Specification Section 03 09 00 - Concrete.

E. Line Post:
   1. ASTM F1083 pipe: Schedule 40, NPS 2.

F. Corner or Terminal Posts:
   1. ASTM F1083 pipe: Schedule 40, NPS 2-1/2.

G. Brace and Rails:
   1. ASTM F1083 pipe: Schedule 40, NPS 1-1/4.

H. Tension Wire:
   1. Top and bottom of fabric: ASTM A824, galvanized steel, Class 3.

I. Fence Fittings (Post and Line Caps, Rail and Brace Ends, Sleeves-Top Rail, Tie Wires and Clips, Tension and Brace Bands, Tension Bars, Truss Rods):
   1. ASTM F626.

J. Swing Gate:
   1. ASTM F900.
   2. Materials as specified for fence framework and fabric.
   3. Hardware:
      a. Galvanized per ASTM A153.
      b. Hinges to permit 90-degree inward and 90-degree outward gate opening per location as shown on plans.

K. Electric Gate Operator:
   1. Pre-wired gate operator for swing gates, including all selected attachments, accessory equipment, and mounting brackets.
   2. Gates requiring openers include:
      a. South Entrance Road Double Swing Gate length is 32 FT.
      b. South Entrance Road Single Swing Gate length is 14 FT.
      c. North Entrance Road Truck Double Swing Gate length is 32 FT, bidirectional.
   3. South Entrance Road Double Gate and South Entrance Road Single Gate Operators:
      1) Basis of Design: HySecurity SwingSmart DC20.
      2) Operation shall be by means of a brushed DC electric motor driving a double reduction gear reducer with 600:1 ratio and an articulating arm to rotate from zero to 90 degrees.

3) The closing action of the articulating arm shall cause the gate to be mechanically locked in place without the use of externally operated electric or mechanical locks.

4) The opening and closing cycle times will vary depending on gate size and weight, from 10 seconds to 15 seconds.

5) The output of the gear reducer shall be protected from excessive torque loads by means of an adjustable breakaway torque limiter which can also function as an emergency means of opening the gate.

6) The gear reducer shall be filled with synthetic lubricant capable of allowing operation down to -25˚DegC (-13˚DegF) without a heater.

7) Operator shall operate in the event of a power failure in an uninterruptible power supply mode to the extent the two 8Ah batteries can maintain adequate power.

8) Gate Capacity: 800 LB (363 kg) or better.

9) Standard mechanical components shall include as a minimum:

   a) Two piece linear low density polyethylene cover with locking toggle action latches. Access to electronics does not require removal of gate arm linkage.

   b) Articulating linkage for actuation of gate with covers to protect bystanders from pinch hazards and provision to bolt linkage as well as weld linkage. Spherical connection at gate.

   c) SmartTouch control board. All circuit boards to be conformal coated to resist moisture induced failures.

   d) Frame to be constructed of 1/4 IN thick steel plate, welded.

   e) Finish: Frame to be zinc plated. Other components zinc plated or non-corroding.

   f) Easily adjustable limit switches to limit travel in each direction.

4. North Entrance Road Truck Double Gate Operator:

   1) Basis of Design: HySecurity SwingRiser 19 twin.

   2) Operation shall be by means of a hydraulic cylinder acting upward in a steel post assembly to cause the post and the gate panel to rotate from zero to 90 degrees without the use of articulating arms, screw drives or mechanical devices.

   3) The closing action of the gate panel shall cause the free end of the gate to be mechanically locked in place without the use of externally operated electric or mechanical locks.

   4) The opening and closing cycle times will vary depending on gate size and weight, from 14 seconds to 30 seconds.

   5) The opening action of the gate panel shall allow the gate to rise approximately twelve (12) IN and clear adjacent curbs or obstructions.

6) The post assembly shall be fully enclosed and not offer any openings for foreign material to enter.

7) Actuator assembly shall be supported on non-lubricated synthetic bearing surfaces.

8) Bearings providing rotation and lift to the actuator assembly shall be permanently lubricated cam followers. (Note: Degree of swing is built in at the factory and cannot be changed in the field).

9) Standard mechanical components shall include as a minimum:

   a) Indexing arm to allow precise closing adjustment.

   b) 2-1/4 IN industrial quality sealed cam followers.

   c) Drop bolt-locking device or post-locking device.

   d) NEMA 3R electric enclosure for electric controls, hydraulic pump and valves.

10) Finish: Electrical Enclosure is gray polyester powder coat over galvanized steel. Actuator post is pure zinc metallic flame spray equivalent to hot dip galvanizing.

11) NEMA 4R limit switches to limit travel in each direction.

12) Hydraulic hand pump for emergency operation.

13) Hoses shall be 1/4 IN, rated to 2,750 working psi.

14) Hose fittings at valve block and at actuator post assembly, shall be quick disconnect type.

15) High performance hydraulic fluid with a viscosity index greater than 375.

16) Minimum standard electrical components: Industrial grade.

17) Contact sensitive gate edge on the inside and outside of the leading edge of all gate panels.

18) Three (3) loops for each access point: Outside Obstruction, Inside Obstruction and Free Exit.

19) Photo eye across the lane and behind any panel the will create a pinch point of less the 16 IN.

5. Electric Motor:

   1) For South Entrance Road Single and Double Swing Automated Gates:

      a) 1/2 HP, 56C, 115-120 VAC, 1-phase, 60 Hz, 1,750 RPM or 3,400 RPM depending on application, TEFC, continuous duty motor with a minimum service factor of 1.15. Re-use existing electrical conduits from panel in Scalehouse.

2) For North Entrance Road Truck Automated double Gate:

a) 2 HP, 56C, 208 VAC, 3-phase, 60 Hz, 1,750 RPM or 3,400 RPM depending on application, TEFC, continuous duty motor with a minimum service factor of 1.15.

6. All components shall have overload protection.
7. Controls: Smart Controller Board containing:
   a. Inherent entrapment sensor (IES).
   b. Built in “warn before operate” system.
   c. Built in timer to close.
   d. Liquid crystal display for reporting of functions.
   e. Twenty-four (24) programmable output relay options.
   f. Built-in power surge/lightning strike protection.
   g. Menu configuration, event logging and system diagnostics easily accessible with a PC and manufacturer’s software:
      1) RS232 port for connection to laptop or other computer peripheral and RS485.
      2) Connection of Master/Slave systems or network interface.
   h. Transformer: 250 VA, dual voltage , non-jumpered taps, for all common voltages.
   i. Accessory Power: 12 VDC, 24 VDC.
8. Required external sensors: See 1.05B. Specify photo eyes or gate edges or a combination thereof to be installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
9. Control devices: Radio control, access control card readers, vehicle detectors, key-switch (emergency only).
10. Long Range Radio Frequency Identification System:
    1) The AVI System is to be comprised of a long distance standard TRANSIT reader and tags and, when used with the C•CURE 800/8000 system, provides a highly secure and convenient long range security solution.
    2) The TRANSIT long-range vehicle identification reader to have a built-in antenna and a wide variety of interfaces to ensure seamless and flexible integration. The reader to quickly identify Nedap AVI tags from distances of up to 10 meters (33 FT) with vehicles traveling at speeds up to 200 km/h (125 MPH).
    3) The TRANSIT reader operates at an operating frequency of 2.438 to 2.457 GHz. Each TRANSIT reader has 32 channels (138 channels) with 600 kHz spacing. This frequency offset enables you to set up to 32 readers in close proximity to each other at these different frequencies without interference.

4) The TRANSIT reader to be in weatherproof protected housing IP65 (NEMA 4x). The reader will continue to operate reliably under harsh environmental conditions such as rain, snow and ice.

5) RFID Reader: The Reader shall be a self-contained cover that includes a Radio Frequency (RF) module, digital signal processor (DSP), antenna, input/output (I/O) ports and serial communications interface.

   a) The Readers shall be placed so that each Reader reads one lane of entry / exit.

   b) The Readers shall use Radio Frequency Identification (RFID) technology and communicate with transponders (ID-Tags) that can be fixed to vehicles.

   c) Readers shall be able to detect ID-Tags within 10-200ms depending on speed and distance. Communications between Reader and transponder shall be secure.

   d) All entry / exit information must be able to be recorded to an embedded Software database, tracking the time of entry / exit.

   e) Reader must operate within the limits established by the FCC part 15 without the need for a site license.

   f) Reader must be listed and in compliance with UL 60950-1 Second Edition.

   g) The Reader shall have a flexible supply voltage (10 to 30 VDC). The average power consumption shall be as low as 5 W with maximum peaks of 15 W.

   h) Listed or Certified, Class 2 or LPS (Limited Power Source) suitable for outdoor use, rated 24V DC.

   i) 1A and Class 2 wiring required.

   j) The TRANSIT reader interfaces with the host system via Wiegand 37-bit interface without use of converters.

   k) It shall be possible to configure and to control the Reader via TCP/IP communication using any standard web browser.

   l) It shall be possible to configure Readers automatically using scripts on USB memory stick.

   m) Reader must incorporate integral mounting flanges.

   n) Reader Enclosure:

      i Reader enclosure to be made of metal to provide shielding from RF interference.

      ii The Reader shall be a self-contained device, with a minimum weather proof, polycarbonate and stainless steel encapsulation conforming to IP66.

iii The Reader shall be ventilated to avoid water condensation.

iv The Reader shall be mounted according to VESA 75mm standard and can be mounted horizontally or vertically.

v The operating temperature shall be -22 DegF (-30 DegC) to +140 DegF (+60 DegC).

vi Wall mounting set to include pole mounting set and with weather proof protection hood.

6) Tag: Long range, lithium powered tags programmed with random numbers in a 37-bit Wiegand format and to feature an integrated mounting device to provide ease of installation.

a) Provide Project Representative with 200 heavy duty tags.

b) Heavy Duty Tag – for applications requiring long-range identification in a harsh environment. The tag is weather, shock and vibration proof and can withstand chemicals.

c) Operating Frequency: 2.400-2.483 GHz.

d) Nominal Read/Write Range: 70 FT (21 m).

e) Typical Read/Write Range: 50 FT (15 m).

f) Physical Dimensions: 4.92 x 1.74 x 1.13 IN (12.5 x 4.42 x 2.87 cm).

g) Weight: 4.17 OZ (118 g).

h) Operational Temperature: -40 to +185 DegF (-40 to +85 DegC).

i) Service Life: 8 years to 10 years (nominal).

j) Battery Type: Lithium battery.

k) Mounting holes must be reinforced with metal to allow for attachment by rivets or bolts without cracking or deforming the tag enclosure.

l) Tag Identification numbers must be able to match customer defined numbering sequence.

m) Tag identification number must be programmable and able to be re-programmed by customer.

n) Tags must rated for outdoor use and be ultrasonically welded to prevent entry of water and foreign debris.

o) Tags must have rewritable memory for application storage which can be written at equal distance as the tags are read.

7) Antenna:

a) Specified for RFID reader and tag for a complete RFID system.

b) Durable, UV stabilized ABS with rugged design for outdoor use.

c) Integral mounting holes.

d) Small footprint and low profile for unobtrusive installations.

e) Very low wind load rating.

f) Multiple mounting kits available.

2.03 SOURCE QUALITY CONTROL

A. Test related fence construction materials to meet the following standards:
   1. Posts and rails: ASTM F1043, Heavy Industrial.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with:
   1. Manufacturer's instructions.
   2. Lines and grades shown on Drawings.
   3. ASTM F567.

B. Do not start fence installation before final grading is complete and finish elevations are established.

C. Drill holes in firm, undisturbed or compacted soil.

D. Place fence with bottom edge of fabric at maximum clearance above grade, as shown on Drawings.
   1. Correct minor irregularities in earth to maintain maximum clearance.

E. Space line posts at equal intervals not exceeding 10 FT OC.

F. Provide post braces for each gate, corner, pull and terminal post and first adjacent line post.

G. Install tension bars full height of fabric.

H. Rails:
   1. Fit rails with expansion couplings of outside sleeve type.
   2. Rails continuous for outside sleeve type for full length of fence.

I. Provide expansion couplings in top rails at not more than 20 FT intervals.

J. Anchor top rails to main posts with appropriate wrought or malleable fittings.

K. Install bracing assemblies at all end and gate posts, as well as side, corner, and pull posts.
   1. Locate compression members at mid-height of fabric.
   2. Extend diagonal tension members from compression members to bases of posts.

3. Install so that posts are plumb when under correct tension.

L. Pull fabric taut and secure to posts and rails.
   1. Secure so that fabric remains in tension after pulling force is released.
   2. Secure to posts at not over 15 IN OC, and to rails at not over 24 IN OC, and to tension wire at not over 24 IN OC.
   3. Use U-shaped wire conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two (2) full turns.
   4. Bend ends of wire to minimize hazards to persons or clothing.

M. Install post top at each post.

N. Automated Gates:
   1. Construct with fittings or by welding.
   2. Provide rigid, weatherproof joints.
   3. Assure right, non-sagging, non-twisting gate.
   4. Coat welds with rust preventive paint, color to match pipe.

O. Install electric gate operator as follows:
   1. Install gate operator in accordance with manufacturer instructions.
   2. Coordinate locations of operators with contract drawings; other trades and shop drawings.
   3. Installer shall ensure that the service to the operator is at least 15 Amps.
   4. Electrical wiring to conform to NEC (NFPA 70) and manufacturer's installation instructions.

3.02 FIELD QUALITY CONTROL

A. Provide Gate Operator Manufacturer field services Engineer for testing. Test gate operators through ten (10) full cycles and adjust for operation without binding, scraping or uneven motion. All anchor bolts shall be fully concealed in finished installation.

B. Provide Tyco Security Software House Certified Dealer Simplex Grinnell manufacturer representative, as per Section 28 34 00 – Electronic Detection, Alarm and Access Control, for installation of Automatic Vehicle Identification (AVI) (aka Long Range RFID) system, RFID and automated gate control interface, and for access control card reader and automated gate interface. Provide 4 HRS of demonstration of the AVI complete system and 4 HRS of training for operation and maintenance of AVI and automated gates as an access control system.

C. Provide training for automated gates and accessories operation and maintenance, minimum duration of training 4 HRS.

END OF SECTION

SECTION 32 31 16
WELDED WIRE SWING GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metallic-coated-steel, welded-wire swing gates for the Household Hazardous Waste Exterior Covered Barrel Storage Area.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.02 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Leadership in Energy and Environmental Design (LEED®) Documentation: Submit the following in accordance with Section 01 81 30 – Sustainability Requirements:
   1. Product Data for MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content; include statement indicating costs for each product having recycled content.
   2. Product Data for MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   3. LEED Materials Tracking Form: Form to be provided in an electronic format to the Contractor to record LEED materials used on the project.

C. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Product data sheet on each component included in the system
   2. Shop Drawings:
      a. Scaled drawing to include plans, elevations, sections, details, and attachments to other work.
         1) Minimum plan scale: 1/8 IN = 1 FT.
         2) Minimum detail scale: 1-1/2 IN = 1 FT.

3. Samples:
    a. Finish and color samples for each product specified for Project Representative's preliminary color selection.

D. Quality Assurance Submittals:
    1. Fabricator qualifications.
    2. Installer qualifications.

E. Closeout Submittals:
    1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Ametco Manufacturing Corporation (www.ametco.com).
    2. Grating Pacific (www.gratingpacific.com).
    3. Master Halco (www.masterhalco.com).
    4. Metalco Fence & Railing Systems; Atlantis Products, Inc. (www.metalco.com).
    5. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 MATERIALS:

A. Swing Gates:
    1. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes 2 IN by 2 IN formed from 0.108 IN nominal-thickness, metallic-coated steel sheet or formed from 0.105 IN nominal thickness steel sheet and hot-dip galvanized after fabrication.
    2. Infill: Welded-wire fence fabric matching adjacent fence, plain rectangular weave:
        a. Metallic-coated-steel wire.
        b. Spacing of Vertical Wires: 3 IN.
        c. Vertical Wire Size: 1/4 IN.
        d. Spacing of Horizontal Wires: 1 IN.
        e. Horizontal Wire Size: 1/4 IN DIA wires encasing vertical wires and spaced at 8 IN.

3. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 FT wide. Provide center gate stops for pairs of gates.
    a. Swing Gate to fitted with panic bar.
    b. Hinges: Provide 2 hinges for each leaf up to 6 FT in height and 1 additional hinge for each additional 24 IN in height or fraction thereof.

B. Metallic-Coated-Steel Finish: High-performance coating.

2.03 COMPONENTS

A. Metallic-Coated-Steel Wire: Welded-wire fence fabric, hot-dip galvanized after fabrication. Weight of zinc coating shall be not less than 1.0 OZ/SF.

B. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.

2.04 METALLIC-COATED-STEEL FINISHES

A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a zinc-phosphate conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

C. Powder Coating: Epoxy prime coat and TGIC polyester topcoat, with a minimum dry film thickness of 2 mils for topcoat and a total dry film thickness of 4 mils.
    1. Color and Gloss: As selected by Project Representative from manufacturer's full range.
    2. Comply with surface finish testing requirements in ASTM F 2408.

D. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Apply at spreading rates recommended by coating manufacturer.
    1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 – EXECUTION

3.01 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

END OF SECTION

SECTION 32 32 23
STRUCTURAL EARTH WALLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Work shall consist of furnishing and construction of a Structural Earth Wall retaining wall system in accordance with these specifications and as shown on the Construction Drawings.
   2. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the Construction Drawings.
   3. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the Construction Drawings.

B. Related Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Section 31 23 00 - Earthwork.

C. Completely coordinate with work of other trades.

1.02 QUALITY ASSURANCE

A. Sampling and Testing Concrete Masonry Units: ASTM-C140.

B. Manufacturer: Company licensed to manufacturer modular concrete units.

C. Installer must have experience, facilities, equipment, and personnel to complete work promptly and in a manner that will provide satisfactory results.

D. Owner will hire an independent soils laboratory to conduct in place moisture and density tests.

E. Comply with manufacturer's standard guideline Specifications.

F. Specific proprietary requirements included in this Section, below.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Before fabrication, the Contractor shall submit a field construction manual for the structural earth walls, prepared by the wall manufacturer, to the Project Representative for approval. This manual shall provide step-by-step directions for construction of the wall system.

2. Detailed design calculations and Working Drawings to the Project Representative for approval. If not prepared by the license/patent holder for the structural earth system, the design calculation and Working Drawing submittal shall include documentation that the design calculation and Working Drawing submittal has been reviewed by, and received the concurrence of, the headquarters organization of the structural earth wall manufacturer as identified in the Special Provisions. Review and concurrence by a sales representative office is not acceptable.

C. Quality Assurance Submittals:
   1. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units and specific geogrid):
      a. Has been successfully utilized on a minimum of five (5) similar projects, (i.e., height, soil fill types, erection tolerances)
      b. Has been successfully installed on a minimum of 1 million (1,000,000) SF of retaining walls.
   2. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully.
      a. Contact names and telephone numbers shall be listed for each project.
      b. Provide evidence that the design engineer has a minimum of five years of documentable experience in the design for reinforced soil structures.
   3. Furnish a Manufacturer's Certificate of Compliance certifying that the structural earth wall materials conform to the specified material requirements. This includes providing a Manufacturer's Certificate of Compliance for all concrete admixtures, cement, fly ash, steel reinforcing bars, reinforcing strips, reinforcing mesh, tie strips, fasteners, welded wire mats, backing mats, construction geotextile for wall facing, drainage geosynthetic fabric, block connectors, and joint materials. The Manufacturer's Certificate of Compliance for geogrid reinforcement shall include the following information for each geogrid roll:
      a. Manufacturer's name and current address.
      b. Full product name.
      c. Geosynthetic structure, including fiber/yarn type.
      d. Geosynthetic Polymer type (for all temporary and permanent geosynthetic retaining walls only).
      e. Geosynthetic roll number(s).
      f. Geosynthetic lot number(s).
      g. Proposed geosynthetic use(s).
      h. Certified test results.

4. A copy of all test results performed by the Contractor or the Contractor's supplier, which are necessary to ensure compliance with the Specifications, shall be submitted to the Project Representative along with each Manufacturer's Certificate of Compliance.

1.04 DESIGN CALCULATIONS

A. The design calculation submittal shall include detailed design calculations based on the wall geometry and design parameters specified in the Drawings and Specifications. The calculations shall include detailed explanations of any symbols, design input, materials property values, and computer programs used in the design of the walls. All computer output submitted shall be accompanied by supporting hand calculations detailing the calculation process. If MSEW 3.0, or a later version, is used for the wall design, hand calculations supporting MSEW are not required.

B. The design calculations shall be based on the current AASHTO LRFD Bridge Design Specifications, including current interims, the current WSDOT Bridge Design Manual LRFD (BDM), and the WSDOT Geotechnical Design Manual (GDM), and also based on the following:
   1. The wall design calculations shall address all aspects of wall internal stability for the service, strength, and extreme event limit states.
   2. The wall surcharge conditions (backfill slope) shown in the Drawings.
   3. A 2 FT surcharge shall be used in the design in any SEW adjacent to an road or parking area utilized by vehicular traffic.
   4. If the Drawings detail traffic barrier or metal beam guardrail on top of or adjacent to the wall, the barrier and guardrail shall be designed for a minimum TL-2 impact load, unless otherwise specified in the Drawings or Special Provisions, and the wall shall be designed for the impact load transferred from the barrier to the wall.
   5. If the Drawings detail pedestrian barrier or security fence on top of or adjacent to the wall, the barrier and the fence shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications and the wall shall be designed for the impact load transferred from the barrier and fence to the wall.
   6. The Contractor shall provide all necessary details for traffic barrier, metal beam guardrail, pedestrian barrier, and security fence installation on top of or adjacent to SEW's.
   7. The geotechnical design parameters for the wall shall be as specified herein.
   8. The soil reinforcement length shall be as shown in the Drawings. If the Drawings do not show a length, the length shall be either 6 FT, 0.7 times the wall design height H, or the length determined through the Contractor's design, whichever is greater.

C. If there are differences in design requirements between the AASHTO LRFD Bridge Design Specifications and the BDM or GDM, the BDM and GDM requirements shall govern.

D. The design calculations shall be performed under the guidance of and sealed by a Professional Engineer licensed to practice in the state of Washington.

1.05 WORKING DRAWINGS

A. All design details shown in the Working Drawings shall be selected from the design details and products specified for the specific structural earth wall manufacturer in the Preapproved Wall Appendix in the current WSDOT Geotechnical Design Manual (GDM). Geosynthetic reinforcement shown in the Working Drawings shall be selected from the products listed in this Specification.
   1. Submit request for substitution in accordance with Specification Section 01 60 00.

B. The Working Drawing submittal shall include all details, dimensions, quantities, and cross sections necessary to construct the wall based on the wall geometry and design parameters specified in the Drawings and Specifications, and shall include, but not be limited to, the following items:
   1. A plan and elevation sheet or sheets for each wall, containing the following:
      a. An elevation view of the wall that includes the following:
         1) The elevation at the top of the wall, at all horizontal and vertical break points, and at least every 50 FT along the wall.
         2) Elevations at the base of welded wire mats or the top of leveling pads and foundations, and the distance along the face of the wall to all steps in the welded wire mats, foundations, and leveling pads.
         3) The designation as to the type of panel, block, or module.
         4) The length, size, and number of geogrids or mesh or strips, and the distance along the face of the wall to where changes in length of the geogrids or mesh or strips occur.
         5) The length, size, and wire sizes and spacing of the welded wire mats and backing mats, and the distance along the face of the wall to where changes in length, size, and wire sizes and spacing of the welded wire mats and backing mats occur.
         6) The location of the original and final ground line.
      b. A plan view of the wall that indicates the offset from the construction centerline to the face of the wall at all changes in horizontal alignment; the limit of the widest module, geogrid, mesh, strip, or welded wire mat, and the centerline of any drainage structure or drainage pipe that is behind or passes under or through the wall.
      c. General notes, if any, required for design and construction of the wall.
      d. All horizontal and vertical curve data affecting wall construction.
      e. A listing of the summary of quantities provided on the elevation sheet of each wall for all items, including incidental items.

f. A cross section showing limits of construction. In fill sections, the cross section shall show the limits and extent of select granular backfill material placed above original ground.

g. Limits and extent of reinforced soil volume.

2. All details, including steel reinforcing bar bending details.

3. All details for foundations and leveling pads, including details for steps in the foundations or leveling pads.

4. All modules and facing elements shall be detailed. The details shall show all dimensions necessary to construct the element, all steel reinforcing bars in the element, and the location of reinforcement element attachment devices embedded in the precast concrete facing panel or concrete block.

5. All details for construction of the wall around drainage facilities, sign, signal, luminaire, and noise barrier wall foundations, and structural abutment and foundation elements shall be clearly shown.

6. All details for connections to and installation of traffic barriers, metal beam guardrail, security fence, or pedestrian barriers, on top of or adjacent to the wall shall be shown.

C. The Working Drawings shall be created under the guidance of and sealed by a Professional Engineer licensed to practice in the state of Washington.

1.06 SOIL CHARACTERISTICS

A. The following geotechnical design parameters shall be used for the design of the structural earth wall(s) Wall 1B and Wall 2:

Soil Properties	Wall Backfill	Retained Soil	Foundation Soil
Unit Weight (pcf)	130	125	130
Friction Angle (deg)	36	30	34
Cohesion (psf)	0	0	0

1. For the Service Limit State, the wall shall be designed to accommodate a differential settlement of 0.5 IN per 100 FT of wall length.

2. For the Extreme Event I Limit State, the wall shall be designed for a horizontal seismic acceleration coefficient kh of 0.48g and a vertical seismic acceleration coefficient ky of 0.0g.

a. Additional geotechnical information is provided in the Revised Geotechnical Data Report prepared by Shannon and Wilson, Inc. provided as Available Information only, see Section 01 10 00 – Summary of Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification has been received.

B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations.
   1. Damaged materials shall not be incorporated into the work.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Concrete block faced structural earth walls shall be constructed of only one of the following wall systems. The Contractor shall make arrangements to purchase the concrete blocks, soil reinforcement, attachment devices, joint filler, and all necessary incidentals from the source identified with each wall system:
   1. Mesa Wall (a registered trademark of Tensar Corporation), Tensar Corporation, 2500 Northwinds Parkway Suite 500, Atlanta, GA 30009, (770) 334-2090, FAX (678) 281-8546, www.tensarcorp.com.
   2. KeySystem I Wall (a registered trademark of Keystone Retaining Wall Systems, Inc.), Keystone Retaining Wall Systems, Inc., 4444 West 78th Street, Minneapolis, MN 55435, (952) 897-1040, FAX (952) 897-3858, www.keystonewalls.com.
   3. Allan Block Wall (a registered trademark of the Allan Block Corporation), Allan Block Corporation, 5300 Edina Industrial Blvd., Suite 100, Edina, MN 55439, (800) 899-5309, (FAX (952) 835-0013, www.allanblock.com.
   4. Or Approved Equal.

B. Geosynthetic soil reinforcement shall be in accordance with these Specifications and compatible with the selected wall system.

2.02 MODULAR CONCRETE BLOCK UNITS

A. Concrete for dry cast concrete blocks shall meet the following requirements:
   1. Have a minimum 28-day compressive strength of 4,000 psi.
   2. Conform to ASTM C 1372, except as otherwise specified.
   3. The lot of blocks produced for use in this project shall conform to the following freeze-thaw test requirements when tested in accordance with ASTM C 1262. Minimum acceptable performance shall be defined as weight loss at the conclusion of 150 freeze-thaw cycles not exceeding 1 percent of the block's initial weight for a minimum of four of the five block specimens tested.
   4. The concrete blocks shall have a maximum water absorption of 1 percent above the water absorption content of the lot of blocks produced and successfully tested for the freeze-thaw test specified in item 3 above.

B. Precast concrete blocks will be accepted based on successful compressive strength tests and visual inspection at the jobsite. The precast concrete blocks shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength conforms to the 28-day requirements and when the visual inspection is satisfactorily completed. Testing of dry cast concrete blocks shall conform to ASTM C 140.

C. All concrete blocks shall be manufactured within the following tolerances:
   1. Vertical dimensions shall be + 1/16 IN of the Plan dimension and the rear height shall not exceed the front height.
   2. The dimensions of the grooves in the top and bottom faces of the concrete blocks shall be formed within the tolerances specified by the proprietary wall manufacturer, for the fit required for the block connectors.
   3. All other dimensions shall be + 1/4 IN of the Plan dimension.

D. Tie attachment devices, except for geosynthetic reinforcement, shall be set in place to the dimensions and tolerances shown in the Drawings prior to casting.

E. The forms forming the concrete blocks shall be removed in accordance with the recommendations of the wall manufacturer, without damaging the concrete.

F. The concrete surface for the front face of the concrete block shall be flat, and shall be a conventional “split face” finish in accordance with the wall manufacturer’s Specifications. The finish and appearance of the concrete blocks shall also conform to ASTM C 1372. The color of the concrete block shall be concrete gray, unless otherwise shown in the Drawings.

G. The date of manufacture, production lot number, and the piece-mark, shall be clearly marked or tagged on each pallet of concrete blocks.

H. All precast concrete blocks shall be handled, stored, and shipped to prevent chipping, cracks, fractures, and excessive stresses.

2.03 MORTAR

A. Mortar shall conform to ASTM C 270, Type S, with an integral water repellent admixture as approved by the Project Representative. The amount of admixture shall be as recommended by the admixture manufacturer. To ensure uniform color, texture, and quality, all mortar mix components shall be obtained from one manufacturer for each component, and from one source and producer for each aggregate.

2.04 BACKFILL FOR CONCRETE BLOCK FACED STRUCTURAL EARTH WALL

A. All backfill material within the structural earth wall reinforced zone shall be free draining, free from organic or otherwise deleterious material.

B. Backfill material within the reinforced zone shall conform to the following requirements for grading and quality (percentages by weight):

Sieve Size	Percent Passing
1 1/2 IN	99% to100%
1 IN	90% to 100%
No. 4	50% to 80%
No. 40	30% max.
No. 200	7.0% max.
Sand Equivalent	50% min.

C. All material within the structural earth wall reinforced zone shall be substantially free of shale or other soft, poor durability particles, and shall not contain recycled materials, such as glass, shredded tires, Portland Cement concrete rubble, or asphaltic concrete rubble. The material shall meet the following aggregate durability requirements:

Property	Test Method	Allowable Test Value
Los Angeles Wear, 500 rev.	AASHTO T 96	35 percent max.
Degradation	WSDOT Test Method 113	15 percent min.

D. For walls with metallic soil reinforcement, all material within the structural earth wall reinforced zone shall meet the following chemical requirements:

Property	Test Method	Allowable Test Value
Resistivity	WSDOT Test Method 417	3,000 ohm-cm, min.
pH	WSDOT Test Method 417	5 to 10
Chlorides	AASHTO T 291	100 ppm max.
Sulfates	AASHTO T 290	200 ppm max.

E. If the resistivity of the backfill material equals or exceeds 5,000 ohm-cm, the specified chloride and sulfate limits may be waived.

F. For walls with geogrid soil reinforcement, all material within the structural earth wall reinforced zone shall meet the following chemical requirements:

Property	Test Method	Allowable Test Value
pH	WSDOT Test Method 417	4.5 to 9

G. Wall backfill material satisfying these gradation, durability, and chemical requirements shall be classified as nonaggressive.

2.05 GEOSYNTHETIC SOIL REINFORCEMENT

A. Geosynthetic soil reinforcement shall be in accordance with this Section and compatible with the selected wall system.

B. Geogrids shall consist of a regular network of integrally connected polymer tensile elements with an aperture geometry sufficient to permit mechanical interlock with the surrounding backfill. The long chain polymers in the geogrid tensile elements, not including coatings, shall consist of at least 95 percent by mass of the material of polyolefins or polyesters. The material shall be free of defects, cuts, and tears.

C. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high density polyethylene.
   1. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 Meg/m and a carboxyl end group values less than 30.
   2. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.

D. Manufacturing Quality Control:
   1. The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.
   2. The QC testing shall include:
      a. Tensile Strength Testing.
      b. Melt Flow Index (HOPE).
      c. Molecular Weight (Polyester).

E. Acceptable Products and associated design parameters:
   1. Tensar Earth Technologies, Inc., Atlanta, GA.
   2. Strata Systems, Inc., Cumming, GA.
   3. Linear Composites Ltd, Chattanooga, TN.
   4. Synteen Technical Fabrics, Inc., Lancaster, SC.
   5. TenCate (Mirafi), Pendergrass, GA.
   6. Luckenhaus Technical Textiles, Martinville, VA.
   7. Or Approved Equal.

F. Acceptable Products with Long-term and Ultimate Strengths of Geosynthetic Products Qualified for Use in non-aggressive environments:
   1. Acceptability of the product requires that the approved long-term geosynthetic strength as listed in the table below meet or exceed the required long-term strength specified in the design. The ultimate tensile strength listed in the table below is to be used for lot specific acceptance once the product arrives at the Project Site.

Product	**T_{ult}[1] (lb/ft)**	**Long-Term Strength Reduction Factors**			**[2]Long-Term Tensile Strength, T_{al} (lb/ft)**	**[3]Low Strain Creep Stiffness, $_{J2\%}$ (lbs/ft)**
		RFID	**RFCR**	**RFD**		
Miragrid 2XT, MD - TenCate	2000	1.12	1.45	1.3	947	11000
Miragrid 3XT, MD - TenCate	3500	1.12	1.45	1.3	1660	19200
Miragrid 5XT, MD - TenCate	4700	1.12	1.45	1.3	2230	25800
Miragrid 7XT, MD - TenCate	5900	1.12	1.45	1.3	2790	32400
Miragrid 8XT, MD -	7400	1.12	1.45	1.3	3510	40700

TenCate						
Miragrid 10XT, MD - TenCate	9500	1.12	1.45	1.3	4500	52200
Miragrid 20XT, MD - TenCate	13705	1.12	1.45	1.3	6490	75300
Miragrid 22XT, MD - TenCate	20559	1.12	1.45	1.3	9740	113000
Miragrid 24XT, MD - TenCate	27415	1.12	1.45	1.3	13000	151000
ParaGrid 30/05, MD – Linear Composites	3425	1.1	1.39	1.3	1723	20200
ParaGrid 40/05, MD – Linear Composites	4110	1.1	1.39	1.3	2068	23600
ParaGrid 50/05, MD – Linear Composites	4452	1.1	1.39	1.3	2240	25300
ParaGrid 60/05, MD – Linear Composites	4795	1.1	1.39	1.3	2412	27000
ParaGrid 65/05, MD – Linear Composites	5479	1.1	1.39	1.3	2756	30400
ParaGrid 70/05, MD – Linear Composites	6164	1.1	1.39	1.3	3101	33700
ParaGrid 80/05, MD – Linear Composites	6849	1.1	1.39	1.3	3446	37100
ParaGrid 90/05, MD – Linear Composites	7534	1.1	1.39	1.3	3790	40500
ParaGrid 100/05, MD – Linear Composites	8562	1.1	1.39	1.3	4307	45600
ParaGrid 110/05, MD – Linear Composites	10274	1.1	1.39	1.3	5169	54000
ParaGrid 125/05, MD – Linear Composites	11986	1.1	1.39	1.3	6030	62500
ParaGrid 150/05, MD – Linear Composites	12329	1.1	1.39	1.3	6203	64200
ParaGrid 175/05, MD – Linear Composites	13699	1.1	1.39	1.3	6892	70900
ParaGrid 180/05, MD – Linear Composites	3425	1.1	1.39	1.3	1723	20200
ParaGrid 200/05, MD – Linear Composites	4110	1.1	1.39	1.3	2068	23600
Raugrid 3x3N, MD	2055	1.1	1.55	1.3	927	6750

- Luckenhaus						
Raugrid 4x2N, MD - Luckenhaus	2740	1.1	1.55	1.3	1236	10300
Raugrid 5x2N, MD - Luckenhaus	3425	1.1	1.55	1.3	1545	13800
Raugrid 6x3N, MD - Luckenhaus	4110	1.1	1.55	1.3	1854	17200
Raugrid 8x3N, MD - Luckenhaus	5480	1.1	1.55	1.3	2472	23800
Raugrid 11x3N, MD - Luckenhaus	7535	1.1	1.55	1.3	3399	33000
Raugrid 13x3N, MD - Luckenhaus	8905	1.1	1.55	1.3	4018	38700
Raugrid 15x3N, MD - Luckenhaus	10275	1.1	1.55	1.3	4636	44100
SF20, MD - Synteen	1939	1.18	1.58	1.3	800	8390
SF35, MD - Synteen	3055	1.18	1.58	1.3	1260	11900
SF55, MD - Synteen	4199	1.18	1.58	1.3	1732	15600
SF80, MD - Synteen	7398	1.18	1.58	1.3	3052	29800
SF90, MD - Synteen	8500	1.18	1.58	1.3	3507	30900
SF110, MD - Synteen	10207	1.18	1.58	1.3	4211	37600
SF350, MD - Synteen	27400	1.18	1.58	1.3	11305	124000
SG150, MD - Stratagrid	1875	1.1	1.5	1.3	874	8530
SG200, MD - Stratagrid	3600	1.1	1.5	1.3	1678	26500
SG350, MD - Stratagrid	5000	1.1	1.5	1.3	2331	42400
SG500, MD - Stratagrid	6400	1.1	1.5	1.3	2984	20500
SG550, MD - Stratagrid	8150	1.1	1.5	1.3	3800	31100
SG600, MD - Stratagrid	9100	1.1	1.5	1.3	4242	35600
SG700, MD - Stratagrid	11800	1.1	1.5	1.3	5501	37600
Tensar UX1400MSE MD	4800	1.12	2.59	1.1	1504	26100
Tensar UX1500MSE MD	7810	1.1	2.59	1.1	2492	41000
Tensar UX1600MSE MD	9870	1.1	2.59	1.1	3149	53800
Tensar UX1700MSE, MD	11990	1.1	2.63	1.1	3768	69100
Tensar UX1400HS MD	4800	1.12	2.59	1.1	1504	26100
Tensar UX1500HS MD	7810	1.1	2.59	1.1	2492	41000

Tensar UX1600HS MD	9870	1.1	2.59	1.1	3149	53800
Tensar UX1700HS, MD	11990	1.1	2.63	1.1	3768	69100

2. Tult is determined using ASTM D6637 for geogrids and ASTM D4595 for geotextiles. The value provided in the table represents the manufacturer's Minimum Average Roll Value (MARV) or minimum value for the product. Acceptance test results for the product as delivered to the project must be greater than or equal to this value.
3. Tal is determined at a design life of 75 years and is based on the MARV or minimum value for Tult provided in this table.
4. J2% is the creep stiffness determined at a strain level of 2 percent after 1,000 HRS of loading, based on the MARV or minimum value for Tult provided in this table.
5. RFID = installation damage reduction factor, RFCR = creep reduction factor, RFD = durability reduction factor.
6. MD = Machine Direction (longitudinal direction), XMD = Cross Machine Direction (transverse direction).

2.06 DRAIN PIPE

A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM 03034.

2.07 ADDITIONAL REQUIREMENTS FOR PROPRIETARY WALL SYSTEMS

A. KeySystem I Wall:
   1. Reinforcing strips shall be composed of welded wire fabric strips conforming to AASHTO M 55 with wire conforming to AASHTO M 32, and attached to block connector plates conforming to ASTM A 36. Reinforcing strips and block connector plates shall be galvanized after fabrication in accordance with AASHTO M 111. Damage to galvanizing shall be repaired with one coat of approved galvanizing repair paint.
   2. Block alignment pins shall be fiberglass conforming to the requirements of Keystone Retaining Wall Systems, Inc.
   3. Block connector pins shall conform to AASHTO M 32, and shall be galvanized after fabrication in accordance with AASHTO M 111.

B. MESA WALL - Tensar Geogrid Materials:
   1. The values of T_{al} and T_{ult} as listed for the products used shall meet or exceed the values required for the wall manufacturer's reinforcement design as specified in the structural earth wall design calculation and working Drawing submittal.
   2. The minimum ultimate tensile strength of the geogrid shall be a minimum average roll value (the average test results for any sampled roll in a lot shall meet or exceed the values shown herein. The strength shall be determined in accordance with ASTM D 6637, for multi-rib specimens.

3. The ultraviolet (UV) radiation stability, in accordance with ASTM D 4355, shall be a minimum of 70 percent strength retained after 500 HRS in the weatherometer.
4. The longitudinal (i.e., in the direction of loading) and transverse (i.e., parallel to the wall or slope face) ribs that make up the geogrid shall be perpendicular to one another. The maximum deviation of the cross-rib from being perpendicular to the longitudinal rib (skew) shall be no more than 1 IN in 5 FT of geogrid width. The maximum deviation of the cross-rib at any point from a line perpendicular to the longitudinal ribs located at the cross-rib (bow) shall be 0.5 IN.
5. The gap between the connector and the bearing surface of the connector tab cross-rib shall not exceed 0.5 IN. A maximum of 10 percent of connector tabs may have a gap between 0.3 IN and 0.5 IN. Gaps in the remaining connector tabs shall not exceed 0.3 IN.
6. The Contractor shall take random samples of the geogrid materials at the job site for quality control testing at the independent testing laboratory identified in the field construction manual as approved by the Engineer. Unless otherwise approved by the Project Representative, the Contractor shall take all geogrid test samples in the presence of the Project Representative. The Contractor shall submit the geogrid test samples to the independent testing laboratory identified in the field construction manual as approved by the Project Representative, for testing. A copy of the results of all job control testing completed by the independent testing laboratory shall be submitted to the Project Representative within 30 calendar days of the submittal of the samples to the laboratory.
7. Approval of the geogrid materials will be based on testing of samples from each lot. A “lot” shall be defined as all geogrid rolls sent to the project site produced by the same manufacturer during a continuous period of production at the same manufacturing plant having the same product name.
8. The geogrid samples will be tested for conformance to the specified material properties. If the test results indicate that the geogrid lot does not meet the specified properties, the roll or rolls which were samples will be rejected. Two additional rolls for each roll tested which failed from the lot previously tested will then be selected at random by the Project Representative for sampling and retesting. If the retesting shows that any of the additional rolls tested do not meet the specified properties, the entire lot will be rejected. If the test results from all the rolls retested meet the specified properties, the entire lot minus the roll(s) which failed will be accepted.
9. All geogrid materials which have defects, deterioration, or damage, as determined by the Project Representative, will be rejected. All rejected geogrid materials shall be replaced at no expense to the Owner.
10. The geogrid materials shall not be exposed to temperatures less than –20 DegF and greater than 122 DegF.

11. Block connectors for block courses with geogrid reinforcement shall be glass fiber reinforced high-density polypropylene conforming to the following minimum material Specifications:

Property	Specification	Value
Polypropylene	ASTM D 4101 Group 1 Class 1 Grade 2	73 ± 2 percent
Fiberglass Content	ASTM D 2584	25 ± 3 percent
Carbon Black	ASTM D 4218	2 percent minimum
Specific Gravity	ASTM D 792	1.08 ± 0.04
Tensile Strength at yield	ASTM D 638	8,700 ± 1,450 psi
Melt Flow Rate	ASTM D 1238	0.37 ± 0.16 ounces/10 min.

12. Block connectors for block courses without geogrid reinforcement shall be glass fiber reinforced high-density polyethylene (HDPE) conforming to the following minimum material Specifications:

Property	**Specification**	**Value**
HDPE	ASTM D 1248 Type III Class A Grade 5	68 ± 3 percent
Fiberglass Content	ASTM D 2584	30 ± 3 percent
Carbon Black	ASTM D 4218	2 percent minimum
Specific Gravity	ASTM D 792	1.16 ± 0.06
Tensile Strength at yield	ASTM D 638	8,700 ± 725 psi
Melt Flow Rate	ASTM D 1238	0.11 ± 0.07 ounces/10 min.

C. Allan Block Wall:
1. Wall backfill material placed in the open cells of the precast concrete blocks and placed in the one to 3 FT zone immediately behind the precast concrete blocks shall conform to the following gradation requirements:

Sieve Size	Percent Passing
1 IN	99% to100%
3/4 IN	80% to 100%
3/8 IN	0% to 40%
No. 4	0% to 4%
No. 200	0% to 2%

2. Geogrid reinforcement shall be a product listed above. The values of T_{al} and T_{ult} as listed above for the products used shall meet or exceed the values required for the wall manufacturer's reinforcement design as specified in the structural earth wall design calculation and Working Drawing submittal.
3. The minimum ultimate tensile strength of the geogrid shall be a minimum average roll value (the average test results for any sampled roll in a lot shall meet or exceed the values shown above). The strength shall be determined in accordance with ASTM D 6637, for multi-rib specimens.
4. The ultraviolet (UV) radiation stability, in accordance with ASTM D 4355, shall be a minimum of 70 percent strength retained after 500 HRS in the weatherometer.
5. The Contractor shall take random samples of the geogrid materials at the job site for quality control testing at the independent testing laboratory identified in the field construction manual as approved by the Engineer.. Unless otherwise approved by the Project Representative, the Contractor shall take all geogrid test samples in the presence of the Project Representative. The Contractor shall submit the geogrid test samples to the independent testing laboratory identified in the field construction manual as approved by the Project Representative, for testing. A copy of the results of all job control testing completed by the independent testing laboratory shall be submitted to the Project Representative within 30 calendar days of the submittal of the samples to the laboratory.
6. Approval of the geogrid materials will be based on testing of samples from each lot. A "lot" shall be defined as all geogrid rolls sent to the project site produced by the same manufacturer during a continuous period of production at the same manufacturing plant having the same product name.
7. The geogrid samples will be tested for conformance to the specified material properties. If the test results indicate that the geogrid lot does not meet the specified properties, the roll or rolls which were samples will be rejected. Two additional rolls for each roll tested which failed from the lot previously tested will then be selected at random by the Project Representative for sampling and retesting. If the retesting shows that any of the additional rolls tested do not meet the specified properties, the entire lot will be rejected. If the test results from all the rolls retested meet the specified properties, the entire lot minus the roll(s) which failed will be accepted.
8. All geogrid materials which have defects, deterioration, or damage, as determined by the Project Representative, will be rejected. All rejected geogrid materials shall be replaced at no expense to the Owner.
9. The geogrid materials shall not be exposed to temperatures less than 20 DegF and greater than 122 DegF.

PART 3 – EXECUTION

3.01 EXCAVATION AND FOUNDATION PREPARATION

A. Contractor shall excavate to the lines and grades shown on the Construction Drawings.
   1. Project representative shall inspect the excavation and approve prior to placement of leveling material or fill soils.
   2. Proof roll foundation area as directed to determine if remedial work is required.

B. Over excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Project Representative.

C. The foundation for the Structure shall be graded for a width equal to or exceeding the length of reinforcing as shown in the structural earth wall Working Drawings as approved by the Project Representative. Prior to wall construction, the foundation, if not in rock, shall be compacted as approved by the Project Representative.

D. At the foundation level of the bottom course of precast concrete blocks, an unreinforced concrete leveling pad shall be provided as shown in the Drawings. The leveling pad shall be cured a minimum of 12 HRS and have a minimum compressive strength of 1,500 psi before placement of the precast concrete facing panels or concrete blocks.

3.02 PRECAST CONCRETE BLOCK ERECTION

A. Concrete blocks shall be erected in a running bond fashion in accordance with the wall manufacturer's field construction manual, and may be placed by hand. The top surface of each course of concrete blocks, including all pockets and recesses, shall be cleaned of backfill and all extraneous materials prior to connecting the reinforcing strips or geosynthetic reinforcing, and placing the next course of concrete blocks. Concrete blocks receiving geosynthetic reinforcement shall be connected as specified by the manufacturer or herein. Cap block top courses shall be bonded to the lower course of concrete blocks as specified below. All other concrete blocks shall be connected with block connectors or pins placed into the connector slots.

B. Precast concrete blocks shall be placed in successive horizontal lifts as backfill placement proceeds in the sequence shown in the structural earth wall Working Drawings as approved by the Project Representative.

C. Place the front of blocks side-by-side. Do not leave gaps between adjacent blocks.
   1. Layout of corners and curves shall be in accordance with manufacturer's recommendations.

D. Reinforcing shall be placed normal to the face of the wall, unless otherwise shown in the Drawings or directed by the Project Representative. Prior to placement of the reinforcing, backfill shall be compacted.

E. Geosynthetic reinforcing shall be placed in accordance with Paragraph 3.04 of this Specification and as follows:
   1. The Contractor shall stretch out the geosynthetic in the direction perpendicular to the wall face to remove all slack and wrinkles, and shall hold the geosynthetic in place with soil piles or other methods as recommended by the geosynthetic manufacturer, before placing backfill material over the geosynthetic to the specified cover.
   2. The geosynthetic reinforcement shall be continuous in the direction perpendicular to the wall face from the back face of the concrete panel to the end of the geosynthetic or to the last geogrid node at the end of the specified reinforcement length. Geosynthetic splices parallel to the wall face will not be allowed.

F. At the completion of each course of concrete blocks and prior to installing any block connectors or geosynthetic reinforcement at this level, the Contractor shall check the blocks for level placement in all directions, and shall adjust the blocks by grinding or rear face shimming, or other method as recommended by the structural earth wall manufacturer's representative and as approved by the Project Representative, to bring the blocks into a level plane.

G. For concrete block wall systems receiving a cap block top course, the cap blocks shall be bonded to the lower course either with mortar, or with an adhesive capable of bonding the concrete block courses together.

3.03 SPECIFIC ERECTION REQUIREMENTS FOR PRECAST CONCRETE BLOCK FACED STRUCTURAL EARTH WALLS

A. Mesa Wall:
   1. For all concrete block courses receiving geogrid reinforcement, the fingers of the block connectors shall engage the geogrid reinforcement apertures, both in the connector slot in the block, and across the block core. For all concrete block courses with intermittent geogrid coverage, a #3 steel reinforcing bar shall be placed, butt end to butt end, in the top block groove, with the butt ends being placed at a center of a concrete block.

3.04 BACKFILL

A. Backfill placement shall closely follow erection of each course of welded wire mats and backing mats, or concrete blocks. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the welded wire mats and backing mats, or concrete blocks. Backfill shall be placed in a manner that segregation does not occur. Construction equipment shall not operate directly on the wall reinforcement. A minimum backfill thickness of 6 IN over the reinforcement shall be required prior to operation of vehicles or equipment.

B. The Contractor shall place wall backfill over geosynthetic reinforcement, or construction geotextile for wall facing, in accordance the following:
   1. The area to be covered by the geosynthetic shall be graded to a smooth, uniform condition free from ruts, potholes, and protruding objects such as rocks or sticks. The geosynthetic shall be spread immediately ahead of the covering operation. The geosynthetic shall not be left exposed to sunlight during installation for a total of more than 14 calendar days. The geosynthetic shall be laid smooth without excessive wrinkles. Under no circumstances shall the geosynthetic be dragged through mud or over sharp objects which could damage the geosynthetic. The cover material shall be placed on the geosynthetic such that the minimum initial lift thickness required will be between the equipment tires or tracks and the geosynthetic at all times. Construction vehicles shall be limited in size and weight, to reduce rutting in the initial lift above the geosynthetic, to not greater than 3 IN deep to prevent overstressing the geosynthetic. Turning of vehicles on the first lift above the geosynthetic will not be permitted.
   2. Soil piles or the manufacturer's recommended method, shall be used as needed to hold the geosynthetic in place until the specified cover material is placed.
   3. Should the geosynthetic be torn, punctured, or the overlaps or sewn joints disturbed, as evidenced by visible geosynthetic damage, Subgrade pumping, intrusion, or Roadbed distortion, the backfill around the damaged or displaced area shall be removed and the damaged area repaired or replaced by the Contractor at no expense to the Owner. The repair shall consist of a patch of the same type of geosynthetic placed over the damaged area. The patch shall overlap the existing geosynthetic from the edge of any part of the damaged area by the minimum required overlap for the application.
   4. If geotextile seams are to be sewn in the field or at the factory, the seams shall consist of one row of stitching unless the geotextile where the seam is to be sewn does not have a selvage edge. If a selvage edge is not present, the seams shall consist of two parallel rows of stitching, or shall consist of a J-seam, Type SSn-1, using a single row of stitching. The two rows of stitching shall be 1.0 IN apart with a tolerance of plus or minus 0.5 IN and shall not cross except for restitching. The stitching shall be a lock-type stitch. The minimum seam allowance, i.e., the minimum distance from the geotextile edge to the stitch line nearest to that edge, shall be 1 1/2 IN if a flat or prayer seam, Type SSa-2, is used. The minimum seam allowance for all other seam types shall be 1.0 IN. The seam, stitch type, and the equipment used to perform the stitching shall be as recommended by the manufacturer of the geotextile and as approved by the Project Representative.
   5. The seams shall be sewn in such a manner that the seam can be inspected readily by the Project Representative. The seam strength will be tested and shall meet the requirements stated herein.

C. Misalignment or distortion of the precast concrete blocks due to placement of backfill outside the limits of this Specification shall be corrected in a manner as approved by the Project Representative.

D. Reinforced backfill shall be compacted to 95 percent of the maximum density as determined by ASTM D698.
   1. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, ±3 percent.
   2. In the top 2 FT, horizontal layers shall not exceed 4 IN in depth before compaction. No layer below the top 2 FT shall exceed 8 IN in depth before compaction.
   3. For wall systems with geosynthetic reinforcement, the minimum compacted backfill lift thickness of the first lift above each geosynthetic reinforcement layer shall be 6 IN.
   4. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.
   5. The Contractor shall not use sheepsfoot rollers or rollers with protrusions for compacting backfill reinforced with geosynthetic layers, or for compacting the first lift of backfill above the construction geosynthetic for wall facing for each layer of welded wire mats. Rollers shall have sufficient capacity to achieve compaction without causing distortion to the face of the wall in accordance with the tolerances specified.
   6. The Contractor shall compact the zone within 3 FT of the back of the wall facing panels without causing damage to or distortion of the wall facing elements (welded wire mats, backing mats, construction geotextile for wall facing, precast concrete facing panels, and concrete blocks) by using a plate compactor as approved by the Project Representative. No soil density tests will be taken within this area.
   7. The Contractor shall use compacting equipment approved by the Project Representative.

E. At the end of each day's operation, the Contractor shall shape the last level of backfill to permit runoff of rainwater away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

F. Wall materials damaged or disturbed during backfill placement shall be either removed and replaced, or adjusted and repaired, by the Contractor as approved by the Project Representative at no additional expense to the Owner.

3.05 ADJUSTING

A. The structural earth wall manufacturer shall provide a qualified and experienced representative to resolve wall construction problems as approved by the Project Representative. The structural earth wall manufacturer's representative shall be present at the beginning of wall construction activities, and at other times as needed throughout construction. Recommendations made by the structural earth wall manufacturer's representative and approved by the Project Representative shall be followed by the Contractor.

B. The completed wall shall meet the following tolerances:
   1. Deviation from the design batter and horizontal alignment, when measured along a 10 FT straightedge, shall not exceed 3/4 IN.
   2. Deviation from the overall design batter of the wall shall not exceed 1/2 IN per 10 FT of wall height:
   3. The maximum allowable offset in any concrete block joint shall be 3/4 IN.
   4. The base of the structural earth wall excavation shall be within 3 IN of the staked elevations, unless otherwise approved by the Project Representative.
   5. The external structural earth wall dimensions shall be placed within 2 IN of that staked on the ground.
   6. The backfill reinforcement layers shall be located horizontally and vertically within 1 IN of the locations shown in the structural earth wall Working Drawings as approved by the Project Representative.

C. At least 5 working days prior to the Contractor beginning any structural earth wall Work at the site, a structural earth wall preconstruction conference shall be held to discuss construction procedures, personnel, and equipment to be used, and other elements of structural earth wall construction. Those attending shall include:
   1. Representing the Contractor: The superintendent, on site supervisors, and all foremen in charge of excavation, leveling pad placement, concrete block and soil reinforcement placement, and structural earth wall backfill placement and compaction.
   2. Representing the Structural Earth Wall Manufacturer: The qualified and experienced representative of the structural earth wall manufacturer as specified at the beginning of this Section.
   3. Representing the Owner: The Project Representative, the Geotechnical Engineer, Construction Manager, and others as deemed necessary.

END OF SECTION

SECTION 32 32 43
SOLDIER PILE AND SOLDIER PILE TIEBACK WALLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:
   1. Soldier Piles for Wall 4.
   2. Shaft Drilling, Steel Piles, Backfill Concrete or Controlled Density Fill (CDF), Timber Lagging, Prefabricated Drainage Mat, and Concrete Fascia Panel, and Tiebacks.

B. This Work consists of constructing soldier pile walls and soldier pile tieback walls.

C. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Division 03 – Concrete.
   4. Division 31 – Earthwork.

D. Completely coordinate with work of other trades.

1.02 REFERENCES

A. Comply with the requirements of Section 01 09 05 - Reference Standards and as listed herein. The following is a list of standards referenced in this Section.
   1. American Welding Society (AWS):
      a. AWS D1.1/D1.1M Structural Welding Code – Reinforcing Steel.
      b. AWS D1.4 Structural Welding Code – Reinforcing Steel.
   2. American Society for Testing and Materials International (ASTM):
      a. ASTM A 36 Standard Specification for Carbon Structural Steel.
      b. ASTM A 53/A 53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. ASTM A 108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
      d. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      e. ASTM A 321 Standard Specification for Steel Bars, Carbon, Quenched and Tempered (Withdrawn 2007).
      f. ASTM A 500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

g. ASTM A 563 Standard Specification for Carbon and Alloy Steel Nuts.

h. ASTM A 572 Standard Specification for High-Strength Low- Alloy Columbium-Vanadium Structural Steel.

i. ASTM A 615/A 615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

j. ASTM A 675i4 675M Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

3. American Wood Preservers' Association (AWPA):

   a. U-1 Use Category System: User Specification for Treated Wood.

   b. T-1 Use Category System: Processing and Treatment Standard.

4. Steel Structures Painting Council (SSPC):

   a. SSPC Surface Preparation Standard.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:

1. Shop plans for all structural steel, including the steel soldier piles, and shall submit shop plans and working drawings for permanent ground anchors to the Project Representative for approval.

2. Permanent ground anchor grout mix design and the procedures for placing the grout to the Project Representative for approval.

3. Forming plans for the concrete fascia panels to the Project Representative for approval:

   a. Where the lateral pressure from concrete placement is less than or equal to the design earth pressure, the Contractor may tie forms directly to the soldier piles.

   b. Where the lateral pressure from concrete placement is greater than the design earth pressure, the Contractor shall follow one of the following procedures:

      1) Tie the forms to strongbacks behind the lagging, or use some other system that confines the pressure from concrete placement between the lagging and the form panels, in addition to the ties to the soldier piles.

      2) Reduce the rate of placing concrete to reduce the pressure from concrete placement to less than or equal to the design earth pressure in addition to the ties to the soldier piles.

      3) Follow a procedure with a combination of a. and b.

   c. The Contractor shall design the forms for an appropriate rate of placing concrete so that no cold joints occur, considering the wall thickness and height, and volume of concrete to be placed.

4. Soldier pile wall temporary lagging design Working Drawings and supporting design calculations. The submittal shall include, but not be limited to, the following:
    a. Description of the material used for the lagging, including identification of applicable material Specifications.
    b. Installation method and sequence.
    c. If the lagging material is to be removed during or after installation of the permanent fascia, a description of how the lagging is removed without disturbing or damaging the fascia, soldier piles, and retained soil, and a description of how, and with what material, the void left by the removal of lagging is to be filled.
    d. Lagging materials and lagging installation methods that cause the buildup of, and prevent the relief of, pore water pressure will not be allowed. Free-draining materials are defined as those materials that exhibit a greater permeability than the material being retained.
    e. Temporary lagging is defined as lagging that is in service as a structural member for a maximum of 36 months before a permanent load-carrying fascia is in place.
    f. Temporary lagging may be treated or untreated timber or another material selected by the Contractor.
    g. Timber for temporary lagging shall conform to the minimum actual thickness specified in the table below for the soil type, exposed wall height, and lagging clear span as shown in the Plans.
5. Design of temporary lagging for all soldier pile walls based on the following:
    a. The Minimum Actual Thickness of Timber Used as Temporary Lagging table below.
    b. The soil type as specified in the Plans or as determined from the geotechnical report prepared for the project.
        1) The following shall be considered Type 1 soils:
            a) Cohesive fine-grained soils either CL or CH of medium consistency with $\gamma H/Su < 5$.
            b) Cohesive fine-grained soils either CL or CH that are stiff to very stiff and nonfissured.
            c) Fine-grained soils either ML or SM-ML that are above the water table.
            d) Coarse-grained soils either GW, GP, GM, GC, SW, SP, or SM that are medium dense to dense.
        2) The following shall be considered Type 2 soils:
            a) Cohesive fine-grained soils either CL or CH that are heavily overconsolidated and fissured.

b) Fine-grained ML soils or coarse-grained SM-ML soils that are below the water table.

c) Coarse-grained SC soil that is medium dense to dense and is below the water table.

d) Coarse-grained soils either SW, SP, or SM that are loose.

3) The following shall be considered Type 3 soils:

a) Cohesive fine-grained soils either CL or CH that are soft with $\gamma H/Su > 5$.

b) Fine-grained slightly plastic ML soil that is below the water table.

c) Coarse-grained SC soil that is loose and below the water table.

c. Exclusions.

1) Regardless of whether site soils conform to one of the soil types defined above, site soils under the following conditions are excluded from the Type 1, Type 2, and Type 3 soil classifications:

a) Disturbed soils such as those in landslides or known unstable areas.

b) Layered soils dipping into the excavation steeper than 4H:1V.

d. Lagging for soldier pile walls located in site soils excluded from the Type 1, Type 2, and Type 3 soil classifications shall be designed in accordance with the latest AASHTO LRFD Bridge Design Specifications with current interim specifications. Use of the Minimum Actual Thickness of Timber Used as Temporary Lagging table for timber lagging in these situations will not be allowed.

Minimum Actual Thickness of Timber Used as Temporary Lagging							
Soil Type[1]	1	1	2	2	3	3	3
Exposed Wall Height (feet)	25 and under	Over 25 to 60	25 and under	Over 25 to 60	15 and under	Over 15 to 25	Over 25
Clear Span of Lagging (feet)	Minimum Actual Thickness of Rough Cut Timber Lagging (inches)[3]						
5	2	3	3	3	3	3	4
6	3	3	3	3	3	4	5
7	3	3	3	4	4	5	6
8	3	4	4	4	5	6	[2]
9	4	4	4	5	[2]	[2]	[2]
10	4	5	5	5	[2]	[2]	[2]

[1] *Soil Type as defined above.*

[2] *For exposed wall heights exceeding the limits in the table above, or where minimum rough cut lagging thickness is not provided, the Contractor shall design the lagging in accordance with the latest AASHTO LRFD Bridge Design Specifications with current interim specifications.*

[3] *Table modified from FHWA document "Lateral Support Systems and Underpinning" (Report No. FHWA-RD-75-130).*

6. The soil pressure diagram, either as shown in the Plans or as included in the Revised Geotechnical Report provided as Available Information, see Specification Section 01 10 00 – Summary of Work, including the surcharge for temporary construction load when shown in the Plans.
7. Shaft installation plan referencing the Available Information geotechnical report(s) prepared for this project. This plan shall provide at least the following information:
    a. An overall construction operation sequence and the sequence of shaft construction.
    b. List, description, and capacities of proposed equipment including but not limited to cranes, drills, augers, bailing buckets, final cleaning equipment, and drilling units. The narrative shall describe why the equipment was selected, and describe equipment suitability to the anticipated site and subsurface conditions. The narrative shall include a project history of the drilling equipment demonstrating the successful use of the equipment on shafts of equal or greater size in similar soil/rock conditions.
    c. Details of shaft excavation methods including proposed drilling methods, methods for cleanout of the shafts, disposal plan for excavated material and drilling slurry (if applicable), and a review of method suitability to the anticipated site and subsurface conditions.
    d. Details of the method(s) to be used to ensure shaft stability (i.e., prevention of caving, bottom heave, etc. using temporary casing, slurry, or other means) during excavation and concrete placement. This shall include a review of method suitability to the anticipated site and subsurface conditions. If temporary casings are proposed, casing dimensions and detailed procedures for casing installation and removal shall be provided. If slurry is proposed, detailed procedures for mixing, using, maintaining, and disposing of the slurry shall be provided. A detailed mix design, and a discussion of its suitability to the anticipated subsurface conditions shall also be provided for the proposed slurry.
    e. Details of soldier pile placement including internal support bracing and centralization methods.
    f. Details of concrete placement including proposed operational procedures for pumping and/or tremie methods.
    g. Details of the device used to prevent unauthorized entry into a shaft excavation.

1.04 QUALITY ASSURANCE

A. The steel soldier piles shall be placed so that the centerline of the pile at the top is within 1 IN of the Plan location.

B. The steel soldier pile shall be plumb, to within 0.5 percent of the length based on the total length of the pile.

C. Top of steel soldier piles shall be cut off to within one (1) IN of designed elevation.

D. Welding, repair welding, and welding inspection shall conform to the AWS D1.1/D1.1M Structural Welding Code requirements for welding, repair welding, and welding inspection for all other steel fabrication.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 60 00 - Product Requirements.

B. Structural steel, metal fabrications and timber lagging shall be stored off the ground on platforms, skids, or other supports.

1.06 PROJECT CONDITIONS

A. See Section 01 10 00 - Summary of Work for reference to Geotechnical Information as Available Information about subgrade conditions.

B. Site conditions as reported in the Geotechnical information indicate that caving of drill holes may occur. Therefore, Contractor shall use appropriate construction methods to prevent caving.

C. Site conditions as reported in the Geotechnical information indicate that ground water will likely be encountered. Contractor shall use appropriate placement methods for pile backfill concrete.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural Steel for Piles: ASTM A572, Grade 50.

B. Bars and Plates: ASTMA36.

C. Concrete:
   1. Lean Concrete as described in Section 03 09 00 - Concrete.

D. Steel Pipe: ASTM A 53, Grade B or ASTM A 500, Grade B or C.

E. Lagging:
   1. Douglas Fir-Larch, grade No.2 or better or Hem-fir No.1 or better, rough sawn.
      a. Refer to Section 01 81 30 – Sustainability Requirements for requirement for use of certified wood for timber lagging.
   2. Preservative treated, Pressure treated:
      a. AWPA Use Category UC4B per AWPA U-1.
      b. Retention per AWPA T-1:
         1) ACZA: 0.40 pcf.
         2) CCA Type A or Type C: 0.40 pcf.

F. Welded Shear Connectors (Headed Studs):
   1. ASTM A108.

2. Manufacturers:
    a. Nelson.
    b. Midwest Fasteners, Inc.
    c. Or Approved Equal.

G. Coating for Piling: As specified in Paragraph 2.03 of this Section.

H. Prefabricated Drainage Mat:
1. Prefabricated drainage core shall consist of a three dimensional polymeric material with a structure that permits flow along the core laterally, and which provides support to the geotextiles attached to it.
2. Prefabricated drainage mat shall have a single or double dimpled polymeric core with a geotextile attached and shall meet the following requirements:

Geotextile Property	ASTM Test Method	Geotextile Property Requirements[1]
AOS	D 4751	No. 60 max.
Water Permittivity	D 4491	0.4 sec^{-1} min.
Grab Tensile Strength, in machine and x-machine direction	D 4632	Nonwoven – 100 lb min.
Width Thickness	D 5199	12 In. min. 0.4 In. min.
Compressive Strength at Yield	D 1621	100 psi min.
In Plan Flow Rate Gradient = 0.1, Pressure = 5.5 psi Gradient = 1.0, Pressure = 14.5 psi	D 4716	5.0 gal./min./ft. 15.0 gal/min./ft.

[1] Minimum average roll values (i.e., the test results for any sampled roll in a lot shall meet or exceed the values shown in the table).

3. Acceptable Products:
    a. SiteDrain Sheet 184; American Wick Drain, Inc., Monroe, NC.
    b. SiteDrain P-180; American Wick Drain, Inc., Monroe, NC.
    c. Delta Drain 6000HS HI-X; Cosella-Dorken Products, Inc., Beamsville, ON.
    d. 6000 HI-X Geotextile; Cosella-Dorken Products, Inc., Beamsville, ON.
    e. Delta Drain 6000 HI-X; Cosella-Dorken Products, Inc., Beamsville, ON.
    f. Or Approved Equal.

2.02 FABRICATION

A. All fabrication shall be performed in the shop.

B. Welding shall comply with AWS Code for procedures, appearance and quality of welds.

C. Welded shear connectors (headed studs): Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors using automatic welding equipment recommended by the shear connector manufacturer.

2.03 SHOP COATING

A. Soldier piles shall be shop coated following fabrication to the limits shown in the Plans with the following surface preparation and coating materials.
   1. Surface preparation: SSPC SP6 Commercial Blast Cleaning.
   2. Primer: Zinc Rich Urethane, Tnemec Series 90-97 or approved equal, applied at2.5 to 3.5 mils DFT.
   3. Finish Coat: High Solids Epoxy, Tnemec Series 141 PotaPox 80 or approved equal, applied at '10 to 12 mils DFT.

B. Coatings damaged during delivery and handling shall be repaired prior to installation using procedures and materials recommended by the coating manufacturer.

PART 3 – EXECUTION

3.01 SHAFT EXCAVATION

A. Shafts shall be excavated to the required depth as shown in the Plans. The minimum diameter of the shaft shall be as shown in the Plans.

B. The excavation shall be completed in a continuous operation using equipment capable of excavating through the type of material expected to be encountered.

C. The Contractor may use temporary telescoping casing to construct the shafts.

D. If the shaft excavation is stopped the shaft shall be secured by installation of a safety cover.

E. It shall be the Contractor's responsibility to ensure the safety of the shaft and surrounding soil and the stability of the sidewalls.

F. Where caving in conditions are encountered, no further excavation will be allowed until the Contractor has implemented the method to prevent ground caving as submitted in accordance with the Shaft Installation Plan and as approved by the Project Representative. A temporary casing, slurry, or other methods specified in the Shaft Installation Plan as approved by the Project Representative shall be used if necessary to ensure such safety and stability.

G. No more than 2 IN of loose or disturbed material, shall be present at the bottom of the shaft just prior to beginning concrete placement.

H. The excavated shaft shall be inspected and approved by the Project Representative prior to proceeding with construction.

I. Obstructions: When obstructions are encountered, the Contractor shall notify the Project Representative promptly.
   1. An obstruction is defined as a specific object (including, but not limited to, boulders, logs, and man made objects) encountered during the shaft excavation operation that prevents or hinders the advance of the shaft excavation.
   2. When efforts to advance past the obstruction to the design shaft tip elevation result in the rate of advance of the shaft drilling equipment being significantly reduced relative to the rate of advance for the prior shaft excavation, then the Contractor shall attempt drill through, or if that fails, remove the obstruction.
   3. The methods of drilling through and removal of such obstructions and the continuation of excavation shall be as proposed by the Contractor and reviewed by the Project Representative.
   4. If the Contractor is unable to drill through, and then is unable to remove the obstruction, two piles will be installed, one on either side of the obstruction.
      a. The locations of the two replacement piles shall be reviewed and approved by the Project Representative.

J. Excavation of shafts shall not commence until a minimum of 12 HRS after the shaft backfill for the adjacent shafts has been placed.

K. All temporary casings installed for the shafts shall be removed.
   1. A minimum 5 FT head of concrete shall be maintained to balance the soil and water pressure at the bottom of the casing.
   2. The casing shall be smooth.

3.02 INSTALLING SOLDIER PILES

A. Soldier piles shall be full length with no field splices.

B. The prefabricated steel soldier piles shall be lowered into the drilled shafts and secured in position. Concrete cover over the soldier pile shall be 3 IN minimum, except that the cover over the soldier pile flange plate reinforcing at permanent ground anchor locations shall be 1 1/2 IN minimum.

3.03 BACKFILLING SHAFT

A. The excavated shaft shall be backfilled with either controlled density fill (CDF), or pumpable lean concrete, as shown in the Plans and subject to the following requirements:
   1. Dry shaft excavations shall be backfilled with CDF.
   2. Wet shaft excavations shall be backfilled with pumpable lean concrete.
   3. Pumpable lean concrete shall be in accordance with Division 03 - Concrete.
   4. A wet shaft is defined as a shaft where water is entering the excavation and remains present to a depth of 6 IN or more.

5. When the Plans or test hole boring logs identify the presence of a water table at or above the elevation of the bottom of soldier pile shaft, the excavation shall be considered as wet, except as otherwise noted. Such a shaft may be considered a dry shaft provided the Contractor furnishes and installs casing that is sufficiently sealed into competent soils such that water cannot enter the excavation.

B. Placement of the shaft backfill shall commence immediately after completing the shaft excavation and receiving the Project Representative's approval of the excavation. CDF or pumpable lean concrete shall be placed in one continuous operation to the top of the shaft. Vibration of shaft backfill is not required.

C. If water is not present, the shaft backfill shall be deposited by a method that prevents segregation of aggregates. The shaft backfill shall be placed such that the free-fall is vertical down the shaft without hitting the sides of the soldier pile or the excavated shaft.

D. If water is present, the shaft backfill shall be deposited by tremie methods.

E. The Contractor's method for depositing the shaft backfill shall have approval of the Project Representative prior to the placement of the shaft backfill.

3.04 INSTALLING LAGGING AND PERMANENT GROUND ANCHORS

A. The excavation and removal of CDF and pumpable lean concrete for the lagging installation shall proceed in advance of the lagging and shall not begin until the CDF and pumpable lean concrete are of sufficient strength that the material remains in place during excavation and lagging installation.

B. If the CDF or pumpable lean concrete separates from the soldier pile, or caves or spalls from around the soldier pile, the Contractor shall discontinue excavation and lagging installation operations until the CDF and pumpable lean concrete is completely set.

C. The bottom of the excavation in front of the wall shall be level.

D. For walls with or without permanent ground anchors, the bottom of excavation shall not be more than 3 FT below the bottom level of the lagging already installed, but in no case shall the depth of excavation beneath the bottom level of installed lagging be such to cause instability of the excavated face.

E. For walls with permanent ground anchors, the bottom of excavation shall be not more than 3 FT below the permanent ground anchor level until all permanent ground anchors at that level are installed and stressed, but in no case shall the depth of excavation beneath the permanent ground anchor level be such to cause instability of the excavated face.

F. Any caving that occurs during excavation shall be backfilled with free-draining material as approved by the Project Representative.

G. Installing, stressing, and testing the permanent ground anchors shall be in accordance with Section 31 51 00 – Permanent Ground Anchors and the construction sequence specified in the Working Drawings.

H. The lagging shall be installed from the top of the soldier pile proceeding downward. The lagging shall make direct contact with the soil. When and where lagging is not in full contact with the soil being retained the void shall be filled with a free-draining material as approved by the Project Representative.

3.05 PREFABRICATED DRAINAGE MAT

A. For walls with concrete fascia panels, prefabricated drainage mat shall be installed full height of the concrete fascia panel and full width between soldier pile flanges, unless otherwise shown in the Plans.

B. The prefabricated drainage mat shall be attached to the lagging in accordance with the manufacturer's recommendations. The fabric side shall face the lagging. Splicing of the prefabricated drainage mat shall be in accordance with the manufacturer's recommendations.

C. The Contractor shall ensure the hydraulic connection of the prefabricated drainage mat to the previously installed material so that the vertical flow of water is not impeded.

D. The Contractor shall tape all joints in the prefabricated drainage mat to prevent concrete intrusion during concrete fascia panel construction.

3.06 CONCRETE FASCIA PANEL

A. The Contractor shall construct the concrete fascia panels as shown in the Plans, and in accordance with the forming plan as approved by the Project Representative. The concrete fascia panels shall be cured in accordance with the Section 03 31 31 – Concrete, Materials, and Proportioning.

B. The Contractor shall provide the specified surface finish as noted, and to the limits shown, in the Plans to the exterior concrete surface. When noted in the Plans, the Contractor shall apply pigmented sealer to the limits shown in the Plans.

C. Asphalt or cement concrete gutter shall be constructed as shown in the Plans.

END OF SECTION

SECTION 32 40 00
SITE FURNISHINGS

PART 1 – GENERAL

1.01 GENERAL

A. Provide and install all items hereinafter identified.

1.02 SCOPE OF WORK

A. Furnish all materials, equipment, labor, and related items necessary to complete the work shown on the Drawings and/or Specifications. The items of work to be performed shall include but are not limited to:
   1. Benches.
   2. Bike Racks.
   3. Handrails.

1.03 RELATED WORK DESCRIBED ELSEWHERE

A. Related work in other sections of these specifications includes but is not limited to:
   1. 31 23 00 – Earthwork.
   2. 32 13 13 – Concrete Pavement, Sidewalk and Steps.

1.04 REFERENCES

A. ASTM Testing Standards:
   1. ASTM A 536 – Standard Specification for Ductile Iron Castings.
   2. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
   3. ASTM D 522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
   4. ASTM D 523 – Standard Test Method for Specular Gloss.
   5. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
   6. ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
   7. ASTM D 3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
   8. ASTM D 3363 – Standard Test Method for Film Hardness by Pencil Test.
   9. ASTM G 155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.

B. ISO Testing Standards:
   1. ISO 1520 – Paints and Varnishes – Cupping Test.
   2. ISO 2815 – Paints and Varnishes – Buchholz Indentation Test.

C. ANSI/BIFMA Testing Standards:
   1. ANSI/BIFMA X5.4-2005 – Standard Test for Lounge Seating.

D. LFI Testing Standards:
   1. LFI PT-019 – Standard Test for Strength and Durability.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer regularly engaged in manufacture of site furnishings for more than 15 years.

B. Product Support: Products are supported with complete Engineering Drawings and design patents.

C. Production: Orders are delivered within a 60 day schedule.

D. Facility Operator: Welders and machine operators are certified.

1.06 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Leadership in Energy and Environmental Design (LEED®) Documentation: Submit the following in accordance with Section 01 81 30 – Sustainability Requirements:
   1. Completed LEED Materials Tracking Form.

C. Approval Submittals:
   1. Manufacturer's product data, storage, and handling requirements and recommendations, and installation methods.
   2. Manufacturer's Shop Drawings, including plans and elevations, indicating overall dimensions and drawn at scale.
   3. Manufacturer samples of materials, finishes, and colors.

D. Closeout Submittals:
   1. Extended Warranty: Provide two executed copies of the Extended Warranties required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.07 EXTENDED WARRANTY

A. In accordance with the provisions of Section 01 78 00 – Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. Two (2) year limited warranty against defects in material and workmanship commencing on the date of substantial completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site in the manufacturer's original, unopened containers and packaging, with labels clearly indicating product name and manufacturer.

B. Store materials in clean, dry area in accordance with manufacturer's instructions. Keep materials in manufacturer's original containers and packaging until installation.

C. Protect materials and finish during handling and installation to prevent damage, impacts, and/or abrasion.

PART 2 – PRODUCTS

2.01 HARDWARE

A. All metal hardware including bolts, deformed bars for connections, threaded rod, anchor bolts, nuts, washers - shall be stainless steel unless otherwise noted. All bolts, threaded rod and anchor bolts conform to ASTM A-307, Grade A, unless otherwise noted. Tamper resistant, hex head and nut on all bolts and threaded rod unless otherwise indicated. All bolts, threaded rod shall have standard cut washers respective size, unless otherwise indicated - bolts to have washers each end, galvanized steel bolts, rods, etc. shall have galvanized steel washers and nuts. Hardware not noted by size shall be sufficient to draw and hold members securely.

2.02 BENCHES

A. Subject to compliance with requirements of the Contract Documents, the following products are acceptable:
   1. Product 1 (Basis of design): Bancal 88 IN backed bench, no arms, available from Landscape Forms Inc., Tim Gish, (800) 430-6206 ext 1319.
      a. Anchoring:
         1) Threaded rods are embedded. Threaded rods included with bench.
      b. Materials:
         1) Supports: 0.25 IN carbon steel plate.
         2) Seat and Backrest: Wood for exterior use:
         3) Ipe, solid stock, select South American hardwood.
            a) Board edges: Eased.
      c. Finishes:
         1) Wood is unfinished.
         2) Metal color finish is Pamgard II – Stormcloud.

2. Product 2: Knight bench available from Forms + Surfaces, Mike Benz (425) 996-6192.
    a. Anchoring:
        1) Surface Mount.
        2) Provide threaded anchors and stainless steel mounting screws.
    b. Materials:
        1) Backed Bench: 8 FT aluminum frame with invisible welds.
        2) Seats: FSC 100 percent Ipe hardwood slats.
    c. Finishes: Frame is polished aluminum. Wood is Penofin hardwood formula 'Transparent Natural'.
3. Product 3: MLB720W bench available from Maglin, James Thompson (855) 904-0330.
    a. Anchoring:
        1) Surface Mount.
        2) Provide threaded anchors and stainless steel mounting screws.
    b. Materials:
        1) Frame: Solid cast aluminum.
        2) Seats: Ipe hardwood slats.
    c. Finishes:
        1) Frame is Black.
        2) Wood has penetrating sealer.
4. Or Approved Equal in compliance with procedures for product options and substitutions as specified in Specification Section 01 60 00 - Product Requirements.

2.03 BIKE RACKS

A. Subject to compliance with requirements of the Contract Documents, the following products are acceptable:
    1. Product 1 (Basis of design): Bola Bicycle Rack available from Landscape Forms Inc., Tim Gish, (800) 430-6206 ext 1319.
        a. Anchoring: Embedded.
        b. Materials: 304 Stainless Steel.
        c. Finish: Electropolish.
    2. Product 2: Trio Bike Rack available from Forms + Surfaces, Mike Benz (425) 996-6192.
        a. Anchoring: Surface Mount.
        b. Materials: Cast Aluminum.
        c. Finish: Aluminum Texture.

3. Product 3: Model LSK-017 Bike Rack available from FairWeather Site Furnishings, Bill Whitcomb (800) 323-1798 ext. 209.
    a. Anchoring: Surface Mount.
    b. Materials: Flat Steel.
    c. Finish: Semi-Gloss Silver with Clear Gloss topcoat.
4. Or Approved Equal in compliance with procedures for product options and substitutions as specified in Specification Section 01 60 00 – Product Requirements.

2.04 HANDRAILS

A. Handrails shall be aluminum pipe and constructed with mechanically fastened (nonwelded), smooth, and continuous ADA railing system.

B. Rail shall allow for adjustment to match the angle of the stairs and provide a continuous, uninterrupted gripping surface with no sharp edges or projections. The handrail and support end posts shall be continuous, with the supporting end posts providing a straight and vertical return to the concrete surface.

C. Handrail pipe shall be 1 1/2 IN outer diameter pipe.

D. Railing shall be surface mount with flanges.

E. Finish shall be black baked-on enamel.

F. Provide product submittal with product technical cutsheet, material and finish samples for Project Representative review and approval prior to procurement.

PART 3 – EXECUTION

3.01 GENERAL

A. Stake alignment and locations of all site furnishings for review by Project Representative at least 10 working days prior to installation. Incorrectly located work shall be removed and replaced by the Contractor at no additional cost to the Owner.

B. Install rigid, plumb and true to lines and levels shown. Verify that all site furnishings called for in this Section "fit" according to the Drawings and existing site features.

C. All ends of bolts to be tamper-resistant. Remove all sharp edges and metal burrs.

D. Assemble (if required) and install all site furnishings specified by name/manufacturer as per approved manufacturer's printed instructions/recommendations.

E. Layout site furnishings as shown on Drawings. Contractor shall take particular care to install expansion joints and joints at regular intervals or as indicated on Drawings.

F. Install following items with thickened concrete paving as noted on the Drawings:
   1. Bike Racks.
   2. Benches.

3.02 BENCHES

A. Install plumb and level as detailed in on Drawings. Install in accordance with manufacturer's instructions.

B. Repair minor damages to finish in accordance with manufacturers instructions and as approved by the Project Representative. Remove and replace damaged components that cannot be successfully repaired as determined by the Project Representative.

C. Clean the benches promptly after installation in accordance with manufacturer's instructions. Do not use harsh cleaning materials or methods that could damage finish.

D. Protect installed benches to ensure that benches will be without damage or deterioration, except for normal weathering until the time of Substantial Completion.

3.03 BIKE RACKS

A. Install plumb and level as detailed in locations shown on Drawings. Install in accordance with manufacturer's instructions.

B. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by the Project Representative. Remove and replace damaged components that cannot be successfully repaired as determined by the Project Representative.

C. Clean the rack promptly after installation in accordance with manufacturer's instructions. Do not use harsh cleaning materials or methods that could damage finish.

D. Protect installed racks to ensure that racks will be without damage or deterioration at the time of Substantial Completion.

3.04 HANDRAILS

A. Install plumb and true as detailed in on Drawings. Install in accordance with manufacturer's instructions.

B. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by the Project Representative. Remove and replace damaged components that cannot be successfully repaired as determined by the Project Representative.

C. Clean the handrails promptly after installation in accordance with manufacturer's instructions. Do not use harsh cleaning materials or methods that could damage finish.

D. Protect installed handrails to ensure that handrails will be without damage or deterioration, except for normal weathering until the time of Substantial Completion.

END OF SECTION

SECTION 32 84 00
IRRIGATION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Work shall include designing, installing, and/or maintaining a complete, fully functional, irrigation system in all areas of work as indicated in the Work Order, capable of supplying water for irrigation.
   1. Maintenance of irrigation system shall include fully winterizing system per industry standards.
   2. Work also includes supplying all materials needed to install and operate the irrigation system.

B. The sprinkler irrigation system shall be constructed using the sprinkler heads, risers, valves, piping, fittings, controllers, wiring, etc., of sizes and types as called for in these Specifications.
   1. The system shall be constructed to grades and conform to the site landscape plan.

C. The term "Contractor" as used in this Specification Section shall refer to the Sprinkler System Contractor.

D. Prior to final acceptance of the Irrigation System, submit a written "watering schedule" to ensure adequate watering of all plant materials during the Guarantee Period of this Contract.

E. Provide and install a separate Irrigation Meter as required for the proper operation of the irrigation system. See Civil Contract Drawings.

1.02 SCOPE OF WORK

A. Work includes obtaining all necessary permits from agencies with jurisdiction over the Project Site.

B. Furnish and install a complete sprinkler irrigation system to provide efficient and even irrigation (with minimum overspray on signs, paved or non-paved areas and no overspray onto buildings) of all planting areas shown on the Drawings and as specified in the Specifications, complete and ready for operation.
   1. Head-to-head coverage shall be provided.
   2. The work included in this Specification (whether mentioned or not) shall consist of all labor, tools, materials, tests, permits and other related items necessary for the installation and operation of the irrigation system.

C. Irrigation equipment shall be coordinated with utility location to avoid overspray onto or spray blockage from above grade utilities, such as electric transformers, light standards, etc.

D. Any item of labor, material or equipment not specified or shown in detail, but incidental to or necessary for the complete installation and proper operation of the system, shall be furnished by the Contractor without additional cost to the Owner.

E. Pipe Sleeves:
   1. Irrigation sleeves shall be provided and installed as shown on the Drawings and as specified in these Specifications.
      a. Coordinate location and installation of pipe sleeving prior to paving operations.
   2. All irrigation pipe sleeves required for the execution of the work is to be provided under this Section.

1.03 RELATED WORK DESCRIBED ELSEWHERE

A. Related Sections:
   1. The work of the following Sections is related to the work of this Section.
   2. Other Sections, not referenced below, may also be related to the proper performance of this work.
   3. It is the Contractor's responsibility to perform all the work required by the Contract Documents.
      a. Section 01 20 00 – Payment Procedures.
      b. Section 01 73 00 – Operation and Maintenance Manuals.
      c. Section 01 78 00 – Closeout Procedures.
      d. Section 03 05 05 – Testing.
      e. Section 32 90 00 – Landscaping.
      f. Section 31 23 00 – Earthwork.

B. Reference Standards:
   1. This Section incorporates by reference the latest revision of the following documents.
      a. In case of conflict between the requirements of this Section and those of a listed document, the more stringent requirements shall prevail.
   2. ASTM International (ASTM):
      a. B3, Standard Specification for Soft or Annealed Copper Wire.
      b. D1557, Standard Test Method for Laboratory Compaction of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))[1].
      c. D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Related Pipe (SDR Series).
      d. D2464, Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80[1].
      e. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40[1].

1.04 WARRANTY AND MAINTENANCE PERIOD

A. In accordance with the provisions of Section 01 78 00 – Closeout Procedures, provide a Warranty for the Work of this Section:
   1. Warranty period of this Section is one (1) year commencing on the date of Substantial Completion and includes:
      a. One (1) year equipment and installation guarantee.
      b. One (1) year maintenance of system.
      c. Removal of the irrigation system lateral lines at the end of the one (1) year period as shown on Contract Drawings.
      d. Restoration of planting areas after removal of the irrigation system.
   2. See Section 01 20 00 – Payment Procedures for contract requirements for landscape establishment bond provision.

B. The irrigation system equipment and installation shall be guaranteed for all workmanship and material including:
   1. Repair and/or replace defective irrigation equipment and material as determined by the Project Representative for the duration of the warranty period.
   2. Repairs and/or replacements shall be made in the same manner as specified for the original irrigation system and shall be done at no cost to the Owner.

C. It is expressly understood the Contractor will be responsible during the one (1) year irrigation warranty period for normal maintenance of the irrigation system, including but not limited to work defined in the Contractor's Operation and Maintenance Manual and Watering Plan Schedule Submittals.

D. At the end of the one (1) year period, the Contractor shall remove all automatic irrigation control valves, lateral pipe and sprinkler heads downstream from the mainline and gate valves.
   1. Carefully remove existing irrigation equipment to avoid damage and to allow for future reuse and/or recycling of material.
   2. The removed irrigation equipment shall be neatly provided to the Project Representative for Owner's future use.

E. Existing planting areas disturbed by removal of irrigation equipment shall be restored to pre-removal conditions at no additional cost to Owner.

1.05 QUALIFICATIONS OF INSTALLER

A. Contractor must be a bonded sprinkler irrigation Contractor.
   1. The sprinkler irrigation system must be installed by an experienced sprinkler irrigation mechanic or journeyman plumber.

1.06 VERIFICATION

A. Before proceeding with any work, inspect the site, carefully check all grades and verify all dimensions and conditions affecting the work in order to proceed safely.

B. Report to the Project Representative all deviation and/or conflicts between Drawings, Specifications and site conditions.
   1. Extra work arising from failure to do so shall be done at the Contractor's expense.

C. Prior to the start of any work, verify available static water pressure (PSI) and gallons per minute (GPM) at point of connection to water service.
   1. Any replacement, relocation or additional materials required as a failure to check (PSI) and (GPM) shall be done at the Contractor’s expense.

1.07 CHANGE ORDERS AND SUBSTITUTIONS

A. Extra work requiring compensation shall not be done without prior written approval of the Project Representative in the form of a Change Order.

B. The intent of the Specifications is to provide a totally integrated irrigation system.
   1. Substitutions will be accepted only if they are proven to be wholly compatible with this system.

1.08 PERMITS, CODES AND REGULATIONS

A. Apply for and pay for all necessary permits and fees as required by Local Authority and prevailing ordinances and/or codes.

B. Keep fully informed and shall comply with all existing laws, codes, ordinances, and regulations, which in any way affect the conduct of the work.

1.09 PROTECTION OF WORK, PROPERTY AND PERSONS

A. Take all necessary precautions to protect work in progress, all property, persons, utilities, walks, curbs, pavement and buildings from any damage that might be incurred arising from this Contract.
   1. Repair to the satisfaction of the Project Representative, at the Contractor's expense, any damage to the above and existing landscape.

1.10 INTERPRETATION OF DRAWINGS

A. Locate irrigation piping, valves or controllers as closely as possible or as per related details, to curbs, fences or edges of paving.
   1. Locate mainline, automatic control valves, battery operated controllers, lateral lines and sprinkler heads inside property line.

B. Parallel pipe lines may be placed in a common trench.

1.11 CONDUCT OF WORK

A. Continuously maintain a competent superintendent or foreman during progress of the work, with the authority to act in all matters pertaining to the work.

B. Confine operations to the working areas allotted by the Project Representative, including material and equipment storage.

C. Progressively clean the work site of debris and rubbish as the work proceeds.

D. Repair to the satisfaction of the Project Representative any damage to existing utilities.
   1. Existing known utilities have been shown on the Drawings and will be made available from the Project Representative or Utility Companies.
   2. It will be the Contractor's responsibility to verify these locations on the ground with a pipe-finder or by other means.
   3. Protect existing known utilities.
   4. Should the ditching intercept and damage any existing utilities, all further work within said area shall stop until the Project Representative is advised and the Project Representative can review a repair method and schedule.

E. Provide any barricades and safety guards, and any other structures or improvements necessary for the complete protection of the public.

F. Any of the Owner's property damaged by the Contractor, including existing buildings, equipment, piping, pipe covering, sewers, sidewalks, landscaping, etc., shall be replaced or repaired by Contractor in a manner satisfactory to the Project Representative at the Contractor's expense before Final Payment is made.

G. Repair for all damages to the grounds, walks, roads, buildings, piping systems, electrical systems and their equipment and contents caused by leaks in the piping systems being installed or having been installed by him, at the Contractor’s expense and in a manner satisfactory to the Project Representative before Final Payment is made.

1.12 SYSTEM PROTECTION

A. As a part of the guarantee under this contract, deactivate and drain the system prior to the onset of the freezing season and reactivate the system at the onset of the spring growing season; each task must be accomplished once during the one (1) year guarantee.
   1. In the event the system is completed in a season when the system will not be in use, winterize the system upon completion of testing (and approval by the Project Representative) and reactivate the system in the spring.
   2. Upon completion of the winterizing phase, submit a letter to the Project Representative certifying that the system was winterized and drained and indicate the date, which such action was accomplished.
   3. The Contractor is liable for any damage resulting from failure to comply.

4. Notify the Project Representative 48 HRS prior to the work so that a Project Representative can be present during the winterizing and reactivating phases of work.

1.13 TESTS

A. Where indicated on the Drawings and/or as specified in the Specifications, tests are to be witnessed by the Project Representative.
   1. Provide advance notice of 48 HRS in writing to the Project Representative before proceeding with tests.
      a. Pressure Test:
         1) All system joints, connections, couplings, valves and all other junction points shall be left exposed until completion and acceptance of the pressure test.
         2) All leaks, however minor, shall be repaired and corrected.
         3) The Project Representative shall be present during the test.
         4) The total sprinkler irrigation system shall be pressure tested for acceptance.
      b. Performance Coverage Tests:
         1) Upon completion of the system installation and after the flushing and pressure tests are completed, the system shall be operated in the presence of the Project Representative.
         2) The automatic system shall be cycled to the satisfaction of the Project Representative.
         3) The Project Representative may request that up to five (5) percent of the total nozzles and five (5) percent of the heads may also be relocated at no extra cost to the Owner.

B. The system shall be PRE-TEST for Pressure and Performance Coverage prior to the Project Representative's review of said tests to confirm that the sprinkler irrigation system will meet the requirements of the specified tests.

1.14 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Samples and/or manufacturer's "Catalog Cuts" of all material as noted in Specifications.
      a. Failure to do so may result in non-acceptance of materials already used or hauled to the site.
      b. Any removal or delays incurred will be at the expense of the Contractor.
      c. All samples submitted for approval must be unaltered to allow for proper inspection and review.

2. Shop Drawings:

    a. Irrigation plan and calculations for any changes to the specified basis of design. Contractor shop drawing shall include all necessary information (such as PSI, GPM, pipe sizes, head locations, valve schedule, etc.) for a complete design review.

    b. Minimum Drawing scale shall be 1 IN = 20 FT unless otherwise approved by the Project Representative.

C. Closeout Submittals:
    1. As-Built Drawings; Keys; Tools; Permits; Water Schedule; Instructions; Maintenance/Operation Manuals; etc.; as required per these Specifications.

    2. As Built Drawings:

        a. Maintain a current record of all pipe, head and other equipment placement and shall record any variations of the original Drawings approved by the Project Representative.

            1) Upon completion of the irrigation system and prior to release of the final payment, provide the Project Representative with a neat and legible reproducible "As Built Drawing(s)" of the complete irrigation system.

            2) Any pipe not installed in accordance with the Drawings, as originally contracted, shall be dimensioned to a permanent structure sufficient for location after burial.

PART 2 – PRODUCTS

2.01 GENERAL

A. All materials and equipment shall be new and of the best quality.
    1. All items of equipment or material shall be as specified or approved equal.

2.02 PLASTIC PIPE

A. PVC pipe upstream and downstream of the control valves shall be Schedule 40 and conform to all requirements of ASTM D2241.

B. PVC Pipe sleeving shall be Schedule 40 and conform to all requirements of ASTM D 2241 unless otherwise noted on the Drawings.

C. All pipe shall be marked with manufacturer's name, class of pipe and NSF seal.
    1. Pipe shall bear no evidence of interior or exterior extrusion marks.

    2. Pipe walls shall be uniform, smooth and glossy.

    3. Pipe may be pre-belled or with individual solvent-weld couplings.

D. All fittings for lateral lines shall conform to the requirements of ASTM D2466 Schedule 40 PVC with exception to steam rotor head riser assembly nipples, which shall be ASTM D2464 Schedule 80 PVC.
   1. All lateral line fittings shall be of the solvent weld type except where risers, valves, etc. require threaded transition fittings.

E. All threaded fittings for mainlines shall conform to requirements of ASTM D2464, Schedule 80 PVC.
   1. All glued fittings for mainlines shall conform to the requirements of ASTM D2466, Schedule 40 PVC.

F. All pipe must be delivered in at least 20 FT lengths.

G. All PVC pipe and fittings shall conform to the following minimums:

Tensile Strength 78 F	5,000 PSI
Izod impact strength (notched)	15 FT LB/IN
Modulus of elasticity	300,000 PSI
Compressive strength	8,500 PSI
Flexural strength	10,000 PSI

2.03 BATTERY OPERATED CONTROLLER AND SOLENOID

A. Subject to compliance with requirements of the Contract Documents, products of the following Manufacturers shall be incorporated into the Work of this Section.
   1. Rainbird (Basis of Design).
   2. Hunter.
   3. Toro.
   4. Or Approved Equal.

B. Acceptable products
   1. Rainbird TBOS CMUS Control Module with Rainbird TBOS-PSOL: Potted Latching Solenoid and TBOS_ADAPP: Solenoid Adapter for plastic valves (Basis of Design):
   2. Hunter Battery-Powered Controller with DC Latching Solenoids.
   3. Toro Junior DC Battery-Operated Controller with DC Latching Solenoid.
   4. Or Approved Equal.

2.04 SPRINKLER HEADS

A. Sprinkler heads shall be minimum 12 IN pop-ups with in-head check valves and pressure regulators.

B. Subject to compliance with requirements of the Contract Documents, products of the following Manufacturers shall be incorporated into the Work of this Section.
   1. Hunter (Basis of Design).
   2. Toro.
   3. Rainbird.
   4. Or Approved Equal.

C. Acceptable products
   1. Hunter PRS heads with MP Rotator nozzles (Basis of Design).
   2. Toro 570 ZXF Series heads with Precision Rotating Nozzles.
   3. Rainbird 1800 SAM P45 with Rotary Nozzles.
   4. Or Approved Equal.

2.05 AUTOMATIC CONTROL VALVE

A. Subject to compliance with requirements of the Contract Documents, products of the following Manufacturers shall be incorporated into the Work of this Section.
   1. Rainbird. (Basis of Design).
   2. Toro.
   3. Hunter.
   4. Or Approved Equal.

B. Acceptable products
   1. Rainbird PEB Series.
   2. Toro 252 Series.
   3. Hunter ICV Series.
   4. Or Approved Equal.

2.06 QUICK COUPLING VALVES

A. Quick Coupler Valves:
   1. Shall have a service rating of not less than 125 PSI for nonshock cold water.
   2. The body of the valves shall be of cast Copper Alloy No. C84400 Leaded Semi-Red Brass conforming to ASTM B 584.
   3. The base of the valve shall have standard female pipe threads.
   4. The design of the valve shall be such that it will open only upon inserting a coupler key and will close as the coupler is removed from the valve.
   5. Leakage of water between the coupler and valve body when in operation shall not be accepted.

6. The valve body receiving the coupler shall be designed with double worm slots to allow smooth action in opening and closing of the valve with a minimum of effort.
7. Slots shall be notched at the base to hold the coupler firmly in the open position.
8. Couplers shall be of the same material as the valve body with stainless steel double guide lugs to fit the worm slots.
9. Couplers shall be of one piece construction with steel reinforced side handles attached.
10. All couplers shall have standard male pipe threads at the top.
11. Couplers shall be furnished with all quick coupler valves unless otherwise specified.

B. Provide two (2) matching valve keys, two (2) cap keys and two (2) hose swivels.

2.07 MANUAL GATE VALVES

A. Valves shall be of the same size as the pipes on which they are placed and shall have union or flange connections. Service rating (for nonshock cold water) shall be 150 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and hand wheel or suitable cross wheel for standard key operation. Manufacturer's name, type of valve, and size shall be imprinted or printed on the valve.

2.08 VALVE BOXES

A. Unless otherwise specified, all automatic valves shall be enclosed in Carson Industries, Rainbird or NDS plastic valve box with locking lid or approved equal.

B. Size valve boxes as required to provide approximately 3 IN clear between the valve box and the valve on all sides.
   1. Provide and install valve box extensions as required.

C. Double Check Valve:
   1. Double check valve assemblies (DCVAs) shall be of a manufacturer and product model approved for use by the department of Health, Olympia, Washington or a Department of Health-certified agency.

D. Irrigation Water Meter:
   1. Water meter shall be per Code. See Civil Drawings.

2.09 BACKFILL MATERIALS

A. Sump Gravel (for use under valve boxes only):
   1. Three-quarter (3/4) minus round, water worn, washed pea gravel.

B. Sand (backfill soils around PVC pipe):
   1. Fine granular material naturally produced by rock disintegration and free from organic material, loam, clay and other deleterious substances.

C. Native Material (backfill soil around PVC pipe):
   1. Soil native to the project site that is free of wood and other deleterious materials and free of rocks over 1 IN DIA.

D. Crushed Surfacing Top Course (backfill soil around PVC pipe sleeves):
   1. Per WSDOT Standard Specification 9-03.9(3).

2.10 MANUAL DRAIN VALVES

A. Manual drain valves may be a 1/2 IN or 3/4 IN PVC or metal gate valve manufactured for irrigation systems.
   1. Valves shall be designed for underground installation with suitable cross wheel for operation with a standard key, and shall have a service rating of not less than 150 PSI nonshock, cold water.
   2. The Contractor shall furnish three standard operating keys per Contract.
   3. Manual drain valves shall be installed in a valve box with a vandal-resistant lid as shown in the Plans.
   4. Manual drain valves on potable water systems shall only be allowed on the downstream side of approved cross-connection control devices.
   5. Other supplies.

B. Electrical tape shall be black plastic, 3/4 IN wide and a minimum of 0.007 IN thick and the all-weather type.

C. All flexible nipples or pipe joints shall be "Toro Funny Pipe"; "Rainbird Swing Pipe"; "Hunter Swing Joint" or approved equal.

D. Electrical wire used between the automatic controller and automatic control valves shall be solid or stranded copper, minimum size AWG 14. Insulation shall be Type USE Chemically Cross Linked Polyethylene or Type UF, and shall be listed by a Nationally Recognized Testing Laboratory. Each conductor shall be color coded and marked at each end and at all splices with zone or station number identification. Low voltage splices shall be made with a direct bury splice kit using a twist-on wire connector and inserted in a waterproof polypropylene tube filled with a silicone electrical insulating gel or heat-shrinkable insulation tubing. Heat-shrinkable insulation tubing shall consist of a mastic-lined heavy-wall polyolefin cable sleeve.

PART 3 – EXECUTION

3.01 TRENCHING

A. Trenches shall allow for 12 IN of cover for irrigation main lines.
   1. Trenches for sleeves shall allow for a minimum of 18 IN of cover unless otherwise noted on the Drawings.

2. Excavate no wider at any point than is necessary to lay pipe or install equipment.
3. Excavate with vertical sides and provide bracing and shoring as required.

B. All trenches must be straight and not have abrupt changes in grade.
   1. Trenching that may potentially disturb root systems of existing trees shall be brought to the attention of the Project Representative before proceeding with work.

C. The trench bottoms and bedding material surrounding all pipes must be free of rocks greater than 1 IN DIA and all sharp-edged objects.
   1. Bed and surround all pipe with approved specified “BACKFILL MATERIAL” and as shown on Drawings.

D. Pulling of pipe is not permitted unless otherwise approved by the Project Representative.

3.02 INSTALLATION

A. General:
   1. Confirm existence and location of all existing utilities and newly installed utilities prior to the commencement of work.

B. PVC Pipe and Fittings (includes pipe sleeves):
   1. Due to the nature of PVC pipe and fittings, exercise care in handling, loading, unloading and storing to avoid damage.
      a. Any pipe that has been dented or damaged shall be discarded until such damage has been cut out and the pipe is rejoined with a coupling.
   2. Solvent weld PVC pipe only during non-freezing weather and cover in rainy weather.
   3. PVC pipe ends shall be cut to ninety (90) degrees to the pipe length and cleaned of all cutting burrs prior to cementing.
      a. Use approved reaming tool.
      b. Pipe ends shall be wiped clean with a rag lightly wetted with PVC thinner.
      c. Cement shall be applied with a light coat on the inside of the fitting and a heavier coat on the outside of the pipe.
      d. Pipe shall be inserted into the fitting and given a quarter turn to seat the cement.
      e. Excess Cement shall not be used.
      f. Pipe will be tested as indicated elsewhere in these Specifications.
      g. No backfilling will be permitted other than at the centers of pipe lengths until the pressure test is completed.

4. Backfilling shall be done when pipe is not in an expanded condition due to heat or pressure.
    a. Cooling of the pipe can be accomplished by operating the system for a short time before backfill or by backfilling in the early part of the morning before the heat of the day.
5. No PVC pipe may be threaded or connected to a threaded fitting without an adapter.
6. Provide protection at all times ample to keep rock, dirt, gravel, debris, and other foreign materials from entering piping, valves, and other irrigation equipment.
7. Great care must be taken to insure that the inside of the pipe is absolutely clean.
    a. Any pipe ends not being worked on must be protected and not left open.
8. All threaded joints are to have Teflon tape or pipe dope applied to male threads only.

C. Head Locations.
1. Locate sprinkler heads 9 IN from the building foundation unless otherwise noted.
    a. Heads immediately adjacent to walks, curbs, shrub/groundcover planting bed edge, etc. shall have 1 IN clearance between the head and walks, curbs, shrub/groundcover planting bed edge, etc. unless otherwise noted.

D. Risers:
1. All sprinklers and quick coupler head risers must be constructed according to the "Sprinkler Head Riser" and “Quick Coupling Valve” details.
    a. The pipe risers must have the same inlet size as the sprinkler and quick coupler heads.
2. Minimum riser size shall be the pipe size of the sprinkler head.
3. Risers are to be capped after installation to keep inside of pipe clean.
4. Care must be taken not to over-tighten the steel pipe into the PVC fittings.

E. Double Check Valve: See Civil Drawings.

F. Valve Boxes:
1. All plastic valve boxes in planting areas shall be installed 1 IN above finished grade.

G. Automatic Control Valves with Battery Operated Controller and Solenoid:
1. Install as shown on Drawings and per manufacturers written recommendations.
2. Before installation of any automatic valves, the supply line must be thoroughly flushed.

3. All automatic valves shall be enclosed in valve boxes set above finish grade as shown on details.
    a. Valve box extension may be required.
    b. Locate valve boxes in shrub and groundcover planting beds wherever possible and at points of easy access from paved areas.
4. Locate outside of paved areas and grouped together where possible.
    a. Where valves occur adjacent to paved areas, install so that valve boxes will not be closer than 12 IN to paving and perpendicular or parallel to it.
    b. Group boxes shall be spaced evenly to provide a neat appearance.

H. Quick Coupling Valves:
1. Locate all quick couplers in shrub and/or groundcover planting beds when possible and at points of easy access from paved and/or lawn areas.

I. Irrigation Water Meter: See Civil Drawings.

J. Pipe Sleeves:
1. All sleeves shall extend a minimum of 12 IN beyond the edges of pavement.
2. Pipe for irrigation mains and laterals may be installed with sleeves but shall not include any pipes with couplers whenever possible.
3. Plug all ends of sleeves and irrigation mains and laterals to prevent soil from entering.

K. Pressure Testing:
1. Before backfilling, flush all new PVC main water lines; then pressure test at ninety (90) psi.
    a. This pressure shall be maintained until all joints, fittings and pipes have been inspected.
    b. Correct any leakage and repeat test until the system is watertight.
    c. Maximum psi loss in a fifteen (15) minute test shall be five (5) psi.
    d. Test the system prior to contacting Project Representative for final pressure test.
2. Before backfilling, all PVC lateral lines shall be flushed and pressure tested with the system exposed to static pressure.
    a. This pressure shall be maintained until all joints, fittings and pipes have been inspected.
    b. Correct any major leakage and repeat test until the system is reasonably watertight.
    c. Do not install heads prior to testing. Plug risers at location of head connection.

3. To be valid, all tests must be witnessed by the Project Representative.
    a. Give 48 HRS written notice to the Project Representative prior to the anticipated date of inspection.

L. Backfilling:
1. In refilling trenches, the bedding around the pipe and fittings shall be approved “Backfill Material” and shall be well tamped.
    a. If necessary, provide suitable imported backfill.
    b. Trenches shall be thoroughly compacted and water-settled.
    c. Trenches shall be backfilled uniform with the surrounding grade, raked to a slight mound, then compacted to achieve minimum compaction required by Project Representative.
2. All roots greater than 1/4 IN DIA, all rocks greater than 1IN DIA, and surplus excavation shall be removed from the trench unless otherwise directed.
3. Trenches under roads or paved areas shall be backfilled and tamped with a mechanical tamper in successive 6 IN lifts to at least ninety-five (95) percent density as determined by ASTM D 1557.
    a. Paving shall be replaced to the satisfaction of the Project Representative.
4. Before backfilling, all underground appurtenances including risers, valves, double check valves, drain valves, etc., must remain exposed so that they can be viewed during testing.
    a. Leave all joints exposed; then complete backfilling after flushing, pressure testing, inspection and preparation of "As-Built Drawings".
    b. The location, inspecting and testing provisions of these Specifications will be strictly adhered to.
    c. If, for any reason, any part of the sprinkler system is backfilled before approved location, testing, or inspection is authorized by Project Representative, it must be completely uncovered and exposed until approved for backfilling by the Project Representative.

M. Manual Drain Valve:
1. Install per “Manual Drain Valve” detail shown on Drawings.

3.03 CLEAN-UP

A. Clean all work areas including paving, curbs, catch basins, manholes and lawn, or debris caused by the irrigation work on this project, or any part of the project, on completion of operations and prior to watering.
1. All hard surfaced areas shall be washed clean.
2. Daily clean up shall be required on all areas used for circulation, parking, or other daily use.

3.04 FINAL TESTING

A. Before the sprinkler system will be accepted, perform a water "Performance Coverage Test" to determine if the water coverage and operation of the system is complete and satisfactory, in the presence of the Project Representative.
   1. If any part of the system is inadequate, it shall be repaired or replaced at the Contractor's expense and the test repeated until accepted.
   2. Provide 48 HRS written notice to the Project Representative prior to the field review.
   3. Adjust and balance sprinkler heads for optimum and uniform coverage without excessive fogging or overthrow on to signage, pavement(s), structure(s) and building(s); adjust all sprinkler head heights and set all valve boxes to proper grade prior to final review by Project Representative.

B. Provide all necessary equipment and shall perform all work connected with the test.

C. If any part of the system is inadequate it shall be repaired or replaced at the Contractor’s expense and the test repeated until accepted.

D. The irrigation system shall be guaranteed to give complete and satisfactory service from time of installation until Final Acceptance.

3.05 OPERATION

A. Starting at the time of planting, and ending at completion of the work, irrigate all planted areas with 1 IN of water per week, in at least two (2) equal increments, to be scheduled at intervals of one half week or more frequently.

3.06 PLANT DISTURBANCE OR DAMAGE CAUSED BY IRRIGATION SYSTEM REMOVAL

A. Remove irrigation system at end of one (1) year warranty period as shown on Contract Drawings.

B. Plants disturbed by work required to remove irrigation system shall be replanted at the Contractor’s expense.
   1. If in the opinion of the Project Representative, the irrigation work has damaged plants installed as part of the irrigation removal, replace the damaged plants at Contractor expense.

C. All planting work resulting from irrigation repair work shall comply with the Contract Documents.

3.07 FINAL ACCEPTANCE

A. Upon completion and approval of all tests, final acceptance of the system will be contingent upon providing signed and approved sprinkler/plumbing/health/electrical permits as may be applicable in the area, as well as reproducible "As Built Drawings" and two (2), three (3) ring binders of all catalog cuts/manufacturers' instructions/maintenance and operation information.

B. Prior to final acceptance of the irrigation system, provide a recommend watering schedule for all landscape improvements.

3.08 WARRANTY

A. The entire sprinkler system shall be guaranteed to give complete and satisfactory service as to materials and workmanship for a period of one (1) year from the date of final acceptance of the work by the Project Representative.

B. Should any trouble develop within one (1) year which, in the opinion of authorized Project Representative personnel, is due to inferior or faulty material and/or workmanship, the trouble shall be corrected, without delay, to the satisfaction of the authorized Project Representative's personnel and at the Contractor's expense.

C. Any settling of backfilled trenches shall be repaired at the Contractor's expense, including but not limited to, restoration of pavement and planted areas.

END OF SECTION

SECTION 32 90 00
LANDSCAPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Scope of Work:
   1. Furnish all materials, equipment, labor, tools, materials, tests, permits, and other related items necessary to complete the work shown on the Drawings and/or as specified in the Specifications in a first quality workmanlike manner. Section Includes:
      a. Planting soil preparation.
      b. Seeding.
      c. Plants and planting.
      d. Maintenance of planting including hand watering and weeding.
      e. Pruning and repair of existing trees.
      f. Plant warranty.
      g. Preparation of a landscape maintenance plan for the Owner.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Section 01 20 00 – Payment Procedures.
   3. Section 01 78 00 – Closeout Procedures.
   4. Section 32 84 00 – Irrigation System.
   5. Section 31 10 00 – Site Clearing.

C. Location of Work:
   1. All areas within the limits of clearing and grading and all areas outside of the limits which are disturbed in the course of the work.

1.02 EXTENDED WARRANTY

A. In accordance with Section 01 78 00 - Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. Warranty period for work of this Section is two (2) years commencing on the date of Substantial Completion. The landscape establishment period shall equal the warranty period.
   2. Replace plants not in normal healthy growing condition at the end of the warranty period. Replace with plants that are identical species, size, and quality per Specifications.

3. It is expressly understood the Contractor will be responsible during the two (2) year landscape establishment period for the normal maintenance of the landscape, as described in Article 3.11 herein.

B. See Section 01 20 00 – Payment Procedures for contract requirements for landscape establishment bond provision.

1.03 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI); Z60.1, American Standard for Nursery Stock.
   2. AOAC International (AOAC).
   3. United States Department of Agriculture (USDA): Federal Seed Act.
   4. Scientific nomenclature shall conform with *Flora of the Pacific Northwest* (Hitchcock and Chronquist, 1998), or the USDA PLANTS database (http://plants.usda.gov/). Names not present in these listings shall conform to accepted scientific nomenclature in the nursery trade.
   5. ASTM International (ASTM):
      a. D5276, Standard Test Method for Drop Test of Loaded Containers by Free Fall.

B. Quality Control:
   1. Landscape Contractor Qualifications:
      a. Landscape Contractor shall be a specialist in installing and planting landscape products with documented 5 years of experience in performing landscape work of comparable size, scope, and quality.
      b. Landscape Contractor shall be registered in the State of Washington and qualified for landscaping work through certification by the Washington Association of Landscape Professionals (WALP).
      c. Supervision: Provide the services of at least one qualified person who shall be present at all times during execution of the work of this Section. That individual, who shall direct the work, shall be thoroughly familiar with the types of materials being installed and the proper methods for their installation.
   2. Project Representative Observance:
      a. It is required that the Project Representative observe the work specified herein. The Contractor shall request observance at least twenty-four (24) HRS in advance of the time such observance is required. Observance is required on the following portions of the work:
         1) Completion of Subgrade Preparation.
         2) Completion of Planting Soil Preparation and Placement.
         3) Completion of Plant Location Staking and Layout.

4) Review of Plant Materials.

5) Beginning of Plant Installation and Planting.

6) When planting and associated work has been completed.

7) Maintenance inspections.

3. Pruning: All tree pruning to be performed by an International Society of Arboriculture (ISA) registered and licensed arborist in the State of Washington.

1.04 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Delivery:
1. Deliver soil additives to the site in the original and unopened containers bearing the manufacturer's guaranteed chemical analysis, weight, manufacturer's name, trademark, and conformance with state law.
2. Protect plant material during delivery to prevent damage to rootballs, trunks, stems, or desiccation of leaves.
3. Transport plants in enclosed trucks. Provide adequate protection so that trunks are not scarred in transport and branches are not broken. Tree trunks shall be wrapped with protective covering prior to handling and loading. Covering shall be removed at the time when plant materials will be inspected at the job site.

B. Handling:
1. Exercise care in handling, loading, unloading, and storing of plant materials.
2. Plant materials damaged in any way shall be discarded and replaced with undamaged materials.
3. Protect bark of trees from rope chafing.
4. Do not drag plant material without proper root and branch protection.

C. Storage:
1. Protect plant materials from mechanical damage, wind, excessive sun, and drying out. If planting is delayed more than four (4) HRS after delivery, set plants in shade and keep roots moist by covering with mulch, soil, or other acceptable means of retaining moisture.
2. Protect packaged materials from deterioration during storage. Do not store herbicides or pesticides with any other landscape material.

1.05 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Leadership in Energy and Environmental Design (LEED®) Documentation: Submit the following in accordance with Section 01 81 30 – Sustainability Requirements:
1. Completed LEED Materials Tracking Form.

C. Approval Submittals:

1. Seed mix technical data including:

   a. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.
   b. Type of herbicide to be used during first growing season to contain annual weeds and application rate.
   c. Certification that each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.

2. Watering Plan and Schedule: Prior to substantial completion, the Contractor shall submit a written “watering plan and schedule” to the Project Representative and Owner to ensure adequate watering (summer, autumn, winter, and spring) of all plant materials during the landscape establishment period.

3. Plant Material Documentation:

   a. Within thirty (30) calendar days after Award of Project Contract and Notice to Proceed, submit written documentation to the Project Representative that all specified plant materials have been ordered. Should the Contractor neglect to provide this documentation within the allocated time, Contractor may forfeit any option to substitute plant materials.

   b. The Contractor shall provide all plants of the size, species, variety and quality noted and specified. If unavailable, the Contractor shall notify the Project Representative in writing immediately and provide the names and telephone numbers of five (5) nursery suppliers that have been contacted. If substitution should be permitted, it can be made only with the prior written acceptance of the Project Representative.

   c. List plant suppliers’ names, addresses, and phone numbers.

   d. List respective plant storage or nursery locations with addresses.

   e. Approval of plant material shall not be considered as Final Acceptance.

4. Miscellaneous:

   a. Copies of invoices for soil additives used on Project showing grade furnished, along with certification of quality and warranty, and quantity.

   b. Samples: Submit a sample of each of the following items:

      1) Planting Soil: One (1) LB bag labeled with material source.

      2) Compost: One (1) LB bag labeled with material source.

      3) Mulch: One (1) LB bag labeled with material source.

      4) Washed Cobble Rock: Four (4) LB bag or bucket labeled with material source.

c. Weed and Pest Control Plan:

1) The Weed and Pest Control Plan shall be submitted and approved by the Project Representative prior to starting any landscape work.

2) The Weed and Pest Control Plan shall include scheduling and methods of all control measures described in this Section, including soil preparation methods to meet the required soil surface conditions in the planting areas.

3) The weed control plan shall show general weed control including hand, mechanical, and chemical methods, timing, application of herbicides including type, rate, use, and timing, and noxious weed control. Target weeds and unwanted vegetation to be removed shall be identified and listed in the weed control plan based on King County's noxious weed list.

4) The plan shall be prepared and signed by a licensed commercial operator with a Washington State Department of Agriculture (WSDA) Commercial Applicator pesticide license. The plan shall include methods of weed control, dates of weed control operations, and the name, application rate, and Material Safety Data Sheets (MSDS) of all proposed herbicides. In addition, the Contractor shall furnish the Project Representative with a copy of the current product label for each herbicide / pesticide and spray adjuvant to be used. These product labels shall be submitted with the weed control plan for approval.

5) All herbicides / pesticides must be carefully selected and applied in accordance with U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology, Washington State Department of Agriculture, King County Noxious Weed Control Board, and local sensitive area ordinances and regulations.

D. Quality Assurance Submittals:

1. Comply with provisions of Section 01 43 00 – Quality Assurance and Control and the requirements of this Section.

2. Subgrade and Planting Soil Analysis Reports: Provide soil tests for the subgrade soil and the planting soil from an approved soil testing laboratory. Testing shall be performed in accordance with the most current edition of "Methods of Soil Analysis" published by the Soil Science Society of America, Inc. The soil test analysis reports shall include the following:

a. Fertility Analysis:

1) Extractable analytes: Nitrate, nitrogen, ammoniacal nitrogen, phosphorous, potassium, calcium, magnesium, copper, zinc, manganese, and iron.

2) Saturation extract values: Calcium, magnesium, potassium, sodium, boron, sulfate, pH, lime content, salinity, and sodium absorption ratio.

b. Organic content and Particle size appraisal: Organic percent by over-dried weight, and USDA particle size.

c. Cation Exchange Capacity (CEC)

d. The soil analysis reports shall include a statement that the laboratory has reviewed the planting plan and the Planting Specifications, and that its recommendations respond to the specific needs of the Contract.

E. Closeout Submittals:

1. Operations and Maintenance Manual Content: Provide Operations and Maintenance manual documentation for care of all plantings on a monthly schedule for a calendar year, in accordance with Section 01 73 00 – Operation and Maintenance Manuals.

2. Maintenance Plan:

a. Provide a type written maintenance plan with maintenance schedule and color photographs of all plants for Owner's use following Contractor's landscape establishment period.

b. Submit twenty (20) days prior to final acceptance.

3. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.06 SEQUENCING AND SCHEDULING

A. Installation Schedule:

1. Provide schedule showing when trees, shrubs, groundcovers, vines, and other plant materials are anticipated to be delivered to project site and to be planted.

2. Show schedule of when seed areas are anticipated to be planted.

3. Indicate planting schedules in relation to schedule for irrigation system installation, soil preparation and finish grading.

4. Indicate anticipated times when the Project Representative will be required to review installations for initial acceptance and final acceptance.

B. Pre-installation Meeting:

1. Meet with Project Representative and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Project Representative.

C. Permits, Codes, and Regulations:

1. The Landscape Contractor shall obtain and pay for all necessary permits and fees as required by the Local Authority and prevailing ordinances, and/or codes.

2. The Landscape Contractor shall keep full informed and shall comply with all existing laws, codes, ordinances, and regulations which in any way affect the conduct of the work.

D. Conditions at the Site:
   1. Before proceeding with any work, the Landscape Contractor shall inspect the site, carefully check all grades, and verify all dimensions and conditions affecting the work.
   2. The Landscape Contractor shall report to the Project Representative all deviations and/or conflicts between the Contract Drawings, Contract Specifications, and site conditions. Extra work arising from failure to do so shall be done at the Landscape Contractor's expense.
   3. Take all necessary precautions to protect work in progress, all property, persons, walks, curbs, pavement, and buildings from any damage that might be incurred arising from this Contract. Do not mix planting soil directly on paved surfaces. Protect existing trees designated to remain.
   4. Locate all underground utilities prior to commencement of work. Protect known utilities. Promptly notify the Project Representative of any conflict between proposed work and utilities or other obstruction(s). The Contractor shall pay for the expense of making any and all repairs for damage from work therefrom.
   5. The landscape Contractor shall progressively clean the work site of debris and rubbish as the work proceeds.
   6. Contractor is responsible for protecting work from vandalism until acceptance of work in whole or in part.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

A. Subject to compliance with the Contract Documents, the manufacturers and suppliers listed in the applicable Articles below are acceptable.

B. Submit request for substitution(s) in accordance with Specification Section 01 60 00.

2.02 MATERIALS

A. Existing Subgrade Soil:
   1. The Contractor shall be responsible for all soil additives required for the performance of this Contract and for determining the quantity of additives required to fulfill Contract obligations.
   2. Soil Analysis Reports of the subgrade soil shall be per the soil analysis report article herein:
      a. Contractor shall send a minimum of three (3) representative samples of subgrade soil to an approved soil testing laboratory. Location of three samples shall be determined by Project Representative.
      b. Each sample shall consist of a composite of soil collected from a 1 IN, 8 IN, and 16 IN depth.
      c. The cost for soil testing must be borne by the Contractor.

d. Soil Analysis Reports must be submitted to the Project Representative for acceptance prior to incorporating soil additives into the subgrade and placing compost and planting soil per Article subsection 2.03 herein.

B. Planting Soil:
1. The Contractor shall be responsible for the supply of all natural soil and soil additives required for the performance of this Contract and for determining the volume of planting soil and soil additives required to fulfill Contract obligations.
2. Soil shall be free of weeds, pests, toxic substances and other undesirable material harmful to plant growth.
3. Planting soil mix shall be a mixture of compost and sand.
   a. Compost shall be per Article subsection 2.02.C.
   b. Sand shall be "Washed Building Sand" and meet the following chemical and mechanical analysis:

SIZE	SIEVE	% PASSING
No. 4	ASTM E11	100 %
No. 270	ASTM E11	0-2 %

   1) Salinity (millimhos per centimeter of Saturation extract @ 25 DegC).
      a) Permissible Range: Nil – 3.0.
   2) Boron (saturation extract concentration):
      a) Permissible Range: Nil – 1.0 ppm.
   3) Sodium (sodium absorption ratio – SAR):
      a) Permissible Range: Nil – 6.0.
4. Planting soil mix shall be a two-way mix soil consisting of one-half (1/2) sand and one-half (1/2) compost by volume thoroughly mixed together. Mixed soil shall have a pH range of 5.0 to 7.0.
5. Soil Analysis Reports of the planting soil shall be per the soil analysis report Article subsection 2.03 herein.
   a. Contractor shall send one (1) representative samples of mixed planting soil to an approved soil testing laboratory.
   b. The cost for testing must be borne by the Contractor.
6. Submit sand, compost and planting soil supplier's certification of material for Project Representative's review and acceptance prior to use on project site.

C. Compost:
1. 100 percent Groco, manufactured by Groco and distributed by Sawdust Supply, 15 South Spokane Street, Seattle, WA. (206) 622-5141.

2. Or Red-E-Topsoil, Pacific Topsoils Inc., Cedar Grove Compost or Iddings Farm Service. Compost available from:

Red-E-Topsoil
Redmond, Washington
Tel: (425) 868-6500
Email: None

Cedar Grove Compost
Maple Valley, Washington
Tel: (425) 432-2395
Email: infocg@cedar-grove.com

Pacific Topsoils Inc.
Everett, Washington
Tel: (425) 337-2700
Email: sales@pacifictopsoils.com

Iddings Farm Service
Covington, Washington
Tel: (253) 630-0600
Email: info@iddingsinc.net

3. Or Approved Equal meeting the following:
   a. Composted material shall be derived from a Type 1 feedstock and produced by a facility in compliance with WAC 173-350-220. The compost shall meet Grade AA Compost as defined by the Washington State Department of Ecology's Interim Guidelines for Compost Quality (Publication #94-38, Revised November 1994). Compost material shall have 100 percent passing a 1/2 IN screen. The carbon to nitrogen ratio (C:N) of the compost shall be in the range of 20:1 to 40:1. Organic matter content of the composted material shall be a minimum 40 percent dry weight basis, and the moisture content shall be in the range of 35 to 50 percent as determined by ASTM D 2974. The pH of the compost shall be within the range of 5.5 to 7.5 as determined by ASTM D 2976. The maximum electrical conductivity of composted Material shall be 6 ohms/cm. Decomposed Organic Compost shall be mature as determined by US Composting Council stability test ratings referred to in the Ch 173-350 WAC.
4. All compost shall be tested within six (6) months of proposed use. The Contractor shall submit a Manufacturer's certificate of Compliance indicating the test results, a one (1) LB sample, the Supplier's name and contact information, to the Project Representative a minimum of ten (10) Working Days in advance of use.

D. Mulch:
   1. Bark Mulch shall be derived from Douglas Fir and Western Hemlock tree species.
   2. Bark is defined as the outermost coarse protective layer of the tree, located outside of the cambium layer.
   3. It shall be ground so that a minimum of 95 percent, by volume, of the material will pass through a one (1) IN sieve.
   4. Ground bark shall not contain elements in quantities that would be detrimental to plant life.
   5. Wood cellulose tissue of fiber (wood pulp), wood waste, wood shavings, wood sawdust, wood chips, or any product that contains greater than 5 percent, by volume, of the hard, lignified wood portion of the tree will not be accepted.

6. Mulch shall be weed-seed free.

E. Soil Additives:
   1. Soil additives applied during soil preparation shall meet soil testing laboratory's recommendations.
   2. Soil additives shall be complete commercial brand with chemical analysis shown on unopened container when delivered.
   3. Soil additives shall be packaged in new, waterproof, non-overlaid bags clearly labeled as to weight, manufacturer and content.

F. Erosion Control Fabric shall be jute or other biodegradable, natural woven fiber fabric.

G. Weed and Pest Control: Weeds specified as noxious by the Washington State Department of Agriculture, the local Weed District, or the King County Noxious Weed Control Board, and other species identified by the Project Representative, shall be controlled on the project in accordance with the Weed and Pest Control Plan.
   1. Weed control shall be required for all areas within the project limits designated by the Project Representative, including, but not limited to planting areas, restoration areas, mulch areas, and mulch rings.
   2. The Contractor shall identify all target weeds, specific to the site, to be controlled in the Weed and Pest Control Plan.
   3. All chemical pesticides shall be labeled and used in accordance with governing agencies defined in the Weed and Pest Control Plan.

H. Erosion Control Seed: Fresh, clean, new crop seed labeled in accordance with USDA Rules and Regulations under the Federal Seed Act in effect on the date of bidding. Provide seed mix consisting of 50 percent Hard Fescue, 45 percent Sheep Fescue, and 5 percent Microclover at application rate of 100 LBS/ACRE.
   1. A complete analysis of the seed shall be submitted to the Project Representative including percent of pure seed, germination, other crop seed, inert and weeds, and the germination test data. All crop seed in excess of one (1) percent must be itemized.
   2. Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.
   3. Grasses, legumes, or cover crop seed of the type specified shall conform to the standards for "Certified grade seed or better as outlined by the State of Washington Department of Agriculture "Rules for Seed Certification." Seed shall be furnished in standard containers on which shall be shown the following information:
      a. Common name of seed.
      b. Lot number.
      c. Net weight.
      d. Percentage of purity.

e. Percentage of germination.

f. Percentage of weed seed content and inert materials clearly marked for each kind of seed in accordance with applicable state and federal law.

I. Water:
1. Contractor shall make at Contractor expense, whatever arrangements are necessary to ensure an adequate supply of water to meet the needs of this Contract.
2. Contractor shall also furnish necessary hose, equipment, water trucks, attachments, and accessories for the adequate irrigation of planted areas as may be required to complete the work specified.
3. All costs for water incurred during the contract period shall be borne by the Contractor unless other arrangements are made with the Project Representative.
4. All water shall be free from substances harmful to plant growth.

J. Washed Cobble Rock:
1. Washed Cobble Rock shall be naturally occurring water-rounded aggregate material and shall have a well-graded distribution of cobble sizes as indicated on Drawings.
2. Cobbles shall be of a uniform grey color.
3. The grading of cobble shall be determined by the Project Representative by visual inspection of the sample.
4. Color of cobble shall be as reviewed and approved by Project Representative.

K. Wood Cellulose Fiber Mulch:
1. Wood cellulose fiber mulch shall be specially processed one-hundred (100) percent virgin wood fiber containing no growth or germination-inhibiting ingredients and shall be dyed a suitable color to facilitate inspection of placements of the material.
2. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry.
3. When hydraulically sprayed on the ground, the material shall allow the absorption and percolation of moisture.
4. Each package of cellulose fiber shall be marked by the manufacturer to show the air dry weight content.
5. The hydro-seeding process shall utilize only 100 percent virgin wood fiber mulch in which 30 percent of the fibers shall be 0.15 IN long or longer.

L. Plants:
1. See plant schedule on Contract Drawings for plant list.

2. Plant Source: The Contractor is advised that a growing contract may be necessary to secure the required quantities, the specified size, variety, and grade of plant material.
    a. Trees, shrubs, groundcovers, and vines:
        1) No collected plants are acceptable; only nursery grown plants will be accepted.
        2) For trees, shrubs, groundcovers, or vines not grown specifically for this contract, plants are required to be from stock grown in same environmental conditions or climatic zone as the project site.
3. Sound, healthy, vigorous, with normal top and root systems, free from disease, insect pests or their eggs or larvae, species and size as indicated on Drawings.
4. Plants shall not be pruned at the nursery or prior to delivery. Plants shall have all leaders and buds intact.
5. Plant material with weeds in the top of the rootballs or containers will be rejected.
6. Plants shall not exhibit symptoms of wind burn, drying out, or sun scalding. Root balls shall be moist and leaves shall exhibit healthy growth.
7. Grading of plant material and root ball/container sizes shall be in accordance with the code of standards of the American Nursery & Landscape Association.
8. Trees with multiple leaders, unless specified, will be rejected. Trees with a damaged or crooked leader, bark abrasions, sunscald, disfiguring knots, insect damage, or cuts of limbs over three quarter (3/4) IN in diameter that are not completely closed will be rejected.
9. No less than ten (10) percent of each variety and/or species of plant delivered to the project shall be accurately labeled with durable, legible labels with weather-resistant ink or preprinted labels. Whether or not labeled, any plants, which do not conform to the Plant Schedule and/or Contract Drawings, shall be replaced immediately with plants conforming. Plant material labels shall be durable, legible labels stating the correct plant name.
10. Provide the number of plants shown on the Plant Schedule in Contract Drawings, or to cover at specified spacing whichever is greater.
11. Trees grown in fabric bags shall have a well-established root system reaching the sides of the fabric bag to maintain a firm ball when the fabric is removed, but shall not have excessive root growth encircling the fabric bag. Fabric bags shall be entirely removed prior to planting.

M. Snags:
1. Construct snags using tree trunks salvaged from tree removal during site clearing and grubbing activities. Do not remove lower branches entirely. Cut branches back so that stubs are left minimum 12 IN in length.

2. Cuts made by chainsaw shall be disguised to look like natural breaks rather than sawn cuts. The cut at top of the snag is important to look like a natural break: provide slits along the edges and sledgehammer and/or crowbar to break, pry, and pop the slits open and create a jagged edge per drawings.

N. Down Log:
   1. Construct down logs using tree trunks salvaged from tree removal during site clearing and grubbing activities. Remove foliage and cut back branches. Stubs are ok as long as maximum length does not exceed 12 IN.
   2. For anchoring: use biodegradable, natural fiber rope and nontreated wood anchor (12IN section of 2 IN x 4 IN nontreated lumber or a remnant length of left-over branches of similar dimension removed from the log itself).

O. Brush Pile:
   1. Construct Brush Pile using tree branches salvaged from tree removal during site clearing and grubbing activities and from creation of snags and down logs.

P. Accessories:
   1. Wrapping Material: Burlap in strips and secured to tree with good quality six-ply cotton twine or binder twine.
   2. Weed Barrier Fabric: landscape fabric, Polypropylene, woven or spunbound, color: black, thickness 3 OZ.
   3. Tree Stakes: Furnish as detailed on Contract Drawings.

2.03 SOIL ANALYSIS REPORTS

A. Provide soil tests for subgrade and planting soil from an approved soil testing laboratory. Testing shall be performed in accordance with the most current edition of “Methods of Soil Analysis” published by the Soil Science Society of America, Inc. The soil test analysis reports shall include the following:
   1. Fertility Analysis.
      a. Extractable analytes: nitrate, nitrogen, ammoniacal nitrogen, phosphorous, potassium, calcium, magnesium, copper, zinc, manganese, and iron.
      b. Saturation extract values: calcium, magnesium, potassium, sodium, boron, sulfate, pH, lime, salinity, and sodium adsorption ratio.
   2. Organic Content and Particle Size Appraisal.
      a. Organic percent by over-dried weight.
      b. USDA Particle Size.
   3. Cation Exchange Capacity (CEC).
   4. Laboratory Recommendations:
      a. The soil test analysis report shall include:

1) A statement that the soil test laboratory has reviewed the planting plan and the landscaping specifications.

2) Recommendations for soil additives responding to the specific needs of the Contract and for healthy plant growth.

PART 3 – EXECUTION

3.01 SUBGRADE EXAMINATION

A. It shall be the Contractor's responsibility to verify the existence of proper subgrade elevations prior to beginning subgrade preparation work.
   1. All planting areas shall be finish graded, verified, and accepted by the Project Representative before commencement of planting.
   2. All subgrade planting areas shall allow for compost, planting soil and mulch to be added to individual planting areas as specified herein.
   3. All grades shall flow smoothly into one another and produce positive stormwater drainage. The Contractor is responsible for any adverse drainage conditions that may affect plant growth unless the Contractor contacts the Project Representative indicating any possible problem, within 24 HRS from the time adverse drainage conditions have been identified.

B. Areas to receive plant materials shall be cleaned, grubbed, cultivated and graded before installing Compost and Planting Soil. Weeds shall be removed per Weed and Pest Control Plan prior to beginning Subgrade preparation work.

C. Placing of compost shall constitute acceptance of subgrade conditions by Contractor.

D. Subgrade preparation and soil testing shall be reviewed and approved by the Project Representative prior to proceeding with soil preparation work.

E. In the event that undisclosed rock, crushed rock, gravel borrow, soils contaminated with toxic substances, hardpan, or underground construction work and/or obstructions are encountered in the subgrade, alternate planting locations may be selected by the Project Representative.
   1. Where alternate planting locations are not accepted, the obstruction shall be removed to a depth of not less than three (3) FT below the bottom of root ball or roots when plant is properly set at the required grade or other solutions to the planting problem will be reviewed with the Project Representative.
   2. The Contractor shall be paid for work required to solve the planting problem, such as, the removal of such rock, contaminated soils, hardpan or underground obstruction encountered at a unit price basis and agreed upon by a Change Order prior to commencement of work.

F. Where tree locations fall under existing overhead wires, or crowd existing trees, adjust locations as directed by Project Representative.

G. Prior to installing Compost and Planting Soil, a percolation test shall be performed. This shall be accomplished by excavating two (2) pits that are each a minimum of two (2) FT in depth and two (2) FT in diameter. Location of pits shall be per Project Representative field directive. Fill the pit with water and allow the pit to drain for twenty-four (24) HRS. After twenty-four (24) HRS, refill the pit with water.
   1. If the time required for the pit to drain completely after being filled the second time is greater than twenty-four (24) HRS, the Contractor shall notify the Project Representative.
   2. The Contractor shall be paid for work required to solve the drainage problem, such as, installation of French drains or drainage sumps at a unit price basis and agreed upon by a Change Order prior to commencement of work.

H. It shall be the Contractor's responsibility to verify a weed and pest free subgrade prior to beginning subgrade preparation work. If required, the Contractor shall be paid for weed and pest removal based upon a Project Representative approved Weed and Pest Control Plan.

3.02 SOIL PREPARATION

A. Provide and install soil additives to subgrade soil per Soil Analysis Report recommendations from soil testing laboratory, per Article subsection 2.03 herein.

B. All areas to receive planting shall be cleared of all debris greater than 1 IN in diameter before scarifying. Provide and install a four (4) IN compacted depth of compost over all planting areas and scarify to a depth of six (6) IN into the subgrade soil. Project Representative shall verify and approve the depth of scarification of subgrade soil prior to installation of planting soil.

C. After compost is thoroughly scarified into the subgrade, lightly compact, and provide eight (8) IN compacted depth of planting soil or twenty (20) IN compacted depth of planting soil per Drawings. Install planting soil two equal depth lifts. Compact each lift of planting soil before installing the next lift. Drag to even grade, remove debris and rocks larger than one (1) IN in diameter, and roll for firmness prior to planting.

D. Finish Grading:
   1. Finish grade is defined as the top surface of planting soil prior to the installation of mulch, or seed planting unless otherwise noted on the Contract Drawings.
   2. Finish grading shall consist of placing, grading and lightly rolling planting soil, providing for surface drainage, cutting all necessary drainage swales and generally conforming to finish grades shown on the Contract Drawings and as directed by the Project Representative.
   3. Compact finish grade to eighty-five (85) percent of maximum dry density as determined by ASTM D 1557.
   4. After settling, finish grade in seed planting areas shall be one half (1/2) IN below all walks, curbs and/or other hard surfaces.

5. After settling, finish grade in tree, shrubs and groundcover planting areas shall be three (3) IN below all walks, curbs, and/or other hard surface edges.
6. All planting areas shall be finish graded and accepted by the Project Representative before commencement of planting. Project Representative to direct locations for digging of test holes to verify proper placement and thickness of planting soil.
7. All planting areas shall be prepared so that they are weed and pest free at the time of planting, at time of Final Acceptance, and upon completion of Landscape Establishment Period of the Project.

3.03 STAKING AND LAYOUT

A. Staking and layout refers to locating and verifying all planting locations. Make required field adjustments as directed without additional cost to the Owner. No work shall commence on installation of materials until staking and layout is verified by the Project Representative.

3.04 TREES, SHRUBS, GROUNDCOVERS AND VINES INSTALLATION

A. Notification:
   1. Notify Project Representative of source of plants and plant materials at least thirty (30) days prior to planting to permit Project Representative's inspection of plant source qualifications.

B. Review of Plant Materials:
   1. The review and acceptance of all plant materials by the Project Representative prior to planting is mandatory. The Contractor has three (3) options to secure approval of plant materials:
      a. Have plants available at the project site for review during scheduled site visits.
      b. Have Project Representative review plants at the place of growth at the Contractor's expense.
      c. Submit color photographs of representative specimens of each type of plant on the plant schedule. Photos shall be minimum physical size 4 x 6 IN and minimum 150 DPI for digital formats. Photographs shall be taken from an angle that depicts the condition of foliage, the rootball and the size of each typical plant to be furnished. A scale rod or other measuring devise shall be included in each photograph. For species where more than twenty (20) plants are required, include a minimum of three (3) photos that show the average plant, the best quality plant, and the worst quality plant to be provided. Label each photograph with the plant name, plant size, and name of the growing nursery.
   2. Project Representative reserves the right to reject any or all plant material at any time until final review and acceptance. Remove rejected plants immediately from the site.
   3. Produce upon request, sales receipt for all nursery stock and certificates of inspection from federal, state, and other authorities.

C. Planting Procedure:

1. Planting shall occur between October 1 to March 1, and when weather conditions are consistent with good horticultural practice. If container stock looks to be rootbound, slash roots vertically with a sharp knife along outside of ball in three places minimum before planting. Finish grade at plants, after planting and settling, shall afford positive drainage away from crown.
2. Planting in restoration zones shall not occur in water saturated soils or in areas of standing water, except in areas specifically designated as wetlands. Install plants within wetland areas during the saturated period.
3. Set all trees, shrubs and groundcovers, and vines according to spacing on Contract Drawings. If ground position is more than two (2) FT from the plan position, consult with Project Representative before proceeding.
4. After approval of staking and layout, excavate pits as indicated in Contract Drawings and in accordance with ANLA/ANSI Z60.1.
    a. The inside surfaces of all planting pits are to be rough, not smooth.
    b. Excavation is unclassified; excavate all materials without additional cost.
    c. If the Contractor encounters clay soil or any unusual condition which may be detrimental to the new planting, the Contractor shall notify the Project Representative immediately. Unsuitable material, if encountered, shall be removed from the site and planting soil distributed to replace the unsuitable material as Extra Work in accordance with the Specification. Unsuitable material removal will be paid for as a Change Order in accordance with the Specifications.
5. Tree pits to be circular in shape with sides as indicated on Contract Drawings.
6. Shrub and groundcover beds:
    a. Plant shrubs used in mass plantings in individual holes of required size and spacing as indicated on Contract Drawings.
7. Set plants straight and plumb, in locations when indicated and at such level that after settlement they bear same relationship to finished grade as they did in their former setting.
    a. Carefully compact planting soil under and around root balls to prevent voids.
    b. Remove all rope and wire from tree rootballs.
    c. Remove burlap from top third of tree rootballs.
    d. Plants supplied in containers shall be kept moist at all times and shall be removed from the container in a manner that prevents damage to the root system. The plants shall not be removed from the container by pulling on the stem.
8. Backfill plants with planting soil. Thoroughly water the backfill so that backfill is thoroughly saturated and settled. After settling, apply additional planting soil as needed to bring to finish grade.

9. After planting is complete, form a level saucer three (3) IN high around each tree extending to limit of plant pit for watering purposes.
10. Mulch plant pit after saucer has been shaped.
    a. Mulch to limits of tree pits or uniformly over shrub, groundcover, and vine planting beds, as indicated on Contract Drawings to a depth of three (3) IN.
    b. In mass plantings of shrubs, mulch entire area uniformly among shrubs to a depth of three (3) IN.
    c. If mulching is delayed and soil has dried out, water plants thoroughly before spreading mulch.
11. Staking: Stake trees immediately after planting as detailed on Drawings.
12. All groundcover plant materials shall be installed continuous under all trees and shrubs as indicated on Drawings.
13. Water plants during planting operations.
    a. All plant material planted in restoration zones shall be watered on the same day as planted until backfill soil around the roots of each plant is thoroughly saturated. No more plants shall be planted on any day than can be watered on that day.
    b. Water each plant a minimum of once each week, more if necessary during periods of drought or heat, until final acceptance.
    c. Apply sufficient water to moisten backfill around each plant so that moisture will extend into the surrounding soil.

3.05 EROSION CONTROL SEED INSTALLATION

A. General:
1. Seeding shall be accomplished in the spring (after April 10) or autumn (before October 1) of the year and/or when weather conditions are favorable for proper working of the soil and seed germination.
2. Seed shall be spread by an acceptable mechanical (hopper or culti-packer) or hydro-seed/mulch methods only. Hydro-seeding shall include first application with seed and 10 percent mulch fiber; second application with no seed and 90 percent mulch fiber.
3. Seeding shall be done only after planting soil placement, finish grading and adjacent construction and plantings have been completed.
4. Wood Cellulose Fiber Mulch shall be in accordance with Section 2.2.K.
5. Rate of mulch application in hydro-seeding is 35 LBS per 1000 SQ FT for areas having zero to 4H:1V slope; 50 LBS per 1000 SQ FT for areas between 2H:1V and 4H:1V slope; and 60 LBS per 1000 SQ FT for areas greater than 2H:1V slope.
6. Notify Project Representative in cases where terrain is steeper than 2H:1V, there are areas that exceed 10,000 SQ FT, and where areas having a vertical drop greater than 15 FT.

B. Any seeded areas that have become compacted prior to seeding must be scarified to a depth of six (6) IN by acceptable means, then finish graded as herein before described.

C. Seeding:
   1. After finish grading of seed areas, remove any debris or rocks over one (1) IN in size. Rake to true grade and roll for firmness. If soil is dry, lightly sprinkle with water prior to rolling. Grades after rolling shall be accepted by the Project Representative prior to seeding.
   2. Application rate of seed mix shall be one hundred (100) LBS/Acre.

D. Seed Area Establishment:
   1. The Contractor shall be responsible for the watering of seed areas through the landscape establishment period of the project.
   2. To encourage deep rooting, each watering shall be thorough when enough to provide soil moisture a minimum of six (6) IN below soil surface. Permit soil to dry sufficiently between watering, but not so dry as to damage the planting.
   3. Seed beds must achieve vigorous growth with a full stand of erosion control planting and be uniform in appearance as accepted by the Project Representative. A full stand of erosion control planting is defined as a uniform grass/clover cover with no bare spots over three (3) IN square.
   4. Check for barren areas, maximum three (3) IN square, in seed bed approximately twenty-one (21) days after seeding and overseed as originally specified at the time or at such time as weather and season permit for seed germination or as accepted by the Project Representative.

3.06 WASHED COBBLE ROCK INSTALLATION

A. Install as indicated on Contract Drawings.

3.07 SNAGS

A. Install as indicated on Contract Drawings.

3.08 DOWN LOG

A. Install as indicated on Contract Drawings.

3.09 BRUSH PILE

A. Install as indicated on Contract Drawings.

3.10 PROTECTION

A. All planting materials shall be properly protected against harm from normal weather conditions and the public by the Contractor until Final Acceptance. Maintenance of all the planted areas until Final Acceptance, shall include, but not be limited to, watering, mowing, weeding, and pruning as well as replacement of any plants that appear to be in distress. Tree stakes shall be kept secure at all times. Although planting should occur in spring or fall of year whenever possible, and when weather conditions are favorable, special planting techniques, defoliating, wilt proofing or spray misting may be required should unseasonable planting conditions occur. No work shall be performed in, over or adjacent to planting areas without approved protection and safeguards.

B. Plant losses due to abnormal weather conditions such as, floods, excessive wind damage, drought, severe freezing or abnormal rains; as determined by the National Weather Service, will not be the responsibility of the Contractor.

3.11 LANDSCAPE ESTABLISHMENT AND WARRANTY PERIOD

A. General:
   1. Warranty and maintenance work for this Section is two (2) years commencing on the date of Substantial Completion..
   2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
   3. Protection of new materials:
      a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
      b. Repair and pay for all damaged items.
   4. Replace unacceptable materials with materials and methods identical to the original Specifications. The Contractor shall replace all dead or missing plants before final acceptance, including all plants stolen or damaged by the acts of others.

B. Warranty Period:
   1. Any plant material that is twenty-five (25) percent or more dead or disfigured shall be considered dead and must be replaced at no charge. A tree shall be considered dead when the main leader has died back or there is twenty-five (25) percent of the crown dead. Plants shall be considered disfigured when excessive dead wood has been removed or when the symmetry, typical habit or growth, or sculptured form has been impaired by the removal of dead wood.
   2. All plants are subject to one (1) replacement only per item, and the Contractor shall submit, after each replacement period, a marked planting plan showing the exact location of each item replaced at that time. The Project Representative may require the Contractor to replace dead plants prior to the end of the warranty period at no additional cost.

3. The Contractor has the right to enter upon the property for inspection and curative treatment of any materials needing such which are still under warranty during the entire warranty period. The Project Representative is to be notified a minimum of two days in advance of any inspection and any corrective or curative treatment measures so as to arrange for convenient access to the area.
4. The warranty shall be applicable to any growing conditions through which plants of like kind could be expected to survive, and any deformity or cause of death which could be attributed to or affected by, the physiological condition of the plant shall be deemed replaceable cause; however, this would not apply to plant losses due to unusually severe weather conditions such as floods, excessive wind damage, severe freezing, or abnormal rains as specified in Section 00700 – General Terms and Conditions, Article 1.0 Definitions.
5. Replacements made by the Contractor shall be made in the same manner as specified for the original planting, and shall be done at no cost to the Owner.
6. Replace all trees, shrubs, and groundcovers when plants are no longer in a satisfactory growing condition as determined by the Project Representative for the duration of the warranty period. Make replacements within seven (7) days of notification from the Project Representative.
7. It is expressly understood that the Contractor will be responsible, during the two (2) year landscape establishment and warranty period, for normal landscape maintenance of the project.

C. Landscape Maintenance during Landscape Establishment:
1. Maintenance shall consist of providing adequate and proper care for all plant materials and landscape areas with project limits during a landscape maintenance period to ensure the resumption of growth of the planted material. Maintenance of the landscape shall include, but not be limited to watering, weeding, reapplication of composted mulch, monitoring and treating any disease and/or pest-problems, restoring plant materials and mulch after removal of irrigation system, cultivating and any other maintenance requirements, per standard trade practices, to keep the plant materials in a normal healthy growing condition.
2. Erosion Control Seeded Areas: Mow at least four (4) times a year. Water accordingly to maintain survival and establishment of grasses. Regrade and reseed eroded or bare areas that are evident at the end of the two (2) year landscape establishment period.
3. Wetland Buffer Planting and Weed Control in Wetland Buffer See Wetland Mitigation Plan.
4. The Contractor shall be held responsible for the loss of any plant material, whether dead or missing, from the time of initial planting to the end of the warranty period. The Contractor shall replace all dead or missing plants before Final Acceptance, including all plants stolen or damaged by acts of other.

5. Watering: Plants shall be watered by the Contractor as needed to keep them in a healthy growing condition. The Contractor shall be responsible for the watering patterns and timing, including the setting of automatic sprinkler controls. All irrigation system components installed as part of the Work shall be maintained and operated by the Contractor as part of the landscape maintenance work. The Contractor shall be responsible for the disassembly and removal of the irrigation system at end of one (1) year as shown on Contract Drawings.. Subsequent method of watering during the second year of landscape establishment shall be per an approved watering plan and schedule. During the second year of of the landscape establishment period the plant materials shall be hand watered by garden hose and water truck methods.

6. Mulch: Mulch shall be applied and replaced at the end of each plant establishment year. The final mulch application shall be made one (1) week before the final inspection of all planting areas at the end of the two (2) year landscape establishment period.

7. Fastenings: Tree ties and fastenings shall be kept intact and effective in maintaining firm support for plant material per Contract Drawings. Fastenings shall be adjusted as needed by the Contractor to prevent strangulation or irregular growth. Fastenings and stakes shall be removed at the completion of the landscape establishment period.

8. Inspection of Work: A general cleanup shall be made after any work performed by the Contractor at the project site during the landscape establishment period.

9. Weed and Pest Control: The Contractor shall maintain all mulched bed areas around trees, shrubs, and groundcovers in a weed-free condition during the landscape establishment period. A combination of chemical and mechanical control shall be allowed subject to approval by the Project Representative. At least ten (10) working days before the beginning of the landscape establishment period, the Contractor shall submit a Weed and Pest Control Plan identifying the means, manner, methods, and timing intervals to ensure weed control and consistent with King County Noxious Weed Control Program, Best Management Practices. This Weed and Pest Control Plan will be subject to revision dependent on results of the implemented plan.

    a. The Contractor shall use extreme care to ensure confinement of the chemicals within the areas designated. The use of chemical herbicides and/or spray chemical pesticides shall require the use of anti-drift and activating agents and a spray pattern indicator, unless otherwise allowed by the Project Representative.

    b. All applications of post-emergent herbicides shall be made while green and growing tissue is present. Should unwanted vegetation reach the seed stage in violation of these Specifications, the Contractor shall physically remove and bag the seed heads. All physically removed vegetation and seed heads shall be disposed of off-site at no cost to the Owner.

c. The Contractor shall assume all responsibility for rendering any area unsatisfactory for planting by reason of chemical application. The Contractor shall replace, repair and pay for all damages caused by his/her negligence to the satisfaction of the Project Representative prior to final payment.

d. If Japanese knotweed is encountered within the project limits, it shall be chemically treated with an approved herbicide, applied by stem injection or combination of methods approved by Project Representative and consistent with King County Noxious Weed Control Program, Best Management Practices. Chemical treatment shall be applied in the late summer or early fall, unless the project construction working days fall outside of this time period.

10. Inspection: Plants and landscaped areas will be inspected once every three (3) months by the Project Representative during the landscape establishment period. Should the Project Representative determine at any time that the Contractor is not providing adequate and proper care of plant material or is performing substandard landscape maintenance work, they will order the Contractor in writing to correct and remedy such unsatisfactory work or practices. The Contractor shall make the necessary corrections within a ten (10) day period immediately following receipt of such notice. Notice will be made in writing to the Contractor following inspection of the Project Site.

11. Approximately thirty (30) days before the end of the landscape establishment period, the Contractor shall accompany the Project Representative on a walking inspection of the planting areas. Conditions found unacceptable by the Project Representative shall be corrected by the Contractor within a fourteen (14) day period immediately following the inspection. After correction, the Contractor shall notify the Project Representative for an inspection.

3.12 FINAL ACCEPTANCE

A. Final Acceptance of all landscaping work described in this Specification Section for substantial completion, with the exclusion of replacements of plant materials under the Landscape Establishment and Warranty Period and landscape maintenance during the Landscape Establishment and Warranty Period, shall be made by the Project Representative to determine one hundred (100) percent completion of the work per Contract Drawings. This review shall be made upon written request to the Project Representative no less than forty-eight (48) HRS prior to the anticipated date of inspection.

END OF SECTION

SECTION 32 91 05
TOPSOILING AND FINISHED GRADING

PART 1 – GENERAL

1.01 SUMMARY

A. The Work consists of completing finished grading and furnishing and placing top soil, compost, and soil amendments, and soil bioengineering where shown in the Plans or as designated by the Project Representative.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Division 02 - Existing Conditions.
   4. Section 31 10 00 - Site Clearing.
   5. Section 31 23 19 - Temporary Dewatering.
   6. Section 32 90 00 - Landscaping.

C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Clearing and Grading Development Standards – 2010.
      b. Transportation Department - Design Manual – January 9, 2013.
      c. Utilities Department:
         1) Storm and Surface Water Engineering Standards.
         2) Sanitary Sewer Engineering Standards.
         3) Water Engineering Standards.

PART 2 – PRODUCTS

2.01 MATERIALS (NOT USED IN THIS SPECIFICATION SECTION)

2.02 TOLERANCES

A. Finish Grading Tolerance: 0.1 FT plus/minus from required elevations.

PART 3 – EXECUTION

3.01 PREPARATION

A. Correct, adjust and/or repair rough graded areas.
   1. Cut off mounds and ridges.
   2. Fill gullies and depressions.
   3. Perform other necessary repairs.
   4. Bring all sub-grades to specified contours, even and properly compacted.

B. Loosen surface to depth of 2 IN, minimum.

C. Remove all stones and debris over 2 IN in any dimension.

3.02 ROUGH GRADE REVIEW

A. Reviewed by Project Representative in Specification Section 31 10 00 – Site Clearing.

3.03 ACCEPTANCE

A. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

SECTION 33 05 16
PRECAST CONCRETE MANHOLE STRUCTURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Precast concrete manhole structures and appurtenant items.
      a. Sanitary sewer manholes and appurtenances.
      b. Drain manholes and appurtenances.
      c. Storm sewer manholes and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 31 21 33 - Trenching, Backfilling, and Compacting for Utilities.
   4. Section 03 21 00 - Reinforcement.
   5. Section 03 31 30 – Concrete, Materials, and Proportioning.
   6. Section 09 91 00 - Painting and Protective Coatings.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. C150, Standard Specification for Portland Cement.
      c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
      d. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
      e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
      f. D4022, Standard Specification for Coal Tar Roof Cement, Asbestos Containing.
   2. City of Bellevue (COB):
      a. Sewer Engineering Standards, January 2012.
      b. Surface Water Engineering Standards, January 2012.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Fabrication and/or layout Drawings:
      a. Include detailed diagrams of manholes showing typical components and dimensions, reinforcements and other details.
      b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to Drawing identification number or notation.
      c. Indicate knockout elevations for all piping entering each manhole.

1.04 PROJECTCONDITIONS

A. The high groundwater elevation is as described in the Revised Geotechnical Report prepared by Shannon & Wilson, Inc. provided as Available Information only. See Specification Section 01 10 00 – Summary of Work.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Manhole rings, covers and frames:
      a. Per COB Sewer Engineering Standards January 2012, Appendix S-4.
   2. Black mastic joint compound:
      a. Kalktite 340.
      b. Tufflex.
      c. Plastico.
      d. Or Approved Equal.
   3. Premolded joint compound:
      a. Ram Nec.
      b. Kent Seal.
      c. Or Approved Equal.
   4. Emulsified fibrated asphalt compound:
      a. Sonneborn Hydrocide 700B Semi-Mastic.

b. Henry HE789.

c. Or Approved Equal.

5. Fiberglass manhole frame and cover:

a. Virtual Polymer Compounds.

b. GMI Composites, Inc.

c. Or Approved Equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 SANITARY SEWER, STORM AND DRAIN MANHOLE STRUCTURE COMPONENTS

A. Manhole Components:

1. Per COB Sewer Engineering Standards January 2012, Section S4-13.
2. Reinforcement: ASTM C478.
3. Minimum wall thickness: 5 IN.
4. Minimum base thickness: 12 IN.
5. Provide the following components for each manhole structure:

a. Base (precast) with integral bottom section or (cast-in-place).

b. Precast bottom section(s).

c. Precast barrel section(s).

d. Precast eccentric transition section.

e. Precast adjuster ring(s).

f. Precast concrete transition section.

g. Precast flat top.

6. Unless dimensioned or specifically noted on Drawings, provide manhole section with minimum 48 IN inside dimensions.

B. Nonpressure Type Frames and Cover:

1. Per COB Sewer Engineering Standards January 2012, Section S4-15.
2. Cast iron frame and covers: ASTM A48, Class 35 (minimum).
3. Ductile iron frame and covers: ASTM A-536, Grade 80-55-06.
4. Use only cast iron or ductile iron of best quality, free from imperfections and blow holes.
5. Furnish frame and cover of heavy-duty construction a minimum total weight of 450 LBS.
6. Machine all horizontal surfaces.

7. Furnish unit with solid nonventilated lid with concealed pickholes.
    a. Letter covers "SEWER" for all collection system manholes, "DRAIN" for all gravity unit drains returning flow to the headworks, and "STORM" for storm sewer systems.
8. Ensure minimum clear opening of 24 IN DIA.

C. Pressure Type Frame and Cover:
1. Per COB Sewer Engineering Standards January 2012, Section S4-15.
2. Provide covers meeting the requirements of Paragraph 2.2B and as modified below.
3. Furnish frame and bolted cover of heavy-duty construction.
    a. Equip unit with six (6) stainless steel countersunk 3/8 IN DIA by 1-1/2 IN long bolts with stainless steel washers.
4. Provide solid lid and minimum 1/8 IN thick x 1/2 IN wide continuous strip neoprene gasket.
5. Furnish unit with a minimum of six (6) anchorage holes and six (6) 6 IN long x 3/4 IN DIA stainless steel anchor bolts.

D. Special Coatings and Joint Treatment:
1. Joints of precast sections:
    a. Black mastic compound: ASTM D4022.
2. Aluminum components embedded in concrete:
    a. See Section 09 91 00 – Painting and Protective Coatings for protective coating for aluminum embedded in concrete.
3. Vertical wall surfaces:
    a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type I for all exterior and interior vertical wall surfaces.

E. Sanitary Sewer Manhole Concrete:
1. Provide all sanitary manholes constructed with Portland ASTM C150, Type I or II cement with a tricalcium aluminate content not to exceed 8 percent.
2. Mix aggregate shall be a minimum of 50 percent crushed limestone.
3. Provide 3,000 psi non-shrink grout.

F. Fiberglass Frame and Cover:
1. Fiber Reinforced Polymer containing 45 percent to 70 percent fiber reinforcement.
2. Thermoset resin matrix.
3. Meets AASHTO M306-05 H-20 and H-25 traffic requirements of 50,000 LBS, with 100,000 LBS ultimate load bearing.

PART 3 – EXECUTION

3.01 MANHOLE CONSTRUCTION

A. General:
   1. Per COB Sewer Engineering Standards January 2012, Section S5-09 and S-10.
   2. Construct cast-in-place concrete base slabs.
   3. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
   4. On all straight runs, lay pipe through manhole and cut out top half of pipe.
      a. See detail on Drawings.
      b. If pipes deflect at manhole, shape as specified in Paragraphs 2 and 4.
   5. Shape inverts accurately and steel trowel finish.
      a. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert using as large a radius as manhole inside diameter will permit.
      b. Pour base slab integral with bottom barrel section.

B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.

C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above established high groundwater elevation shown trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.

D. For horizontal joints that fall below established high groundwater elevation shown, install a resilient O-ring type gasket or pre-molded joint compound.

E. Seal all pipe penetrations in manhole.
   1. Form pipe openings smooth and well shaped.
   2. After installation, seal cracks with, non shrink grout.
   3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 IN to ensure complete seal.

F. Set and adjust frame and cover final 6 IN (minimum) to 18 IN (maximum) to match finished pavement or finished grade elevation using precast adjuster rings.

END OF SECTION

SECTION 33 11 13
WATER MAIN CONSTRUCTION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Coordination and interface with existing facilities and utilities.
   2. Connections to existing watermains.
   3. Testing, flushing and disinfection.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 32 91 05 - Topsoiling and Finished Grading.
   4. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   5. Section 40 05 23 - Valves: Basic Requirements.
   6. Section 40 20 16 – Pipe: Ductile.
   7. Section 40 20 19 – Pipe: Copper.
   8. Section 40 20 23 – Pipe: Plastic.
   9. Section 40 50 05 - Gate Valves.
   10. Section 33 12 19 - Fire Hydrant.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Work Association (AWWA):
      a. B300, Standard for Hypochlorites.
      b. B301, Standard for Liquid Chlorine.
      c. C651, Standard for Disinfecting Water Mains.
   2. City of Bellevue (COB) Water Engineering Standards, January 2012.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Submit results of the leakage tests, identifying the specific length of pipe tested, the test pressure, the duration of test and the amount of leakage.

2. Submit satisfactory bacteriological test reports on disinfection requirements.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Per COB Water Engineering Standards January 2012, Chapter W4.

B. Pipe: Refer to Sections 40 05 13 – Pipe and Pipe Fittings: Basic Requirements and 40 20 16 – Pipe: Ductile.

C. In-Line Valves:
   1. Refer to Sections 40 05 23 – Valves: Basic Requirements.
   2. Provide adjustable valve boxes. Include price of valve boxes in price of valve installed complete.

D. Fire Hydrants: Refer to Section 33 12 19 – Fire Hydrant.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Per City of Bellevue 2012 (or current) Water Engineering Standards Chapter W5.

B. Install water main to the line and grade on the Drawings. Watermains to be staked at a minimum 100 FT interval with depth of cuts monitored.

C. Field verify depth of utilities that will be crossed.
   1. Adjust water main elevation as required during construction.
   2. No separate payment will be made for field verification or adjustment of main depths as required.

D. Contractor will restore all existing structures or services damaged by Contractor's operations at no cost to Owner.

3.02 INTERRUPTION OF SERVICE

A. Interruption of service to water users shall not exceed 4 HRS. Notify property owners of interruption a minimum of 24 HRS in advance.

3.03 UNDERGROUND SERVICES

A. Notify utility representative prior to construction to obtain available information on location of existing utilities. The Contractor shall be responsible for locating all utilities.

B. Existing water services are to be connected to the new watermains. Damage to existing water service to be repaired, using copper pipe and union the same size as existing service.

3.04 DRIVEWAY REMOVAL AND REPLACEMENT

A. All Portland cement concrete and asphalt noted for removal and replacement shall be cut prior to removal. Cut by sawing, vertical cut to be 1 IN minimum. The remaining depth of section may be broken out in a manner subject to Project Representative's approval. Width of section removed to be either a width not greater than the outside diameter of the water main plus 4 FT-0 IN or broken out to the nearest joint.

B. Replace Portland cement concrete and asphalt equal to or better than original paving plus 2 IN.

C. Debris resulting from the above operations shall be removed and hauled as directed by the Project Representative.

D. Include driveway removal and replacement in cost of the bid unit price of the water main.

3.05 GRAVEL SURFACED DRIVES AND ROADWAYS

A. The Contractor shall restore all damaged gravel surfaced drives and roadways to a condition equal to or better than original. Payment to be at bid unit price for this item.
   1. Replacement gravel gradation.

3.06 PROTECTION OF EXISTING UTILITIES

A. Per COB Water Engineering Standards, January 2012, Section W5-19.

B. Contractor to verify the location of all underground utilities. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.

C. A representative of the underground utilities shall be notified 24 HRS in advance of crossings.

3.07 CONNECTIONS TO EXISTING WATERMAINS

A. Per COB Water Engineering Standards January 2012, Section W5-14.

B. Make connections to existing watermains as shown on Drawings, by attaching to existing or changed fitting. Cost for making connections shall include cost of all fittings including flexible couplings, and shall be included in the bid unit price of the water main.

C. Where the connection is made to an existing water main which can be adequately isolated from the distribution system, it shall be termed a "dry connection."

D. Contractor is responsible for controlling and disposing of water in the trench at no additional cost to the Owner.

3.08 SEWER CROSSINGS

A. Per COB Water Engineering Standards January 2012, Section W3-06.

B. Concrete collars shall be provided at each end of the ductile iron pipe to connect to the existing sewer pipe as shown on the Drawings.

C. Payment for crossings shall be included in the bid unit price of the water main.

3.09 TREES

A. Do not remove trees without written instructions from the Project Representative unless tree removal is shown on Drawings. No separate payment will be made for tree removal.

3.10 FENCES, SIGNS, MAILBOXES, ETC.

A. Restore all damaged fences, signs, mailboxes, etc., to their original conditions. No separate payment will be made for these items.

3.11 FIELD QUALITY CONTROL

A. Sealing, Flushing, and Disinfection of Potable Water Systems:
   1. Per COB Water Engineering Standards January 2012, Section W5-17.
   2. Maintain interior of all pipes, fittings and other accessories free from dirt and foreign material at all times. If, in the opinion of the Project Representative, the pipe contains dirt that will not be removed by flushing, the pipe interior shall be cleaned and swabbed with bactericidal solution. At close of day's work or whenever workmen are absent from jobsite, plug, cap or otherwise provide watertight seal from open ends of pipe to prevent ingress of foreign material. If water is in trench, seal shall remain in place until trench is pumped dry.
   3. After favorable performance of pressure test and prior to final acceptance, thoroughly flush the entire potable water piping system and perform disinfection as prescribed. Perform all work including preventative measures during construction in full compliance to AWWA C651.
   4. Flush each segment of the system to provide a flushing velocity of not less than 2.5 FT per second.
   5. Drain flushing water to location approved by the Project Representative.
   6. Perform disinfection using one of the following forms:
      a. Application of chlorine gas-water mixture by means of solution-feed chlorinating device. Liquid chlorine shall comply with AWWA B301.
      b. Application of calcium hypochlorite, or sodium hypochlorite. Chlorine compounds shall comply with AWWA B300.

7. Disinfect pipe with chlorinated water as per AWWA C651. Method of application of chlorine shall be by continuous feed method or slug method. During disinfection procedure, ensure that initial and residual chlorine concentrations meet AWWA C651 requirements by testing by an approved method as directed by the Project Representative. Cost of testing shall be included in the Bid Unit Price for watermains and no separate payment will be made for this item.
8. Tag the system during the disinfection procedure.
9. Following disinfection for required contact period, neutralize chlorine residual in water by treating with reducing agent. (Refer to AWWA C651) Flush all treated water from pipeline at its extremities until replacement water throughout pipe, upon test is proved comparable in quality to water in existing system. Take two samples to test for bacteriological quality as directed by Project Representative. Repeat disinfection procedure until two satisfactory results are obtained. Quality of water delivered by the new water main to remain satisfactory for a minimum period of two (2) days.
10. Secure satisfactory bacteriological reports on samples from the system. Ensure all sampling and testing procedures are in full compliance to AWWA C651, and applicable requirements of the State of Washington. No separate payment will be made for this item.
11. The Project Representative will provide the water required to fill the main initially and will pay for the water required to flush the main once. Filling and flushing shall be performed during periods of low usage, between the hours of midnight and 4:00 AM. Flushing water will be based on a maximum of 8 HRS total. Any additional refilling or reflushing to be at the Contractor's expense at the City's commercial water rates.

END OF SECTION

SECTION 33 12 19
FIRE HYDRANT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Dry-barrel fire hydrant.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.
   4. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Works Association (AWWA):
      a. C502, Standard for Dry-Barrel Fire Hydrants.
      b. M17, Installation, Operation and Maintenance of Fire Hydrants.
   2. City of Bellevue (COB) Water Engineering Standards January 2012.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Requirements for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data:
      a. Acknowledgement that products submitted meet the requirements of the standards referenced.
      b. Manufacturer's installation instructions.
      c. Acknowledge and verify dimensions and provide list of integral parts and materials.
   2. Prior to submission of Shop Drawings, submit one (1) copy of complete submittal information direct to City of Bellevue Fire Department, Attn: Fire Chief, and request and secure written approval of hydrant selection.
      a. Incorporate copies of written approval letter with submittals.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation in accordance with Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the acceptable manufacturers are found in Appendix W-4 of the COB Water Engineering Standards January 2012.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 FIRE HYDRANT

A. Design and Fabrication:
   1. Per COB Water Engineering Standards January 2012, Section W4-20.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install hydrants at locations indicated in accordance with AWWA M17 and the following:
   1. Per COB Water Engineering Standards January 2012, Section W5-06.
   2. Remove foreign material from barrel of hydrant before placement.
   3. Install plumb and at same elevation as connecting pipe and main.
   4. Place each hydrant on a slab of concrete not less than 6 IN thick and 18 IN SQ.
   5. Block backside of hydrant, opposite pipe connection, with concrete firmly wedged between hydrant and vertical face of undisturbed trench.
   6. Place granular bedding material around base of hydrant to the dimensions shown in the Drawings.
   7. Firmly tamp carefully compacted backfill around hydrant to surface of ground and to a distance of 5 FT in front of hydrant.

3.02 COATINGS AND FINISHES

A. Provide hydrant with below grade and above grade coatings as per COB Water Engineering Standards January 2012, Section W4-20.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes but is not limited to materials and procedures for construction of storm drains, permanent ditches, culverts, drainage appurtenances, drains and under drains associated with surface water management structures, rain gardens, bioretention swales, oil/water separator plates, media filter systems, manholes, inlets, catch basins, pre-settling vaults, cisterns and appurtenances used for surface water management installed in accordance with the Drawings and these Specifications, including all codes and requirements referenced therein.

B. Related Sections:
   1. Section 03 09 00 –Concrete.
   2. Section 31 10 00 – Site Clearing.
   3. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
   4. Section 31 23 00 – Earthwork.
   5. Section 31 25 00 – Soil Erosion and Sedimentation Control.
   6. Section 31 69 00 – Foundation Subsurface Drain System.
   7. Section 32 16 13 – Concrete Curb and Gutter.
   8. Section 32 90 00 – Landscaping.
   9. Section 32 91 05 – Topsoiling and Finished Grading.
   10. Section 33 05 16 - Precast Concrete Manhole Structures.
   11. Section 33 44 16 – Prefabricated Trench Drain System.
   12. Section 40 05 13 – Pipe and Pipe Fittings: Basic Requirements.
   13. Section 40 20 16 – Pipe: Ductile.
   14. Section 40 20 23 – Pipe: Plastic.
   15. Section 40 90 10 – Supervisory, Control and Data Acquisition System.

1.02 REFERENCED STANDARDS

A. City of Bellevue, Utilities Department, Storm and Surface Water Engineering Standards, January 2012, as amended to date and all references therein (Engineering Standards).

B. City of Bellevue Storm and Surface Water Utility Code, Chapter 24.06.

C. Washington State Department of Ecology (Ecology) Stormwater Management Manual for Western Washington, February – 2005.

D. American Society of State Highway Transportation Officials (AASHTO) www.aashto.org, including, but not limited to:
   1. AASHTO M 45 Standard Specification for Aggregate for Masonry Mortar.

2. AASHTO M 85 Standard Specification for Portland Cement.
3. AASHTO M 170 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. AASHTO M 198 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
5. AASHTO M 252 Standard Specification for Corrugated Polyethylene Drainage Pipe.
6. AASHTO M 294 Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500 mm Diameter.
7. AASHTO M 306 – Standard Specifications for Drainage, Sewer, Utility and Related Castings.

E. ASTM International (ASTM) www.astm.org, including, but not limited to:
1. ASTM A 36 - Standard Specification for Carbon Structural Steel.
2. ASTM A 48 Standard Specification for Gray Iron Castings.
3. ASTM C 94M Standard Specification for Ready-Mixed Concrete.
4. ASTM A 276 - Standard Specification for Stainless Steel Bars and Shapes.
5. ASTM A 536 - Standard Specification for Ductile Iron Castings.
6. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
8. ASTM C 443-05a Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
9. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
10. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
11. ASTM D 638-08 Standard Test Methods for Tensile Properties of Plastics.
12. ASTM D 1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
13. ASTM D 1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
14. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
15. ASTM D 2729 Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

16. ASTM D 2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
17. ASTM D 3212-07 Standard Specifications for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
18. ASTM D 3350 Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.
19. ASTM F 477-08 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
20. ASTM F 679-08 Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

F. American Water Works Association (AWWA) www.awwa.org, including, but not limited to:
   1. AWWA C 151 / ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water.

1.03 SUBMITTALS

A. Submittal Procedures: Refer to Section 01 33 00 – Submittal Procedures, for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data for stormwater and drainage piping and appurtenances, including valves and couplings.
   2. Product data including for manholes, inlets, trench drains, and catch basins.
   3. Shop Drawings for vault piping and appurtenances including outlet control risers, shear gates, pump systems and valves.
   4. Shop Drawings for precast concrete storm drainage manholes and catch basins, trench drains, including frames, covers, grates, knockouts and steps, landings and ladders.
   5. Provide shop drawings for Detention Vault Media Filter System.
   6. Trench Drain Product Data per Section 33 44 16 – Prefabricated Trench Drain System.
   7. Cistern Systems:
      a. Cistern tank, piping, structures, pumps, pump controls, motor starter, and instruments associated with cistern tank rainwater level, and wetwell rainwater level. Coordinate with control system integrator for cistern system submersible pumps functionality as per Section 40 90 10 Supervisory, Control and Data Acquisition System (SCADA).
      b. Buoyancy calculations and counter measures design assuming a fully saturated fill with an empty tank. Design calculations accounting for the maximum loads anticipated over the cisterns.
      c. Shop Drawings indicating volumes and capacities as indicated on the Drawings.

C. Quality Assurance Submittals:
   1. Qualifications of Qualified Professional Engineer.
   2. Structural calculations stamped by a Qualified Professional Engineer for catch basins or manholes greater than fifteen (15) FT deep.
   3. Certifications.
      a. Submit all certifications and tests in single coordinated document. Partial submittals with not be accepted.

D. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation in accordance with Section 01 73 00 – Operation and Maintenance Manuals and in conformance with Engineering Standards Section D6-03.5:
      a. Information shall be provided for all systems, features that require Maintenance provided under this Section.
      b. Provide water quality media filter system Operation and Maintenance Manual that includes local media materials providers and operations guidelines as recommended by the Manufacture.
      c. Cistern systems.
      d. Provide maintenance schedule, logs and media supply sources for Detention Vault Media Filter System.
      e. Provide Filterra systems O&M Manual that includes local materials providers and operations guidelines as recommended by the Manufacture.
   2. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section for the cistern systems in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.04 DEFINITIONS

A. Qualified Professional Engineer: A Professional Structural Engineer who is legally authorized to practice in Washington State and who is experienced in providing engineering services for the design of manholes that are similar to those indicated for this Project in material, type, quantity, and configuration.

B. Pipe Zone refers to the area from the top of the foundation level for the pipe (same as the bottom of pipe bedding) to a minimum of 1 FT above the pipe crown.

1.05 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm drainage systems, including Washington State Department of Health.

B. Utility Compliance: Comply with City of Bellevue Engineering Standards and regulations and standards pertaining to storm drainage systems.

C. Contractor shall coordinate with City of Bellevue for all necessary inspections and approval of the completed systems.
   1. All Work specified in this Section is subject to inspection, witness of testing, and approval of the City of Bellevue.

D. Contractor to provide structural calculations for catch basins or manholes deeper than fifteen (15) FT from finished grade. Calculations to be stamped by a Structural Engineer licensed in the State of Washington.

E. Butt fusion for high density polyethylene (HDPE) pipe:
   1. Qualify butt fusion procedures by subjecting specimen joints, made according to the recommended procedure for the work, to the following tests:
      a. Tensile test per ASTM D638.
      b. Conducted at ambient air temperature and humidity.
   2. Butt fusion joint procedure qualifies with the following test results:
      a. Elongation at yield of no less than twenty-five (25) percent.
      b. Failure of the material initiates outside the joint area.

F. When two or more units of the same type or class, materials or equipment are required, these units shall be products of one manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect storm drain pipes, precast drainage structures, and appurtenances in accordance with Section 01 60 00 – Product Requirements.

B. Conduct an inspection at time of delivery of storm drain pipes, precast drainage structures, and appurtenances to verify correct products, markings, and quantities.

C. Handle manholes, catch basins and inlet structures according to manufacturer's written rigging instructions.

D. Materials shall be inspected for damage due to manufacturing or shipment.

E. Materials shall be stored and handled to avoid damage and personal injury. Pipe and drainage structures shall never be dropped on the ground. Replace any damaged materials and remove damaged materials from the Project Site at no additional cost to the Owner.

F. Pipe should be stored in such a manner that support is provided along its length to avoid concentrated loads on pipe ends.

G. Protective covers shall remain in place until material is ready for installation.

H. Rubber gasket material shall be stored in a clean, cool place, protected from dust, sunlight, and contaminants. Rubber gaskets shall be protected from direct sunlight at all times except during actual handling and installation. Pipes with gaskets affixed shall be installed in the storm drain line within twenty-eight (28) calendar days.

I. On-site storage and handling shall comply with manufacturer's recommendations.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with the Earthwork Plan and Contractor's Erosion and Sediment Control Plan (CESCP).

B. Coordinate with other utility, roadway, and retaining wall construction.

1.08 EXTENDED WARRANTY

A. In accordance with Section 01 78 00 - Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. Warranty period for Work of this Section is two (2) years commencing on the date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the list provided in Appendix D-4 of City of Bellevue Engineering Standards, and the following:
   1. Precast catch basins:
      a. Hanson Pipe and Precast of Tacoma, Washington.
      b. Granite Precast Concrete of Bellingham, Washington.
      c. Wilbert Precast of Spokane, Washington.
      d. Western Concrete Products of Spokane, Washington.
      e. Or Approved Equal.
   2. Flexible connectors between pipe and catch basins and manholes: A-LOK Products, Inc., or Approved Equal.
   3. Flexible couplings between dissimilar storm drain pipe: Fernco Inc., or Approved Equal.
   4. Storm Drain Pipe and Fittings:
      a. Corrugated polyethylene pipe (CPEP):
         1) ADS/Hancor, Inc. of Washougal, Washington.
         2) Polytubes, Ltd. of Arlington, Washington.
         3) Pacific Corrugated Plastic Pipe, LLC of Hubbard, Oregon.
         4) Or Approved Equal.
      b. Polyvinyl chloride (PVC) pipe:
         1) JM Eagle, Inc. of Eugene, Oregon.
         2) Ipex, Inc. of Langley, British Columbia.
         3) Or Approved Equal.
      c. HDPE pipe:
         1) JM Eagle, Inc. of Eugene, Oregon.

2) Performance Pipe Inc., a Division of Chevron Phillips Chemical Company LP; Ferguson Industrial Plastics.

3) Or Approved Equal.

5. CPEP Culvert Pipe and Fittings:
   a. ADS/Hancor, Inc. of Washougal, Washington.
   b. Polytubes, Ltd. of Arlington, Washington.
   c. Pacific Corrugated Plastic Pipe, LLC of Hubbard, Oregon.
   d. Or Approved Equal.
6. Nonshrink, Nonmetallic Grout:
   a. Masterflow 928, Master Builders.
   b. Euco NS Grout, Euclid Chemical Co.
   c. Sure-Grip HP Grout, Dayton Superior.
   d. Five Star Grout, Five Star Products.
   e. Crtstex, L & M Construction Chemicals.
   f. Or Approved Equal.
7. Trench Drain: See Section 33 44 16 – Prefabricated Trench Drain System.
8. Filterra systems water quality treatment units.
   a. No substitutions permiteed.
9. Cistern System:
   a. Contech Construction Products Inc. “Basis of design”.
   b. RainHarvest Systems LLC.
   c. WaterHarvest Soutions (WAHASO).
   d. Or Approved Equal.

2.02 STORM DRAIN PIPE AND FITTINGS

A. General: Provide pipe and pipe fitting materials compatible with each other. Unless pipe material is specified otherwise on the Drawings, the Contractor shall use the materials allowable under the City of Bellevue Surface Water Engineering Standards Section D7-02 per the installation application unless directed otherwise by the Project Representative.
   1. Conveyance Pipe Material per Engineering Standards Section D7-02 and Standard Details: D-33, D-34, and D-54 through D- 58, and as follows:
   2. CPEP: CPEP shall meet the requirements of AASHTO M 252 for pipe up to ten (10) IN DIA and AASHTO M 294 Type S for twelve (12) IN through thirty-six (36) IN DIA pipe.
      a. If cover is less than two (2) FT or greater than fifteen (15) FT an alternative storm drain material shall be required as indicated below.
      b. Pipe joints shall conform to ASTM D 3212.

c. Pipes shall be tightly joined by integral bell/bell or bell and spigot couplings with elastomeric gaskets meeting ASTM F 477.

3. PVC: PVC drainpipe, couplings, and fittings meeting the requirements of ASTM D 1785. The maximum pipe size shall be 18 IN in diameter.

   a. Joints shall conform to ASTM D 3212 using elastomeric gaskets conforming to ASTM F 477. Fittings and joints shall be of a schedule or pressure class that equals or exceeds that of the plastic pipe. Fittings and joints shall be compatible with the pipe to which they attach. Fittings for use with non-pressure systems shall conform to the requirements of the same ASTM designation as the pipe used.

4. HDPE: HDPE pipe shall have the Plastic Pipe Institute (PPI) recommended designation of PE3408/PE3608 per PPI TR-4, and shall have an ASTM D3350 (2005) cell classification of 345464C or higher.

   a. Pipe shall have a manufacturer's recommended hydrostatic design stress rating of eight hundred (800) PSI based on a material with a 1600 PSI design basis determined in accordance with ASTM D2837.

   b. Pipe shall have a suggested design working pressure of 50 psi at 73.4 DegF and dimension ratio (DR) of 21 or thicker.

   c. Pipe shall be black and manufactured with UV protection for exposed installation.

5. For low cover (<2.0 FT) situations where vehicular traffic is expected the following pipe materials shall be used for storm drains:

   a. Ductile iron pipe conforming to ANSI A 21.51 or AWWA C 151, and coating per AWWA C105. Pipe shall be furnished with push-on joint or mechanical joint conforming to AWWA C111, except where otherwise noted calling for flanged joints. Pipe shall be Class 52.

6. For high cover (>15.0 FT) situations one of the following pipe materials shall be used for storm drains:

   a. Solid Wall PVC pipe and fittings, conforming to ASTM D 3034 SDR 35 for diameters up to 15 IN and ASTM F 679 for diameters 18 IN to 24 IN using a minimum pipe stiffness of 115 psi in accordance with Table 1, with integral bell gasketed joints.

      1) Joints for solid wall PVC pipe shall conform to ASTM D 3212 using elastomeric gaskets conforming to ASTM F 477.

      2) Pipe shall be made of PVC plastic having a cell classification of 12454 or 12364 as defined in ASTM D 1784 and shall have a minimum SDR of 35 and minimum pipe stiffness of 46 psi.

      3) Pipe shall be installed in compliance with ASTM D 2321.

   b. HDPE pipe meeting HDPE pipe Specifications above with a DR of 17 or thicker.

B. Flexible Connectors between Pipe and Concrete Structures:
   1. Provide a flexible pipe to structure connector whenever pipes greater than 4 IN in diameter penetrate into a precast concrete catchbasin, manhole, or other drainage structure. This does not apply to penetrations into Type 1 and Type 1-L catch basins or where pipe slopes exceed manufacturer's recommendations for the resilient connector.
   2. Where a flexible connector between a pipe and concrete structure is not provided.
   3. The connector for pipes with corrugated outer walls shall be the "Z-LOK STM Connector" as manufactured by A-LOK Products, Inc., or Approved Equal.
   4. The connector for pipes with smooth outer walls shall be "A-LOK Premium Connector" as manufactured by A-LOK Products, Inc., or Approved Equal.
   5. The connector shall conform to the requirements of ASTM C-923.
   6. The design of the connector shall provide a flexible, watertight seal between the pipe and concrete structure.
   7. The connector shall assure that a watertight seal is made between:
      a. The connector and the structure wall by casting the connector integrally with the structure wall during the manufacturing process in a manner that will not pull out during pipe coupling. The connector shall also be capable of being cast into a round structure.
      b. The connector and the pipe.

C. Joining Dissimilar Storm Drain Pipe:
   1. Joining of dissimilar pipe shall not be allowed unless indicated otherwise in the Drawings.
   2. Any change in pipe material shall occur across a manhole, catch basin, or other structure unless indicated otherwise on the Drawings.
   3. All contiguous pipe shall be of the same size, material, thickness, class, and treatment and shall be that required for the maximum height of cover.
   4. Where couplings are indicated on the Drawings between dissimilar storm drain pipe, provide a flexible coupling.

2.03 UNDERDRAIN PIPE FOR SITE DRAINAGE

A. Refer to Specification Section 31 69 00.

B. Gravel Backfill for Drains shall meet the requirements for Filter Material: Refer to Specification Section 31 69 00.

2.04 TRENCH DRAINS

A. See Specification Section 33 44 16.

2.05 CULVERTS

A. Culverts and appurtenances shall be in accordance with Engineering Standards Section D7-02.3.

B. General: Provide culverts and joints materials compatible with each other. Culverts shall be round in cross-section unless noted otherwise. The following materials are acceptable for culverts:
   1. Reinforced concrete culvert pipe conforming to the requirements of AASHTO M 170. All bell and spigot concrete culvert pipe shall be joined with rubber gaskets and gasket material shall meet the requirements of AASHTO M 198. The plane ends of the pipes shall be perpendicular to their longitudinal axes.
   2. Corrugated polyethylene culvert pipe meeting the requirements of AASHTO M 294 Type S or D with silt-tight joints. Joints for corrugated polyethylene culvert pipe shall be made with either a bell/bell or bell and spigot coupling and shall incorporate the use of a gasket conforming to the requirements of ASTM D 1056, ASTM F 477, or ASTM D 5249. All gaskets shall be factory installed on the coupling or on the pipe by the producer.

2.06 VALVES, OPERATORS, AND APPURTENANCES

A. Plug valves shall be per section 40 50 10 – Plug Valves.

B. Gate Valves shall be wedge gate valves per section 40 50 05 – Gate Valves.

C. Use transition coupling for connection to storm drain pipe.

D. Include valve box, riser, and riser stem with valve installation.

2.07 CLEANOUTS

A. Cleanouts shall be 6 IN minimum, in accordance with Engineering Standards, as indicated on the Drawings and Standard Detail D-52.

2.08 OIL/WATER SEPARATORS AND PLATES FOR SITE STORM DRAINAGE

A. Refer to Section 03 48 00 – Precast Concrete Vaults and Oil Water Separators.

2.09 DETECTABLE MARKING TAPE

A. Refer to Section 10 14 00 – Identification Devices.

2.10 MANHOLES, CATCH BASINS, AND INLETS

A. Manholes, catch basin, and inlets applicable to the storm drain system shall be in accordance with the Engineering Standards Section D4-5, Section D7-03, and Standard Details D-1 through D-24.

B. Manholes shall be 48 IN DIA minimum of the offset type and shall be precast concrete sections with either a cast in place base, or a precast base made from minimum 3,000 PSI structural concrete.

C. Joints between precast wall sections shall be confined O-ring or as otherwise specified.

D. Manhole steps shall be polypropylene, Lane International Corp. No. P-13938 or Approved Equal.

E. Manhole ladders shall be polypropylene, Lane International Corp. or Approved Equal, and shall be compatible with the steps.

F. Frames and covers shall be ductile iron, and rated for the anticipated vehicle loading.

G. Castings shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability.

H. Repair of defects by welding, or by the use of “smooth-on” or similar material, will not be permitted. Frames and covers shall be machine finished or ground on seating surfaces so as to assure non-rocking fit in any position and interchangeability of covers.

I. Where shown on Drawings, frames and covers shall be installed integral to the pre-cast manhole/catch basin cover.

J. Precast Reinforced concrete, ASTM-C478, risers, flat tops sections, eccentric cone, adjuster sections as required with cast-in-place concrete base slab.

K. Unless otherwise specified, cast (gray) iron products shall conform to ASTM Designation A48 Class 30 and ductile iron to ASTM Designation A526 Grade 80-55-06. Strength requirements for Federal Specification RR-F-621D apply.

L. When a structure does not function as an inlet, provide a solid locking cover in accordance with the standard details in Appendix A to these Specifications.

M. Block lettering shall be cast into the top surfaces of storm drain grates and covers. Solid covers shall have “DRAIN” in three (3) IN letters. Grates shall have “OUTFALL TO STREAM, DUMP NO POLLUTANTS” in 1/2 IN letters. All solid covers and grates shall be secured with five-eighths (5/8) IN Stainless Steel Socket Head Cap Screws as depicted on the standard details.

2.11 DETENTION VAULT FLOW CONTROL PIPING

A. See Structural Drawings 01C504 through 01C509 for detention vault geometry and configuration.

B. Flow control riser and pipe shall be in accordance with the Sheet 01C510 of the Drawings and Standard Detail D-32.

C. Riser outlet pipe shall go to the media filter chamber as indicated on the Drawings and have sufficient anchoring along the wall to address buoyant forces from the maximum anticipated water surface.

2.12 DETENTION VAULT MEDIA FILTER SYSTEM

A. Media filter system shall be constructed as indicated on Drawing 01C504 and comply with Engineering Standards Section D5-03, providing enhanced treatment.

B. Access to media filter system for maintenance shall comply with Engineering Standards and Manufacturers’ requirements and local requirements for access to underground vaults.

C. Filtration system shall be passive, media filled filtration cartridge type furnished complete and operable as shown and specified.

D. System shall be provided complete with cartridges and media installed and operational.

E. Filter Media shall be Zeolite-Perlite-Granular Activated Carbon (ZPG): ZPG is a mixed media that shall be composed of a 1.3 FT^3 outer layer of 100 percent Perlite (see below) and a 1.3 FT^3 inner layer consisting of a mixture of 90 percent Zeolite (see below) and 10 percent Granular Activated Carbon (see below).

F. Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The perlite media shall have a bulk density ranging from 6.5 to 8.5 LB/FT^3 and particle sizes ranging from that passing through a 0.50 IN screen and retained on a U.S. Standard #8 sieve.

G. Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite, which has a geological structure of potassium-calcium-sodium aluminosilicate. The zeolite media shall have a bulk density ranging from 44 to 48 LB/FT^3, particle sizes ranging from that passing through a U.S. Standard #4 sieve to that retained on a U.S. Standard #6 sieve, and a cation exchange capacity ranging from 1.0 to 2.2 meq/g.

H. Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam activated. The GAC media shall have a bulk density ranging from 28 to 31 LB/FT^3 and particle sizes ranging from that passing through a U.S. Standard #4 sieve to that retained on a U.S. Standard #8 sieve.

2.13 FILTERRA SYSTEM WATER QUALITY UNIT

A. Filterra® units are a product of Filterra Bioretention Systems,11352 Virginia Precast Road, Ashland VA 23005.

B. Filterra units to comply with Engineering Standards Section D5-03 providing enhanced treatment and installed as indicated on the Drawings.

C. Access to Filterra units shall comply with Engineering Standards and Manufacturers' requirements.

2.14 MORTAR

A. Mortar for hand-mortared joints shall consist of one (1) part Portland cement, three (3) parts fine sand, and sufficient water to allow proper workability.

B. Cement shall conform to the requirements of AASHTO M85, Type I or Type II.

C. Sand shall conform to the requirements of AASHTO M45.
   1. Water shall be clear and apparently clean. If the water contains substances that cause discoloration, unusual or objectionable smell or taste, or other suspicious content, the Project Representative may require the Contractor to provide test results documenting that the water meets the physical test requirements and chemical limits described in ASTM C94M Section 5.1.3, Tables 2 and 3.

2.15 NONSHRINK, NON-METALLIC GROUT

A. Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.16 PERVIOUS PAVEMENT FOR SIDEWALK

A. Pervious pavement shall be as indicated on the Drawings and details.

B. Pervious Pavement for sidewalks shall conform to the Drawings and Engineering Standards D6-03.2(B) –Bioretention, Engineering Standards D6-04.2 - Pervious Pavement, and Standard Details NDP-11 through NDP 17.

2.17 RAINWATER CISTERNS

A. System Description: Each cistern system shall consist of manufactured components integrated into an automated system. The system shall accept rainwater through pre-filters prior to entering the storage tank. Water will be pumped out of the storage tank to the plumbing system. System will proved water at the desired design point and pressure on an on-demand basis. The basic components consist of the following:
   1. Underground tank and pipes.
   2. Pre-settling vault and pre-filter (gutter screens will be installed on all connected roof gutters draining to a cistern).
   3. Pumping well and pump with piping, wiring, level controls and alarms.
   4. Access riser and appurtenances.

B. Rainwater cisterns shall be provided as a complete operational unit constructed in the location limits and layout as indicated on the Drawings and details, and be provided by a single manufacturer as possible, for both cisterns. Cisterns will meet criteria provided on the Drawings and details.

C. Inlet, outlet and over flow pipes shall be the sizes and locations indicated on the Drawings and details.

D. Manholes, associated structures and appurtenances shall be the type, and at the locations indicated on the Drawings.

E. Rainwater Cisterns shall conform to the Drawings and Engineering Standards Section D6-03.2(C).

F. Cistern unit shall be a complete and operable rain water cistern system within the intent of the Contract Documents; including but not limited to, all materials and labor for complete installation and testing. Cisterns units shall be in compliance with the Engineering Standards and Drawings, and applicable provisions and recommendations in the reference standards.

G. The sizing and construction of this tank shall be consistent with industry protocols and shall comply with the applicable regulations.

H. Cistern shall support accessory equipment – such as access openings, risers, drop/fill tubes, pre-filters, wet well, submersible pumps, floating filter and hose, control wiring for pump, risers, inlet/outlet piping, and ladders when installed according to tank manufacturers current Installation Manual and Operating Guidelines.

I. Pump Controls to be located separately from the cisterns and shall automatically switch between rainwater and domestic water supply, see Section 40 90 10 – Supervisory Control and Data Acquisition, for control design and configuration.

J. Submersible pumps shall meet the following performance criteria:
   1. Administration Building cistern pump shall provide a minimum of 21 gpm at an operating or total dynamic head of 24 FT, at 60 percent efficiency and provide a 2 IN DIA discharge pipe leaving the cistern or pump well.
   2. Transfer Station cistern pump shall provide a minimum of 240 gpm at an operating or total dynamic head of 24 FT, at 60 percent efficiency and as indicated on the plans. Provide a 4 IN DIA discharge pipe leaving the pump well going to the mechanical room.
   3. Pump control, motor starter, cistern tank/wet well level switches and wiring shall meet functionality as per Section 40 90 10 - Supervisory, Control and Data Acquisition System (SCADA), refer to Contract Documents.
   4. Pumps shall be removable without entering the tank and have waterproof connections and cables.

2.18 AMENDED SAND FILTER VAULT AND MEDIA

A. Large Amended Sand Filter vault shall be per the Drawings and Details, and the Engineering Standards and Ecology requirements for BMP T8.10.

B. Sand for vault shall meet requirements of Section 12.6.2 of the Ecology stormwater manual - Volume V, using 10 percent Calcitic limestone by volume as allowed by Ecology and the City of Bellevue. Sand shall be Amended as noted on the Drawings.

C. Vault shall be designed to HS-20 vehicular traffic.

D. Geotextile for Amended Sand Filter Vault shall meet the following:
   1. Geotextile Nonwoven polypropylene:

Grab Tensile Strength (ASTM D4751)	200 PSI min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 PSI min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

E. Gravel Drain Rock.

PART 3 – EXECUTION

3.01 EXCAVATION, PREPARATION AND BACKFILL OF TRENCHES

A. Comply with Section 31 23 00 - Earthwork and Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

B. Work in accordance with Engineering Standards Section D8-04.3 - Storm Drain Trench, Section D8-04.6 -Backfilling Trenches, Section D8-13 - Trench Excavation, and Section D7-02.5 - Trench Backfill.

3.02 LAYING PIPE

A. Install in accordance with Engineering Standards Section D8-04.5 - Laying Storm Sewer Pipe.

B. Survey Line and Grade:
   1. Utilize survey line and grade control hubs.
   2. Transfer line and grade into the trench where they shall be carried by means of a:
      a. Laser beam, or;
      b. Taut grade line supported on batter boards.
   3. If batter boards are used:
      a. Batter boards shall be at intervals of not more than thirty (30) FT.
      b. Not less than three (3) batter boards shall be in use at one (1) time.
      c. Grades shall be constantly checked and in the event the batter boards do not line up, the Work shall be immediately stopped, the Project Representative notified, and the cause remedied before proceeding with the Work, at no additional cost to the Owner.
   4. Any other procedure shall have the written approval of the Project Representative.

C. Pipe Laying - General:
   1. Installed in accordance with Engineering Standards Section D8-03 and D8-04.
   2. After an accurate grade line has been established, the pipe shall be laid in conformity with the established line and grade in the properly dewatered trench.
   3. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surfaces.
   4. All pipe laid in the trench to the specified line and grade shall be kept in longitudinal compression until the bedding or backfill has been compacted to the crown of the pipe.
   5. All pipe shall be laid to conform to the prescribed line and grade shown in the Drawings, within the limits that follow.
   6. Pipe shall be laid to a true line and grade at the invert of the pipe and the Contractor shall exercise care in matching pipe joints for concentricity and compatibility.
   7. In no case shall two sections of pipe be joined together with ends having the maximum manufacturer’s tolerance.
   8. The invert line may vary from the true line and grade within the limits stated to develop uniformity, concentricity, and uniform compression of jointing material provided such variance does not result in a reverse sloping invert.

9. The limit of the variance of the invert elevation shall not exceed plus or minus one half (0.5) IN at the time of backfill. Checking of the invert elevation of the pipe may be made by calculations from measurements on the top of the pipe.
10. The pipe, unless otherwise approved by the Project Representative, shall be laid up grade from point of connection on the existing pipe or from a designated starting point.
11. The pipe shall be installed with the bell end forward or upgrade.
12. When pipe laying is not in progress, the forward end of the pipe shall be kept tightly closed with an approved temporary plug.
13. Where pipe joints must be deflected to accommodate required horizontal or vertical curvature, deflection shall not exceed one-half the manufacturer's recommended deflection and pipe shall first be joined in straight alignment and then deflected as required.
14. Valves shall be installed per manufacturer's recommendations.
15. Upon Substantial Completion of the Work, all pipe and appurtenances shall be open, clean, and free draining.

D. Underdrain Pipe Bedding Material:
1. Filter material shall be placed from 3 IN below pipe to 6 IN above top of pipe for perforated sections. Filter Material shall be as specified in Section 31 69 00 – Foundation Subsurface Drain Systems and as indicated on the Drawings.

E. Rubber Gasketed Joints:
1. In laying pipe with rubber gaskets, the pipe shall be handled carefully to avoid knocking the gasket out of position or contaminating it with foreign material.
2. Any gasket so disturbed shall be removed, cleaned, relubricated if required, and replaced before joining the sections.
3. The pipe shall be properly aligned before joints are forced home.
4. Sufficient pressure shall be applied in making the joint to ensure that the joint is home, as defined in the standard installation instructions provided by the pipe manufacturer.
5. Ramming of pipe by hand or machinery will not be permitted.
6. Any pipe damaged during joining and joint tightening shall be removed and replaced at no additional cost to the Owner.
7. Care shall be taken to properly align the pipe before joints are fully seated.
8. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned.

9. Since most gasketed joints tend to creep apart when the end of the pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.
10. Sufficient restraint shall be applied to the line to ensure that joints once home are held so by compacting backfill material under and alongside the pipe or by other acceptable means.
11. At the end of the work day, the last pipe shall be restrained in such a manner as may be required to prevent creep.

F. Plugs and Connections:
1. Plugs for pipe branches, stubs, or other open ends which are not to be immediately connected shall be made of an approved material and shall be secured in a place with a joint comparable to the main line joint, or stoppers may be of an integrally cast breakout design.
2. Plugs shall be marked with post that is labeled with pipe size, material and depth.

G. Storm Drain Line Connections:
1. Storm line connections to trunks, mains, or laterals shall be left uncovered until after the Project Representative has inspected and approved the Work.
2. After approval of the connection, the trench shall be backfilled as specified.

H. Backfilling:
1. Refer to Section 31 23 00 – Earthwork and Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

3.03 BEDDING THE PIPE

A. Placed in accordance with Engineering Standards Section D8-04.4, Section D8-04.6 - Backfilling Trenches, Section D7-02.4, and Standard Detail D-46.

B. Shape bottom of trench to fit bottom of pipe.

C. Fill unevenness with tamped sand or gravel backfill.

D. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

E. Pipe bedding material shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells.

F. All adjustment to line and grade shall be made by scraping away or filling in with bedding material under the body of the pipe and not by blocking or wedging.

G. Bedding disturbed by pipe movement, or by removal of shoring movement of a trench shield or box, shall be reconsolidated prior to backfill.

H. Pipe bedding shall be as specified in the Drawings and shall be placed in loose layers and compacted as specified in Section 31 23 00 – Earthwork.

I. Pads between pipes shall be polyethylene foam plank (Dow Plastics Ethafoam 220) or approved equal, according to City of Bellevue Standards D8-02.

3.04 HDPE PIPE INSTALLATION

A. General:
   1. Cut, fabricate, and install in conformance with pipe manufacturer's recommendations.
   2. Use only personnel experienced in working with polyethylene pipe to join, lay, and pull the pipe.

B. Joining pipe sections and fittings:
   1. Unless otherwise indicated, join sections of polyethylene pipe into continuous lengths using the thermal butt-fusion method in accordance with the pipe manufacturer's recommendations.
   2. The joint weld strength to be equal to or greater than the tensile strength of the pipe.
   3. Thermal butt fusion: Perform in accordance with the pipe manufacturer's recommendations as to equipment and technique.
      a. Butt fusion welding:
         1) Personnel operating the butt fusion welder shall be certified by either a) and c), or b) and c), of the following criteria:
            a) Previous demonstrated experience, during the past twelve (12) months, in the use of the procedures on similar projects using the same welding machine and type of pipe as proposed.
            b) Certification of Training and Apprenticeship.
            c) All operators shall make a specimen joint from pipe to be used for the work. This joint shall then be subjected to the test requirements specified herein.
         2) Use only certified butt fusion welding techniques.
         3) Where conditions permit, join sections of HDPE pipe into continuous lengths.
         4) Cut out all defective and rejected joints completely and reweld the joint.

C. Fittings and Connections:
   1. Where Drawings show factory fabricated flange assemblies, join to HDPE pipe by thermal welding method.
   2. Fittings to be butt fusion welded per ASTM D3261.

D. Install blind flanges to prevent soil or other foreign material from entering the pipe following installation.

3.05 DETECTABLE MARKING TAPE

A. Refer to Section 33 11 13 – Water Main Construction.

3.06 ABANDON EXISTING STORMWATER STRUCTURES

A. Abandon and Plug all stormwater features as indicated on the Drawings and in accordance with Engineering Standards Section D8-08.

3.07 MANHOLES, CATCH BASINS, AND INLETS

A. Install in accordance to the Engineering Standards Section D8-05 Manholes Catch Basins, and Inlets.

B. The excavation for all manholes, inlets, and catch basins shall be sufficient to leave 1 foot in the clear between their outer surfaces and the earth bank.

C. Manholes, catch basins, and inlets shall be constructed on a compacted or undisturbed level foundation. If the Contractor elects to use a separate cast-in-place base, the concrete shall be Class 4000 as specified in Section 03 09 00 – Concrete.

D. Upon Substantial Completion of the Work, all manholes, catch basins, inlets, and other storm drainage and wastewater structures shall conform to the requirements of the Drawings except as approved by the Project Representative.

E. Manhole sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder steps.

F. The completed manhole and catch basins shall be stable and true to dimension.

G. Rough, uneven surfaces will not be permitted on the structure.

H. Manholes, catch basins, and inlets shall be watertight.

I. Each manhole shall be provided with not less than 12 IN or more than 24 IN of grade adjustment between the top of the cone and the top of the manhole frame.

J. Masonry units or precast concrete adjustment rings shall be installed to adjust to final grade in accordance with Engineering Standards Section D8-05.3 - Adjust Manhole and Catch Basins to Grade.

K. The outside and inside of manhole adjusting bricks or rings and the joints of precast concrete sections shall be plastered and troweled smooth with 1/2 IN (minimum) of mortar in order to attain a watertight surface.

L. All lift holes shall be completely filled with expanding mortar, smoothed both inside and outside, to insure water tightness.

M. All steel loops shall be removed, flush with the manhole wall. The stubs shall be covered with mortar and smoothed.

N. Frames and covers shall be provided locking lids unless shown otherwise in the Drawings.

O. Frames and covers shall be adjusted to conform to the final finished surface grade.

P. The cover or grating of a manhole, catch basin, or inlet shall not be grouted to final grade until the final elevation of the pavement, gutter, ditch, or sidewalk in which it is to be placed has been established, and until permission thereafter is given by the Project Representative to grout the cover or grating in place.

Q. Covers shall be seated properly to prevent rocking.

R. Ladder rungs shall be grouted in the precast concrete walls.

S. Rungs shall be uniformly spaced at 12 IN and be vertically aligned per Standard Details D-4 and D-5.

T. In the event any pipe enters the manhole through the precast concrete units, the Contractor shall make the necessary cut through the manhole wall and steel mesh.
   1. The steel shall be cut flush with the face of the concrete and shall be cut in such a manner that it will not loosen the reinforcement in the manhole wall.

U. The ends of all pipes shall be trimmed flush with the inside walls.

V. Rubber gaskets or flexible plastic gaskets may be used in tongue and groove joints of precast units.

W. All other joints, openings cut through the walls, and pipe connections without a flexible connector shall be grouted and watertight. Mortar shall conform to the requirements of Paragraph 2.15 of this Section.

X. If gaskets are used, handling of the precast units after the gasket has been affixed shall be done carefully to avoid disturbing or damaging the gasket or contaminating it with foreign material.

Y. Attain proper alignment before the joints are fully seated.

Z. During insertion of the tongue or spigot, the units shall be partially supported to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned.

AA. Backfilling around the Work will not be allowed until the concrete or mortar has thoroughly set.

BB. Backfilling of manholes, catch basins, and inlets shall be done in accordance with the provisions of Section 31 23 00 – Earthwork and Engineering Standards Section D8-05.2 - Backfilling Structures.

CC. Any shoring or extra excavation required shall meet the requirements of Section 31 23 00 – Earthwork.

DD. Catch basin, grate inlet, and drop inlet connections to a storm drain shall be so placed that the connecting pipe may be easily rodded over its entire length. After the connections are made, the Contractor shall rod all inlet and outlet pipes. All connections that cannot be successfully rodded shall be removed and new connections made.

EE. Where flexible connectors or expansion couplings have not been specified, pipe connections to storm drainage manholes and catch basins shall be grouted and watertight.

FF. Install extension sections or risers as indicated on the standard details in Appendix A to these Specifications. Sections and risers shall be of the same material as indicated on the standard details.

GG. Provide frame, grates and covers in accordance the standard details provided in Appendix A to these Specifications.

HH. A light coating of anti-seize thread compound shall be applied to all screws used to secure grates and covers at the time of installation. The anti-seize compound shall be Loctite 767 or Approved Equal. Anti-seize compound shall be applied according to the manufacturer's recommendations.

3.08 DETENTION VAULT RISER CONTROL STRUCTURE

A. Install in accordance to the Drawings, and Engineering Standards D8-6.

B. Install in accordance to the Drawings, Standard Details NDP-11 through NSP 17, and Engineering Standards Section D6-03.2(B).

C. Provide sufficient anchoring for anticipated buoyant forces with full vault.

D. Leak test riser control pipe according to Engineering Standard Section D8-06.4.

3.09 MEDIA FILTER CARTRIDGES AND FLOW KIT

A. Prepare chamber and Install cartridges per manufacturer's guidelines and as indicated on the Drawings.

B. Install after site no longer requires use of the vault for TESC treatment, and the vault and chamber has been cleaned of sediment.

3.10 FILTERRA SYSTEM WATER QUALITY UNIT

A. Activation of the Filterra unit is performed ONLY by the Supplier. Purchaser is responsible for Filterra inlet protection and subsequent clean out cost. This process cannot commence until the project site is fully stabilized and cleaned (full landscaping, grass cover, final paving and street sweeping completed), negating the chance of construction materials contaminating the Filterra system. Care shall be taken during construction not to damage the protective throat and top plates.

B. Activation includes installation of plant(s) and mulch layers as necessary.

C. Each correctly installed Filterra unit is to be maintained by the Supplier, or a Supplier approved contractor for a minimum period of 1 year. The cost of this service is to be included in the price of each Filterra unit. Extended maintenance contracts are available at extra cost upon request.

D. Annual included maintenance per manufacturer's criteria.

3.11 POROUS PAVEMENT FOR SIDEWALK

A. Install accordance to the Drawings and Engineering Standards Section D6-03.2(B).

3.12 TRENCH DRAIN

A. Install per manufacturer's guidelines and as indicated on the Drawings.

3.13 RAINWATER CISTERNS

A. Install in accordance to the Drawings, Manufacturer's Guidelines, Details and Engineering Standards Section D6-03.2(B) and applicable requirements for underground storage tanks.

B. Install detectable warning tape along the outside edges of the cistern and piping system.

C. Test the Cistern systems in conformance with Manufacturer's Guidelines for both full and empty conditions, and operational loads.

3.14 AMENDED SAND FILTER VAULT AND MEDIA

A. Install in accordance with the Engineering Standards and Ecology stormwater manual Volume V, Chapter 8, Section 8.8.

3.15 FIELD QUALITY CONTROL

A. Testing shall conform to Engineering Standards Section D8-09, Section D8-11 and the following:

B. Field-Testing for Storm Drains:

1. Project Representative shall inspect and approve test equipment to be used by Contractor. The Project Representative may require a calibration test at a certified independent laboratory of any gages or other instrumentation.

2. Plugs used to close the pipe for the air test must be securely braced to prevent unintentional release of a plug, which can be a high velocity projectile. Gages, air piping manifold, and valves shall be located at the top of the ground. No one shall be permitted to enter the drainage system where a plugged pipe is under pressure. Air testing apparatus shall be equipped with a pressure release device, such as a rupture disk or a pressure relief valve, designed to activate when the pressure in the pipe exceeds 2 psig above the required test pressure.

3. The first section of pipe installed by each crew shall be tested in order to qualify the crew and material. A successful test for the section shall be a prerequisite to further installation by that crew. Following the initial test, pipes shall be tested from structure to structure.

4. Air shall be slowly supplied to the plugged pipe section until the internal air pressure reaches 4 psig. Wait at least 2 minutes to allow for pressure and temperature stabilization to occur within the pipe.

5. When the pressure decreases to 3.5 psig, the air pressure test shall begin. The test shall consist of measuring the time in seconds for the pressure in the pipe to drop from 3.5 psig to 2.5 psig. The pipe shall be considered acceptable if the time in seconds for the pressure drop is equal to or greater than the required time from the following table:

Time in Seconds for Pressure Drop

Pipe Dia. (IN)	Pipe Length (ft)									
	50	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**
8	72	144	216	284	356	428	456	456	456	456
10	112	224	336	444	556	568	568	568	572	636
12	160	320	480	640	680	680	680	732	824	912
15	252	500	752	852	852	856	1000	1144	1280	1440
18	360	720	1020	1020	1028	1240	1440	1640	1840	2080
21	492	980	1192	1192	1400	1680	1960	2240	2520	2800
24	640	1280	1360	1480	1840	2200	2560	2920	3320	3680

6. This method was developed based on an allowable air loss rate of 0.003 CU FT/minute (cfm) per SQ FT of internal pipe surface, with the total air loss rate not less than 2 cfm nor greater than 3.5 cfm. Contractor may select to test pipe with or without pre-wetting the pipe.

C. Field Quality Control of HDPE Joints by the Project Representative:
   1. Butt-fused specimen joint inspection and testing by Project Representative:
      a. Inspection:
         1) Visually inspect all joints during and after joining to ensure that the joint meets the requirements of the butt fusion welding procedure.
      b. Field testing:
         1) Prepare a trial butt-fused joint specimen.
         2) Allow specimen to cool completely and cut into test straps.
         3) Test straps:
            a) Length: 12-IN minimum or 30 times the wall thickness.
            b) Location of fusion: Center of strap.
            c) Width: 1 IN minimum or 1.5 times the wall thickness.
         4) Visually examine the straps for voids or discontinuities.
         5) Deform the straps by bending, torque, or impact.
         6) If failure of the joint occurs outside of the joint area, the test is acceptable.
   2. Project Representative shall visually inspect the pipeline for damage, cuts, or imperfections just prior to installation in the trench.

D. Cleaning: Clean interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
   1. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
   2. Flush piping between manholes, if required by the Engineering Standards, to remove collected debris.

3.16 TELEVISED INSPECTION

A. Televised Inspection shall conform to COB Engineering Standards Section D8-10 and the following:
   1. Contractor to conduct televised inspection prior to construction for all existing storm drain system components to remain functional throughout and following construction.
   2. After the new storm drainage lines have been constructed, cleaned and flushed, Contractor shall provide a televised inspection of the complete drainage system.
   3. Perform a complete televised inspection of the storm drain pipe and appurtenances and shall provide to the City of Bellevue, a 1/2 IN VHS colored audio-visual tape recording of the inspections together with a written log of the television inspection. In addition, three copies of the written log of the televised inspection shall be provided to the Project Representative. The camera shall be a pan and tilt type equipped with adequate light and focusing to allow inspection of the main, laterals, and full circumference inspection of main line joints and fittings. The City of Bellevue shall determine if the quality of the tape is acceptable.
   4. Immediately prior to the televised inspection, run water through each storm drainage line for 5 minutes to 10 minutes to provide water for detection of any adverse grade sections visible by the presence of ponded water. The camera shall be stopped periodically at the ponded areas and the depth of water shall be measured with a ball of known diameter on the pull line. During the inspection, all tees and other fittings shall be logged as to exact location within 1 percent maximum error in measurement, wherein accuracy is checked with various fittings and the terminating manhole.
   5. The City of Bellevue shall be notified 48 HRS prior to any television inspection and this work shall be performed on a schedule to allow the City of Bellevue to witness the inspection.
   6. If the television inspection shows indications of deflections in the pipe, the City of Bellevue may require that the Contractor pull a proper sized mandrel for the main through the pipe to confirm that the pipe deflection does not exceed the manufacturer's recommendations.
   7. Any defects in material or installation identified by the television inspection shall be repaired as required by the City of Bellevue and the Project Representative at the Contractor's expense.

END OF SECTION

SECTION 33 44 16
PREFABRICATED TRENCH DRAIN SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Prefabricated trench drain system.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.02 QUALITY ASSURANCE

A. Qualifications:
   1. Components for prefabricated trench drains shall be products of a manufacturer specializing in precast polymer concrete trenches for a minimum of three (3) years.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Shop Drawings:
      a. Fabrication and/or layout Drawings:
         1) Layout plan(s) showing dimensions, elevations etc.
         2) Details showing connections, installation, rough-in locations, etc.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Chemical-resistance data.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation in accordance with Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Prefabricated trench drain systems:
      a. ACO Drain, Inc.
      b. Poly Drain, Inc.
      c. L.M. Scofield Company.
      d. Zurn.
      e. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 - Product Requirements.

2.02 ACCESSORIES

A. Grating:
   1. Heavy-duty cast-iron rated meeting the both 10 ton rubber tire wheel loads and H-20 Traffic loads.
      a. Furnish with locking devices to lock grating to trench sections.

B. Catch Basins:
   1. Fabricated from same material as trench sections.
   2. Nominal inside sizes: 12 SQ IN x 24 IN deep.
   3. Provide knockouts for 6 IN DIA piping.
   4. Provide removable galvanized steel trash bucket.

2.03 FABRICATION

A. Trench Sections:
   1. Pre-cast vinylester polymer concrete modular channel sections.
   2. Nominal dimensions: 4 IN interior width, 0.6 percent slope built into the bottom, 1 meter length.
   3. Vertical side walls and a radiused bottom.
   4. Tongue and groove ends with interlocking adjoining sections.
   5. Neutral sections: Same material and basic size as sloped sections with flat bottoms used for extending overall length of sloped trenches.
   6. End caps: Same material as channel, design that allows the caps to interlock with channel sections and either close off the end of the channel or provide for drain pipe connection.

7. Materials used in system shall be able to withstand attack by the following chemicals without failure:
    a. Diesel fuel, hydraulic fluid.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Install trench sections with the top edges level and straight at elevations indicated.
    1. Support channel sections in place while concrete is placed under and around sections as indicated.

END OF SECTION

SECTION 33 52 19
DIESEL FUEL DISPENSING SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Above ground fuel storage tank including all wiring, accessories, structures and appurtenances required for a complete operating and approved installation.
   2. Diesel fuel dispensing systems:
      a. Tank mounted fuel pumps.
      b. Hose reels.
      c. Piping.
   3. Fuel Tank Monitoring System.
   4. Fuel Control System.
   5. Furnish all labor, materials, tools, equipment, and services for fuel dispensing systems as indicated, in accord with provisions of Contract Documents.

B. Related Sections include but are not necessarily limited to:
   1. Division 0 - Bidding Requirements, Contract Forms and Conditions of the Contract.
   2. Division 1 - General Requirements.
   3. Section 09 91 00- Painting and Protective Coatings.
   4. Section 40 05 13 – Pipe and Pipe Fittings: Basic Requirements.
   5. Section 40 20 13 – Pipe: Steel.
   6. Section 40 05 16 – Pipe Support Systems.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. International Fire Code (IFC):
      a. 2006 Edition.
   2. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings.
      b. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
      c. B16.11, Forged Steel Fittings, Socket Welding and Threaded.
   3. American Society for Testing and Materials (ASTM):
      a. A27, Standard Specification for Steel Castings, Carbon, for General Application.

b. A36, Specification for Carbon Structural Steel.

c. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

4. National Fire Protection Association (NFPA):

a. 30, Flammable and Combustible Liquids Code.

b. 30A, Automotive and Marine Service Station Code.

c. 70, National Electrical Code.

5. Underwriters Laboratories Inc. (UL):

a. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.

b. 2085, Insulated Aboveground Tanks for Flammable and Combustible Liquids.

B. Fuel pumps shall be listed by UL and labeled for the diesel blends specified, as appropriate.

C. Qualifications:

1. Installer shall have successfully completed at least three (3) projects of the same scope and the same size or larger within the last 6 years.

a. Installer shall demonstrate specific installation experience in regard to the specific system installation to be performed.

b. Installer shall have taken, if applicable, manufacturer's training courses on the installation of piping, leak detection, and tank management systems and meet the licensing requirements in the State of Washington.

1.03 SYSTEM DESCRIPTION

A. The Work shall include the design, fabrication and installation of the entire fuel storage and dispensing system in conformance with pertinent federal, state, and local code requirements.

1. The completed installation shall conform to NFPA and IFC as applicable.

2. Unattended self-service dispensing system shall comply with IFC 2204.3

B. The work shall include but not limited to:

1. Install new 2,500 GAL aboveground double wall tank and associated safety devices.

2. Install fuel piping and associated safety devices.

3. Install two new hose reel dispensers.

4. Install fuel management and leak detection system.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Leadership in Energy and Environmental Design (LEED) Documentation: Submit the following in accordance with Section 01 81 30 – Sustainability Requirements:
   1. Completed LEED VOC Submittal Form.
   2. Provide completed LEED Materials Submittal Form to declare recycled content, regional manufacture or source, and regional harvest content, as applicable, of the materials contained in this Section for steel and concrete.

C. Approval Submittals:
   1. Complete detailed Drawings of equipment provided including dimensions and connection locations.
   2. Wiring and control system diagrams and piping layouts.
   3. Manufacturer's standard catalog data, prior to the purchase or installation of the particular component, highlighted to show brand name, model number, size, options, performance charts and curves, etc., in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment.
      a. Copy of the Certificate of Approval for all equipment and devices where required by code.
   4. Exterior above ground piping Drawings (minimum scale 1/8 IN equals 1 FT) with information including:
      a. Dimensions of piping from wall surfaces.
      b. Centerline dimensions of piping.
      c. Centerline elevation and size of intersecting conduit/conduit racks, or other potential interferences requiring coordination.
      d. Location and type of pipe supports and anchors.
      e. Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
      f. Line slopes and air release vents.
   5. Project Data:
      a. Product technical data including:
         1) Acknowledgement that products submitted meet requirements of standards referenced.
         2) Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
         3) Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components.
            a) Attach technical product data on gaskets, pipe, fittings, and other components.

D. Quality Assurance Submittals.
   1. Test reports.
      a. Copies of pressure test results on all piping systems.
      b. Copies of pressure test results on primary and secondary tanks.
      c. Notification of time and date of piping pressure tests.

E. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment, piping, pipe coatings and pipe jackets during handling using method recommended by manufacturer.
   1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to equipment and pipe during transit.
   1. Repair abrasions, scars, and blemishes.
   2. If repair of satisfactory quality cannot be achieved replace damaged material immediately.

1.06 COMMISSIONING

A. The Work of this Section shall include the Contractor's labor and materials for participation in the Commissioning Activities (CX) as a Commissioning Team Member (CxT) as required by Section 01 95 00 – Commissioning Requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Aboveground storage tanks:
      a. Containment Solutions.
      b. Convault.
      c. Or approved equal.
   2. Tank heater:
      a. Chromalax.
      b. Warren Electric Corporation.
      c. Or approved equal.
   3. Hose Reels:
      a. Hannay.
      b. Reelcraft.

c. Or approved equal.

4. Fuel Nozzle:
   a. Wiggins, ZZ9A1.
   b. No Substitutions.
5. Fuel Receiver
   a. Wiggins, ZNC2A.
   b. No Substitutions.
6. Fuel Meter:
   a. Fill Rite, Series 900D.
   b. Total Control Systems, 682.
   c. Liquid Controls, Model M-5.
   d. Or approved equal.
7. Submersible Pumps:
   a. Franklin Fueling Systems.
   b. Red Jacket.
   c. Or approved equal.
8. Fuel System Manual On/Off Switch:
   a. Appleton.
   b. Crouse-Hinds.
   c. Or approved equal.
9. Fueling system and storage tank valves and accessories:
   a. Morrison Brothers.
   b. OPW.
   c. Or approved equal.
10. Fuel filtering system:
    a. ALGAE-X International (AXI).
    b. ASA Environmental Products.
    c. Fuel Purification Systems.
    d. Or approved equal.
11. Tank inventory, leak detection, alarm and electronic level sensing:
    a. Veeder-Root.
    b. No Substitutions.
12. Automatic fuel management system:
    a. OPW Fuel Management Systems, K800.
    b. No Substitutions.

B. Submit requests for "or equal" substitutions in accordance with Section 01 60 00 – Product Requirements.

2.02 NEW ABOVEGROUND STORAGE TANK

A. New tank shall be rectangular, above ground, fire rated, double wall vault type design
   1. Capacity: 2,500 GAL.
   2. Fuel: Diesel or B20.

B. Tank shall be designed with ballistic and vehicle impact protection.

C. Tank system shall be a standard size, standard option tank system or approved equal.
   1. Galvanized materials (zinc coated) shall not be allowed in direct contact with any fuel.

D. The storage tank system must be provided with all safety and overfill prevention devices required by IFC 2006, NFPA 30, NFPA 30A, and local codes.

E. Tank system shall be a factory fabricated, concrete encased storage tank with integral secondary containment, in accordance with NFPA 30 and NFPA 30A.
   1. Design and manufacture tank system for horizontal above ground installation.
   2. Primary tank:
      a. Construct primary storage tank of single wall ASTM A36 steel in accordance with UL 142.
      b. Isolate the primary tank from the exterior concrete vault with either insulation, an inert material, or minimum 2 IN standoffs.
         1) Tanks isolated with insulation or an inert material shall then be encased by a minimum of 30 mil, high density, polyethylene liner.
         2) The lined tank shall be encased by a minimum of 4 IN of 3000 psi strength, monolithically poured, reinforced concrete.
   3. Secondary tank:
      a. The secondary tank shall provide pressure testable containment for primary tank.
      b. The secondary tank shall be fitted with the following, in addition to openings for all ports in the primary tank:
         1) 2 IN annular space monitoring tube to provide a means to detect product leakage from the primary tank.
         2) 2 IN normal vent port.
         3) An emergency vent port sized according to NFPA 30 requirements.
      c. Port openings shall be constructed with full welds to prevent moisture from seeping between the fire proofing material and secondary and primary tanks.

4. Tank system shall conform to the requirements of UL 2085, bear the UL 2085 label and provide at least two (2) HRS fire protection.
    a. No exterior enclosure shall be allowed to cover the reinforced concrete.
5. Skid mount tank system and provide with lifting lugs which allow tank relocation.
6. Provide the tank system with the manufacturer's standard ladder and platform assembly, except as modified herein.
    a. Construct the assembly of structural steel and allow access to the top of the tank system.
7. All openings shall be located in the top of tank.
    a. Provide openings only for access, inspection, filling, emptying and venting of the tank.

F. Tank exterior protective coating: See Section 09 91 00 – Painting and Protective Coatings.

G. Tank Manways.
1. Piping will not penetrate through access manways.
2. Provide tank manways with a manway cover and an interior tank ladder for each tank compartment.
3. Tank manways shall have an internal diameter of 18 IN.
4. Provide tank manways with a matching flanged watertight manway cover.
    a. Construct manway covers of cast steel in accordance with ASTM A27, grade 60-30 as a minimum.
5. Construct interior tank ladders of either fiberglass or steel.
    a. If steel, completely coat the ladders in the same fashion as the interior tank bottom coating.
    b. Provide two (2) stringers a minimum 3/8 IN thick and a minimum 2 IN wide.
    c. Provide rungs of minimum 3/4 IN rod on 12 IN centers.
    d. Securely affix members of the ladders.
    e. Ladders shall be of sufficient length to extend from the bottom of the tank to the top surface of the tank. Rigidly connect ladders to the tank bottom in accordance with the tank manufacturer's standard.
    f. Connect ladders to the top of the tank with pipe guides or slip bars to accommodate expansion of the two stringers.

H. Tank Piping Penetrations:
1. Pipe penetrations will enter through the top of a tank.
    a. Drains located at the bottom of a primary storage tank will not be allowed.

2. Provide the number of tank piping penetrations as required per Plans.
    a. Provide 4 IN 150 LB carbon steel flange connection for installation of tank heater.
3. Provide nylon dielectric bushings on all pipe connections to a tank.
4. Pipe connections to a tank shall be through welded-in-place double tapered NPT couplings.
5. Provide the termination of fill lines within a tank with an anti-splash deflector.
    a. Fill line shall terminate within 6 IN from the bottom of the tank.
6. Piping shall be ASTM A53 black steel construction. Minimum wall thickness shall be schedule 40.

I. Tank Atmospheric Venting:
1. Provide pressure vacuum vent designed to provide normal venting for above ground storage tank.
2. Pressure vacuum vent shall be:
    a. Morrison Brothers Figure 548.
    b. Or approved equal.
3. Vent must be used in conjunction with emergency vent.
    a. Pressure/vacuum vent opening pressure shall be set below that of the emergency vent so that the normal vent relieves first.
4. Vent pipe and vent shall be in accordance with NFPA 30, NFPA 30A, UL 142 and UL 2085.
5. Vent pipe sizing shall be not less than 2 IN nominal diameter.
6. Discharge point shall be at least 12 FT above adjacent ground level.

J. Tank Emergency Venting:
1. Vent shall be designed to relieve only at a pressure setting above that of the normal vent.
2. Emergency vent shall be:
    a. Morrison Brothers Figure 244.
    b. Or approved equal.
3. Vent shall comply with NFPA 30, NFPA 30A, UL 2085 and UL 142.
4. Vent capacity shall comply with NFPA 30, NFPA 30A, UL 2085 and UL 142 for the size of tank and fuel specified.

K. Tank Overfill Prevention Device:
1. Provide tank with an overfill prevention device installed at the fill port.
2. Device shall stop flow of product when the tank reaches a preset warning level.
    a. Device shall stop flow of product at 95% tank level.

b. See Part 2.05 of this section for Fuel Tank Monitoring System requirements.

3. Tank overfill prevention device shall be:
   a. Morrison Brothers Figure 9095A.
   b. Or approved equal.
4. Overfill prevention device shall comply with NFPA 30 and NFPA 30A.
5. Use adapters per manufacturer.

L. Tank Inventory Measurement:
1. Provide the above ground storage tank with an inventory measurement probe.
2. See Part 2.05.

M. Tank Gages:
1. Provide tank with clock gage.
2. Gage shall be activated by float switch.
3. Gage shall be:
   a. Morrison Brothers 818 Series.
   b. Or approved equal.
4. Gage shall be accessible and viewable when the tank is filled.
   a. Gage shall be viewable from 20 FT to 30 FT minimum.
   b. Orientate gage facing towards tank load out location.
5. Furnish each tank with two (2) copies of calibrated charts which indicate the liquid contents in gallons for each 1/8 IN of tank depth.

N. Tank Heater:
1. Provide 4 IN 150 LB flange connection.
2. Tank heater shall be activated by thermostat.
3. Tank heater shall be vertically installed.
4. Tank Heater shall be:
   a. Chromalox, Model TMI-1T1E4.
   b. Or approved equal.
5. Heater shall activate when fuel temperature drops to 50 DegF and shut off at 60 DegF.
6. Electrical: 208 V, 5 KW.
7. Length of heater shall be such that bottom of heating element is approximately 2 IN above the bottom of the tank.
   a. Tank height will be determined upon final selection of tank.

2.03 EQUIPMENT

A. Vehicle Refueling Hose Reels:
   1. Provide two (2) Hose Reels located as shown on Drawings.
   2. Provide hose reels for dispensing of diesel fuel for use with submersible pumps located on the aboveground storage tank.
   3. Hose Reels shall be:
      a. Hannay.
      b. Or approved equal.
   4. Normal Flow Hose Reel, DHR-1:
      a. Single product (diesel), spring rewind, single hose.
      b. Diameter: 1 IN.
      c. Flowrate:
         1) Diesel: 15 GPM.
   5. High Flow Hose Reel, DHR-2:
      a. Single product (diesel), spring rewind, single hose.
      b. Diameter: 1-1/4 IN.
      c. Flowrate:
         1) Diesel: 25 GPM.
   6. Corrosion resistant cabinet.
   7. Hose:
      a. Smooth bore, black rubber 15 FT long for diesel up to B20 biodiesel.
      b. Fuel Nozzle:
         1) Normal Flow Hose Reel:
            a) Provide OPW 7H or equal.
            b) Nozzle inlet: 1 IN.
            c) Automatic closing type hose nozzle valve.
            d) Provide hanger for storage when not in use.
         2) High Flow Hose Reel:
            a) Provide Wiggins Model Number ZZ9A1, no substitutions.
            b) Provide appropriate adapter if necessary between hose and nozzle.
   8. Filter and strainer: Suitable for use with No. 2 diesel fuel, and up to B20 biofuel. See Part 2.04.C.2.

9. Base, frame and panels designed for outdoor use to provide vibration free support and weather protection for items above.
    a. Provide exterior finishes of stainless steel or electrostatically primed and finished with a durable non-fading baked enamel.
    b. Color to be approved by Project Representative.
10. All items UL listed for diesel fuel and unleaded gasoline as appropriate.
11. Shear Valve:
    a. Provide shear valve on fuel lines.
    b. Valve shall shut off flow of fuel to the dispenser in the event of an impact and/or fire.
    c. Provide test plug for pressure testing.
    d. Provide mounting bracket for installation within dispenser sump.
    e. Double poppet construction.
    f. Shear valve for fuel lines shall be:
        1) Morrison Brothers 636 series.
        2) OPW 10 series.
        3) Or approved equal.

B. Fuel Meter:
1. Digital meter accurate to within 1.25 percent.
2. Register: LCD type for 999 GAL delivery with battery backed 999,999 GAL totalizer.
3. Materials of construction shall be compatible with diesel / biodiesel fuel up to B20.
4. Pulser:
    a. Shall be compatible or integrated with fuel meter selected.
    b. Shall be compatible with and have the ability to communicate with OPW K800 fuel management system.
        1) Pulse/gallon output 10:1 pulses per GAL, compatible with fuel meter and OPW K800 fuel management system.

C. Submersible Petroleum Pumps:
1. Pump shall be self lubricating and easily removable without disconnecting discharge piping.
    a. The pump and motor assembly shall be readily separable from the pump column pipe to allow for simple field replacement of pump and / or motor.
2. Pump shall be provided with check valve, air eliminator, expansion relief valve, siphon nozzle and venturi, siphon check and pressure test screw.
3. Submersible pumps shall fit standard 4 IN NPT tank openings.

4. Pump intake inlet shall be horizontal to prevent drawing sediment from the tank bottom into the pump inlet.
5. Pump manifold shall be completely sealed against product leakage to the ground and water leakage to the tank.
6. Siphon system shall include integral siphon check valve to maintain liquid level after pump has been de-energized.
7. Submersible pump for dispensing Diesel Fuel or B20 Biodiesel:
    a. A single pump shall be provided for each diesel hose reel.
        1) Normal Flow Pump, FP-1:
            a) Flow rate: 15 GPM at 72 FT TDH minimum.
            b) 1/3 HP.
            c) Pump shall be:
                i Franklin Fueling Systems.
                ii Veeder-Root, Red Jacket.
                iii Or approved equal.
        2) High Flow Pump, FP-2:
            a) Flow rate: 25 GPM at 85 FT TDH minimum.
            b) 3/4 HP.
            c) Pump shall be:
                i Franklin Fueling Systems.
                ii Veeder-Root, Red Jacket.
                iii Or approved equal.
8. General Description:
    a. Fixed speed.
    b. Pumps shall be Class 1, Group D Atmospheres, UL Listed for specified fuel, 1 PH., 208/230 V, hermetically sealed motor windings, thermal overload protection. Suitable for exposed outdoor installation.
9. Outer Shell, Stator, Rotor Shaft: Stainless steel with 16 tooth splined motor shaft.
10. Impellers: 2 stage centrifugal.
    a. Acetyl thermoplastic construction, hydraulically balanced.
11. Pump materials of construction shall be suitable for the fuel pumped as specified.
12. Pump shall only operate when fuel control system switches power on and the switch located near the hose reel is manually activated.
13. Final pump length selection shall be based on storage tank provided.

D. Emergency Switch:
   1. Provide easily accessible emergency switch within 100 FT, but not closer than 20 FT of hose reel for emergency power shut-off.

E. Fuel On/Off Switch:
   1. Provide manually activated ON/OFF switch located near each hose reel.
   2. Switch shall be compatible to communicate with OPW K800 Fuel Control System.
   3. Switch enclosure shall be NEMA 4 rated for outdoor use.

F. Storage Tank Diesel Fuel Filtering System:
   1. Provide a fuel filtering system compatible with diesel fuel and diesel fuel up to B20.
   2. Filtering system shall be standalone equipment automatically activated/deactivated on adjustable timer.
   3. Flow rate: 2.5 GPM minimum.
   4. Filtration system shall be enclosed and designed for outdoor use underneath a canopy.
      a. Enclosure shall be a minimum of NEMA 3R rated.
   5. Components to include, not limited to:
      a. Primary filter/water separator.
      b. Main pump.
      c. Filter drain.
      d. Filtration wastewater container.
      e. Enclosure unit heater or other means of freeze protection.
      f. Leak detection.
      g. Operator interface panel.
      h. Alarm system with automatic shutdown.
   6. Operator interface panel:
      a. Provide interface panel for user configuration, monitoring, control, alarm indication, and manual on/off ability.
   7. Audible alarm system:
      a. Provide audible alarm indication for the following conditions:
         1) Filter servicing required.
         2) Leak detected.
         3) High separator water level.
         4) High pump pressure.
         5) Pump tripped or overloaded.

2.04 ADAPTERS, COUPLERS AND ACCESSORIES

A. Tank Fill:
   1. Fuel Receiver Connection shall be:
      a. Wiggins, Model ZNC2A.
      b. No Substitutions.
   2. Locking Ball Valve:
      a. Provide a UL listed locking full port ball valve for each product fill line.
      b. Ball valve: forged brass body, chrome plated ball, blowout proof stem, Teflon seals, and carbon steel handle.
      c. Ball valve shall be:
         1) Morrison Brothers Figure 691B.
         2) OPW, 21 BV (with locking handles).
         3) Or approved equal.
   3. Check Valve:
      a. Provide a swing check valve for each product fill line.
      b. Check valves shall be constructed for use with fuel types as specified.
      c. Check valves shall be:
         1) Morrison Brothers Figure 246.
         2) OPW, 175.
         3) Or approved equal.
   4. Overfill Prevention Valve:
      a. See Part 2.02.K of this Specification Section.

B. Tank Fill Spill Container:
   1. Provide a remote spill container for use during tank filling operations.
   2. 12 gage steel construction.
   3. Minimum capacity of 15 GAL.
   4. Container used for diesel loadout shall have a single 2 IN port.
   5. Container shall have a pedestal mount, lockable lid, and a 1 IN drain with lockable ball valve.
   6. Remote spill container shall be:
      a. Morrison Brothers 515 series.
      b. Pomeco/OPW, 211-RMOT.
      c. Or approved equal.

C. Fuel Discharge Line Accessories:
   1. Ball valve.
      a. Provide a UL list full port ball valve in discharge line of each pump.

b. Ball valve: Forged brass body, chrome plated ball, blowout proof stem, Teflon seals, and carbon steel handle.

c. Ball valves shall be:

1) Morrison Brothers Figure 691.

2) OPW, 21BV.

3) Or approved equal.

2. Line Strainer:

a. Provide a Y-type or tube type line strainer in each product discharge line.

b. Basket shall have bottom access and be removable for cleaning and/or replacement.

c. Yoke: Malleable iron.

d. Strainer: 100 mesh, stainless steel.

e. Strainer shall be:

1) Morrison Brothers Figure 285.

2) OPW.

3) Or approved equal.

3. External Emergency Valve:

a. Provide an external emergency valve in each product discharge line.

b. Valve shall have a fusible link. Valve shall activate and stop flow in the event of a fire.

c. External Emergency Valve shall be:

1) Morrison Brothers Figure 346.

2) OPW, 1785.

3) Or approved equal.

4. Solenoid Valve:

a. Provide solenoid valve in each product discharge line.

b. Valve shall be normally closed and shall open upon receipt of an electronic signal from fuel control system when switched on.

c. Operates on 120 volts.

d. Enclosure shall be watertight and rated for hazardous locations – NEMA 3, 4X, 7 and 9; groups C and D.

e. Built-in expansion relief.

f. Soleniod valve shall be:

1) Morrison Brothers Figure 710.

2) OPW, 821.

3) Or approved equal.

5. Expansion Relief Valve:
   a. Provide an expansion relief valve in each product discharge line.
   b. Valve shall be used for relief of excess pressure, product shall return back to storage tank.
   c. Expansion relief valve shall be:
      1) Morrison Brothers Figure 78DI.
      2) OPW, 82RV.
      3) Or approved equal.

D. Fire extinguishers:
   1. Provide a minimum of one (1) fire extinguisher per IFC 2205.5.
      a. Minimum rating of 2-A:20-B:C per IFC 2205.5.
   2. Locate extinguisher as shown on plans.

E. Warning signs:
   1. Provide warning signs per IFC 2205.6 & IFC 2204.3.5.
   2. See Section 10 14 00 – Identification Devices Part 3.03 for type.

2.05 FUEL TANK MONITORING SYSTEM

A. Electronic Monitoring System Panel:
   1. Panel shall be Veeder Root TLS-350.
   2. Panel produce an audible and visual alarm in the event of a detected leak, tank overflow and tank low level.
      a. Audible alarms shall be a buzzer sounding at 70 decibels or greater.
      b. Each visual alarm shall indicate the type and location of the alarm condition.
      c. Visual alarms shall be capable of delineating between individual alarm conditions.
   3. Panel shall initiate a remote tank fill audible/visual alarm at 90 percent tank level.
      a. Alarm device shall be located near tank fill box in view of operator.
      b. Alarm shall be manually acknowledged by switch located at alarm.
   4. Panel shall provide a means of delineating between individual alarm conditions.
   5. House panel in a NEMA 4 enclosure.
   6. Panel using computer memory shall be capable of maintaining current programmable information in the event of a power failure.

7. Provide panel with a manual acknowledge switch which shall be capable of deactivating the audible alarm.
    a. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence.
    b. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected.
8. The Monitoring System Panel shall be capable of communication with SCADA system via PLC for remote monitoring.
    a. Vendor shall be responsible to provide any additional modules that may be necessary for Fuel Tank Monitoring System to provide Modbus TCP/IP communication to SCADA system.
    b. Communication with SCADA system shall include:
        1) Tank low level alarm.
        2) Tank fuel level.
        3) 4 FT of level remaining in tank.
        4) Tank leak detection.
9. Panel shall be capable of producing hardcopy printouts of all tests and/or leak notification reports.

B. Aboveground Vaulted Tanks:
1. The interstitial space of each vaulted tank shall be continuously and automatically monitored to detect breaches in the integrity of the primary tank and the exterior vaulted shell.
2. The interstitial space shall be monitored by an electronic capacitance type liquid sensor capable of distinguishing the difference between hydrocarbons and water.
    a. Sensors shall be intrinsically safe for use in Class 1, Division 1, Group D environment as defined by NFPA 70.
    b. Sensors shall be easily removed from the tank.
    c. Sensors shall be compatible with the electronic monitoring panel, Veeder-Root TLS-350.
    d. Sensors shall be UL listed.
3. Interstitial Sensor for Steel Tanks shall be:
    a. Veeder-Root tank interstitial sensor.

C. Tank Inventory Measurement:
1. Provide the above ground storage tank with an inventory measurement probe.
    a. Capable of communicating with Veeder-Root TLS-350 for tank inventory, and tank overfill and low level alarms.

2. Tank Inventory Measurement shall be:

    a. Veeder-Root Mag Plus Inventory Measurement Probe.

D. Alarm Conditions:
1. Fuel alarm, water warning, water alarm, installation alarm and communication alarm are indicated by an audible alarm, a displayed message and a printed message on the Veeder-Root TLS-350 console.

2.06 FUEL CONTROL SYSTEM

A. Fuel Control System:
1. Fuel control system shall be Petro Vend K800 by OPW, no substitutions.

    a. System shall be compatible with existing KCSWD fuel system software, Phoenix Version PWP 3.1 by OPW.

    b. Control system shall include:

        1) One (1) Fuel Island Terminal (K800 FIT).

        2) One (1) Fuel Site Controller (K800 FCS).

    c. System shall control two diesel fuel pumps including adjustable pump time-outs.

    d. Fuel Site Controller:

        1) Locate controller within Transfer Station Telephone / Data room as shown on Drawings or as directed by Project Representative.

        2) Controller shall communicate via PLC with Project Representative supplied software.

2.07 DIESEL FUEL ABOVE GRADE PIPING

A. See Section 40 05 13 – Pipe and Pipe Fittings: Basic Requirements and Section 40 20 13 – Pipe Steel.

B. Aboveground from the pump to the hose reels shall be single wall Schedule 40 black steel pipe in accordance with ASTM A53 with standard 150 LB fittings, butt welded, socket welded or flanged.
1. Butt-welded fittings shall comply with ASME B16.11, forged steel construction.

2. Socket-welded fittings shall comply with ASME B16.11, forged steel construction.

3. Flanges and flanged fittings shall comply with ASME B16.5.

    a. Gaskets shall be compatible with diesel fuel up to B20, Garlock, Gylon Style 3500 or equivalent.

4. Exposed piping shall be painted.

5. Pipe shall be supported in accordance with 40 05 16 – Pipe Support Systems.

C. A flexible single wall braided stainless steel hose shall be used at the outlet of the pump.
1. Hose shall be rated for 150 psi minimum.

2. Hose shall be compatible with fuels to be pumped.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The fuel storage tank and dispensing system must be installed by or under the supervision of a licensed motor fuel tank installer.

B. The installation of the aboveground motor fuel storage tank and dispensing system must comply with the provisions of NFPA 30, NFPA 30A, IFC 2006 and local codes.

C. Handle storage tanks with extreme care to prevent damage during placement and install in accordance with the manufacturer's installation instructions and NFPA 30 or NFPA 30A, as applicable.

D. Provide earthquake restraints for tank.

E. Inspect the exterior surface of each tank for obvious visual damage prior to the placement of each storage tank.
   1. Correct surface damage to a storage tank according manufacturer's requirements before proceeding with the system installation.

F. Field Painting:
   1. Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted, piping shall be painted, and have identification markings applied as specified in Section 09 91 00 – Painting and Protective Coatings.

3.02 TESTS

A. Aboveground Storage Tank Tightness Tests:
   1. Testing shall meet the requirements of UL 142 and UL 2085.
   2. Pressure tests shall be performed in the presence of a Fire Department representative.
   3. Perform a tightness test on each aboveground storage tank.
      a. Perform the tests prior to making piping connections.
   4. Tests shall be capable of detecting a 0.1 gph leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction.
   5. Gages used in the tightness tests shall have a scale with a maximum limit of 10 psig.
   6. Hydrostatically pressurize test each storage tank compartment to 20 psig and monitored for a drop in pressure over a 2 HR period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects.
      a. Pneumatic test the annual space at three (3) psig.
      b. Any test failure shall require corrective action and retest.

7. Piping shall be hydrostatically tested at 100 psig and monitored for a drop in pressure over a 2 HR period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects.
    a. Any test failure shall require corrective action and retest.

B. Manufacturer's Tank Tests:
1. Following the tank tightness test, leak test each storage tank in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed.
2. Any test failure shall require corrective action and retest.

C. System Performance Tests:
1. After all components of the system have been properly adjusted, test the system to demonstrate that the system meets the performance requirements for which it was designed.
2. Test the maximum rated capacity of the system by using several tank trucks simultaneously, if applicable.
    a. The use of tank trucks shall be coordinated with the Project Representative prior to testing.
3. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is obtained from the Project Representative.
4. The tests shall demonstrate the following:
    a. The capability of each fuel pump to deliver the indicated flow of fuel.
    b. The alarm and control panels are operational and perform as designed.
    c. Each fuel meter is operating accurately.
    d. Vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.
    e. Hose reels and nozzles are operational and perform as designed.
    f. Fuel filtration system is operational and performing as designed.
    g. Each safety device works properly and is tested per NFPA requirements as necessary.

D. High Liquid Level Alarm Test:
1. Each storage tank shall be initially overfilled with the appropriate product in order to verify the high liquid level alarms in the remote alarm panel function as designed.
2. The initial overfill shall also verify that the storage tank overfill protection.

3.03 FLUSHING, CLEANING AND ADJUSTING

A. Following installation and equipment testing but prior to system performance testing, the following flushing, cleaning, and adjustments shall be performed.
   1. Initial System Cleaning:
      a. Visually inspect and clean free of debris the interior of each fuel storage tank before filling.
      b. In the event of entry into a storage tank, the Contractor shall ensure a safe atmosphere exists.
      c. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other equipment coming in contact with fuel.
      d. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.
   2. Initial Fuel Supply:
      a. Following the preparations for flushing, fill each storage tank to a 25 percent capacity with the proper fuel according to the fueling system's final operational requirements.
      b. Following the initial fuel supply, measure and record each storage tank's fuel temperature and liquid level.
         1) The liquid level shall be measured using a manual tank gage.
   3. Dispensing Flushing:
      a. Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, to the corresponding hose reel, and then into an empty fuel truck or tank as supplied by the Project Representative.
      b. Periodic samples for inspection by the Project Representative shall be taken during the flushing procedure.
         1) A minimum of 100 GAL shall be flushed through each hose reel nozzle.
         2) The flushing procedure shall be continued until the fuel being delivered is acceptable to the Project Representative.
         3) Each dispensing line shall be flushed in the exact same manner.
   4. Disposal of Initial Fuel Supply:
      a. In the event the fuel contained in the piping system at the conclusion of the flushing operation is not considered by the Project Representative to be of satisfactory quality for the desired use, the Contractor shall be responsible for pumping out the entire fuel supply from the storage tanks and the piping system.
      b. Disposition of the fuel removed from the system shall be the responsibility of the Contractor.

5. Initial System Adjustments:

    a. Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements.

    b. The Project Representative will deliver enough fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls.

    c. Flow rates and pressures shall be adjusted as required to meet the indicated requirements.

    d. The sequence of control for each component shall be adjusted to meet the indicated system requirements.

    e. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

3.04 TRAINING

A. Contractor shall conduct a training course for the operating staff as designated by the Project Representative.
    1. The training period shall consist of a total of 8 HRS of normal working time and shall start after the system is functionally completed but prior to final system acceptance.

    2. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations.

END OF SECTION

SECTION 33 56 16
UNDERGROUND STORAGE TANKS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Underground double walled, fiberglass reinforced plastic (FRP) storage tank as shown on Drawings for HHW canopy secondary containment, including, deadmen, fittings, and accessories.
   2. Associated dual walled high density polyethylene (HDPE) piping.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. ANSI B16.5, Pipe Flanges and Flanged Fittings.
   2. ASTM International (ASTM):
      a. C 33, Standard Specification for Concrete Aggregates.
      b. D 2837, Hydrostatic Design Basis for Thermoplastic Pipes.
      c. D 2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
      d. D 3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
      e. D 3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      f. D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Material.
      g. F 2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
   3. National Fire Protection Association (NFPA):
      a. 30, Flammable and Combustible Liquids Code.
   4. Petroleum Equipment Institute (PEI):
      a. Recommended Practice (RP) 100, Recommended Practices for Installation of Underground Liquid Storage Systems.
   5. Underwriters Laboratories Inc. (UL):
      a. 1316, Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Leadership in Energy and Environmental Design (LEED) Documentation:
   1. Submit the following in accordance with Section 01 81 30 – Sustainability Requirements:
      a. Completed LEED VOC Submittal Form.
      b. Provide completed LEED Materials Submittal Form to declare recycled content, regional manufacture or source, and regional harvest content, as applicable, of the materials contained in this Section for steel and concrete.

C. Approval Submittals:
   1. Manufacturer's written directions regarding material handling, delivery, storage and installation.
   2. Shop drawings including a complete set of scaled drawings detailing dimensions of heights, diameter, elevations to invert, pipe sizes and any other necessary details.
   3. Manufacturer’s product brochures and calibration charts.
   4. Technical product data on gaskets, pipe, fittings, and other components.

D. Quality Assurance Submittals:
   1. Manufacturer’s Qualifications: Manufacturer regularly engaged for past 5 years in manufacture of underground FRP storage tanks of similar type to that specified.
   2. Installer’s Qualifications:
      a. Installer regularly engaged for past 5 years in installation of underground storage tanks of similar type to that specified.
      b. Employ persons trained for installation of underground storage tanks.
   3. Manufacturer’s certification that tank and piping comply with specified requirements and is suitable for the intended application.
   4. Test reports.
      a. As recommended by manufacturer.

E. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content:
      a. Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect tank during transport, handling, and storage using method recommended by manufacturer.

B. Move tanks by lifting and setting only. Do not move tanks by rolling or dragging.

C. Always lift tanks by using the lifting lugs provided with the tank.
   1. Distribute the lifting load evenly between the lifting lugs.
   2. Use spreader bars and equal length slings as required.

D. Before the tank is unloaded or relocated on the job site and before preinstallation testing at the jobsite, Contractor to complete the following steps in the presence of the Project Representative:
   1. Visually inspect the entire exterior surface of the tank to make sure that no shipping or handling damage has occurred.
      a. Rotate or lift the tank to inspect the bottom of the tank.
      b. Look particularly for visible damage, cracks or deep scrapes.
   2. Be sure that all equipment used to lift the tank is rated to handle the load.
   3. Select a smooth, solid, level area on which to place the tank, and clear that area of all large rocks, trash and debris.
   4. Make sure that all tools and other items that may damage the tank during unloading are removed from the trailer bed.
   5. When unloading the tank from the truck, ensure the tank is secured in such a way that it does not roll off the truck.

E. Choose suitable lifting sling(s) for the tank being installed.

F. Tie the tank down if high winds are expected. Do not use wire rope or chains.

G. Pipe shall be prefabricated prior to shipment to the jobsite.
   1. No on-site fabrication to the pipe, fittings or system shall be allowed.

H. Pipe shall be stored on clean, level, dry ground to prevent undue scratching or gouging of the pipe.
   1. The pipe ends shall be capped to prevent water and dirt from contaminating the annular space between the pipes.
   2. If the pipe must be stacked for storage, such stacking should be done in accordance with the pipe manufacturer's recommendations.
   3. The handling of the pipe should be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

I. Segments of pipe having cuts or gouges in excess of 10 percent of the wall thickness of the pipe shall be cut out and removed.
   1. The undamaged portion of pipe can be rejoined after a new end piece has been welded to the pipe.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following underground FRP tank manufacturers are acceptable:
   1. Xerxes (Basis of Design).
   2. Containment Solutions (CSI).

3. Or approved equal.

B. Dual-walled HDPE pipe:
   1. ISCO.
   2. Fusion Support Services.
   3. Or approved equal.

C. Submit requests for "or equal" substitutions in accordance with Section 01 60 00 – Product Requirements.

2.02 UNDERGROUND FRP STORAGE TANK

A. New tank shall be double-walled, horizontal, below ground, FRP type design:
   1. Capacity: 4,000 GAL.

B. Loading Conditions – Tank shall meet the following design criteria:
   1. Internal Load: Tank shall withstand a 5 psig air-pressure test with 5:1 safety factor.
   2. Vacuum Test: To verify structural integrity, every standard 10 FT DIA tank and smaller shall be vacuum tested by the manufacturer at the factory to 11.5 IN of mercury.
   3. Surface Loads: Tank shall withstand H-20 surface and H-20 axle loads when properly installed according to manufacturer's requirements.
   4. External Hydrostatic Pressure and Burial Depth: Tank shall be capable of being buried in ground with 7 FT of overburden over the top of the tank, the hole fully flooded and a safety factor of 5:1 against general buckling.
   5. Tank shall support accessory equipment: Such as drop tubes, submersible pumps and ladders when installed according to tank manufacturers current Installation Manual and Operating Guidelines.

C. Product Storage:
   1. Tank shall be capable of storing liquids with specific gravity up to 1.1.
   2. Tank shall be vented to atmospheric pressure.
   3. Tank shall be capable of storing products identified in the manufacturer's current standard limited warranty.

D. Materials:
   1. Tank shall be manufactured with 100 percent premium resin and chopped glass.
      a. No fillers or extenders will be used.
   2. No General, Orthophthalic, or odd lot resin will be used.

E. All associated internal mounting hardware shall be rustproof and corrosion resistant.

F. Interstitial Space:
   1. Tank shall have a space between the primary and secondary walls to allow for the free flow and containment of leaked product from the primary tank.
      a. The space also allows the insertion of a monitoring device through a monitoring fitting.

G. Hydrostatic Leak Monitoring System:
   1. The leak-monitoring system shall be designed by the manufacturer to detect a leak in either the primary or secondary tank, at installations with or without groundwater.
   2. The hydrostatic monitoring system shall be UL third-party verified and shall meet EPA criteria for tank-tightness testing.

H. Anchor Straps:
   1. Straps shall be FRP anchor straps as supplied by tank manufacturer.
   2. Number and location of straps shall be specified in current literature by tank manufacturer.

I. Manways:
   1. All manways shall be flanged, traffic-rated, and 22 IN DIA minimum, complete with UL-listed cover, gasket and hardware.

J. Gage Plates:
   1. Gage plates shall be installed under each service fitting and manway opening.

K. Ladders:
   1. Ladder shall be the standard ladder as supplied by tank manufacturer.
   2. Ladder material (fiberglass or aluminum) shall be provided for each manway.

L. Fittings:
   1. All fittings shall be located along the top centerline of the tank.
   2. Bottom drain and tangential nozzles are not allowed without authorization from the tank manufacturer.
   3. All standard NPT threaded fittings shall be constructed of carbon steel, FRP or 304 stainless steel.
   4. All standard NPT threaded fittings shall be half-couplings or full coupling and 2, 4, or 6 IN DIA.
      a. Reducers are to be used for smaller sizes where shown and provided by contractor.
   5. All NPT fittings shall withstand a minimum of 150 FT/LBS of torque and 1,000 FT/LBS of bending, both with a 2:1 safety factor.
   6. All optional FRP nozzles shall be flat-faced, flanged and gusseted, and shall conform to ANSI B16.5 150# bolting pattern.
   7. Each interstitial-space monitor fitting shall consist of a 4 IN NPT fitting on the secondary tank.

M. Deadmen:
   1. Use pre-engineered deadmen sized to the specific tank ordered and specific site conditions unless otherwise approved by Project Representative.

N. Backfill:
   1. Use only approved backfill material. Do not mix approved material together with sand or in situ soil.
      a. If using rounded stones as backfill material, they must con-form to the specifications of ASTM C 33, size numbers 6, 67 or 7.
      b. If using crushed stones as backfill material, they must con-form to the specifications of ASTM C 33, size numbers 7 or 8.

2.03 DUAL-WALLED HDPE PIPE

A. Pipe material shall be high density, extra high molecular weight polyethylene conforming to ASTM D 3350.

B. Pipe supplied under this Specification shall have IPS (Iron Pipe Size) OD and shall meet ASTM D 3035.

C. Fittings shall be manufactured with the same OD as carrier and containment pipe and have minimum pressure rating for carrier equal to the carrier pipe.
   1. All fittings shall meet the pressure requirements of the system as specified and based on ASTM D 2837.

D. All molded fittings shall be manufactured per ASTM D3261.

E. Pipe joints and fittings shall be supplied to the job site ready for simultaneous butt-fusion.
   1. The fabricator shall show that the materials are capable of butt-fusion and shall provide a procedure to consistently produce sound welds.

F. Carrier pipe support shall be with full round centralizers welded to the carrier pipe.
   1. The centralizers will be either molded or machined from HDPE Pipe Grade resins or sheet.
   2. Manual or hand cut centralizers are not permitted since they have a low degree of dimensional accuracy.
   3. Centralizers should have at least two openings that will permit the flow of liquid between the carrier pipe and the containment pipe.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install underground storage tanks in accordance with manufacturer's instructions, NFPA 30, and PEI RP 100.

B. Install underground storage tanks and associated piping at locations and to elevations indicated on the Drawings.

C. Ensure tank excavation is free from materials that may cause damage to tanks or tank coating.

D. Do not allow foreign matter to be introduced into excavation or backfill during tank installation.

E. Backfill:
   1. Place backfill material along bottom side of tanks by shoveling and tamping to ensure tanks are fully and evenly supported around bottom quadrant.
   2. Deposit backfill material carefully around and over tanks to avoid damage to tanks and tank coating.
   3. Before placing backfill over tanks visually inspect tank, tank coating, and pipe connections.

F. Contractor to ensure adequate cover is provided per manufacturer's instructions for traffic-rated application.

G. Deadmen and anchoring system to be designed and installed per site-specific conditions.

H. Dual Walled HDPE Pipe:
   1. Sections of polyethylene pipe shall be joined into continuous lengths on the job site following the guidelines of ASTM F 2620, using simultaneous butt fusion as the method of joining the dual contained polyethylene piping system.
   2. Supplier shall approve all fusion equipment used for the containment system.
      a. The butt fusion equipment used to join the pipe shall be capable of meeting all normal butt fusion requirements: Alignment, heating, trimming and fusion pressure.
   3. Supplier shall provide written butt fusion pressure procedure as part of the submittal package.
   4. Fused segments of pipe shall be moved to avoid damage to the pipe.
      a. Handle dual contained pipe with care.
      b. Limit bending of the pipe.
      c. Nylon slings are preferred.
   5. The trench and trench bottom shall be constructed in accordance with ASTM D 2321-Section 7.
   6. Embedment materials shall be Class I materials as defined by ASTM D 2321- Section 6.
   7. Bedding of the pipe shall be performed in accordance with ASTM D 2321-Section 8.Compaction rates shall be in accordance with Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
   8. Haunching and initial backfill shall be as specified in ASTM 2321- Section 9 using Class I materials.

9. The clean and dry installation of the containment piping's annular space is critical.
    a. The pipe installation contractor shall ensure that the pipe's annular space is clean and dry.

3.02 TESTS

A. FRP Tank:
    1. All UL-labeled tanks must be air tested per manufacturer's instructions after backfill is brought close to the top of the tank.
    2. After air testing, tank shall be soap tested to verify integrity per manufacturer's instructions.

B. Dual Walled HDPE Pipe:
    1. The carrier (inside pipe) shall be tested at 20 FT of head or 10 psi air for gravity systems.
        a. Air pressure should be allowed to equalize for 10 minutes, then monitor the pipe for the test period of 10 minutes, during which no drop in pressure shall be allowed.
    2. The annular space between the carrier and containment pipe shall be tested at 10 PSE air pressure.
        a. Air pressure should be allowed to equalize for 10 minutes, then monitor the pipe for the test period of 10 minutes, during which no drop in pressure shall be allowed.

END OF SECTION

SECTION 40 05 05
EQUIPMENT: BASIC REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.
   4. Section 05 50 00 - Metal Fabrications.
   5. Section 07 92 00 - Joint Sealants.
   6. Section 09 91 00 - Painting and Protective Coatings.
   7. Section 10 14 00 - Identification Devices.
   8. Division 11 - Equipment.
   9. Division 12 - Furnishings.
   10. Division 26 - Electrical.
   11. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   12. Section 40 05 16 - Pipe Support Systems.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Gear Manufacturers Association (AGMA).
   3. ASTM International (ASTM):
      a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   4. International Electrotechnical Commission (IEC).
   5. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
   6. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6, Enclosures for Industrial Control and System.

c. MG 1, Motors and Generators.

7. InterNational Electrical Testing Association (NETA):
   a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
8. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC):
      1) Article 430, Motors, Motor Circuits, and Controllers.
9. National Institute for Certification in Engineering Technologies (NICET).
10. National Institute of Standards and Technology (NIST).
11. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
12. Underwriters Laboratories, Inc. (UL).
    a. 508, Standard for Safety Industrial Control Equipment.
    b. 508A, Standard for Safety Industrial Control Panels.

B. Electrical Equipment and Connections Testing Program:
   1. Testing firm:
      a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration , and adjusting of systems.
      b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
   2. Field personnel:
      a. Minimum of one (1) year field experience covering all phases of electrical equipment inspection, testing, and calibration.
      b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
      c. Supervisor certified by NETA or NICET.
   3. Analysis personnel:
      a. Minimum three (3) years combined field testing and data analysis experience.
      b. Supervisor certified by NETA or NICET.

C. Miscellaneous:
   1. A single manufacturer of a "product" to be selected and utilized uniformly throughout Project even though:
      a. More than one (1) manufacturer is listed for a given "product" in Specifications.
      b. No manufacturer is listed.
   2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power Drawings and defined in Division 26.
   3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and sure their compatibility.

1.03 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
   1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater.
   2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater.
   3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment:
   1. One (1) or more assemblies capable of performing a complete function.
   2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
   3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.

D. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. General for all equipment:
      a. Data sheets that include manufacturer's name and complete product model number.
         1) Clearly identify all optional accessories that are included.
      b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
      c. Manufacturer's delivery, storage, handling, and installation instructions.
      d. Equipment identification utilizing numbering system and name utilized in Drawings.
      e. Equipment installation details:
         1) Location of anchorage.
         2) Type, size, and materials of construction of anchorage.
         3) Anchorage setting templates.
         4) Manufacturer's installation instructions.
      f. Equipment area classification rating.
      g. Shipping and operating weight.
      h. Equipment physical characteristics:
         1) Dimensions (both horizontal and vertical).
         2) Materials of construction and construction details.
      i. Equipment factory primer and paint data.
      j. Manufacturer's recommended spare parts list.
      k. Equipment lining and coatings.
      l. Equipment utility requirements include air, natural gas, electricity, and water.
      m. Ladders and platforms provided with equipment:
         1) Certification that all components comply fully with OSHA requirements.
         2) Full details of construction/fabrication.
         3) Scaled plan and sections showing relationship to equipment.
   2. Mechanical and process equipment:
      a. Operating characteristics:
         1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
         2) Brake horsepower requirements.

3) Copies of equipment data plates.

b. Piping and duct connection size, type and location.

c. Equipment bearing life certification.

d. Equipment foundation data:

1) Equipment center of gravity.

2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.

3. Electric motor:

a. Motor manufacturer and model number.

b. Complete motor nameplate data.

c. Weight.

d. NEMA design type.

e. Enclosure type.

f. Frame size.

g. Winding insulation class and temperature rise.

h. Starts per hour.

i. Performance data:

1) Motor speed-torque curve superimposed over driven machine speed-torque curve during start-up acceleration and at rated terminal voltage a minimum permissible or specified terminal voltage for all motors over 10 HP.

2) Time-current plots with acceleration versus current and thermal damage curves at the operating and ambient temperatures and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 10 HP.

3) Guaranteed minimum efficiencies at 100 percent, 75 percent, and 50 percent of full load.

4) Guaranteed minimum power factor at 100 percent, 75 percent, and 50 percent of full load.

5) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.

6) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.

j. Bearing data and lubrication system.

k. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.

l. Maximum permissible capacitor (kVAC) that can be connected to the motor.

m. Recommended size of power factor correction capacitors to improve power factor to 0.95 lagging when operated at full load.

n. Fabrication and/or layout Drawings:

1) Dimensioned outlined Drawing.

2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).

o. Certifications:

1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.

2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.

a) Include minimum speed at which the motor may be operated for the driven machinery.

p. Electrical gear:

1) Unless specified in a narrow-scope Specification Section, provide the following:

a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.

2) Control panels:

a) Panel construction.

b) Point-to-point ladder diagrams.

c) Scaled panel face and subpanel layout.

d) Technical product data on panel components.

e) Panel and subpanel dimensions and weights.

f) Panel access openings.

g) Nameplate schedule.

h) Panel anchorage.

4. Systems schematics and data:

a. Provide system schematics where required in System Specifications.

1) Acknowledge all system components being supplied as part of the system.

2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.

3) Provide technical data for each system component showing compliance with the Contract Document requirements.

4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.

5. For factory painted equipment, provide paint submittals in accordance with Specification Section 09 91 00 - Painting and Protective Coatings.
6. Qualifications for:
    a. Electrical equipment and connections testing firm and personnel.
7. Testing plans, in accordance with PART 3 of this Specification Section:
    a. Electrical equipment and connection testing.
8. Samples:
    a. Sample form letter for equipment field certification.
9. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
10. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
11. Field noise testing reports if such testing is specified in narrow-scope Specification Sections.
12. Notification, at least one (1) week in advance, that motor testing will be conducted at factory.
13. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
14. Motor test reports.
15. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
16. Provide three (3) bound final written reports documenting vibration monitoring and testing for specified equipment.
    a. Include the acceptance criteria of all equipment tested.
    b. Provide individual tabbed sections for information associated with each piece of tested equipment.
17. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
18. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
19. Certification that driven equipment and VFD are compatible.

C. Quality Assurance Submittals:
    1. Closeout Submittals.

2. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.
3. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.05 EXTENDED WARRANTY

A. In accordance with the provisions of Section 01 78 00 – Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. Warranty period for Work of this Section is two (2) years commencing on the date of Substantial Completion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Motors:
      a. Baldor.
      b. General Electric.
      c. Marathon Electric.
      d. Reliance Electric.
      e. Siemens.
      f. Teco-Westinghouse.
      g. U.S. Motors.
      h. WEG.
      i. Or approved equal.
   2. Mechanical variable speed drives:
      a. ABB.
      b. Reliance.
      c. Yaskawa.
      d. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00.

2.02 MANUFACTURED UNITS

A. General:
   1. Furnished equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.

2. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
3. Provide testing of electrical equipment and connections in accordance with Division 26.
4. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
    a. Contract Drawings and Specifications.
    b. Related construction change documentation.
    c. Approved Shop Drawings.
    d. Approved Operation and Maintenance Manuals.
    e. Other pertinent information as required.

B. Equipment Monitoring and Testing Plans:
1. Approved in accordance with Shop Drawing submittal schedule.
2. Included as a minimum:
    a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
    b. List and description of testing and analysis equipment to be utilized.
    c. List of all equipment to be testing, including:
        1) Name and tag numbers identified in the Contract Documents.
        2) Manufacturer's serial numbers.
        3) Other pertinent manufacturer identification.

C. Instruments Used in Equipment and Connections Quality Control Testing:
1. Minimum calibration frequency:
    a. Field analog instruments: Not more than 6 months.
    b. Field digital instruments: Not more than 12 months.
    c. Laboratory instruments: Not more than 12 months.
    d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
2. Carry current calibration status and labels on all testing instruments.
3. See individual testing programs for additional instrumentation compliance requirements.

D. Testing and Monitoring Program Documentation:
1. Provide reports with tabbed sections for each piece of equipment tested.
2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
    a. Include legible copies of all forms used to record field test information.

3. Prior to start of testing, submit one (1) copy of preliminary report format for Project Representative review and comment.
    a. Include data gathering and sample test report forms that will be utilized.
4. In the final report, include as a minimum, the following information for all equipment tested:
    a. Equipment identification, including:
        1) Name and tag numbers identified in the Contract Documents.
        2) Manufacturer's serial numbers.
        3) Other pertinent manufacturer identification.
    b. Date and time of each test.
    c. Ambient conditions including temperature, humidity, and precipitation.
    d. Visual inspection report.
    e. Description of test and referenced standards, if any, followed while conducting tests.
    f. Results of initial and all retesting.
    g. Acceptance criteria.
    h. "As found" and "as left" conditions.
    i. Corrective action, if required, taken to meet acceptance.
    j. Verification of corrective action signed by the Contractor, equipment supplier, and Project Representative.
    k. Instrument calibration dates of all instruments used in testing.
5. Provide three (3) bound final reports prior to Project final completion.

E. Electrical Equipment and Connections Testing Program:
1. Perform testing on Division 26 equipment and connections in accordance with Division 26 requirements.
2. Testing of motors:
    a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 10 HP or above.
    b. Bump motor to check for correct rotation.
3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

F. Other Testing:
1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.

2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
    a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.

G. Electric Motors:
1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
2. Design for frequent starting duty equivalent to duty service required by driven equipment.
3. Design for full voltage starting.
4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
5. Size for altitude of Project.
6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
8. AC electric motors less than 1/3 HP:
    a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
    c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
9. AC electric motors 1/3 to 1 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
        1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
10. AC electric motors 1-1/2 to 10 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.

b. Permanently lubricated sealed bearings conforming to ABMA standards.

c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.

11. AC electric motors greater than 10 HP:

a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.

b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.

1) Design bearing life for 90 percent survival rating at 50,000 HRS of operation for motors up to and including 100 HP.

2) For motors greater than 100 HP, design bearing life for 90 percent survival rating at 100,000 HRS of operation.

c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.

d. Thermal protection:

1) For motors 50 HP and above controlled from a variable frequency drive and for all other motors 100 HP and above, provide integral thermal detectors with normally closed contacts that will open on overtemperature or resistance type temperature detector (RTD) complete with monitor and alarm panel having a normally closed contact that will open on overtemperature.

a) Two (2) thermal sensing devices per phase in each phase hot-spot location.

b) Monitor and alarm panel:

i For constant speed motors, install panel in and energize from the motor starter equipment.

ii For variable speed motors, install panel in and energize from the variable speed drive equipment.

H. NEMA Design Squirrel Cage Induction Motors:

1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.

2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.

3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.

4. For use on variable frequency type adjustable speed drives, provide:

a. Induction motors that are in compliance with NEMA MG 1, Part 31.

b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.

c. Insulated drive end bearing on all motors.

d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 HP and larger.

e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 HP and larger.

f. Shaft grounding ring on all motors:

1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.

2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.

5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DegC ambient.

6. Design motors for continuous duty.

7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent greater than the maximum HP requirements of the driven equipment over its entire operating range.

a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.

8. Motor enclosure and winding insulation application:

a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	TEFC, Standard Insulation
Wet indoor Areas	TEFC, Standard Insulation
Wet outdoor Areas	TEFC, Extra Dip and Bake for Moisture or TEFC Encapsulated Windings
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division I Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, Extra Dip and Bake for moisture

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.

I. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.

J. V-Belt Drive:
   1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
   2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
   3. Provide static proof belts.

K. Mechanical Variable Speed Drives:
   1. Oil-lubricated shaft-mounted reduction gear drive capable of 300 percent shock load and providing a 1.5 service factor in accordance with AGMA.
   2. Assure infinite speed adjustment over a 100:1 range.
   3. Secure drive to equipment base.
   4. Flexible coupling between drive shaft and equipment shaft.

2.03 ACCESSORIES

A. Guards:
   1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
   2. Interior applications:
      a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
      b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
      c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
   3. Exterior applications:
      a. Construct from 16 GA stainless steel or aluminum.
      b. Construct to preclude entrance of rain, snow, or moisture.
      c. Roll to conform to shaft or coupling surface.
      d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
   1. Cast-in-place anchorage:
      a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
      b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
      c. Provide two (2) nuts for each bolt.
   2. Drilled anchorage:
      a. Adhesive anchors per Specification Section 05 50 00.

b. Epoxy grout per Specification Section 03 31 30.

c. Threaded rods same as cast-in-place.

C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:
1. Provide gages in accordance with Specifications and Drawings.
2. Provide at the following locations:
a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
b. At locations identified on Drawings.
3. Utilize tapping sleeves for mounting per Specification Section 40 05 13.

E. Lifting Eye Bolts or Lugs:
1. Provide on all equipment 50 LBS or greater.
2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

2.04 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
1. Provide drain connection for 3/4 IN PVC tubing.

G. Machine the mounting feet of rotating equipment.

H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that can not be properly prepared and painted.
   1. When such back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
   2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Specification Section 07 92 00.

I. Critical Speed:
   1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
   2. Excessive vibration is sufficient cause for equipment rejection.
   3. Ratio of all rotative speeds to critical speed of a unit or components: Greater than 1.2.

J. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
   1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
   2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
   3. Affix entire assembly with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to delivery.
      a. Control panels without an affixed UL 508A label shall be rejected.

2.05 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:
   1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Specification Section 09 91 00 to receive field painting.
      a. Field painted equipment: See Specification Section 09 91 00 - Painting and Protective Coatings for factory applied primer/field paint compatibility requirements.

B. Field paint other equipment in accordance with Specification Section 09 91 00 - Painting and Protective Coatings.
   1. See Specification Section 09 91 00 for factory applied primer/field paint compatibility requirements.

2.06 SOURCE QUALITY CONTROL

A. Motor Tests:
   1. Test motors in accordance with NEMA and IEEE standards.

2. Provide routine test for all motors.
3. Provide complete test for all motors.
    a. Complete tests include all the requirements of the routine test:
        1) Temperature rise at rated load.
        2) Percent slip.
        3) Locked rotor torque.
        4) Breakdown torque.
4. The Project Representative reserves the right to select and have tested, either routine or complete, any motor included in the project.
    a. The Project Representative will pay all costs, including shipping and handling, for all motors successfully passing the tests.
    b. The Contractor shall pay all costs, including shipping and handling, for all motors failing the tests.
    c. If two (2) successive motors of the same manufacturer fail testing, the Project Representative has the right to reject all motors from that manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Seismic Restraints:
    1. Provide seismic restraints on all piping and equipment with the exception of the following:
        a. Piping less than 1 IN DIA when used for compressed air.
        b. Piping less than 2-1/2 IN DIA for all other cases.
        c. Piping suspended by individual hangers where the distance from the top of the pipe to the bottom of the support for the hanger is 12 IN or less.
        d. These restraints shall be capable of resisting seismic loads as defined in the International Building Code.

C. Utilize templates for anchorage placement for slab-mounted equipment.

D. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
    1. Route clear of major traffic areas and as approved by Project Representative.

E. DO NOT construct foundations until major equipment supports are approved.

F. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.

G. Equipment Base:
   1. Construct level in both directions.
   2. Take particular care at anchor bolt locations so these areas are flat and level.

H. Machine Base:
   1. Mount machine base of rotating equipment on equipment base.
      a. Level in both directions, using a machinist level, according to machined surfaces on base.
   2. Level machine base on equipment base and align couplings between driver and driven unit using steel blocks and shims.
      a. Size blocks and shims to provide solid support at each mounting bolt location.
         1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
      b. Provide blocks and shims at each mounting bolt.
         1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
      c. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.

I. Couplings:
   1. Align in the annular and parallel positions.
      a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.
         1) Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
      b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
   2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
   3. Check surfaces for runout before attempting to trim or align units.

J. Grouting:
   1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
      a. Extend dam or formwork to cover leveling shims and blocks.

b. Do not use nuts below the machine base to level the unit.

2. Saturate top of roughened concrete subbase with water before grouting.

   a. Add grout until entire space under machine base is filled to the top of the base underside.

   b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.

3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.

   a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.

   b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.

   c. Recheck driver-driven unit for proper alignment.

3.02 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
   1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
   1. Has been properly installed and lubricated.
   2. Is in accurate alignment.
   3. Is free from any undue stress imposed by connecting piping or anchor bolts.
   4. Has been operated under full load conditions and that it operated satisfactorily.
      a. Secure and deliver a field written report to Project Representative immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks.
   1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.03 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs in accordance with Specification Section 10 14 00.

3.04 FIELD PAINTING AND PROTECTIVE COATINGS

A. For required field painting and protective coatings, comply with Specification Section 09 91 00 - Painting and Protective Coatings.

3.05 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape stripped ends of conductors and associated connectors with electrical tape.
   1. Wrapping thickness shall be 150 percent of the conductor insulation thickness.

E. Connections to carry full ampacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

3.06 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment Specifications.

B. Inspect wire and connections for physical damage and proper connection.

C. After installation and prior to energizing the motor, provide insulation resistance test of all motors 10 HP and above.
   1. Conduct test with 500 or 1000 Vdc megger.
   2. Test each phase separately.
   3. Disconnect all extraneous leads to the motor.
   4. Comply with NEMA MG 1 safety requirements and test procedures.

D. Bump motor to check for correct rotation:
   1. Ensure motor has been lubricated.
   2. Check prior to connection to driven equipment.

E. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs and cross member that are cast welded or bolted, shall be tested for a natural frequency of vibration after equipment is mounted.
   1. Keep the ratio of the natural frequency of the structure to the frequency of the disturbing force out of the range from 0.5 to 1.5.

END OF SECTION

SECTION 40 05 13
PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Process piping systems.
   2. Utility piping systems.
   3. Plumbing piping systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.
   4. Section 10 14 00 - Identification Devices.
   5. Section 31 21 33 - Trenching, Backfilling, and Compacting for Utilities.
   6. Section 40 05 05 - Equipment: Basic Requirements.
   7. Section 40 05 16 - Pipe Support Systems.
   8. Section 40 05 23 - Valves: Basic Requirements.
   9. Section 40 41 13 - Heat Tracing Cable.
   10. Section 40 42 00 - Pipe, Duct and Equipment Insulation.
   11. Division 40 - Process Integration.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
      b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
      c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
      d. M278, Standard Specification for Class PS 46 Polyvinyl Chloride (PVC) Pipe.
      e. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.

2. American Iron and Steel Institute (AISI).
3. American Society of Mechanical Engineers (ASME):
    a. B16.3, Malleable Iron Threaded Fittings.
    b. B16.5, Pipe Flanges and Flanged Fittings.
    c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
    d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
    e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
    f. B36.19, Stainless Steel Pipe.
    g. B40.100, Pressure Gauges and Gauge Attachments.
4. ASTM International (ASTM):
    a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
    c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
    d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
    f. A197, Standard Specification for Cupola Malleable Iron.
    g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
    h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
    i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
    j. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
    k. A536, Standard Specification for Ductile Iron Castings.
    l. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
    m. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
    n. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
    o. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

p. B88, Standard Specification for Seamless Copper Water Tube.

q. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

r. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

s. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

t. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.

u. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

v. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

w. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.

x. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

y. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

z. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

aa. D2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.

bb. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

cc. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

dd. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

ee. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.

ff. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

gg. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

5. American Water Works Association (AWWA):

a. B300, Standard for Hypochlorites.

b. C200, Standard for Steel Water Pipe - 6 IN and Larger.

c. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.

d. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.

e. C301, Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type.

f. C606, Standard for Grooved and Shouldered Joints.

g. C651, Standard for Disinfecting Water Mains.

h. C800, Standard for Underground Service Line Valves and Fittings.

6. American Water Works Association/American National Standards Institute (AWWA/ANSI):

a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.

b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.

7. Chlorine Institute, Inc. (CI):

a. Pamphlet 6, Piping Systems for Dry Chlorine.

8. Cast Iron Soil Pipe Institute (CISPI):

a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

9. International Plumbing Code (IPC).

10. National Fire Protection Association (NFPA):

a. 54, National Fuel Gas Code.

b. 69, Standard on Explosion Prevention Systems.

11. Underwriters Laboratories, Inc. (UL).

12. City of Bellevue (COB):

a. Sewer Engineering Standards, January 2012.

b. Water Engineering Standards, January 2012.

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.03 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

1.04 SYSTEM DESCRIPTION

A. Piping Systems Organization and Definition:
   1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
   2. See PIPING SPECIFICATION SCHEDULES in PART 3.

SYSTEM	Abbreviation	Description
System 5	NG	Natural Gas
System 9	IRW, NPW	Irrigation Water, Non Potable Water
System 10	PWC, PWH	Potable Water Cold, Potable Water Hot
System 11	CA	Compressed Air
System 15	STW	Storm Water Drains
System 17	UD	Underdrain
System 19	RFGI	Refrigerant
System 21	RL, SRL, VT, WST	Rain Leader, Secondary Rain Leader, Vent, Waste
System 23	SAN, IW	Sanitary Sewer, Industrial Waste

1.05 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
      c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
         1) Attach technical product data on gaskets, pipe, fittings, and other components.
   2. Fabrication and/or layout Drawings:
      a. Exterior yard piping Drawings (minimum scale 1 IN equals 10 FT) with information including:
         1) Dimensions of piping lengths.

2) Invert or centerline elevations of piping crossings.

3) Acknowledgement of bury depth requirements.

4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.

5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.

6) Line slopes and vents.

b. Interior piping Drawings (minimum scale 1/8 IN equals 1 FT) with information including:

1) Dimensions of piping from column lines or wall surfaces.

2) Invert or Centerline dimensions of piping as noted on Drawings.

3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.

4) Location and type of pipe supports and anchors.

5) Locations of valves and valve actuator type.

6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.

7) Acknowledgement of valve, equipment and instrument tag numbers.

8) Provisions for expansion and contraction.

9) Line slopes and air release vents.

10) Rough-in data for plumbing fixtures.

c. Schedule of interconnections to existing piping and method of connection.

3. Qualifications of lab performing disinfection analysis on water systems.

4. Test reports:

a. Copies of pressure test results on all piping systems.

b. Reports defining results of dielectric testing and corrective action taken.

c. Disinfection test report.

d. Notification of time and date of piping pressure tests.

C. Quality Assurance Submittals.

D. Closeout Submittals:

1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

2. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.06 EXTENDED WARRANTY

A. In accordance with the provisions of Section 01 78 00 – Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. Warranty period for Work of this Section is two (2) years commencing on the date of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer.
   1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit.
   1. Repair abrasions, scars, and blemishes.
   2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Dirt strainers (Y type):
      a. Mueller (#351).
      b. Sarco.
      c. Armstrong.
      d. Or approved equal.
   2. Chemical strainers (Y type):
      a. Chemtrol.
      b. Asahi.
      c. Or approved equal.
   3. Dielectric flange kit:
      a. PSI.
      b. Maloney.
      c. Central Plastics.
      d. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00.

2.02 PIPING SPECIFICATION SCHEDULES

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping specification schedules located at the end of PART 3 of this Section.

2.03 COMPONENTS AND ACCESSORIES

A. Insulating Components:
   1. Dielectric flange kits:
      a. Flat faced.
      b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
      c. Suitable for 175 psi, 210 DegF.
      d. 1/32 IN wall thickness bolt sleeves.
      e. 1/8 IN thick phenolic insulating washers.
   2. Dielectric unions:
      a. Screwed end connections.
      b. Rated at 175 psi, 210 DegF.
      c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Dirt Strainers:
   1. Y-type.
   2. Composition bronze.
   3. Rated for test pressure and temperature of system in which they are installed.
   4. 20 mesh Monel screen.
   5. Threaded bronze plug in the blowoff outlet.
   6. Ball valve with hose thread nipple in the blowoff outlet.
   7. Threaded NPT end connections.

C. Strainers for Chemical Applications:
   1. Y-type.
   2. Strainers of same material, test pressure, and temperature rating as system in which strainer is placed.

D. Reducers:
   1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
   2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

E. Protective Coating and Lining:
   1. Include pipe, fittings, and appurtenances where coatings, linings, paint, tests and other items are specified.
   2. Field paint pipe in accordance with Specification Section 09 91 00.

F. Underground Warning Tape: See Specification Section 10 14 00.

G. Pressure Gages:
   1. See Specification Section 40 05 05 and Specification Section 40 90 10.

H. Dry Disconnect Couplings:
   1. Adapters:
      a. Male adapters: Size shown on Drawings.
      b. Adapters:
         1) Female NPT end connection for sludge and flush applications.
         2) Male NPT end connection for chemical applications.
      c. Construct adapters for sludge applications from cast iron or steel.
      d. Construct adapters for chemical and PVC system applications 3 IN and below from polypropylene.
         1) Above 3 IN size, provide stainless steel units.
   2. Couplers:
      a. Built-in valve and spring loaded poppet which close automatically when disconnected.
      b. Designed to remain with only one (1) arm locked in closed position.
      c. Construct couplers for sludge applications fabricated from material utilized for adapters.
      d. Construct couplers for chemical and PVC system applications 3 IN and less from polypropylene with stainless steel arms and pins.
         1) Above 3 IN, provide stainless steel units.
      e. Gasket: Compatible with conveyed liquid.
   3. Dust caps: For all adapters.

I. Sacrificial Anode Cathodic Protection:
   1. 3 LB magnesium sacrificial anodes, prepackaged in a cloth bag containing 75 percent hydrated gypsum, 20 percent bentonite and 5 percent anhydrous sodium sulfate.
   2. TW 600 V or an HMWPE insulated copper lead attached to the anode.

J. Valves:
   1. See schematics and details for definition of manual valves used in each system under 4 IN in size.
      a. See Specification Section 40 05 23 schedule for valve types 4 IN and above and for automatic valves used in each system.

2. See Specification Section 40 05 23.

K. Expansion Joints at FRP and Poly Tanks:
   1. Materials:
      a. Bellows: PTFE-62.
      b. Flanges: PVC, ductile iron or steel.
      c. Limit bolts and nuts: 316 stainless steel
      d. Reinforcing rings: Stainless steel.
   2. Pressure rating at 70 DegF: 70 psig.
   3. Minimum axial movement: 3/8 IN.

PART 3 – EXECUTION

3.01 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.

C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure.
   1. Install second joint not more than 6 FT or less than 4 FT from first joint.

D. Install expansion devices as necessary to allow expansion and contraction movement.

E. Laying Pipe In Trench:
   1. Excavate and backfill trench in accordance with Specification Section 31 21 33.
   2. Clean each pipe length thoroughly and inspect for compliance to specifications.
   3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
   4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
   5. Except for first two (2) joints, before making final connections of joints, install two (2) full sections of pipe with earth tamped along side of pipe or final with bedding material placed.
   6. Lay pipe in only suitable weather with good trench conditions.
      a. Never lay pipe in water except where approved by Project Representative.
   7. Seal open end of line with watertight plug if pipe laying stopped.

8. Remove water in trench before removal of plug.

F. Lining Up Push-On Joint Piping:
   1. Lay piping on route lines shown on Drawings.
   2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
   3. Observe maximum deflection values stated in manufacturer's written literature.
   4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
   5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

G. Anchorage and Blocking:
   1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
   2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
      a. Concrete blocks shall not cover pipe joints.
   3. Provide bearing area of concrete in accordance with drawing detail.

H. Install underground hazard warning tape per Specification Section 10 14 00.

I. Install insulating components where dissimilar metals are joined together.

J. All underground gravity piping shall be sloped at 1/4 IN/FT unless noted on Drawings.

3.02 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
   1. Expansion and contraction.
   2. Operation and access to equipment, doors, windows, hoists, moving equipment.
   3. Headroom and walking space for working areas and aisles.
   4. System drainage and air removal.

C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.

D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

E. Pipe Support:
   1. Use methods of piping support as shown on Drawings and as required in Specification Section 40 05 16.
   2. Piping support systems for piping 12 IN and greater are shown on the Drawings.
      a. Support systems for piping smaller than 12 IN DIA are not shown on the Drawings.
      b. Contractor is responsible for design of these support systems per Specification Section 40 05 16.
   3. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
      a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
   4. Size pipe supports with consideration to specific gravity of liquid being piped.

F. Locate and size sleeves and castings required for piping system.
   1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

G. Use reducing fittings throughout piping systems.
   1. Bushings will not be allowed unless specifically approved.

H. Equipment Drainage and Miscellaneous Piping:
   1. Provide drip pans and piping at equipment where condensation may occur.
   2. Hard pipe stuffing box leakage to nearest floor drain.
   3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
      a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
      b. Hard pipe drainage to nearest floor drain.
   4. Collect system condensate at drip pockets, traps and blowoff valves.
   5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
   6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
      a. Size to handle application with 3/4 IN being minimum size provided.

I. Unions:
   1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.

2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

J. Install expansion devices as necessary to allow expansion/contraction movement.

K. All gravity piping shall be sloped at 1/4 IN/FT unless otherwise noted on drawings.

L. Provide full face gaskets on all systems.

M. Anchorage and Blocking:
   1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

N. Equipment Pipe Connections:
   1. Equipment - General:
      a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
      b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
      c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
         1) Provide tightening torque in accordance with manufacturer's recommendations.
      d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
      e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
      f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
      g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
      h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
         1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.

2) Realign as necessary, install flange bolts and make equipment connection.

i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

2. Plumbing and HVAC equipment:

a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.

b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.

c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.

1) Provide wheel handle stop valve at each laboratory sink water supply.

2) Minimum size: 1/2 IN.

d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.

1) Size trap as required by UPC.

e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

O. Provide insulating components where dissimilar metals are joined together.

P. Instrument Connections: See Drawing details.

3.03 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.04 ACCESS PROVISIONS

A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.

B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 IN size.

C. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or galvanized after fabrication and fitted with screw driver lock of cam type.

D. Provide with key locks, keyed alike, in public use areas.

E. Furnish panels with prime coat of paint.

F. Style and type as required for material in which door installed.

G. Where door is installed in fire-rated construction, provide door bearing UL label required for condition.

3.05 CATHODIC PROTECTION

A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.

B. Make all connections from wire or cable by Thermit Cadwelding accomplished by operators experienced in this process.

C. Install all cables with a loop and overhead knot around each pipe and slack equal to at least 50 percent of the straight line length.

D. After cadwelding, coat all exposed metallic surfaces with hot applied tape.

3.06 HEAT TRACING

A. See Specification Section 40 41 13 - Heat Tracing Cable.

3.07 PRESSURE GAGES

A. Provide at locations shown on the Drawings and specified.

B. See Specification Section 40 05 05.

3.08 FIELD QUALITY CONTROL

A. Pipe Testing - General:
   1. Test piping systems as follows:
      a. Test exposed, non-insulated piping systems upon completion of system.
      b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
      c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.

d. Test buried piping after backfilling has been complete.

2. Utilize pressures, media and pressure test durations as specified in Piping Specification Schedules.
3. Isolate equipment which may be damaged by the specified pressure test conditions.
4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
   a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
   b. Notify the Project Representative 24 HRS prior to each test.
5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
6. Acknowledge satisfactory performance of tests and inspections in writing to Project Representative prior to final acceptance.
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:
   1. Testing medium: Unless otherwise specified in the Piping Specification Schedules, utilize the following test media.
      a. Process and plant air systems:

PIPE LINE SIZE	SPECIFIED TEST PRESSURE	TESTING MEDIUM
2 IN and smaller	75 psi or less	Air or water
2 IN and smaller	Greater than 75 psi	Water
Greater than 2 IN	3 psi or less	Air or water
Greater than 2 IN	Greater than 3 psi	Water

      b. Laboratory gases and natural gas systems: Cylinder nitrogen.
      c. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 psig or less	Air or water
Above 48 IN	Gravity	25 psig or less	Water
All sizes	Pumped	250 psig or less	Water

2. Allowable leakage rates:

   a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage at the specified test pressure throughout the duration of the test.

   b. Hydrostatic exfiltration and infiltration for sanitary and stormwater sewers (groundwater level is below the top of pipe):

      1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.

      2) Average head is defined from groundwater elevation to average pipe crown.

      3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) = 115 x (actual test head to the 1/2 power).

   c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):

      1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.

      2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) = 82 x (actual head to the 1/2 power).

   d. Large diameter (above 48 IN) gravity plant piping systems shall have a maximum exfiltration of 25 gpd per inch-mile.

   e. Non-hazardous gas and air systems which are tested with air shall have a maximum pressure drop of 5 percent of the specified test pressure throughout the duration of the test.

   f. For low pressure (less than 25 psig) air testing, the acceptable time for loss of 1 psig of air pressure shall be:

PIPE SIZE (IN DIA)	TIME, MINUTES/100 FT
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

42	7.3
48	7.6

3. Hydrostatic pressure testing methodology:
    a. General:
        1) All joints, including welds, are to be left exposed for examination during the test.
        2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
        3) Provide temporary restraints for expansion joints for additional pressure load under test.
        4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
        5) Do not paint or insulate exposed piping until successful performance of pressure test.
    b. Soil, waste, drain and vent systems:
        1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
        2) Eliminate leaks before proceeding with work or concealing piping.
        3) Minimum test heights shall be 10 FT above highest stack inlet.
    c. Larger diameter (above 36 IN) gravity plant piping:
        1) Plug downstream end of segment to be tested.
            a) Provide bracing as required.
        2) Fill segment and upstream structure to normal operating level as per hydraulic profile.
        3) Allow 24 HRS for absorption losses.
            a) Refill to original level.
        4) Provide reservoir to maintain constant head over duration of test.
        5) Record reservoir water volume at beginning and end of test.
4. Natural gas systems - testing methodology:
    a. Maintain specified test pressure until each joint has been thoroughly examined for leaks by means of soap suds and glycerin.
    b. Wipe joints clean after test.
5. Air testing methodology:
    a. General:
        1) Assure air is ambient temperature.

b. Low pressure air testing:

1) Place plugs in line and inflate to 25 psig.

2) Check pneumatic plugs for proper sealing.

3) Introduce low pressure air into sealed line segment until air pressure reaches 4 psig greater than ground water that may be over the pipe.

a) Use test gage conforming to ASME B40.100 with 0 to 15 psi scale and accuracy of 1 percent of full range.

4) Allow 2 minutes for air pressure to stabilize.

5) After stabilization period (3.5 psig minimum pressure in pipe) discontinue air supply to line segment.

6) Record pressure at beginning and end of test.

C. Dielectric Testing Methods and Criteria:

1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.

2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.09 CLEANING, DISINFECTION AND PURGING

A. Cleaning:

1. Clean interior of piping systems thoroughly before installing.

2. Maintain pipe in clean condition during installation.

3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.

4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.

5. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.

a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.

b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.

6. After erection of piping and tubing, but prior to installation of service outlet valves, blow natural gas and digester gas systems clear of free moisture and foreign matter by means of air, nitrogen or carbon dioxide.

a. Oxygen shall never be used.

7. Clean chlorine piping in accordance with CI Pamphlet 6.

B. Disinfection of Potable Water Systems:
   1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
   2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
   3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
   4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per second.
   5. Drain flushing water to sanitary sewer.
      a. Do not drain flushing water to receiving stream.
   6. Use continuous feed method of application.
      a. Tag system during disinfection procedure to prevent use.
   7. After required contact period, flush system to remove traces of heavily chlorinated water.
   8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Project Representative to collect samples and test for bacteriological quality.
      a. Repeat entire disinfection procedures until satisfactory results are obtained.
   9. Secure and deliver to Project Representative, satisfactory bacteriological reports on samples taken from system.
      a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of Washington.

C. Purging Natural Gas:
   1. Existing piping:
      a. Turn off gas supply.
      b. Vent line pressure outdoors.
      c. If section exceeds the following, then remaining gas shall be displaced with an inert gas.
         1) 50 FT for 2-1/2 IN pipe.
         2) 30 FT for 3 IN pipe.
         3) 15 FT for 4 IN pipe.
         4) 10 FT for 6 IN pipe.
         5) Any length for 8 IN or larger pipe.

2. New piping:
    a. Including but not limited to:
        1) All fuel gas piping.
        2) Fuel gas trains.
    b. Purge air filled system with fuel gas:
        1) Providing piping length is less than:
            a) 30 FT for 3 IN pipe.
            b) 15 FT for 4 IN pipe.
            c) 10 FT for 6 IN pipe.
            d) Any length for 8 IN and larger pipe.
        2) Providing a moderately rapid and continuous flow of fuel gas is introduced.
            a) Introduce fuel gas at one (1) end.
            b) Vent air at opposite end.
        3) Provided fuel gas flow is continuous without interruption until vented gas is free of air.
        4) The point of discharge shall not be left unattended during purging.
    c. If the piping is 3 IN or larger and exceeds lengths stated above.
        1) Purge air with inert gas in accordance with NFPA 54 and NFPA 69.
        2) Purge inert gas with fuel gas.
3. Discharge of purged gases:
    a. Open end of piping shall not discharge into confined spaces or areas where there are sources of ignition.

3.10 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

3.11 PIPE INSULATION

A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

3.12 SCHEDULES

A. SPECIFICATION SCHEDULE - SYSTEM 5

1. General:

   a. Piping symbol and service:

      a) NG - Natural Gas.

   b. Test requirements:

      1) Test medium: Cylinder Nitrogen.

      2) Pressure: 25 psig.

      3) Duration: 24 HRS.

2. System components:

   a. Pipe size through 26 IN:

      1) Exposed service:

         a) Material: Steel, Grade B, black, Schedule 40.

         b) Reference: ASTM A53.

         c) Lining: None.

         d) Coating: Paint.

         e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.

         f) Joints: Threaded, ASME B16.9 steel butt- or socket-welded joints.

      2) Buried service:

         a) Materials: Steel, Grade B, black, Schedule 40.

         b) Reference: ASTM A53.

         c) Linings: None.

         d) Coatings: Factory coating-mill wrapped with 3-M "Scotchkote," or Energy Coating Company "Encoat" with fittings and uncoated portions fully wrapped after testing with 3-M "Scotchkote" tape.

         e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.

         f) Joints: Threaded, ASME B16.9 steel butt- or socket-welded joints.

Natural Gas Piping Installation:

3. Install piping in accordance with NFPA, local gas company regulations, codes and local ordinances, complete with necessary appurtenances.

4. Install buried pipe at approximately 30 IN deep.

5. Gas cocks:
    a. Install before gas utilization equipment connected to system, at each branch main and at connection to meter.
    b. Design to operate safely under pressures indicated.
    c. Install ground joint unions at intervals to facilitate repairs.
    d. Cocks shall be of type and lubricant recommended by manufacturer for this class of service, and as approved by local gas company.
6. Pipe drainage:
    a. Drain horizontal piping to risers.
    b. Locate drains where required for system drainage.
    c. Install tee fitting with bottom outlet plugged or provide with threaded, capped nipple at bottom of risers or in accordance with applicable codes.
7. Make piping connections with shellacked joints or ground joint unions.
8. Provide vents from gas regulators, pressure reducing valves, and other vented devices to the outdoors and terminate in accordance with applicable codes.
9. Connect piping to pressure reducing valve outside each building as shown on drawings and schedule.
10. Provide flexible connections to vibration isolated equipment suitable for pressures, local and national codes and intended application.
11. Remove cutting and threading burrs.
12. Plug each gas outlet (including valves) with threaded plugs or caps immediately after installation and retain until the piping or equipment connections are completed.
13. Continuously ground gas piping electrically, bond tightly to the grounding connection.
14. Install piping parallel to other piping, but maintain a minimum 12 IN clearance between gas piping and any piping that could reach 200 DegF.
15. All gas piping in air plenums to be all-welded and encased in a Schedule 40 pipe sleeve.
    a. Ends of the sleeve open to atmosphere or sealed with the annullus vented (gas pipe size) to atmosphere.

B. SPECIFICATION SCHEDULE - SYSTEM 9
   1. General:
      a. Piping symbol and service:
         1) IRW - Irrigation Water.
         2) NPW - Nonpotable Water.
      b. Test requirements:
         1) Test medium: Water.
         2) Pressure: 125 psig.
         3) Duration: 6 HRS.
      c. Gaskets and O-rings:
         1) O-rings: Neoprene or rubber.
         2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
         3) Flanged joints (steel): Rubber, AWWA C207.
         4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
   2. System components:
      a. Pipe size to 1 IN:
         1) Exposed service:
            a) Materials: Stainless steel tubing, TP-304L.
            b) Reference: ASTM A269.
            c) Lining: None.
            d) Coating: None.
            e) Fittings: Stainless steel 304L compression type tube fittings.
            f) Joints: Compression type couplings, unions at equipment and valves.
            g) Minimum wall thickness:
               i 1/16 IN OD: 0.010 IN.
               ii 1/8 to 1/4 IN OD: 0.028 IN.
               iii 5/16 to 1/2 IN OD: 0.049 IN.
               iv 5/8 to 1 IN OD: 0.065 IN.
      b. Pipe size 1 IN to 3 IN:
         1) Exposed service:
            a) Materials:
               i Threaded: Steel, Grade B, black, Schedule 40.

ii Grooved type joint system: Use pipe thickness per AWWA C606.

b) Reference: ASTM A53.

c) Lining: None.

d) Coating: Paint.

e) Fittings: Malleable iron or steel meeting ASME B16.3 and ASTM A234.

f) Joints:

i Threaded or grooved type mechanical coupling (AWWA C606) joints.

ii With both systems, provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.

2) Buried service:

a) Materials: Steel, Schedule 40, Grade B.

b) Reference: ASTM A53.

c) Lining: None.

d) Coating: Bituminous.

e) Fittings: Malleable iron meeting ASME B16.3.

f) Joints: Threaded.

c. Pipe size 3 IN through 24 IN:

1) Exposed service:

a) Materials:

i Flanged: Ductile iron, Class 125.

ii Grooved type mechanical joint system: Use pipe thickness per AWWA C606.

b) Reference: AWWA/ANSI C115/A21.15.

c) Lining: Cement.

d) Coating: Paint.

e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.

f) Joints:

i Flanged or grooved type mechanical coupling (AWWA C606) joints.

ii With both systems, provide screwed-on flanges at valves, equipment and structure penetration.

2) Buried service:

a) Materials: Ductile iron, Class 125.

b) Reference: AWWA/ANSI C151/A21.51.

c) Lining: Cement.

d) Coating: Bituminous.

e) Fittings:

i Either AWWA/ANSI C110/A21.10 ductile or gray iron.

ii Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 IN to 16 IN.

f) Joints: Push-on with mechanical (stuffing box type) joint at fittings and valves.

d. Pipe size greater than 24 IN:

1) Exposed service:

a) Material: Steel, fabricated pipe.

b) Reference: AWWA C200.

c) Lining: Cement.

d) Coating: Paint.

e) Fittings: AWWA C208.

f) Joints: Butt welded with rigid AWWA C207 flanges at equipment, valves, and structure penetrations.

2) Buried service:

a) Material: Steel, fabricated pipe.

b) Reference: AWWA C200.

c) Lining: Cement.

d) Coating: Bituminous.

e) Fittings: AWWA C208.

f) Joints: Butt welded.

C. SPECIFICATION SCHEDULE - SYSTEM 10
1. General:
a. Piping symbol and service:
1) PWC - Potable Water Cold.
2) PWH - Potable Water Hot.
b. Test requirements:
1) Test medium: Water.
2) Pressure: 150 psig.
3) Duration: 6 HRS.
c. Gaskets and O-rings:
1) O-rings: Neoprene or rubber.
2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
3) Flanged joints (steel): Rubber, AWWA C207.
4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
2. System components:
a. Pipe size to 3 IN:
1) Exposed service:
a) Material: Copper tubing, Type L.
b) Solder: Cadmium and lead-free solder compatible with tubing and fittings materials.
c) Reference: ASTM B88.
d) Lining: None.
e) Coating: Paint.
f) Fittings: Wrought copper or bronze fittings meeting ASME B16.22.
g) Joints: Soldered or brazed with unions at valves and equipment.
2) Buried service:
a) Material: Copper tubing, Type K.
b) Reference: ASTM B88.
c) Lining: None.
d) Coating: None.
e) Fittings: AWWA C800.
f) Joints: Flared.

b. Pipe size 3 IN through 24 IN:

1) Exposed service:

a) Materials:

i Flanged: Ductile iron, Class 125

ii Grooved type joint system: Use pipe thickness per AWWA C606.

iii With both systems, provide screwed on flanges at equipment, valves and structural penetrations.

b) Reference: AWWA/ANSI C115/A21.15.

c) Lining: Cement.

d) Coating: Paint.

e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.

f) Joints:

i Flanged or grooved type mechanical coupling (AWWA C606) joints.

ii With both systems, provide screwed-on flanges at valves, equipment, and structure penetration.

2) Buried service:

a) Materials: Ductile iron, Class 125.

b) Reference: AWWA/ANSI C151/A21.51.

c) Lining: Cement.

d) Coating: Bituminous.

e) Fittings:

i Either AWWA/ANSI C110/A21.10 ductile or gray iron.

ii Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 to 16 IN.

f) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.

3. Install drain tees with capped nipples of IPS brass 3 IN long at low points.

a. If low point occurs in concealed piping, provide approved flush access panel.

b. These drains are not shown on Drawings.

4. Slope water lines down to drain points not less than 1 IN in 60 FT.

5. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.

a. Pipe joint cement permitted only on external threads.

6. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
7. Install ball, butterfly and plug valves where indicated or required to adequately service all parts of system and equipment.
    a. Install valves on each branch serving restroom.
    b. Install valves on inlet and outlet connections of heat exchangers and on other equipment connected to water lines.
8. Install unions between valves and connections to each piece of equipment, and install sufficient number of unions throughout piping system to facilitate installation and servicing.
    a. On copper pipe lines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 IN and over install brass flange unions.
9. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
10. Where exposed pipes 6 IN in size and smaller pass through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated plates large enough to completely close hole around pipes.
    a. Secure plates to pipe by set screw in approved manner.
11. Size supply branches to individual fixtures as scheduled or indicated on Drawings.
12. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.
13. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff and drain valves.
14. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.
15. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

D. SPECIFICATION SCHEDULE - SYSTEM 11
1. General:
a. Piping symbol and service:
1) CA - Compressed Air.
b. Test requirements:
1) Test medium: air.
2) Pressure: 150 psig.
3) Duration: 6 HRS.
c. Gaskets and O-rings:
1) O-ring and flanged joints: Rubber or neoprene, 250 DegF.
2) Grooved coupling joints (steel): AWWA C606, rubber, 250 DegF.
2. System components:
a. Pipe size to 1 IN for A, 3/8 IN to 1 IN for IA:
1) Exposed service:
a) Material: Stainless steel tubing, TP-304L.
b) Reference: ASTM A269.
c) Lining: None.
d) Coating: None.
e) Fittings: Stainless steel 304L, compression type tube fittings.
f) Joints: Compression type couplings, unions at equipment and valves.
b. Pipe size 1 IN to 4 IN:
1) Exposed service:
a) Materials:
i Threaded: Steel, Grade B, black, Schedule 40.
ii Grooved type joint system: Use pipe thickness per AWWA C606.
b) Reference: ASTM A53.
c) Linings: None.
d) Coating: Paint.
e) Fittings: Malleable iron meeting ASME B16.3, ASTM A197 or steel meeting ASME B16.3, ASTM A234.
f) Joints:
i Threaded or grooved type mechanical coupling (AWWA C606) joints.

ii With both systems, provide rigid flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.

2) Buried service:

a) Materials: Steel, Schedule 40, Grade B, black.

b) Reference: ASTM A53.

c) Lining: None.

d) Coating: Bituminous.

e) Fittings: Malleable iron meeting ASME B16.3, ASTM A197 or steel meeting ASME B16.3, ASTM A234.

f) Joints: Threaded.

3. Slope all piping mains approximately 1:100 toward points of drainage.
4. Provide driplegs at low points:
   a. Provide ball type isolation valve.
   b. Route dripleg to nearest wall or column and terminate 4 FT above finished floor.

E. SPECIFICATION SCHEDULE - SYSTEM 15
1. General:
a. Piping symbol and service:
1) SD – Storm Drainage.
b. Test requirements:
1) See Article 3.8.
c. Gaskets:
1) Push-on joints: Rubber, ASTM C443 (Ductile Iron).
2) Push-on joints: Rubber, ASTM D 1785 (PVC 8 IN DIA).
3) Push-on joints: Elastomeric, ASTM D 3212 (PVC >8 IN).
2. System components:
a. Pipe size 8 IN to 36 IN:
1) Buried service up to 2 FT.
a) Material: Ductile Iron, Class 52.
b) Reference: AWWA C151.
c) Fittings: Push-on or mechanical fittings meeting ASTM AWWA 111.
2) Buried service 2 FT to 15 FT.
a) Material: PVC (12 IN to 15 IN).
b) Reference: AWWA C151.
c) Fittings: Smooth or mitered fittings meeting ASTM C14.
d) Joints: Spigot/bell type joint with O-ring gasket to conform to ASTM C443.
3) Buried service greater than15 FT.
a) Material: Solid Wall PVC (12 IN to 15 IN).
b) Reference: ASTM D 3034 SDR 35.
c) Fittings: Smooth or mitered fittings meeting ASTM D 3213.
d) Joints: Spigot/bell type joint with elastomeric gasket conform to ASTM F 477.
e) Material: Solid Wall PVC (18 IN to 24 IN).
f) Reference: ASTM F 679.
g) Joints: Spigot/bell type joint with elastomeric gasket conform to ASTM D 3213.

F. SPECIFICATION SCHEDULE - SYSTEM 17
   1. General:
      a. Piping symbol and service:
         1) UD – Underdrain (See Section 31 69 00).
      b. Test requirements:
         1) Test medium: Water.
         2) Pressure: None, observed for free flow.
         3) Duration: 6 HRS.
   2. System components:
      a. Pipe size 6 IN to 12 IN:
         1) Buried service:
            a) Material: PVC, solid and perforated.
            b) Reference: ASTM D3034, SDR 35.
            c) Fittings: ASTM D3034.
            d) Joints: Integral bell joint, ASTM D3212.

G. SPECIFICATION SCHEDULE - SYSTEM 19
   1. General:
      a. Piping symbol and service:
         1) RFGT - Refrigerant.
      b. Test requirements:
         1) Test medium: R-410a refrigerant.
         2) Pressure: Normal full load operating pressures as specified by cooling equipment manufacturer.
         3) Duration: 6 HRS.
         4) Leak location method: Test all fittings with bubble solution followed by Halide torch or electronic platinum diode meter.
   2. System components:
      a. Pipe size up to 2 IN:
         1) Exposed service:
            a) Material: Factory pre-charged copper line sets sized per manufacturer recommendations for 2 DegF line loss.
            b) Solder: High temperature (melting point not less than 1000 DegF) silver solder compatible with tubing and fittings.
            c) Lining: None.
            d) Coating: Paint.
            e) Fittings: Copper, as required to adapt line sets to equipment.
            f) Joints: Soldered.

H. SPECIFICATION SCHEDULE - SYSTEM 21

1. General:

   a. Piping symbol and service:

      1) RL - Rain Leader.

      2) SRL - Secondary Rain Leader.

      3) VT - Vent.

      4) WST - Waste.

   b. Test requirements:

      1) Test medium: Water.

      2) Pressure: See Article 3.8.

      3) Duration: 6 HRS.

   c. Gaskets: Rubber, ASTM C564.

2. System components:

   a. Pipe size 1-1/4 IN and 1-1/2 IN:

      1) Exposed service.

         a) Material: Galvanized steel, Schedule 40.

         b) Reference: ASTM A53.

         c) Lining: Galvanized.

         d) Coating: Paint.

         e) Fittings: Cast iron drainage.

            i ASTM A126, Class B.

         f) Joints: Threaded.

   b. Pipe size 2 IN and larger:

      1) Exposed service.

         a) Material: Cast iron soil pipe.

         b) Reference: ASTM A74, CISPI 301.

         c) Lining: None.

         d) Coating: Paint.

         e) Fittings: ASTM A74.

         f) Joints: No-hub with elastomeric sealing sleeve and stainless steel clamp assembly conforming to CISPI 301.

      2) Buried service (to 5 FT outside of structure):

         a) Material: Cast-iron soil pipe.

         b) Reference: ASTM A74.

         c) Lining: None.

d) Coating: Bituminous.

e) Fittings: ASTM A74.

f) Joints: Hub and spigot.

Soil and Waste Piping Installation:

1. Install horizontal soil or waste lines less than 4 IN diameter with a slope of not less than 1/4 IN/FT or 2 percent toward the point of disposal.
2. Install 4 IN and larger piping at 1/8 IN per foot.
3. Install as close to construction as possible to maintain maximum head room.
4. Make changes of direction with 1/8 bends and junctions with wye fittings.
5. Use short wye fittings in vertical pipe only.
6. Install handhole test tee at base of each stack.
7. Install cleanouts at dead ends, at changes of direction and at 50 FT intervals on horizontal runs.
    a. Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
8. Install piping true to grade and alignment.
    a. Begin at the system low point.
9. Locate vertical extensions of underground piping below partition walls for concealment in wall.
    a. In locations where hubs are wider than partition, set hubs 1 IN below final floor.
10. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.
11. For hub and spigot joints, install hub facing flow.

Vent Piping Installation:

1. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
2. Originate each vent stack from soil or waste pipe at its base.
3. Where possible, combine soil, waste or vent stacks before passing through roof so as to minimize roof openings.
4. Offset pipes running close to exterior walls away from such walls before passing through roof to permit proper flashing.
5. Provide pipes passing through roofs with cast iron increasers minimum of 12 IN below roof one size larger than pipe but in no case less than 4 IN.
6. Terminate each vent with approved frostproof jacket.

7. Carry vent stacks 4 IN and larger full size through roof.
   a. Extend vent stacks at least 12 IN above roofing.
8. Pipe vents from pressure regulating devices in compliance with local codes.
9. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

I. SPECIFICATION SCHEDULE - SYSTEM 23

1. General:

   a. Piping symbol and service:

      1) SAN - Sanitary Sewer.

      2) IW – Industrial Waste.

   b. Test requirements:

      1) See Article 3.8.

   c. Gaskets:

      1) Push-on joints: Neoprene.

2. System components:

   a. Pipe size 6 IN through 24 IN:

      1) Buried service:

         a) Material: VCP - extra strength.

         b) Reference: ASTM C700.

         c) Lining: None.

         d) Coating: None.

         e) Joints: Compression joints meeting ASTM C425.

END OF SECTION

SECTION 40 05 16
PIPE SUPPORT SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Pipe support and anchor systems.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. ANVIL International (ANVIL).
   2. American Society of Mechanical Engineers (ASME):
      a. B31.1, Power Piping.
      b. B31.3, Process Piping.
   3. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A510, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
      c. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      d. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
   4. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
   5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP-69, Pipe Hangers and Supports - Selection and Application.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.
      d. Scale Drawings showing guides, hangers, supports, anchors, structural members and appurtenances to describe the pipe support system.

C. Closeout Submittals:
   1. Operation and Maintenance Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Model numbers listed are to identify the style, material, and construction of each particular hangar and accessory. Model numbers do not represent a preference to the listed manufacturer over any other. Approved manufacturer's are as follows:
   1. Anvil International.
   2. Empire Industries.
   3. National Pipe Hanger.
   4. Unistrut.
   5. Or approved equal.

C. Submit request for substitution in accordance with Specification Section 01 60 00.

2.02 MANUFACTURED UNITS

A. Hanger Rods:
   1. Material:
      a. ASTM A36.
      b. ASTM A510, Grade 1020.
      c. ASTM A575, Grade M1020.
      d. ASTM A576, Grade 1020.

e. Minimum allowable tensile stress of 12,000 psi at 650 DegF per MSS SP-58.

2. Continuously threaded.
3. Electro-galvanized or cadmium plated after threads are cut.
4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

B. Hangers:
1. Hangers for use directly on copper pipe: Copper or cadmium plated.
2. Hangers for use other than directly on copper pipe: Cadmium plated or galvanized.
3. Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 IN and less	ANVIL Figure 108 with Figure 114
All except noted	Over 4 IN	ANVIL Figure 590
Steam, condensate and hot water	All	ANVIL Figure 181, Figure 82

C. Concrete Inserts for Hanger Rods:
1. Continuous slots:
   a. Unistrut #P1000.
   b. Or approved equal.
2. Individual inserts:
   a. ANVIL Figure 281.
   b. Or approved equal.
3. Self-drilling expansion anchors: Phillips flush-end or snap-off end type.

D. Beam Clamps for Hanger Rods:
1. Heavy duty.
   a. ANVIL Figure 133.
   b. Or approved equal.

E. Trapeze Hangers for Suspended Piping:
   1. Material: Steel.
   2. Galvanized.
   3. Angles, channels, or other structural shapes.
   4. Curved roller surfaces at support point corresponding with type of hanger required.

F. Vertical Pipe Supports: At base of riser.

G. Expanding Pipe Supports:
   1. Spring hanger type.
   2. MSS SP-58.

H. Pipe Support Saddle:
   1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on Drawings.
      a. ANVIL Figure 264.
      b. Or approved equal.

I. Pipe Support Risers:
   1. Schedule 40 pipe.
   2. Galvanized.
   3. As recommended by saddle manufacturer.

J. Pipe Support Base Plate:
   1. 4 IN larger than support.
   2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
   3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
   4. Collar welded to floor plate.
   5. Edges ground smooth.
   6. Assembly hot dipped galvanized after fabrication.

K. Pipe Covering Protection Saddle:
   1. For insulated pipe at point of support.
      a. ANVIL Figure 167, Type B.
      b. ANVIL Figure 126.
      c. Or approved equal

L. Wall Brackets:
   1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
      a. ANVIL Figure 199.
      b. Or approved equal.

M. Pipe Anchors:
   1. For locations shown on the Drawings.
   2. 1/4 IN steel plate construction.
   3. Hot dipped galvanized after fabrication.
   4. Designed to prevent movement of pipe at point of attachment.

N. Seismic Restraints:
   1. Galvanized steel aircraft cables or steel angles or channels.
   2. Steel aircraft cables shall be prestretched to establish a certified minimum modulus of elasticity.
      a. Cable restraints shall be designed to resist seismic tension loads and steel restraints shall be designed to resist both tension and compression loads with a minimum safety factor of 2.
   3. Restraint and connections shall be steel assemblies that swivel to the final installation angle.
   4. Do not mix cable and steel angle restraints to brace the same system.
   5. Steel angles shall be clamped to the threaded hanger rods at the seismic sway restraint locations utilizing a minimum of two (2) ductile iron clamps.
   6. The restraint system shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying its capability to resist seismic forces.
   7. Transverse bracing shall be provided at 40 FT-0 IN maximum spacing unless noted otherwise.
   8. Longitudinal bracing shall be provided at 80 FT-0 IN maximum spacing unless noted otherwise.
   9. Fuel gas piping shall have transverse bracing 20 FT-0 IN OC maximum and longitudinal bracing 40 FT-0 IN OC maximum.
   10. At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the center of gravity of the riser.
      a. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 30 FT-0 IN OC.

O. Pipe Guides:
   1. For locations on both sides on each expansion joint or loop to ensure proper alignment of expanding or contracting pipe.
      a. ANVIL Figure 256.

b. Or approved equal.

2.03 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.
   1. Provide 5 to 1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
   1. ASME B31.3.
   2. MSS SP-58 and MSS SP-69.
   3. Except where modified by this Specification.

E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
   1. ASME B31.1.
   2. MSS SP-58 and MSS SP-69.

F. Check all physical clearances between piping, support system and structure.
   1. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser.
   1. Support pipes for lateral movement with clamps or brackets.

H. Place hangers on outside of pipe insulation.
   1. Use a pipe covering protection saddle for insulated pipe at support point.
   2. Insulated piping 1-1/2 IN and less: Provide a 9 IN length of 9 LB density fiberglass insulation at saddle.
   3. Insulated piping over 1-1/2 IN: Provide a 12 IN length of 9 LB density fiberglass insulation on saddle.

I. Provide 20 GA galvanized steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.

J. Pipe Support Spacing:
   1. General:
      a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
      b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
      c. Provide at least one (1) support for each length of pipe at each change of direction and at each valve.

2. Steel, stainless steel, cast-iron pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

3. Copper pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

4. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

* Maximum fluid temperature of 120 DegF.

5. Support each length and every fitting:
   a. Bell and spigot piping:
      1) At least one (1) hanger.
      2) Applied at bell.
   b. Mechanical coupling joints:
      1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
7. Provide continuous support for nylon tubing.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
   1. Included in this requirement are movements from:
      a. Trap discharge.
      b. Water hammer.
      c. Similar internal forces.
   2. Seismic Restraints:
      a. Provide seismic restraints on all piping with the exception of the following:
         1) Piping less than 1 IN DIA when used for gas and compressed air.
         2) Piping less than 2-1/2 IN DIA for all other cases.
         3) Piping suspended by individual hangers where the distance from the top of the pipe to the bottom of the support for the hanger is 12 IN or less.
         4) Fuel gas piping shall have transverse bracing 20 FT-0 IN OC maximum and longitudinal bracing 40 FT-0 IN OC maximum.
         5) These restraints shall be capable of resisting seismic loads as defined in the International Building Code.

B. Weld Supports:
   1. AWS D1.1.
   2. Weld anchors to pipe in accordance with ASME B31.3.

C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Inspect Hangers for:
   1. Design offset.
   2. Adequacy of clearance for piping and supports in the hot and cold positions.
   3. Guides to permit movement without binding.
   4. Adequacy of anchors.

E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.

F. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
   1. Install concrete inserts as concrete forms are installed.

G. Welding:
   1. Welding rods: ASTM and AWS standards.
   2. Integral attachments:
      a. Include welded-on ears, shoes, plates and angle clips.
      b. Ensure material for integral attachments is of good weldable quality.
   3. Preheating, welding and post heat treating: ASME B31.3, Chapter V.

H. Field Painting: Comply with Section 09 91 00 - Painting and Protective Coatings.

END OF SECTION

SECTION 40 05 23
VALVES: BASIC REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.
   4. Section 40 05 05 - Equipment: Basic Requirements.
   5. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   6. Section 40 50 05 - Gate Valves.
   7. Section 40 50 10 - Plug Valves.
   8. Section 40 50 15 - Butterfly Valves.
   9. Section 40 50 20 - Ball Valves.
   10. Section 40 50 25 - Globe Valves.
   11. Section 40 50 35 - Miscellaneous Valves.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.20.1, Pipe Threads, General Purpose.
      b. B16.1,Grayt Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
      c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
      d. B16.34, Valves-Flanged, Threaded and Welding End.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      c. D638, Standard Test Method for Tensile Properties of Plastics.
      d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
      e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.

f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.

3. American Water Works Association (AWWA):
   a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
   b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
   c. C504, Standard for Rubber-Seated Butterfly Valves.
   d. C507, Standard for Ball Valves, 6 IN through 48 IN (150 mm through 1200 mm).
   e. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
   f. C550, Standard for Protective Coatings for Valves and Hydrants.
   g. C606, Standard for Grooved and Shouldered Joints.
4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. MG 1, Motors and Generators.

1.03 DEFINITIONS

A. The following are definitions of abbreviations used in this Specification Section or one (1) of the individual valve sections:
   1. CWP: Cold water working pressure.
   2. SWP: Steam working pressure.
   3. WOG: Water, oil, gas working pressure.
   4. WWP: Water working pressure.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Valve pressure and temperature rating.

d. Valve material of construction.

e. Special linings.

f. Valve dimensions and weight.

g. Valve flow coefficient.

h. Wiring and control diagrams for electric or cylinder actuators.

2. Test reports.

3. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

C. Closeout Submittals:

1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

2.02 MATERIALS

A. Refer to individual valve Specification Sections.

2.03 VALVE ACTUATORS

A. Valve Actuators - General:

1. Provide actuators as shown on Drawings or specified.

2. Counter clockwise opening as viewed from the top.

3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.

4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 foot-pounds torque on the operating nut.

5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.

6. Extension stem:

a. Install where shown or specified.

b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.

c. Pin all stem connections.

d. Center in valve box or grating opening band with guide bushing.

e. Connect stem to valve actuator with single universal joint with greased sealed bearings.

B. Buried Valve Actuators:
   1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
   2. Box base to enclose buried valve gear box or bonnet.
   3. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.
   4. Provide at least two (2) tee handle keys for actuator nuts, with 5 FT extension between key and handle.
   5. Extension stem:
      a. Provide for buried valves greater than 4 FT below finish grade.
      b. Extend to within 6 IN of finish grade.
   6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.

C. Plastic Valve Vault:
   1. Provide in non-traffic areas only on valve applications 3-1/2 IN and less.
   2. Nominal 7-1/2 IN DIA top section.
   3. Design unit for screw type extension section having nominal 9 IN DIA bell.
   4. Cast iron ring and lid.
   5. Constructed of injection molded polyolefin compound with fibrous inorganic component reinforcing and UV stabilization.
   6. Armor Access Boxes.

D. Exposed Valve Manual Actuators:
   1. Provide for all exposed valves not having electric or cylinder actuators.
   2. Provide handwheels for gate and globe valves.
      a. Size handwheels for valves in accordance with AWWA C500.
   3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
      a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
      b. Provide at least two (2) levers for each type and size of valve furnished.
   4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.

5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
    a. Cadmium-plated chain looped to within 3 FT of finish floor.
    b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
8. Provide cast iron floor stands where shown on Drawings.
    a. Stands to be furnished by valve manufacturer with actuator.
    b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.

E. Submerged Actuators:
1. Mount the valve actuator on top of an extension bonnet 3 FT above any adjacent personnel access.
2. The valve and bonnet connection shall be flanged and watertight.
3. Provide a top brace support for the bonnet.
    a. Mount the brace 6 IN below the top of the wall as shown.
4. Materials:
    a. Extension bonnet: Cast iron ASTM A126 or steel.
    b. Brace and anchor bolts: Type 304 stainless steel.

F. Electric Actuators (varies):
1. Provide electric valve actuators with integral control devices and a remote pushbutton station.
2. Furnish electric actuator integral with valve consisting of:
    a. Motor.
    b. Gearing.
    c. Handwheel.
    d. Limit and torque switches.
    e. Lubricants.
    f. Heating elements.
    g. Wiring.
    h. Terminals for motor power and controls.
    i. Drive nut.
3. Housing/enclosure:
    a. Provide cast iron gear housing and cast iron load bearing enclosure.

b. Non load bearing enclosure and housing: Aluminum or cast iron.

c. Rated for area classification shown on Drawings.

d. Provide O-ring seals for covers and entries.

e. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.

4. Motors:

a. Provide motors that are totally enclosed, high torque design made expressly for valve actuator service and capable of operating the valve under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.

b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10 percent above or below rated voltage.

c. Provide positive method to ensure motor bearings are permanently lubricated.

d. Provide three (3) thermal switches imbedded in windings:

1) 120 degrees apart.

2) Provide motor shutdown at high temperature.

e. Motor housing:

1) Aluminum or cast iron.

2) Totally enclosed nonventilated with cooling fins.

f. Provide motor capable of operating in any position.

g. Provide motor sealed from gearcase to allow any mounting position.

h. Provide motors suitable for 480 V, 3 PH, 60 Hz.

i. Provide shaft with wrench flats through housing for manual operation.

5. Gearing:

a. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter.

b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.

c. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.

d. Limit switch gearings and feedback device reduction gearing:

1) Steel or bronze.

e. Support rotating shafts with anti-friction bearings.

f. Provide separate drive nut/thrust bearing assembly:

1) Mounted to base of actuator.

2) High tensile bronze.

3) Quarter turn actuator: Provide 90 degree mounting intervals.

4) Provide grease fitting on drive assembly.

6. Handwheel:

a. Permanently attached for manual operation.

b. Positive declutch mechanism to engage and disengage handwheel.

c. Handwheel shall not rotate during motor operation.

d. Inoperable motor shall not prevent manual operation.

7. Limit torque and thrust loads in both closing and opening directions by torque limit switches.

a. Provide torque switches with micrometer adjustment and reference setting indicator.

1) Assure adjustment variation of approximately 40 percent in torque setting.

b. Provide switches having rating of not less than 6 A at 120 Vac and 2.2 A at 115 Vdc.

c. Limit and torque switches shall have totally sealed contacts.

8. Furnish electric actuator with two (2) geared limit switch assemblies with each switch assembly having four (4) separate limit switches:

a. Assure each limit switch assembly is geared to driving mechanism and is independently adjustable to trip at any point at and between the fully open and fully closed valve position.

b. Provide minimum of two (2) normally open contacts and two (2) normally closed contacts at each end of valve travel.

c. Provide switches with inductive contact rating of not less than 6 A at 120 Vac, 3 A at 240 Vac, 1.5 A at 480 Vac, 2.2 A at 115 Vdc and 1.1 A at 230 Vdc.

d. Limit switches shall be fully adjustable when power is applied to actuator.

9. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s).

a. Furnish heating elements rated at 120 Vac with heaters continuously energized.

10. Open-close actuator controls:

a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.

b. Provide control assembly in an enclosure rated for the defined area classification.

c. Controls for open/close actuator:

1) Provide remote pushbutton station with enclosure rated for area classification shown on Drawings with:

a) Open pushbutton.

b) Close pushbutton.

c) Stop pushbutton.

d) Remote/local switch.

e) Full open light.

f) Full close light.

g) Open and close relays as required.

2) Provide control enclosure to accept:

a) Remote open/close switches.

3) Provide contacts in control enclosure:

a) Remote/local contact.

b) Full open contact.

c) Full close contact.

4) Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

11. Additional requirements for modulating valve actuators:

a. Proportional position servo-amplifier mounted integral with the actuator control compartment.

b. Positioning of valve shall be proportional to a 4-20 mA signal input to the position servo-amplifier when remote control has been selected.

c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.

d. Provide 4-20 mA signal position control as shown on the Drawings that interfaces with the position control/position feedback instrumentation wiring to and from remote control device or PLC.

G. Electric Actuators (120 V, 1 PH):

1. General:

a. Self contained including motor, gearing, torque switch, limit switches and cast housing.

b. Electrical enclosure: NEMA 4 or NEMA 7 to comply with area rating classification shown on Drawings.

c. Factory assembled requiring only field connection of power and control wires.

d. Comply with Specification Section 40 05 05.

2. Motors:
   a. Produce 1.5 times the required torque.
   b. Sized for two (2) complete open-close cycles without overheating.
   c. One (1) fully closed to fully open cycle to occur within 60 SEC.
   d. Class F insulation.
   e. Operate at plus or minus 10 percent voltage.
   f. 120 Volt, single phase, 60 Hz.
   g. Provide thermal cutout switch and internal heater for actuator enclosure.
   h. Control wiring as shown on Drawing control diagrams.
3. Remote pushbutton station:
   a. Enclosure: NEMA 4 stainless steel.
   b. Control relays shall include:
      1) Open relay.
      2) Closed relay.
      3) interface relay.
   c. Push-to-test indicating lights shall include:
      1) Open.
      2) Closed.
      3) Remote.
   d. Selector switches shall include:
      1) Local-Remote.
      2) Open-Close.
   e. Space heater for enclosure.
   f. Control wiring as shown on control diagrams.
   g. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

H. Cylinder Actuators:
1. General:
   a. Self contained unit including actuator and controls.
   b. Electrical enclosure to meet area classification shown on Drawings.
   c. Factory assembled requiring field supply connection and control wires.

2. Cylinders:
    a. Conform to AWWA C540pneumatic cylinders.
    b. Cylinder barrelStainless steel.
    c. Heads and caps: Bronze.
    d. Cylinder pistons: Bronze.
    e. Double acting and operate on 60 psig water or air supply.
    f. Cylinder rated for 150 psig.
    g. Any hoses between control and cylinder to be oil resistant and arranged to avoid sharp bending from hose weight.
    h. Provide supply filter.
    i. Position cylinder above or to side of valve.
    j. For pneumatically operated pump check service provide air-oil tandem cylinder actuator with speed control valves on oil cylinder.
3. Controls:
    a. Provide pre-piped, pre-wired control:
        1) Pipe with corrosion-resistant metal.
        2) Provide four-way, two-position, 110 V solenoid valve in weatherproof enclosure.
        3) Provide open-closed signal limit switches.
        4) Speed control valves, to independently control opening and closing speed between 10 and 60 seconds.
        5) Manual-automatic selector valve on supply to solenoid.
        6) For modulating valves, provide a positioner, input signal 4-20 mA, including signal converter.
        7) For modulating valves, provide valve position transmitter, 4-20 mA, including signal converter, where shown.
        8) For pump check valves, provide additional two-way solenoid valve with speed control to allow rapid close on loss of electric power.

2.04 FABRICATION

A. End Connections:
1. Provide the type of end connections for valves as required in the Piping Schedules presented in Specification Section 40 05 13 or as shown on the Drawings.
2. Comply with the following standards:
    a. Threaded: ASME B1.20.1.
    b. Flanged: ASME B16.1 Class 125 unless otherwise noted or AWWA C207.

c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.

d. Soldered: ASME B16.18.

e. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.

C. Nuts, Bolts, and Washers:
1. Wetted or internal to be bronze or stainless steel.

a. Exposed to be zinc or cadmium plated.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements: Comply with Specification Section 09 91 00 for painting and protective coatings.

C. Setting Buried Valves:
1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.

2. Set valves and valve boxes plumb.

3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.

4. Install in closed position.

5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.

6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.

D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

E. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.

F. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

G. For threaded valves, provide union on one (1) side within 2 FT of valve to allow valve removal.

H. Install valves accessible for operation, inspection, and maintenance.

3.02 ADJUSTING

A. Adjust valves, actuators and appurtenant equipment to comply with Specifications.
   1. Operate valve, open and close at system pressures.

B. For all 120 Vac and 480 Vac electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
   1. Inspect valve actuators covered by this Specification Section.
   2. Supervise adjustments and installation checks:
      a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
      b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
      c. Simulate a valve position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
   3. Provide Project Representative with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.

END OF SECTION

SECTION 40 20 13
PIPE: STEEL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Steel pipe, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.
   4. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
      b. B1.2, Gages and Gaging for Unified Inch Screw Threads.
      c. B16.3, Malleable Iron Threaded Fittings.
      d. B16.5, Pipe Flanges and Flanged Fittings.
      e. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
      f. B16.11, Forged Steel Fittings, Socket Welding and Threaded.
      g. B31.1, Power Piping.
      h. B31.3, Process Piping.
      i. B31.9, Building Services Piping.
      j. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A181, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
      d. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
      e. A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

f. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

g. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

h. B6, Standard Specification for Zinc.

i. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

3. American Water Works Association (AWWA):

a. C200, Standard for Steel Water Pipe - 6 IN and Larger.

b. C203, Standard for Coal-Tar Protective Coatings and Linings for Steel water Pipeline - Enamel and Tape - Hot Applied.

c. C205, Standard for Cement-Mortar Lining and Coating for Steel Water Pipe - 4 IN and Larger - Shop Applied.

d. C206, Standard for Field Welding of Steel Water Pipe.

e. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.

f. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.

g. C209, Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

h. C210, Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

i. C606, Standard for Grooved and Shouldered Joints.

j. M11, Steel Pipe - A Guide for Design and Installation.

4. Society of Automotive Engineers (SAE):

a. AMS-QQ-P-416, Cadmium Plating Electro deposited.

B. Qualifications:

1. Application of coal tar lining and coating materials including preparation of surfaces, priming, and lining and coating of pipe, fittings, and specials, in shop, repairs of any damage to lining or coating occurring during shipment or any other time, and field lining and coating of ends where linings or coatings have been held back for welded field joints, shall be done by established and recognized pipe company acceptable to Project Representative.

2. Use only certified welders meeting procedures and performance outlined in ASME Section IX, AWWA C200 Section 3.3.3 and other codes and requirements per local building and utility requirements.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. See Section 40 05 13.
   2. Factory test reports.
   3. If mechanical grooved type coupling system is used, submit piping, fittings, and appurtenant items which will be utilized.
   4. Welders certificates.

C. Quality Assurance Submittals: Coating manufacturer's qualifications.

D. Closeout Submittals:
   1. O&M Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Flanged adaptors:
      a. Rockwell (Style 913 (steel)).
      b. Dresser (Style 128 (steel)).
      c. Or approved equal.
   2. Insulating couplings:
      a. Rockwell (Style 416).
      b. Dresser (Style 39).
      c. Or approved equal.
   3. Reducing couplings:
      a. Rockwell (Style 415).
      b. Dresser (Style 62).
      c. Or approved equal.
   4. Transition coupling:
      a. Rockwell (Style 413).
      b. Dresser (Style 62).
      c. Or approved equal.
   5. Compression sleeve coupling:
      a. Rockwell (Style 411 (steel)).

b. Dresser (Style 38 (steel)).

c. Or approved equal.

6. Mechanical couplings and fittings:

a. Victaulic (Style 07 or 77).

b. S.P. Fittings.

c. Or approved equal.

7. Vibration isolation equipment connections for natural gas:

a. Flexonics (Model 401H).

b. Metraflex.

c. Or approved equal.

8. Flexible connectors for hot water equipment:

a. Flexonics (FLG Series).

b. Thermo Tech (F/J/R Series).

c. Or approved equal.

9. Factory-applied plastic or epoxy coatings:

a. "Encoat" Division of Energy Coating Company.

b. "Scotchkote" Division of 3M Company.

c. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00.

2.02 MATERIALS

A. All materials used in steel piping systems defined in Section 40 05 13 shall meet or exceed pressure test requirements specified for each respective system.

B. Steel Pipe (Fabricated Type):
1. AWWA C200:

a. ASTM A36, Grade C steel plate.

b. ASTM A283, Grade D steel plate.

c. ASTM A572, steel plate.

d. ASTM A1011, steel sheet.

C. Steel Pipe (Mill Type): ASTM A53, Type E or S.

D. Fittings (For Fabricated Pipe): AWWA C208.

E. Fittings (For Mill Type Pipe):
1. ASTM A234.

2. ASME B16.3, ASME B16.5, ASME B16.9, ASME B16.11.

F. Flanges (Fabricated Pipe):
   1. Flange material: ASTM A283, Grade C or D, ASTM A181, Grade 1.
   2. Flange finish: Flat faced.

G. Flanges (Mill Type Pipe):
   1. ASME B16.5.
   2. Flat faced.
   3. Slip-on flanges.

H. Nuts and Bolts:
   1. Buried: Cadmium-plated meeting SAE AMS-QQ-P-416, Type 1, Class 2 (Cor-Ten) for buried application.
   2. Exposed: Mechanical galvanized ASTM B695, Class 40.
   3. Heads and dimensions per ASME B1.1.
   4. Threaded per ASME B1.1.
   5. Project ends 1/4 to 1/2 IN beyond nuts.

I. Gaskets: See individual piping systems in Section 40 05 13.

2.03 MANUFACTURED UNITS

A. Couplings:
   1. Flanged adaptors:
      a. Steel or carbon steel body sleeve, flange, followers and Grade 30 rubber gaskets.
      b. Provide units specified in Article 2.1.
      c. Flanges meeting standards of adjoining flanges.
      d. Tie bolt assembly.
         1) For pipe 14 IN and larger.
         2) Minimum four (4) bolts equally spaced around the pipe and extending from cast steel lugs welded on the pipe to lugs welded on the coupling middle ring.
      e. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
   2. Compression sleeve coupling:
      a. Steel sleeve, followers Grade 30 and rubber gaskets.
      b. Provide units specified in Article 2.1.
      c. Flanges meeting standards of adjoining flanges.
      d. Tie bolt assembly.
         1) For pipe 14 IN and larger.

2) Minimum four (4) bolts equally spaced around the pipe and extending from cast steel lugs welded on the pipe to lugs welded on the coupling middle ring.

e. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.

f. Provide field coating for buried couplings per AWWA C203.

3. Mechanical coupling joint:

a. Use of mechanical grooved (AWWA C606) type couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 40 05 13.

b. Utilize units defined in Article 2.1.

2.04 ACCESSORIES

A. Heating Water Application:
1. For steel heating lines, provide braided, flanged stainless steel connectors for connection to equipment.

2. Provide pump connectors with stainless steel construction, rubber filled bellows and flanged end connections.

B. Natural Gas Equipment Isolator: 316L stainless steel, T-321 stainless steel braid with connections compatible with joints in piping system.

2.05 FABRICATION

A. Provide piping (mill or fabricated) for use in this Project with minimum wall thicknesses as follows:
1. 1/8 - 5 IN DIA pipe: Schedule 40.

2. 6 - 10 IN DIA pipe: 3/16 IN.

3. 12 - 14 IN DIA pipe: 7/32 IN.

4. 16 - 48 IN DIA pipe: 1/4 IN.

5. 54 - 60 IN DIA pipe: 5/16 IN.

6. 66 - 72 IN DIA pipe: 3/8 IN.

7. Sizes through 24 IN are nominal OD.

a. Sizes greater than 24 are ID.

8. Wall thicknesses indicated are for standard weight pipe.

a. Design pipe in accordance with operating pressures shown in Piping Schedules for a design stress limited to 50 percent of yield.

B. Furnish cast parts with lacquer finish compatible with finish coating.

C. Furnish without outside coating of bituminous material any exposed pipe scheduled to be painted.

D. Fabricated Fittings:
   1. AWWA C208.
   2. Assure ratio of radius of bend to diameter of pipe equal to or greater than 1.0.
   3. Minimum number of pieces:
      a. Less than 30-Deg deflection: 2.
      b. 30-Deg to less than 45-Deg deflection: 3.
      c. 45-Deg to less than 60-Deg deflection: 4.
      d. 60-Deg through 90-Deg deflection: 5.

E. Taper cement mortar linings as required for valve interfacing.

F. Protective Coatings and Linings:
   1. Provide enamel linings and coatings in accordance with AWWA C203 and the following:
      a. Potable water: Provide minimum dry film of 5 mils of asphaltic coating non-toxic blend of Gilsonite and brown and steam distilled asphalt.
      b. Nonpotable fluids: Provide minimum dry film of 5 mils of acceptable asphalt base material.
      c. Provide coating in accordance with AWWA C203 and subject to following additional requirements.
         1) Do not use enamel lined or coated steel pipe exposed to temperatures below 10 DegF.
         2) Do not handle enamel-lined or coated pipe when temperature of pipe is below 20 DegF.
         3) Coal tar: Provide coal tar enamel having penetration of 15 to 20 at a temperature of 77 DegF.
   2. Provide cement mortar lining in accordance with AWWA C205.
   3. Provide cement mortar coating in accordance with AWWA C205.
   4. Galvanize surface in accordance with hot dip method using any grade of zinc acceptable to ASTM B6.
   5. Wrap pipe in accordance with AWWA C209.
   6. Field paint pipe in accordance with Section 09 91 00.

2.06 SOURCE QUALITY CONTROL

A. Testing:
   1. Shop hydrostatic test fabricated steel pipe and fittings.
   2. Field hydrostatic test all pipe as specified in Section 40 05 13.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Joining Methods - Flanges:
   1. Facing method:
      a. Insert slip-on flange on pipe.
      b. Assure maximum tolerances for flange faces from normal with respect to axis of pipe is 0.005 IN per foot of flange diameter.
      c. Test flanges after welding to pipe for true to face condition and reface, if necessary, to bring to specified tolerance.
   2. Joining method:
      a. Leave 1/8 to 3/8 IN of flange bolts projecting beyond face of nut after tightening.
      b. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, equipment, tank, and other interconnecting piping systems.
      c. When bolting flange joints, exercise extreme care to assure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or cause unnecessary stress, bending or torsional strains being applied to cast flanges or flanged fittings.
         1) Allow one (1) flange free movement in any direction while bolts are being tightened.
      d. Do not assemble adjoining flexible coupled, mechanical coupled or welded joints until flanged joints in piping system have been tightened.
      e. Gradually tighten flange bolts uniformly to permit even gasket compression.
      f. Do not overstress bolts to compensate for poor installation.

C. Joining Method - Welded Joints:
   1. Perform welding in accordance with AWWA C206 and this Section.
   2. For flange attachment perform in accordance with AWWA C207.
   3. Have each welding operator affix an assigned symbol to all his welds.
      a. Mark each longitudinal joint at the extent of each operator's welding.
      b. Mark each circumferential joint, nozzle, or other weld into places 180 degrees apart.
   4. Welding for all process piping shall conform to ASME B31.3.
      a. Welding of utility piping 125 psi and less shall be welded per ASME B31.9.
      b. Utility piping above 125 psi shall conform to ASME B31.1.

5. Provide caps, tees, elbows, reducers, etc., manufactured for welded applications.
6. Weldolets may be used for 5 IN and larger pipe provided all slag is removed from inside the pipe.
7. Weld-in nozzles may be used for branch connections to mains and where approved by Project Representative.
8. Use all long radius welding elbows for expansion loops and bends.
9. Use long radius reducing welding elbows 90 degree bends and size changes are required.

D. Joining Method - Couplings:
   1. Compression sleeve:
      a. Install coupling to allow space of not less than 1/4 IN but not more than 1 IN.
      b. Provide harnessed joint.
         1) Use joint harness arrangements detailed in AWWA M11.
      c. Design harness assembly with adequate number of tie rods for test pressures indicated in Section 40 05 13 and allow for expansion of pipe.
      d. Provide ends to be joined or fitted with compression sleeve couplings of the plain end type.
      e. Grind smooth welds the length of one (1) coupling on either side of joint to be fitted with any coupling.
      f. Assure that outside diameter and out-of-round tolerances are within limits required by coupling manufacturer.
   2. Mechanical coupling:
      a. Arrange piping so that pipe ends are in full contact.
      b. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
      c. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.

E. Joining Method - Threaded and Coupled (T/C):
   1. Provide T/C end conditions that meet ASME B1.2 requirements.
   2. Furnish pipe with factory-made T/C ends.
   3. Field cut additional threads full and clean with sharp dies.
   4. Leave not more than three (3) pipe threads exposed at each branch connection.
   5. Ream ends of pipe after threading and before assembly to remove burrs.
   6. Use Teflon thread tape on male thread in mating joints.

F. Support exposed piping in accordance with Section 40 05 13.

G. Install buried piping per Section 40 05 13.

3.02 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 13.

END OF SECTION

SECTION 40 20 16
PIPE: DUCTILE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Ductile iron piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
      b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
      c. B18.2.1 Square and Hex Bolts and Screws, Inch Series.
      d. B18.2.2 Square and Hex Nuts.
   2. ASTM International (ASTM):
      a. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      c. F2329 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
      d. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
      e. B766 Standard Specification for Electrodeposited Coatings of Cadmium.
   3. American Welding Society (AWS):
      a. D11.2, Guide for Welding Iron Castings.
   4. American Water Works Association (AWWA):
      a. C600, Installation of Ductile Iron Water Mains and their Appurtenances.
      b. C606, Standard for Grooved and Shouldered Joints.

5. American Water Works Association/American National Standards Institute (AWWA/ANSI):
    a. C104/A21.4, Cement-Mortar Lining for Duction Iron Pipe and Fittings.
    b. C105/A21.5, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
    c. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
    d. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    e. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
    f. C150/A21.50, Standard for Thickness Design of Ductile-Iron Pipe.
    g. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
    h. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
6. Society of Automotive Engineers (SAE):
    a. AMS-QQ-P-416, Cadmium Plating - Electro-deposited.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
    1. See Section 40 05 13.
    2. Certification of factory hydrostatic testing.
    3. If mechanical coupling system is used, submit piping, fittings, and appurtenant items which will be utilized to meet system requirements.
    4. Acknowledgement that Contractor has coordinated and accounted for fabrication of special order fittings.

C. Closeout Submittals:
    1. O&M Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Flanged adaptors:
        a. Rockwell Style 913 (steel) or (Style 912 (cast).
        b. Dresser Style 128 (steel) or(Style 127 (cast).

c. Or approved equal.

2. Compression sleeve coupling:
   a. Rockwell Style 431 (cast) or Style 411 (steel).
   b. Dresser Style 153 (cast) or Style 38 (steel).
   c. Or approved equal.
3. Mechanical coupling:
   a. Victaulic (Style 31).
   b. Tyler.
   c. Or approved equal.
4. Insulating couplings:
   a. Rockwell (Style 416).
   b. Dresser (Style 39).
   c. Or approved equal.
5. Reducing couplings:
   a. Rockwell (Style 415).
   b. Dresser (Style 62).
   c. Or approved equal.
6. Transition coupling:
   a. Rockwell (Style 413).
   b. Dresser (Style 62).
   c. Or approved equal.
7. Polyethylene encasement tape:
   a. Chase (Chasekote 750).
   b. Kendall (Polyken 900).
   c. 3 M (Scotchrap 50).
   d. Or approved equal.
8. Restrained Flange Coupling Adapter:
   a. Romac Industries (Style RFCA).
   b. JCM Industries.
   c. Or approved equal.
9. Restrained Coupling:
   a. Romac Industries (Style RG400).
   b. JCM Industries.
   c. Or approved equal.

10. Ductile Iron Pipe (Non-Restrained Joint).
    a. Pipe:
        1) American Ductile Iron Pipe.
        2) US Pipe.
        3) Griffin Pipe Products Co., Inc.
        4) Or approved equal.
    b. Fittings:
        1) Tyler Union.
        2) American Ductile Iron.
        3) Sigma Corporation.
        4) Griffin Pipe Products Co., Inc.
        5) Or approved equal.
11. Ductile Iron Pipe (Restrained joints):
    a. Pipe:
        1) American Ductile Iron Pipe:
            a) Flex-Ring (4IN to 48IN).
            b) Lok-Ring (54IN to 64IN).
            c) Fast-Grip Gasket (4IN to 30IN).
        2) US Pipe:
            a) TR-Flex (4IN to 30IN).
            b) Field-Lok Gasket (4IN to 24IN).
        3) Or approved equal.
    b. Fittings:
        1) American Ductile Iron Pipe:
            a) Flex-Ring (16IN to 48IN).
            b) Lok-Ring (54IN to 64IN).
            c) Fastite with Fast-Grip Gasket (30IN to 64IN).
            d) MJ Coupled Joint (4IN to 14IN).
            e) MJ Fitting with Wedge Restraint (4IN to 14IN).
        2) US Pipe:
            a) TR-Flex (4IN to 30IN).
            b) MJ Field-Lok (4IN to 24IN).
            c) Field-Lok (4IN to 24IN).
            d) MJ Fitting with Wedge Restraint (4IN to 14IN).
            e) Or approved equal.

B. Submit request for substitution in accordance with Specification Division 1.

2.02 MATERIALS

A. Ductile Iron Pipe:
   1. AWWA/ANSI C115/A21.15.
   2. AWWA/ANSI C150/A21.50.
   3. AWWA/ANSI C151/A21.51.

B. Fittings and Flanges:
   1. AWWA/ANSI C110/A21.10.
   2. AWWA/ANSI C115/A21.15.
   3. Flanges drilled and faced per ASME B16.1 for both 125 and 250 psi applications.

C. Flanges: Unless otherwise specified in Article 3.12 of Section 40 05 13, Piping Specification Schedule, or shown on the Drawings, comply with AWWA C115 with the following restrictions.
   1. Flange material: Meeting the requirements of AWWA C207 with the following restrictions:
      a. Ductile iron or gray iron for Pipe Size up to 12 IN.
      b. Ductile iron for Pipe Size greater than 12 IN.
   2. Flange finish: Flat faced.
   3. Flange Type: Solid.

D. Gaskets:
   1. Gasket Materials: Gasket Materials shall meet the requirements C115 and the following:
      a. Rubber: Red Rubber (SBR) per ASTM D1330, Grade I & II.
         1) Hardness (Shore A Value) per ASTM D2240: 80 ± 5.
         2) Minimum Gasket Yield Pressure: 200 psi.
         3) Suitable for Maximum Seating Pressure: 1,200 psi.
      b. Non-Asbestos Synthetic: Shall be a blend of synthetic fibers, fillers, and elastomeric binders suitable for potable water service.
         1) Minimum Gasket Yield Pressure (1/16 IN thick Gasket): 3000 psi.
         2) Minimum Gasket Yield Pressure (1/8 IN thick Gasket): 4000 psi.
         3) Suitable for Maximum Seating Pressure: 15,000 psi.
      c. Neoprene:
         1) Hardness (Shore A Value) per ASTM D2240: 80 ± 5.
      d. EPDM:
         1) Hardness (Shore A Value) per ASTM D2240: 60 ± 5.

2. Gaskets for Flanged Joints:
    a. Unless otherwise specified in Article 3.12 of Section 40 05 13 - Piping Specification Schedule or shown on the Drawings, Gasket materials shall meet the requirements of AWWA C115 with the following restrictions.
        1) Design Internal Pressure: ≤ 150 psi.
            a) Pipe Size 3 IN through 12 IN: Rubber, Full faced, 1/8 IN thick.
            b) Pipe Size 14 IN through 64 IN: Rubber, Ring, 1/8 IN thick.
        2) Design Internal Pressure: > 150 psi and ≤250 psi:
            a) Pipe Size 3 IN through 64 IN: Rubber, Ring, 1/8 IN thick.
    b. When gasket material is specified in Article 3.12 of Section 40 05 13 - Piping Specification Schedule or shown on the Drawings, without type and thickness explicitly denoted, the default gasket type and thickness shall be as follows:
        1) Gasket type: Ring type.
        2) Gasket thickness: 1/8 IN thick.
3. Gaskets for Mechanical Joints: Comply with AWWA/ANSI C111/A21.11.
    a. Gasket material: Vulcanized Styrene Butadiene Rubber (SBR) meeting the physical property requirements per Table 4, AWWA/ANSI C111/A21.11 and the following:
        1) Hardness (Shore A Value) per ASTM D2240: 75 ± 5.
        2) Min Ultimate Tensile Strength per ASTM D412: 1,500 psi.
        3) Min Ultimate Elongation (based on original length) per ASTM D412: 150 percent.
        4) Minimum Aging per ASTM D572: 60 percent.
        5) Maximum Compression Set per ASTM D395, Method B: 20 percent.
        6) Resistance to Surface Ozone per ASTM D1149: No Cracking.
4. Gaskets for Push-on Joints: Comply with AWWA/ANSI C111/A21.11.
    a. Gasket material: Vulcanized Styrene Butadiene Rubber (SBR) meeting the physical property requirements per Table 8, AWWA/ANSI C111/A21.11.
5. Gaskets for Grooved Type Mechanical Coupling (AWWA C606) Joints: Rubber meeting ASTM D2000 meeting the physical property requirements per Table 1, AWWA C606.

E. Nuts and Bolts:
1. Bolts:
    a. ASTM A307, Grade B, Heavy Hex bolts.
    b. Dimensions per ANSI/ASME B18.2.1.

c. Threads per ANSI/ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form), class 2A.

2. Nuts:

a. ASTM A563, Grade A, Heavy Hex.

b. Dimensions per ANSI/ASME B18.2.2.

c. Threads per ANSI/ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form) class 2B.

3. Coating of Nuts and Bolts:

a. Buried:

1) Cadmium plated meeting ASTM B766, Type II Class 12.

2) Zinc/Aluminum Coating per ASTM F1136 “C”, Grade 5.

b. Exposed: Hot-dip galvanized and centrifuged (dip-spin process), per ASTM F2329.

4. Project ends 1/4 to 1/2 IN beyond nuts.

F. If mechanical coupling system is used, utilize pipe thickness and grade in accordance with AWWA C606.

G. Polyethylene Encasement: See AWWA/ANSI C105/A21.5.

H. See Piping Schedules in Section 40 05 13.

2.03 MANUFACTURED UNITS

A. Couplings:

1. Flanged adaptors:

a. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber gaskets.

b. Provide units specified in Article 2.1.

c. Supply flanges meeting standards of adjoining flanges.

d. Rate entire assembly for test pressure specified on piping schedule for each respective application.

2. Compression sleeve coupling:

a. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets.

b. Provide units specified in Article 2.1.

c. Supply flanges meeting standards of adjoining flanges.

d. Entire assembly to be rated for test pressure specified on piping schedule for each respective application.

e. Provide field coating for buried couplings per AWWA C203.

3. Mechanical couplings:

a. Use of mechanical couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 40 05 13.

b. Utilize units defined in Article 2.1.

2.04 FABRICATION

A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled to be painted.

B. Furnish cast parts with lacquer finish compatible with finish coat.

C. Glass Lining:
   1. Minimum two-coat process.
      a. Base coat heated to solidly fuse glass to pipe surface.
      b. Subsequent coat(s) heated to form integral bond with preceding coat.
   2. Final finish parameters:
      a. Thickness: 8-12 mils.
      b. Hardness: Above 5 on MOHS scale.
      c. Density: 2.5-3.0 grams per cubic centimeter.
      d. Metal to lining bonding: Capable of withstanding strain of 0.0001 IN/IN without damage to lining.
   3. Complete compatibility between fittings and piping.

2.05 LININGS AND COATINGS

A. Cement-Mortar Lining:
   1. Provide a single layer of cement mortar lining in accordance with AWWA C104.

B. Where specified in piping schedule, provide linings to a minimum thickness of 40 mils.
   1. Ceramic epoxy for joint repairs:
      a. Potecto 401 Joint Compound.
      b. Carboline Company.
      c. Or approved equal.

2.06 SOURCE QUALITY CONTROL

A. Factory Test:
   1. Subject pipe to hydrostatic test of not less than 500 psi with the pipe under the full test pressure for at least 10 seconds.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Joining Method - Push-On Mechanical (Gland-Type) Joints:
   1. Install in accordance with AWWA/ANSI C111/A21.11.

2. Assemble mechanical joints carefully according to manufacturer's recommendations.
3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
4. Do not overstress bolts.
5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.

B. Joining Method - Push-On and Restrained Joints:
   1. Install in accordance with AWWA/ANSI C151/A21.51.
   2. Assemble joints in accordance with manufacturer's directions.
   3. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket.
      a. Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe.
   4. Assure the gasket groove is thoroughly clean.
   5. For cold weather installation, warm gasket prior to placement in bell.
   6. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately 1/4 IN back.

C. Joining Method - Flanged Joints:
   1. Install in accordance with AWWA/ANSI C115/A21.15.
   2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
   3. Make flange faces flat and perpendicular to pipe centerline.
   4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
   5. Allow one (1) flange free movement in any direction while bolts are being tightened.
   6. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
   7. Align flanges accurately, using spirit level, and pipe properly supported before gasket and bolts are inserted.
      a. Carefully place rubber gasket to ensure full flow and proper sealing of joint.
      b. Give bolt threads light coat of thread lubricant and then insert and turn nuts by hand.
      c. Pull up bolts with wrench, employing crossover method.
      d. Lubricate bolts and nuts and gradually tighten flange bolts per manufacturer’s installation instructions.

e. Gradually tighten flange bolts uniformly to permit even gasket compression.

8. Do not overstress bolts to compensate for poor installation.
9. Where satisfactory sealing of joint is not attained at maximum permissible torque, disassemble, reclean, and reassemble joint with new gasket.

D. Joining Method - Mechanical Coupling Joint:
   1. Arrange piping so that pipe ends are in full contact.
   2. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
   3. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.

E. Flange Adaptors 12 IN and Less:
   1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.
   2. Drill holes not more than 1/8 IN larger than diameter of stud projection.

F. Cutting:
   1. Do not damage interior lining material during cutting.
   2. Use abrasive wheel cutters or saws.
   3. Make square cuts.
   4. Bevel and free cut ends of sharp edges after cutting.
   5. Field cutting of restrained joint pipe utilizing a welded bead (such as TR Flex and Flex-Ring) is not allowed.

G. Support exposed pipe in accordance with Section 40 05 13.
   1. When installing flanged exposed pipe, wall sleeves, and other exposed pipe, “two hole” the pipe such that the top two bolt holes are centered with respect to the vertical centerline.

H. Install buried piping in accordance with Section 40 05 13.

I. Install restrained joint systems where called for on the Drawings or specified in Section 40 05 13 under specific piping system.

3.02 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 13.

END OF SECTION

SECTION 40 20 19
PIPE: COPPER

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Copper piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 31 21 33 - Trenching, Backfilling, and Compacting for Utilities.
   4. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   5. Section 40 05 16 - Pipe Support Systems.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.18, Cast Bronze Solder - Joint Pressure Fittings.
      b. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      c. B16.23, Cast Bronze Solder Joint Drainage Fittings - DWV.
      d. B16.24, Bronze Flanges and Flanged Fittings, 150 and 300 LBS.
      e. B16.26, Cast Bronze Alloy Fittings for Flared Copper Tubes.
   2. ASTM International (ASTM):
      a. B32, Standard Specification for Solder Metal.
      b. B42, Standard Specification for Seamless Copper Pipe, Standard Sizes.
      c. B88, Standard Specification for Seamless Copper Water Tube.
      d. B306, Standard Specification for Copper Drainage Tube (DWV).
   3. American Welding Society (AWS):
      a. A5.8, Specification for Filler Metals for Brazing and Braze Welding.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals: See Section 40 05 13.

C. Closeout Submittals:
   1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Copper Tubing:
   1. Pressure non-buried: ASTM B88, Type L hard.
   2. Pressure buried: ASTM B88, Type K.
   3. Non-pressure: ASTM B306.

B. Copper Pipe: ASTM B42, regular strength.

C. Fittings:
   1. Pressure non-buried: ASME B16.22.
   2. Pressure buried: ASME B16.22 or ASME B16.26.
   3. Non-pressure: ASME B16.23

D. Soldering and Brazing:
   1. Non-buried:
      a. ASTM B32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux up to 180 DegF water temperature.
      b. At 180 DegF and above, use brazing alloy with melting temperature above 1000 DegF and suitable flux.
   2. Buried: Silver solder per AWS A5.8.

E. See Piping Schedules in Section 40 05 13.

F. Unions:
   1. Pipe sizes 2 IN and smaller: Copper, ground joint.
   2. Pipe sizes 2-1/2 IN and larger: Brass flanged unions.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Comply with Section 40 05 13.

3.02 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 13.

B. Utilize only annealed (soft) type tubing where flared joints are used and drawn temper (hard) type tubing where soldered or brazed joints are used.

C. Support exposed piping in accordance with Section 40 05 13 and Section 40 05 16.

D. Install buried piping in accordance with Section 31 21 33 and Section 40 05 13.

END OF SECTION

SECTION 40 20 23
PIPE: PLASTIC

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Plastic pipe.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   4. City of Bellevue (COB):
      a. Sewer Engineering Standards, January 2012.
      b. Storm and Surface Water Engineering Standards, January 2012.

1.02 QUALITY ASSURANCE

A. See Section 40 05 13.

B. Referenced Standards:
   1. City of Bellevue (COB):
      a. Sewer Engineering Standards, January 2012.
      b. Storm and Surface Water Engineering Standards, January 2012.
   2. ASTM International (ASTM):
      a. PVC (polyvinyl chloride) materials:
         1) D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
         2) D1785, Standard Specification for Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.
         3) D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
         4) D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
         5) D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
         6) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
         7) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

8) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

9) F679, Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

10) F794, Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

11) F949, Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

b. Installation:

1) D2321, Standard Practice for Underground Installation of Thermosplastic Pipe for Sewers and Other Gravity-Flow Applications.

3. American Water Works Association (AWWA):

a. PVC (polyvinyl chloride) materials:

1) C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN Through 12 IN, for Water Distribution.

2) C905, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 IN through 48 IN, for Water Transmission and Distribution.

b. Polyethylene (PE) materials:

1) C901, Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 IN through 3 IN, for Water Service.

4. NSF International (NSF).

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittal: See Section 40 05 13.

C. Closeout Submittals:
1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 PVC PRESSURE PIPING (EXPOSED)

A. General:
1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings.

2. Furnish materials in full compliance to following material specifications:
    a. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
    b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Pipe:
    1. Furnish pipe meeting requirements of ASTM D1785.
    2. Pipe 2 IN and less to be solvent welded.
    3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.

C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges/Unions:
    1. Furnish flanges and unions at locations shown on Drawings.
    2. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
    3. For pipe larger than 2 IN, provide 150 LB socket type PVC flange.
    4. For pipe 2 IN and less, provide socket type PVC union with Buna O-rings.
    5. Use flat, full faced natural rubber gaskets at flanged connections.
        a. Furnish heavy hex head bolts, each with one (1) heavy hex nut, ASTM F593 Type 316 stainless steel.
    6. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.

E. Installation:
    1. Field threading PVC will not be permitted.
        a. Perform required threaded connections or attachments by the use of factory molded socket by threaded adapters.
        b. Female adapters are not acceptable.
    2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
        a. Continuously support PVC piping at liquid operating temperatures in excess of 100 DegF.
        b. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.
        c. Support riser clamps on spring hangers.
        d. Do not clamp PVC tightly or restrict movement for expansion and contraction.

2.02 PRESSURE PIPING (UNDERGROUND)

A. Materials: Furnish materials in full compliance with following requirements:
   1. 1/2-3 IN:
      a. AWWA C901 PE with Pressure Class of 200 psi per Table A3, AWWA C901.
      b. Schedule 80 pipe per Section 2.01.
   2. 4-12 IN: AWWA C900 PVC with Pressure Class of 200 psi per Table 2, AWWA C900.
   3. 14-36 IN: AWWA C905 PVC DR-18.
   4. Joints for polyethylene pipe shall be fusion type in accordance with AWWA C901.
   5. Joints for PVC pipe shall be the elastomeric-gasket type with a pressure rating not less than pipe pressure rating meeting performance requirements of ASTM D3139.

B. Installation:
   1. City of Bellevue (COB):
      a. Sewer Engineering Standards, January 2012.
      b. Surface Water Engineering Standards, January 2012.
   2. Field threading of PVC pipe will not be permitted.
   3. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

2.03 PVC DRAINAGE, SEWER PIPING AND UNDERGROUND AIR DUCTS

A. Materials:
   1. Furnish materials in compliance with
      a. COB Sewer Engineering Standard Section S4-02 for gravity sewer pipe.
      b. COB Storm and Surface Water Standards Section D7-2.3 for storm drain pipe.
      c. And in full compliance to the following material specification.
   2. PVC pipe shall be rigid, unplasticized polyvinyl chloride (PVC) made of PVC plastic having a cell classification of 12454-B or 12454-C as described in specification ASTM D1784.
   3. The requirements of this Specification are intended to provide for pipe and fittings suitable for non-pressure drainage of wastewater and surface water.
   4. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.

5. Supply to the Project Representative all information and sample of joining method for his evaluation.
    a. Only jointing methods acceptable to the Project Representative will be permitted.
6. Provide pipe and fittings meeting or exceeding the following requirements:
    a. 4-27 IN DIA: ASTM D3034 and ASTM F679, SDR 35.
    b. 8-30 IN DIA: ASTM F794.
    c. 4-18 IN DIA: ASTM F949.
7. Ensure impact strengths and pipe stiffnesses in full compliance to these Specifications.

B. Installation:
1. City of Bellevue (COB):
    a. COB Sewer Engineering Standard Section S5-04 for gravity sewer.
    b. COB Storm and Surface Water Standards Section D8-04 for storm drain pipe.
2. Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
3. Provide for a maximum deflection of not more than 5 percent.

C. Infiltration and Exfiltration:
1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per IN of pipe diameter per mile per 24 HRS.
2. For exfiltration, all the pipe and fittings shall exceed performance requirements by an air test procedure as specified in Section 40 05 13.
3. Observe full instructions of the Project Representative for carrying of testing procedures.
    a. Perform tests only during presence of the Project Representative or his authorized representative.
4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to Owner and retest until requirements stated are met.

D. Deflection:
1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
2. Pipe with deflection exceeding 5 percent of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 percent.
3. Any repaired pipe shall be retested.

PART 3 – EXECUTION

3.01 IDENTIFICATION

A. Identify each length of pipe clearly at intervals of 5 FT or less.
   1. Include manufacturer's name and trademark.
   2. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance Specifications and NSF approvals when applicable.

3.02 PRESSURE PIPING (UNDERGROUND)

A. Installation:
   1. City of Bellevue (COB):
      a. Sewer Engineering Standards, January 2012.
      b. Surface Water Engineering Standards, January 2012.
   2. Field threading of PVC pipe will not be permitted.
   3. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

3.03 PVC DRAINAGE, SEWER PIPING AND UNDERGROUND AIR DUCTS

A. Installation:
   1. City of Bellevue (COB):
      1) Sewer Engineering Standards, January 2012.
      2) Surface Water Engineering Standards, January 2012.

B. Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
   1. Provide for a maximum deflection of not more than 3 percent.

C. Infiltration and Exfiltration:
   1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per inch of pipe diameter per mile per 24 HRS.
   2. For exfiltration, all the pipe and fittings shall exceed performance requirements by an air test procedure as specified in Section 40 05 13.
   3. Observe full instructions of the Project Representative for carrying of testing procedures.
      a. Perform tests only during presence of the Project Representative or his authorized representative.
   4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to Owner and retest until requirements stated are met.

D. Deflection:
   1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
   2. Pipe with deflection exceeding 5 percent of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 percent.
   3. Any repaired pipe shall be retested.

END OF SECTION

SECTION 40 20 36
PIPE: CAST-IRON SOIL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Cast-iron soil piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.

1.02 QUALITY ASSURANCE

A. See Section 40 05 13.

B. Provide joint type specifically approved by applicable plumbing code.

C. Referenced Standards:
   1. ASTM International (ASTM):
      a. A74, Standard Specification for Cast-Iron Soil Pipe and Fittings.
      b. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
   2. Cast Iron Soil Pipe Institute (CISPI):
      a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
      b. 310,Standard for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
   3. Federal Specifications (FS):
      a. QQ-C-40, Calking: Lead Wool and Lead Pig.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals: See Section 40 05 13.

C. Closeout Submittals:
   1. Operation and Maintenance Manuals: Provide O&M manual documentation in accordance with Section 01 73 00 – Operation and Maintenance Manuals

PART 2 – PRODUCTS

2.01 MATERIALS

A. Pipe (General Application):
   1. ASTM A74.
      a. SV service.
   2. No hub: CISPI 301.

B. Joints (General Application):
   1. Standard:
      a. Oakum.
      b. Lead, FS QQ-C-40 Type 1.
   2. Compression joint: Neoprene gasket, ASTM C564.
   3. Mechanical: No hub, CISPI 310.

C. See Piping Schedules in Section 40 05 13.

2.02 FABRICATION

A. Cast-Iron Soil Pipe: SV service rated.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Observe manufacturer's recommendation for handling, cutting, jointing, installing, and testing.

B. Install products in accordance with CISPI.

C. Support exposed piping in accordance with Section 40 05 13.

D. Install buried piping in accordance with Section 40 05 13.

E. If "standard joint" is used, assure lead is run in one (1) continuous pour.
   1. No second pouring or driving of lead is permitted.
   2. Provide minimum of 12 OZ of lead per inch of pipe diameter per joint.

3.02 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 13.

END OF SECTION

SECTION 40 20 43
PIPE: POLYVINYL CHLORIDE (PVC) CHEMICAL WASTE

PART 1 – GENERAL

1.01 SUMMARY

A. Description:
   1. The Work consists of furnishing and installing polyvinyl chloride chemical waste and vent piping with DWV fittings and jointing where shown in the Plans.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   4. City of Bellevue:
      a. Utilities Department:
         1) Water Engineering Standards.
         2) Sanitary Sewer Engineering Standards.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue:
      a. Utilities Department:
         1) Water Engineering Standards.
         2) Sanitary Sewer Engineering Standards.
   2. ASTM International (ASTM):
      a. D2855, Standard Specification for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. See Section 40 05 13.
   2. Fabrication and/or layout Drawings:
      a. Submit complete layout Drawings of chemical waste systems showing type of fittings, routing and connections to be used at each location.

b. Submit detail of jointing methods and step-by-step procedures to be used on this Project.

3. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. Submit certificate secured from the manufacturer acknowledging compliance to Contract Documents.

C. Closeout Submittals:
1. Operation and Maintenance Manuals: Provide O&M manual documentation in accordance with Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. R&G Sloane Manufacturing Co., Inc.
2. Nibco.
3. Esloh-Thermoplastics Inc.
4. Approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. City of Bellevue:
1. Utilities Department:

a. Water Engineering Standards.

b. Sanitary Sewer Engineering Standards.

B. Provide, install, and connect PVC plastic chemical waste system as shown on Drawings including chemical vents through roof.

C. Uniformity: Ensure that piping, fittings, and solvent cements are integrated components for finished system.

D. Comply with ASTM D2855.

3.02 FIELD QUALITY CONTROL

A. Testing: Conform to Section 40 05 13.

END OF SECTION

SECTION 40 41 13
HEAT TRACING CABLE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Heat tracing cable as required for heat tracing of pipes as indicated on the Drawings.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Division 40 - Process Integration.
   4. Section 40 42 00 - Pipe, Duct and Equipment Insulation.
   5. Section 26 05 00 - Electrical: Basic Requirements.
   6. Section 26 08 13 - Acceptance Testing.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SYSTEM DESIGN REQUIREMENTS

A. The Heat Trace System shall be designed by qualified manufacturer representative.
   1. The designer is responsible for understanding the construction of the building's water piping system and other features of the building that will affect the layout of devices.

B. Provide a complete heat trace system as described herein and indicated on the Drawings.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product technical data:
      a. Power requirements for each circuit based upon actual length of heat trace and maintained temperature.

b. Circuit breaker rating based upon inrush current at minimum expected start-up temperature.

c. Length of heat tape for each pipe size and run.

d. Coordinate and verify length and Watts/FT of heat tape required based upon pipe size and insulation thickness.

1) Include the calculations to support the heat tape output.

e. See Section 26 05 00 for additional requirements.

2. Fabrication and/or layout Drawings:

a. Wiring diagrams showing physical locations of thermostats and heat trace power distribution and monitoring panels.

3. Test reports: Megger test results.

C. Closeout Submittals:
1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shall be stored such that they are not exposed to sunlight or other UV rays.

1.01 COMMISSIONING

A. The Work of this Section shall include the Contractor's labor and materials for participation in the Commissioning Activities (CX) as a Commissioning Team Member (CxT) as required by Section 01 95 00 – Commissioning Requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. Thermon.
2. Chemelex Division; Raychem Corp.
3. Chromalox.
4. Or Approved Equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00.

2.02 HEAT TRACING

A. Design Parameters:
1. Pipe diameter, length and material: See Drawings and Division 40 Specifications.

2. Flange, valve, pipe support size: See Drawings and Division 40 Specifications.
3. Pipe insulation type and thickness: See Drawings and Division 40 Specifications.
4. Temperatures requirements:
    a. Low ambient temperature for the specific location: 16 DegF.
    b. Start-up temperature (thermostat set point):
        1) Water lines: 40 DegF.
    c. High temperature exposure with power off: 185 DegF.
5. Wind factor for the specific location: 10 MPH.
6. Electrical requirements:
    a. Voltage: 120 V.
    b. Circuit breaker: Field coordinate if other than 20A GFEPCI type.
7. Safety factor: 10 percent.

B. Self-regulating or power-limiting parallel circuit construction consisting of an inner core of conductive material between parallel copper bus wires, with inverse temperature - conductivity characteristics with metal overbraid.

C. Thermostats adjustable between 35 and 200 DegF minimum with maximum differential range of 9 DegF, furnished complete with NEMA 4 enclosures in all areas, stainless steel temperature bulb and capillary.

D. All necessary or required components and accessories, such as power connection boxes, end seals, straps, tape and fitting brackets.

E. In non-corrosive and non-hazardous locations, insulation shall be Polyolefin.

F. Power Distribution and Monitoring Panel for one to four circuits as required, NEMA 4 enclosure minimum hinged and lockable.
1. Circuit breakers with 30 mA ground-fault protection.
2. Contactors, 120 Vac.
3. Indicating lights.
4. H-O-A switch.
5. Design base panel: Thermon PDMP-X-120-30.

PART 3 – EXECUTION

3.01 PREPARATION

A. Install materials after piping has been tested and approved.

3.02 INSTALLATION

A. Insulate and heat trace wet pipe systems as indicated on Drawings.

B. Install materials in accordance with manufacturer's instructions.
   1. Each circuit shall not exceed the manufacturer's recommended maximum length.

C. For metallic piping:
   1. Heat tracing shall be installed completely wired.
   2. Cut heat trace to lengths as required and secure to pipe with glass or polyester fiber tape.

D. For non-metallic piping:
   1. Allow for extra heat trace output because non-metallic pipe has a lower heat transfer.
      a. Heat tracing shall be installed completely wired.
   2. Cut heat trace to lengths as required and secure to pipe with aluminum tape through out the length of the trace.

E. Protection and Control Requirements:
   1. Protection by a GFEPCI circuit breaker.
      a. Breaker amperage rating shall be coordinated with Contractor when different than the Contract Drawings.
   2. Provide an ambient sensing thermostat for power and line sensing thermostat for alarm.

3.03 TESTING

A. Megger the cables at the manufacturers recommended voltage level three (3) times.
   1. Before installation.
   2. After attachment to pipe but before insulation is installed.
   3. After pipe insulation is installed but before energization.

B. Functional Testing: See Section 26 08 13.

END OF SECTION

SECTION 40 42 00
PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Insulation:
      a. Piping insulation.
      b. Duct insulation.
      c. Equipment insulation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
      b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
      c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
      d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
      e. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
      f. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
      g. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
      h. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
      i. E96, Standard Test Methods for Water Vapor Transmission of Materials.

j. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Clean rooms and Other Dust-Controlled Areas.

2. National Fire Protection Association (NFPA):

a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

3. Underwriters Laboratories, Inc. (UL):

a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. Submit complete Specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.

2. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.

C. Quality Assurance Submittals:
1. Certifications: Products will meet the requirements of the Contract Documents.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Elastomeric insulation:

a. Rubatex.

b. Armstrong.

c. Or approved equal.

2. Fiberglass insulation:

a. Certainteed Corporation.

b. Schuller (Manville).

c. Owens Corning.

d. Knauf.

e. Or approved equal.

3. PVC jacket:

a. Ceel-Co.

b. PIC Plastics.

c. Or approved equal.

4. Equipment insulation:

a. Certainteed Corporation.

b. Schuller (Manville).

c. Owens Corning.

d. Or approved equal.

5. Ductwork insulation:

a. Certainteed.

b. Schuller (Manville).

c. Owens Corning.

d. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00.

2.02 PIPING INSULATION - ELASTOMERIC

A. General:

1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:

a. Flame spread: 25.

b. Smoke developed: 100.

2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.

3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.

4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.

a. Water-soluble treatments are prohibited.

5. Insulated shields at pipe support points.

B. Pipe, Fitting, and Valve Insulation:
   1. Flexible elastomeric closed cell pipe insulation.
      a. Average thermal conductivity not to exceed 0.22 (Btu-IN)/(HR-FT^2-DegF) at mean temperature of 75 DegF, temperature range -40 to 220 DegF; permeability not to exceed 0.20 by ASTM E96; water absorption 3 percent by ASTM D1056 and ozone resistance.
   2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.03 PIPING INSULATION - FIBERGLASS

A. Pipe and Fitting Insulation:
   1. Preformed fiberglass pipe insulation:
      a. Density: 4 LBS/CF.
      b. Temperature rated: 650 DegF.
      c. Average thermal conductivity not to exceed 0.22 (Btu-IN)/(HR-FT^2-DegF) at mean temperature of 75 DegF.
      d. Fire hazard rating:
         1) UL 723, ASTM E84, NFPA 255.
         2) Flame spread not exceeding 25 and smoke developed not exceeding 100.
   2. Moisture adsorption:
      a. ASTM C553.
      b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at 120 DegF and 96 percent RH.
   3. Fungi and bacteria resistance:
      a. ASTM C665.
      b. Does not breed or promote growth.
      c. Flame attenuated glass fibers bonded with thermosetting resin.
   4. Piping jackets (general applications):
      a. Aluminum: 16 mil embossed aluminum.
      b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B.F. Goodrich PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
      c. Piping jacket not required on concealed piping.
   5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.04 EQUIPMENT INSULATION

A. Insulation for Equipment:
   1. Fire hazard classification:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread not exceeding 25 and smoke developed not exceeding 100.
   2. Provide minimum insulation thickness conforming to Schedules, or as shown on Drawings.

2.05 DUCTWORK INSULATION: FIBERGLASS

A. Flexible Insulation:
   1. Factory-applied foil scrim vapor barrier facing.
   2. Average thermal conductivity not to exceed 0.27 (Btu-IN)/(HR-FT^2-DegF) at a mean temperature of 75 DegF (installed).
   3. Minimum density: 0.75 LB/CF.
   4. Fire hazard classification:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread not exceeding 25 and smoke developed not exceeding 100.

B. Semi-Rigid Insulation for Indoor Installation:
   1. Factory applied vapor barrier facing-white scrim foil.
   2. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT^2-DegF) at a mean temperature of 75 DegF.
   3. Minimum density: 3.0 LB/CF.
   4. Moisture adsorption:
      a. ASTM C553.
      b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at 120 DegF and 96 percent RH.

C. Semi-Rigid Insulation for Outdoor Installation:
   1. Factory-applied foil scrim vapor barrier facing.
   2. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT^2-DegF) at mean temperature of 75 DegF.
   3. Minimum density: 3 LBS/CF.
   4. Finish with Benjamin Foster #4610 weatherproof mastic with white glass fabric membrane.
   5. Fungi and bacteria resistance:
      a. ASTM C665.
      b. Does not breed or promote growth.

D. Provide minimum insulation thickness conforming to Schedule, or as shown on Drawings.

E. Duct Interior Lining Board Roll:
   1. Acoustical performance: Minimum noise reduction coefficients (NRC) is 0.45 when tested in accordance with ASTM C423 on ASTM F25 mounting.
   2. Fire hazard classification:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread not exceeding 25 and smoke developed not exceeding 100.
   3. Service temperature:
      a. ASTM C411.
      b. Cooling and heating ducts up to 200 DegF.
   4. Velocity rating:
      a. ASTM C1071.
      b. Maximum average air velocity is rated at 600 fpm.
   5. Moisture adsorption:
      a. ASTM C553.
      b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at 120 DegF and 96 percent RH.
   6. Fungi and bacteria resistance:
      a. ASTM C665.
      b. Does not breed or promote growth.
   7. Size and performance:
      a. ASTM C518 and ASTM C177.
      b. 1 IN thickness, long textiled glass-type fibers firmly bonded by thermosetting resin.
      c. At 75 DegF mean temperature, the k value, expressed as (Btu-IN)/(HR-FT^2-DegF) does not exceed 0.27.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
   1. Piping below ground covered with earth will not be insulated .
   2. Consider ductwork, piping and equipment as exposed, except as otherwise indicated.

3. Consider ductwork, piping and equipment in walls, partitions, floors, pipe chases, pipe shafts and duct shafts as concealed.
    a. Consider ductwork, piping and equipment above ceilings as concealed.
4. Provide release for insulation application after installation and testing is complete.
    a. Apply insulation on clean, dry surfaces after inspection.
5. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
6. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures.
    a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
    b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
7. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.

C. Piping Insulation - Elastomeric:
1. Slip insulation on pipe prior to connection.
    a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
2. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
3. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.

D. Piping Insulation - Fiberglass:
1. Apply over clean dry pipe.
    a. Butt all joints together firmly.
2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
4. PVC pipe jacket:
    a. Apply jacketing with a minimum of 1 IN overlap.
        1) Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.

b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT.

1) Construct slip-joints by overlapping jacket sections 6 to 10 IN.

c. Provide premolded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.

5. Aluminum pipe jacket:

a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.

b. Provide smooth and straight joint with a minimum 2 IN overlap.

c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 IN back from edge.

d. Center spacing of screws 5 IN maximum or as required to provide smooth tight-fitted joints.

e. Place joints on least exposed side of piping to obtain neat appearance.

E. Equipment: Install per manufacturer's instructions.

F. Ductwork Insulation - Fiberglass:

1. Flexible insulation:

a. Butt edges tightly.

1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 IN strips on 12 IN centers and/or pins, applied on not more than 18 IN centers so that the insulation conforms to the duct surfaces uniformly and firmly.

b. Seal joints with facing overlap or 4 IN wide strips of like facing material adhered and stapled in place.

c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.

d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at corners.

2. Semi-rigid insulation and duct interior lining board:

a. Impaling over pins.

1) Apply insulation with edges tightly butted.

2) Apply insulation with mechanically welded fasteners to the duct and secured with speed clips.

3) Clip pins off close to clip.

4) Space pins as required to hold insulation firmly against duct surface but not less than one (1) pin per 1.5 SF.

5) Seal joints and speed clips with 3 IN wide strip of facing adhered with Benjamin Foster 85-20 adhesive.

b. If the welded pin method is impossible, secure insulation to the duct with Benjamin Foster 85-20 adhesive.

1) Cover the entire surface of duct with adhesive.

2) Use corner metal angle to protect edge of insulation.

3) Protect edge of insulation.

4) Seal joints as above.

G. Install interior duct lining board as indicated above.
1. Overall length shall be as indicated on the Drawings or a minimum of 10 LF past any type of air supply fan.

3.02 REPAIR

A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

3.03 SCHEDULES

A. Refrigeration Lines (35 - 60 DegF):
1. Elastomeric.

2. 1/2 IN thickness for lines 1 IN and smaller.

B. Pipe, Fittings and Valves:
1. Fiberglass.

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Roof Drainage	2-1/2 to 6 IN	1/2 IN	PVC
Hot Water (domestic)	1IN and less	1 IN	PVC
	Over 1 IN	1 1/2IN	PVC
Cold Water (domestic)	1IN and less	1 IN	PVC
	Over 1 IN	1 1/2IN	PVC
Heating Water (120 - 230 DegF)	6 IN and less	1 IN	PVC
Below drain pans serving cooling coils, pre-heat systems, domestic water heaters	1 IN flexible elastomeric closed cell sheet.		
Emergency generator exhaust pipe, fire	2-1/2 IN mineral wool 1200		

APPLICATION	PIPE SIZE	THICKNESS	JACKET
pump engine, and muffler		DegF or equal held in place with stainless steel bands. Field applied 0.05 IN aluminum jacket. Aluminum jacket not to exceed 150 DegF.	
Cold water meter		Uninsulated	

C. Ductwork:
   1. Fiberglass.

DUCT SERVICE	INSULATION AND THICKNESS
Outside air and supply air downstream of heat recovery units, outside building	2 IN semi-rigid for outdoor installation
Outside air ducts, inside building	1-1/2 IN semi-rigid with vapor barrier
Supply air ducts downstream of cooling coils	1 IN flexible with vapor barrier
Exhaust air ducts upstream of heat recovery units, inside building	1-1/2 IN semi-rigid
Exhaust air ducts upstream of heat recovery units, outside building	1-1/2 IN semi-rigid for outdoor installation
All other ductwork	Uninsulated

END OF SECTION

SECTION 40 50 05
GATE VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Gate valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue (COB):
      a. Surface Water Engineering Standards, January 2012.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   3. American Water Works Association (AWWA):
      a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
      b. C504, Standard for Rubber-Seated Butterfly Valves.
      c. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
      d. C515, Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Systems.
      e. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
   4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
      b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
      c. SP-80, Bronze Gate, Globe, Angle and Check Valves.
   5. NSF International (NSF):
      a. 61, Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. OS&Y: Outside Screw and Yoke.

B. NRS: Non-rising Stem.

C. RS: Rising Stem.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals: See Specification Section 40 05 23 – Valves: Basic Requirements.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation in accordance with Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 VALVES: WATER, STEAM CONDENSATE, STEAM TO 125 PSI, AIR; 2-1/2 IN AND SMALLER

A. Class 125 bronze gate valve.

B. Comply with MSS SP-80.

C. Materials:
   1. Body, bonnet, wedge: Bronze.
   2. Stem: Silicon bronze.
   3. Packing: Aramid fibers with graphite (Kevlar®).

D. Design Requirements:
   1. 125 psi steam, 200 psi nonshock WOG.
   2. Screw in bonnet, non-rising stem, solid wedge.

E. Acceptable Manufacturers:
   1. Nibco.
   2. Stockham.
   3. Or approved equal.

2.03 VALVES: STEAM CONDENSATE, STEAM TO 125 PSI, AIR; 3 IN AND LARGER

A. Class 125 iron body gate valve.

B. Comply with MSS SP-70.

C. Materials:
   1. Body, bonnet, wedge: Cast iron, ASTM A126, Class B.
   2. Stem: Brass, bronze, or copper silicon alloy.

D. Design Requirements:
   1. 125 psi steam to 400 DegF, 200 psi WOG.
   2. Bolted bonnet, OS&Y, solid wedge, bronze mounted.
   3. Actuator: Handwheel.

E. Acceptable Manufacturers:
   1. Nibco.
   2. Stockham.
   3. Or approved equal.

2.04 VALVES: WATER (HOT, COLD, HEATING, COOLING, SERVICE, PROCESS, POTABLE, NON-POTABLE, AND WASTEWATER)

A. Double Disc Gate Valve, 3 IN to 12 IN (Water Application):
   1. Comply with AWWA C500.
   2. Materials:
      a. Seating surfaces, stems, stem nut: Bronze.
      b. Body, disc: Cast iron.
   3. Design requirements:
      a. 200 psi working pressure.
      b. Buried: NRS, O-ring stem seal, 2 IN operation nut.
      c. Exposed: NRS, O-ring stem seal, handwheel
      d. Acceptable manufacturers:
         1) American Flow Control.
         2) Clow.
         3) M&H.
         4) Mueller.
         5) Or approved equal.

B. Resilient Wedge Gate Valves, 2 to 48 IN (Water, Wastewater Application):
   1. Comply with AWWA C509.

2. Materials:
    a. Stem and stem nut: Bronze.
        1) Wetted bronze parts in low zinc bronze.
        2) Aluminum bronze components: Heat treated per AWWA C504.
    b. Body, gate: Cast iron.
    c. Resilient wedge: Fully encapsulated rubber wedge Ethylene Propylene Diene Monomer (EPDM)
3. Design requirements:
    a. Minimum 200 psi working pressure.
    b. Buried: NRS, O-ring stem seal, 2 IN square operating nut.
    c. Exposed: OS&Y, stuffing box stem seal,
    d. Counter clockwise open rotation.
    e. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
        1) Comply with AWWA C550.
        2) Comply with NSF 61.
        3) Wetted bronze parts in low zinc bronze.
        4) Aluminum bronze components: Heat treated per AWWA C504.
4. Acceptable manufacturers:
    a. Clow.
    b. Mueller.
    c. American Flow Control.
    d. M & H.
    e. Or approved equal.

C. Double Disc Gate Valves, 14 to 48 IN (Water, Wastewater Application):
1. Comply with AWWA C500.
2. Materials:
    a. Seating surfaces, stem, stem nut: Bronze.
    b. Body, discs: Cast iron.
3. Design requirements:
    a. 150 psi working pressure.
    b. NRS O-ring stem seal.
    c. Provide gear actuator, 20 IN and larger valves.
    d. Provide roller tracks and scrapers for horizontal valves size 16 IN and larger.

e. Provide bypass valve sized per AWWA C500.

4. Acceptable manufacturers:
   a. Clow.
   b. Mueller.
   c. American Flow Control.
   d. M & H.
   e. Or approved equal.

2.05 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators.
   1. Furnish actuator integral with valve.

B. Refer to Specification Section 40 05 23 – Valves: Basic Requirements for actuator requirements.

2.06 FABRICATION

A. General:
   1. Provide valves with clear waterways the full diameter of the valve.

B. Spot valves in accordance with MSS SP-9.

2.07 SOURCE QUALITY CONTROL

A. Perform following tests, in accordance with AWWA C500, on valves constructed in accordance with AWWA C500:
   1. Operation test.
   2. Hydrostatic test.

B. Perform following tests, on valves constructed in accordance with AWWA C509 and AWWA C515:
   1. Operation test.
   2. Shell test.
   3. Seal test.
   4. Hydrostatic test.
   5. Torque test.
   6. Leakage test.
   7. Pressure test.

PART 3 – EXECUTION

3.01 INSTALLATION

A. See Specification Section 40 05 23 – Valves: Basic Requirements.

B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.

C. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION

SECTION 40 50 10
PLUG VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Plug valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Cast Iron Pipe Flanges and Flanged Fittings - Classes 25, 125 and 250.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      b. A536, Standard Specification for Ductile Iron Castings.
      c. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C504, Standard for Rubber-Seated Butterfly Valves.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals: See Specification Section 40 05 23 – Valves: Basic Requirements.

C. Closeout Submittals:
   1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.
      a. See Specification Section 40 05 23 – Valves: Basic Requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 60 00 - Product Requirements.

2.02 NON-LUBRICATED ECCENTRIC PLUG VALVES SEWAGE, SLUDGE, SEWAGE GAS APPLICATIONS

A. Acceptable Manufacturers:
   1. DeZurik.(Basis of Design).
   2. Millikin.
   3. ValMatic.
   4. Victaulic.
   5. Or approved equal.

B. Materials:
   1. Body: Cast-iron ASTM A126, Class B.
   2. Plug: One-piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM A126 Class B.
   3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70 Type A durometer hardness per ASTM D2240.
   4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or bronze.
   5. Valve seats: Welded-in overlay of 90 percent nickel, minimum Brinell hardness of 200, (minimum 1/8 IN thick).
   6. Stem seal: Nitrile butadiene packing or Buna-N dual U-cups or bronze cartridge double O-rings with lower grit seal O-ring per AWWA C504, Section 3.7.

2.03 LUBRICATED SEAL PLUG VALVES (NATURAL GAS APPLICATIONS)

A. Acceptable Manufacturers:
   1. Nordstrom.
   2. Walworth.
   3. Millikin.
   4. Or approved equal.

B. Materials:
   1. Body: Cast iron ASTM A126, Class B.
   2. Plug: Cast iron ASTM A126, Class B.

3. Plug facing: Teflon on tapered plug.
4. Valve seats: Gas-resistant lubricant/sealant.

2.04 NON-LUBRICATED ECCENTRIC PLUG (HEATING-COOLING WATER APPLICATIONS)

A. Acceptable Manufacturers:
   1. DeZurik Figure 499.
   2. Millikin Series 603.
   3. Victaulic Series 365.
   4. Or approved equal.

B. Materials:
   1. Body: Cast iron, ASTM A126, Class B.
   2. Plug: Bronze or nickel-plated cast iron.
   3. Bearings: Bronze or nickel.
   4. Plug seal: Isobutene-isoprene (250 DegF).

2.05 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuator.
   1. Furnish actuator integral with valve.

B. Refer to Specification Section 40 05 23 – Valves: Basic Requirements for actuator requirements.

2.06 DESIGN REQUIREMENTS

A. Non-Lubricated Eccentric Plug Valves (Wastewater, Sludge):
   1. Port area:
      a. Valves 4 IN through 20 IN: Equal to or exceed 80 percent of full pipe area.
      b. Valves greater than 20 IN: 100 percent equivalent full pipe area.
   2. Valve body: Fitted with bolted bonnet.
   3. End connections: See Specification Section 40 05 23 – Valves: Basic Requirements.
   4. Stem seal: Adjustable and replaceable without disassembling valve or bonnet.
   5. Designed for seating drip tight in any flow direction.
   6. Rating:
      a. 1/2 IN through 12 IN, 175 psi working pressure.
      b. 14 IN through 36 IN, 150 psi working pressure.
      c. Three-way valves, 125 psi working pressure.

7. Actuator:
    a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
    b. Positive identification on actuator indicating valve position.
    c. Adjustable stop to set closing torque.

B. Lubricated Plug Valves (Natural Gas):
1. Pressure lubricated valve with sealed ports and grooves.
    a. Re-seatable under full pressure in any position.
2. Pressure rating: 200 psi WOG.
3. Port area: Minimum 60 percent of pipe area.
4. Acceptable to local gas company.

C. Non-Lubricated Eccentric Plug Valve-(HVAC):
1. Port area: Valves 1/2 IN through 2-1/2 IN: Equal to or exceed 100 percent of full pipe area.
2. Valve body: Fitted with threaded bonnet or bolted bonnet.
3. End connections:
    a. Flanges: In full accordance with ASME B16.1, Class 125 including facing, drilling and thickness.
    b. Threaded connection: In full compliance with NPT.
4. Stem seal: Self-adjusting U-cups or multiple O-ring seals.
5. Shut-off: Designed for setting drip-tight at the full rated pressure.

2.07 FABRICATION

A. See Specification Section 40 05 23 – Valves: Basic Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. See Specification Section 40 05 23 – Valves: Basic Requirements.

B. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.

C. Install valve with actuator above pipe or plug centerline.

END OF SECTION

SECTION 40 50 15
BUTTERFLY VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Butterfly valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 13 - Pipe and Pipe Fittings: Basic Requirements.
   4. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue (COB):
      a. Surface Water Engineering Standards, January 2012.
   2. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.
   3. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
      e. A436, Standard Specification for Austenitic Gray Iron Castings.
      f. A536, Standard Specification for Ductile Iron Castings.
      g. B148, Standard Specification for Aluminum-Bronze Sand Castings.
   4. American Water Works Association (AWWA):
      a. C504, Standard for Rubber-Seated Butterfly Valves.
   5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-67, Butterfly Valves.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. See Section 40 05 23 – Valves: Basic Requirements.
   2. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Project Representative in accordance with AWWA C504.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. DeZurik.
   2. Clow.
   3. Mueller.
   4. Pratt.
   5. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 BUTTERFLY VALVES (AWWA C504)

A. Comply with AWWA C504.
   1. Valve bodies:
      a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
      b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
   2. Valve shafts:
      a. Stainless steel, 18-8, Type 304 or 316.
   3. Valve discs:
      a. Potable and nonpotable water:
         1) ASTM A48, Class 40 cast iron.
         2) ASTM A536, Grade 65-45-12 ductile iron.
         3) ASTM A436, Type 1 alloy cast iron.
         4) Bronze in accordance with AWWA C504.

b. Wastewater and similar applications:

1) ASTM A436, Type 1 alloy cast iron.

2) ASTM A536, Grade 65-45-12 ductile iron.

3) ASTM A436, Type 1 alloy cast iron.

4) Bronze in accordance with AWWA C504.

c. Air and similar applications: ASTM A48, Class 40 cast iron.

4. Valve seats:

a. Potable and nonpotable water below 150 DegF:

1) Natural rubber.

b. Potable and nonpotable water and wastewater and air below 180 DegF:

1) Buna-N.

c. Heating water and air 180 to 250 DegF.

1) EPDM.

5. Mating surfaces:

a. Valves less than 30 IN: ASTM A276, 18-8, stainless steel or bronze.

b. Valves 30 IN and larger: ASTM A276, 18-8, stainless steel.

B. Design Requirements:

1. Seat type:

a. Resilient.

b. Comply with AWWA C504.

2. Exposed and submerged valves 3 IN through 20 IN.

a. Body type: Wafer or short body flange (laying length may vary from AWWA C504).

b. Equip wafer type with fully tapped anchor lugs drilled per ASME B16.5.

3. Exposed and submerged valves 24 IN and larger:

a. Body type: Short body flange.

b. Working pressure: Rated for 150 psi (Class 150B per AWWA C504).

4. Direct buried valves:

a. All valves: Working pressure rated for 150 psi (Class 150B per AWWA C504).

2.03 BUTTERFLY VALVES (MSS SP-67)

A. Comply with MSS SP-67.

B. Materials:
   1. Valve bodies:
      a. Wafer body: Cast iron ASTM A126, Class B.
      b. Lug body: Ductile iron, ASTM A395.
   2. Valve shaft or stem:
      a. Stainless steel, ASTM A276, Type 316.
   3. Valve disc:
   4. Ductile iron, ASTM A395, nickel plated.
   5. Valve seat:
      a. Water and air below 180 DegF: Buna-N.
      b. Water and air 180 to 250 DegF: EPDM.
      c. Valve seat shall be a full body seat isolating stem and body from flow.

C. Design Requirements:
   1. Exposed and submerged valves 3 IN through 20 IN.
      a. Body type: Wafer.
      b. Working pressure: Rated for 150 psi.
      c. Equip with fully tapped anchor lugs drilled per ASME B16.5.
   2. Exposed and submerged valves 24 IN and larger:
      a. Body type: Short body flange.
      b. Working pressure: Rated for 150 psi.

2.04 ACCESSORIES

A. Refer to Drawings and/or valve schedule for type of actuators.
   1. Furnish actuator integral with valve.

B. Refer to Section 40 05 23 – Valves: Basic Requirements for actuator requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. City of Bellevue (COB):
   a. Surface Water Engineering Standards, January 2012.

B. See Section 40 05 23 – Valves: Basic Requirements.

END OF SECTION

SECTION 40 50 20
BALL VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Ball valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue (COB):
      a. Surface Water Engineering Standards, January 2012.
   2. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   3. American Water Works Association (AWWA):
      a. C507, Standard for Ball Valves, 6 IN through 48 IN.
   4. Federal Specification (FS):
      a. WW-V-35C, Valve, Ball.
   5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-72, Ball Valves with Flanged or Butt-Welding Ends for General Service.
      b. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.03 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. See Section 40 05 23 – Valves: Basic Requirements.
   2. Test results for AWWA valves.

C. Closeout Submittals:
   1. O&M Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 METALLIC BALL VALVES 1/4 IN TO 3 IN DIA

A. Comply with MSS SP-72.

B. Acceptable Manufacturers:
   1. Apollo.
   2. Jamesbury.
   3. Watts.
   4. Stockham.
   5. Nibco.
   6. Or approved equal.

C. Materials:
   1. Body: Bronze.
   2. Stem, stem gland nut: Brass.
   3. Ball: Brass, chrome plated.
   4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
   5. Handle: Vinyl coated or zinc- or cadmium-plated steel.

D. Design Requirements:
   1. Rated for 400 psi and 250 DegF, WOG for threaded end applications and 285 psi WOG and 150 psi saturated steam service for flanged end applications.
   2. Handles showing direction of opening.
   3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
   4. Stem with reinforced Teflon stuffing box ring and blowout-proof design.

5. Renewable reinforced Teflon seats.
6. Ball design which does not allow media contact with stem.
7. Balancing stop for all applications.
8. Bodies with mounting pad for applications requiring actuators.

2.03 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators.
   1. Furnish actuator integral with valve.

B. Refer to Section 40 05 23 – Valves: Basic Requirements for actuator requirements.

2.04 SOURCE QUALITY CONTROL

A. Shop test AWWA C507 ball valves in accordance with AWWA C507.

B. Furnish record of test.

PART 3 – EXECUTION

3.01 INSTALLATION

A. City of Bellevue (COB): Surface Water Engineering Standards, January 2012.

B. See Section 40 05 23 – Valves: Basic Requirements.

3.02 FIELD QUALITY CONTROL

A. For AWWA C507 ball valves and in accordance with Section 01 95 00 – Commissioning Requirements employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by these Specifications.
   2. Supervise adjustments and installation checks.
   3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
   4. Conduct startup of equipment and perform operational checks.
   5. Provide Project Representative with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 40 50 25
GLOBE VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Globe valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue (COB):
      a. Surface Water Engineering Standards, January 2012.
   2. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-80, Bronze Gate, Globe, Angle and Check Valves.
      b. SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Shop Drawings:
      a. See Section 40 05 23 – Valves: Basic Requirements.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 VALVES: WATER, STEAM CONDENSATE, STEAM TO 125 PSI; 2-1/2 IN AND SMALLER

A. Class 150 bronze globe valve.

B. Comply with MSS SP-80.

C. Acceptable Manufacturers:
   1. Nibco T235Y.
   2. Stockham B22.
   3. Or approved equal.

D. Materials:
   1. Body, bonnet, disc holder and nut: Bronze.
   2. Stem: Copper silicon alloy.
   3. Packing: Teflon impregnated fiber.
   4. Disc: Teflon.

E. Design Requirements:
   1. 150 psi steam at 400 DegF, 300 psi non-shock WOG.
   2. Union bonnet, rising stem, renewable disc.

PART 3 – EXECUTION

3.01 INSTALLATION

A. City of Bellevue (COB):
   1. Surface Water Engineering Standards, January 2012.

B. See Section 40 05 23 – Valves: Basic Requirements.

C. Install globe valves with stem in horizontal position wherever possible.

END OF SECTION

SECTION 40 50 30
CHECK VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Check valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue (COB):
      a. Surface Water Engineering Standards, January 2012.
   2. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).
   3. American Water Works Association (AWWA):
      a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 IN through 24 IN NPS.
   4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
      b. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.03 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

1.04 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Shop Drawings:
      a. See Specification Section 40 05 23 – Valves: Basic Requirements.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 CHECK VALVES: 2.5 IN AND SMALLER

A. Class 125 Bronze Swing Check Valves (Fuel Oil, Compressed Air, Water, Wastewater):
   1. Comply with MSS SP-80.
   2. Acceptable manufacturers:
      a. Nibco T413-Y.
      b. Stockham B-319Y.
      c. Or approved equal.
   3. Materials:
      a. Body, bonnet, disc: Bronze.
   4. Design requirements:
      a. 125 psi steam to 406 DegF, 200 psi WOG.
      b. Horizontal swing, renewable disc.

B. Class 150 Bronze Lift Check Valves (Fuel Oil, Compressed Air):
   1. Comply with MSS SP-80.
   2. Acceptable manufacturers:
      a. Stockham B-322B.
      b. Powell 158B.
      c. Or approved equal.
   3. Materials:
      a. Body, cap, disc holder: Bronze.
      b. Disc: Buna-N.
   4. Design requirements:
      a. 150 psi to 150 DegF, 300 psi WOG.
      b. Lift check, union cap.

2.03 SWING CHECK VALVES: 3 IN TO 24 IN

A. Swing Check Valves (Water, Wastewater, Sludge):
   1. Comply with AWWA C508.
   2. Acceptable manufacturers:
      a. Clow.
      b. American Darling.
      c. Golden Anderson.
      d. Or approved equal.
   3. Materials:
      a. Body and cover: Cast iron.
      b. Seat ring, hinge: Bronze.
      c. Disc:
         1) 3 IN to 4 IN: Bronze.
         2) 6 IN to 24 IN: Cast iron with bronze face.
         3) 6 IN to 24 IN: Cast iron with rubber face.
      d. Hinge shaft: Stainless steel.
      e. Bearings, connecting hardware: Bronze.
   4. Design requirements:
      a. 175 psi working pressure (3 IN to 12 IN).
      b. 150 psi working pressure (14 IN to 24 IN).
      c. Furnish with outside weight and lever or lever and spring.

2.04 CUSHIONED SWING CHECK VALVES: 2 IN TO 24 IN

A. Class 250.

B. Comply with AWWA C508.

C. Acceptable Manufacturers:
   1. Air:
      a. Golden Anderson Figure 250D (Class 250).
      b. APCO Series 6000.
      c. Or approved equal.
   2. Oil:
      a. APCO Series 6100.
      b. Golden Anderson Figure 25-DXH.
      c. Or approved equal.

D. Materials:
   1. Body, cover, disc, levers: Cast iron or cast steel.
   2. Seat: Bronze or stainless steel.
   3. Seat ring: Bronze or rubber (Buna-N).
   4. Hinge: Stainless steel.
   5. Cushion cylinder: Metallic corrosion resistant material.

E. Design Requirements:
   1. Seat ring: Replaceable.
   2. Hinge: Extend out both sides with lever and weight.
   3. Cushion: Air or oil type with adjustable speed control.

2.05 RUBBER FLAPPER SWING CHECK VALVES: 2 IN TO 24 IN

A. Class 125 (175 psi), ASME B16.1.

B. Acceptable Manufacturer:
   1. APCO Series 100.
   2. Milliken Valve Company.
   3. Or approved equal.

C. Materials:
   1. Body and cover: Cast iron.
   2. Flapper: Buna-N, steel reinforced.

PART 3 – EXECUTION

3.01 INSTALLATION

A. City of Bellevue (COB): Surface Water Engineering Standards, January 2012.

B. See Specification Section 40 05 23 – Valves: Basic Requirements.

C. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 40 50 35
MISCELLANEOUS VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Air release and vacuum relief valves.
   2. Automatic control valves:
      a. Pressure relief and pressure-sustaining valves.
      b. Pressure-reducing valves.
      c. Surge arrester valves.
      d. Altitude valves.
      e. Electric check valves.
      f. Float-controlled valves.
      g. Pinch valves.
   3. Float-operated valves (2 IN and smaller).
   4. Pressure-reducing valves (2 IN and smaller).
   5. Pressure relief valves (1 IN and smaller).
   6. Solenoid valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 05 - Equipment: Basic Requirements.
   4. Section 40 05 23 - Valves: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. City of Bellevue (COB):
      a. Surface Water Engineering Standards, January 2012.
   2. American Gas Association (AGA).
   3. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250).

4. American Water Works Association (AWWA):
    a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for Waterworks Service.
    b. C550, Standard for Protective Interior Coatings for Valves and Hydrants.
5. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
    1. Shop Drawings:
        a. See Section 40 05 23 – Valves: Basic Requirements.

C. Closeout Submittals:
    1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 AIR RELEASE AND VACUUM RELIEF VALVES

A. General: Conform to AWWA C512.

B. Alternate 1:
    1. Water
        a. Air Release Valve:
            1) Acceptable manufacturers:
                a) APCO 200A.
                b) GA Industries, Figure 920.
                c) Or approved equal.
            2) Materials:
                a) Body and cover: Cast iron or semi-steel.
                b) Float: Stainless steel.

c) Linkage and trim: Bronze or stainless steel.

3) Design requirements:

a) Size: 1 IN.

b) Working pressure: 150 psi.

c) Release 10 cfm at 10 psi differential at 150 psi line pressure.

b. Air and Vacuum Valve:

1) Acceptable manufacturers:

a) APCO Series 1900.

b) GA Industries, Figure 992.

c) Or approved equal.

2) Materials:

a) Body and cover: Cast iron.

b) Float: Stainless steel.

c) Seat: Buna-N.

c. Combination Air Release and Vacuum Valve:

1) Acceptable manufacturers:

a) GA Industries, Figure 945 or 960.

b) APCO Series S-140C (1 IN-4 IN) S-150C (6 IN) S-151C (8 IN) C.

c) Or approved equal.

2) Materials:

a) Body and cover: Cast iron.

b) Float, linkage and hardware: Stainless steel.

c) Seat: Buna-N.

2.03 AUTOMATIC CONTROL VALVES

a. Pressure-reducing control:

1) Acceptable manufacturers:

a) Clayton, Model 90-01.

b) GA Industries, Figure 4500D.

c) Watts ACV 115 Series.

d) Singer 106-PR.

e) Or approved equal.

2) Design requirements: Modulate basic valve to maintain a uniform downstream pressure as set on control pilots.

b. Surge arrester control (hydraulic):

1) Acceptable manufacturers:

a) GA Industries, Figure 500-A-ABCDE.

b) Clayton, Model 52-03.

c) Watts ACV 116-S2.

d) Singer, Model 106-RPS-L&H.

e) Or approved equal.

2) Design requirements:

a) Open basic valve rapidly at predetermined overpressure and close slowly after restoration of normal pressure.

b) Open rapidly at predetermined under pressure, remain open to dissipate surge and then slowly close.

c) Open rapidly on electric power failure, remain open to dissipate surge and then slowly close.

2. Design requirements:

a. Assembles all control features and hardware on basic valve at factory.

b. Use corrosion-resistant metal for all exposed portions of the control.

c. Include with valve control:

1) Stop valves.

2) Strainer.

3) Valves for opening and closing speed control.

4) Pilot valves.

5) Solenoid valves.

6) Pressure switches as necessary to provide control function.

d. Electric components:

1) 110 V, 1 PH.

2) In weatherproof enclosure unless shown otherwise on the Drawings.

2.04 FLOAT-OPERATED VALVES (2 IN AND SMALLER)

A. Acceptable Manufacturers:

1. GA Industries, Figure 64 (70 psi).
2. GA Industries Figure 52 (175 psi).
3. Cla-Val.
4. Or approved equal.

B. Materials:
   1. All bronze except:
      a. Seat: Rubber.
      b. Float: Copper.

C. Design Requirements:
   1. Working pressure: 150 psi.
   2. Direct float connected and mechanically actuated.

2.05 PRESSURE-REDUCING VALVES (2 IN AND SMALLER)

A. Water Pressure Regulators:
   1. Acceptable manufacturers:
      a. Fisher, Type 75A.
      b. Watts Series 25AUB-Z3.
      c. Or approved equal.
   2. Materials:
      a. Body: Bronze.
      b. Strainer body: Bronze.
      c. Strainer screen: Stainless steel.
   3. Design requirements:
      a. Self-contained diaphragm operated.
         1) Spring loaded.
         2) Field adjustable.
      b. Strainer: Y-type on supply.
      c. Size as shown in Schedule or size equal to connecting line size with 125 psi inlet and 50 psi outlet pressure.

2.06 PRESSURE RELIEF VALVE (1 IN AND SMALLER)

A. Acceptable Manufacturer:
   1. Fisher 98 Series.
   2. Watts.
   3. Or approved equal.

B. Materials:
   1. Body: Cast iron.
   2. Spring: Steel.
   3. Diaphragm water - neoprene.
   4. Trim: 416 stainless steel.

2.07 SOLENOID VALVES (1 IN AND SMALLER)

A. General Service (Air - Water):
   1. Acceptable manufacturer:
      a. ASCO.
      b. J.D. Gould Co.
      c. Or approved equal.
   2. Materials:
      a. Body: Brass.
      b. Seat: Buna-N.
      c. Insulation: Class F.
   3. Design requirements:
      a. 110 Vac.
      b. Two-way, normally closed.
      c. Enclosure: Compatible with area classifications indicated on Drawings.
      d. Working pressure, air and water: 125 psig.
   4. Accessories: Provide strainer on supply.

2.08 PINCH VALVES

A. Acceptable Manufacturers:
   1. Red Valve.
   2. Flexible Valve Corp.
   3. Or approved equal.

B. Materials:
   1. Body: Cast or ductile iron.
   2. Sleeve: EPDM.
   3. Stem: Stainless steel.

C. Size: As shown.

D. Sleeve:
   1. Nonwetted.
   2. Completely enclosed with bonnet.
      a. No packing shall be required.
   3. 100 percent full port design.
   4. Integral flange faces.

E. Pinch Mechanism:
   1. External position indicator.

2. Grease fitting.

F. Positive Opening Tabs:
   1. Ensure that sleeve will not collapse under less than 2 psig internal pressure.
   2. Stainless steel with stainless steel fasteners attached to top and bottom pinch bars.
   3. Attached to nylon reinforced external band around full circumference of sleeve.
      a. Band width: Full width of pinch bars.

2.09 ACCESSORIES

A. Furnish any accessories required to provide a completely operable valve.

2.10 FABRICATION

A. Completely shop assemble unit including any interconnecting piping, speed control valves, control isolation valves and electrical components.

B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance with AWWA C550.

2.11 SOURCE QUALITY CONTROL

A. Shop hydrostatically test to piping system test pressure.

2.12 MAINTENANCE MATERIALS

A. Provide one (1) set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: See Section 40 05 05 – Equipment: Basic Requirements and Section 40 05 23 – Valves: Basic Requirements.

B. City of Bellevue (COB): Surface Water Engineering Standards, January 2012.

C. Air Release, Vacuum Relief, and Pressure Relief Valves:
   1. Pipe exhaust to a suitable disposal point.
   2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.

3.02 FIELD QUALITY CONTROL

A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.

B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

END OF SECTION

SECTION 40 65 21
COMPRESSED AIR SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Compressed air system including:
      a. Scroll air compressor with air receiver and controls.
      b. Air filters.
      c. Air dryers.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 40 05 05 - Equipment: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. Section VIII, Division 1, Construction of Pressure Vessels.
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   3. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 - Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. See Section 40 05 05 – Equipment: Basic Requirements.
   2. Fabrication Drawings:
      a. Air receiver fabrication Drawing showing all tap locations and ASME data plate information.
      b. Show location of all control equipment.
   3. Manufacturer's installation instruction.
   4. Manufacturer's statement of proper installation and start-up.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals.
   2. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.04 EXTENDED WARRANTY

A. In accordance with the provisions of Section 01 78 00 – Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. All air compressor equipment and related components shall have a minimum five (5) year non-prorated parts, including compressors, tanks, controls, etc., and labor warranty including travel from the later date of acceptance.

1.05 COMMISSIONING

A. The Work of this Section shall include the Contractor's labor and materials for participation in the Commissioning Activities (CX) as a Commissioning Team Member (CxT) as required by Section 01 95 00 – Commissioning Requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Air compressor:
      a. Ingersoll-Rand.
      b. Worthington.
      c. Or approved equal.
   2. Air dryer:
      a. Hankison.
      b. Ingersoll-Rand.
      c. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 60 00 – Product Requirements.

2.02 AIR COMPRESSOR UNIT

A. General:
   1. Provide an air compressor unit with the following components:
      a. Scroll air compressors: Two (2) each.

b. Air receiver: One (1) each.

c. Controls: As specified.

2. Compressors and motors shall be mounted on a heavy steel base which is mounted on the horizontal air receiver.

3. Unit shall be factory assembled piped and wired requiring field connection of air discharge piping and electrical power.

4. Compressor features:

a. Cast iron crankcase and cylinder(s).

b. Cylinder(s) bolted to crankcase.

c. Splash lubrication.

d. Finned intercooler.

e. Fan-type balance flywheel.

f. Stainless steel finger valves.

g. Centrifugal unloader.

h. Dry-type inlet filter/silencer with 4 micron replaceable element.

i. Air-cooled after cooler.

5. Motor:

a. See Section 40 05 05.

b. Totally enclosed, fan cooled.

c. V-belt drive with belt guard.

d. 460 V, 3 PH, 60 HZ.

B. Air Receiver:

1. Provide 80 GAL horizontal receiver.

2. Receiver to be ASME National Board coded for 200 psi working pressure.

3. Receivers shall have following accessories:

a. Pressure gage, 0 psi to 200 psi.

b. Drain valve.

c. Service valve.

d. Safety valve.

4. Receivers are to be supported with steel legs or ring base.

C. Controls:

1. Furnish adjustable pressure switch start-stop control.

a. Provide automatic alternation between compressors.

b. Controls to be in NEMA 1 enclosure.

2. Provide automatic oil level shutdown switch.

3. Furnish magnetic starters for motors in NEMA 1enclosure.

2.03 AIR FILTER

A. Particulate Filters
   1. Filter shall remove 99.95 percent of particles down to 1.0 micron.
   2. Filter shall be equipped with a differential pressure indicator.
   3. Provide automatic electric drain valve for condensate.
   4. Provide with replaceable filter element.

2.04 AIR DRYERS

A. Refrigerated Air Dryer:
   1. Dried air shall have a dewpoint of 35 DegF.
   2. Dryer capacity shall be based upon inlet air at 100 psig, 100 percent relative humidity, 100 DegF ambient temperature with a maximum of 5 psi maximum pressure loss across the unit.
   3. Pressure vessels to be UL approved or ASME coded for 200 psi operating pressure.
   4. Construct with corrosion resistant materials with heat exchanger being aluminum, stainless steel or epoxy coated copper.
   5. All copper components exposed to ambient air to be epoxy coated.
   6. Provide following unit mounted indicators:
      a. Temperature indicators:
         1) Inlet air.
         2) Outlet air.
         3) Refrigerant suction.
         4) Refrigerant discharge.
      b. Pressure indication:
         1) Air outlet.
      c. Indicator lights:
         1) Power on.
         2) Compressor on.
         3) High temperature.
   7. Cycle refrigerant compressor to maintain outlet temperature.
   8. Provide controls to automatically start and stop refrigerant compressor with safety shut down interlocks for thermal overloads.
   9. Unit enclosure to be NEMA 1.
   10. Power supply to be 115 V, 1 PH, 60 HZ.

11. Provide automatic electric drain valve piped to nearest drain.

2.05 ACCESSORIES

A. Automatic Electric Drain Valves:
   1. Provide automatic drain valve for condensate:
      a. Valve shall have solenoid actuated valve.
      b. Solenoid shall have integral timer with adjustable setpoint for opening frequency 1 HR to 24 HRS and length of time open, 1 second to 10 seconds.
      c. Power supply to be 110 V, 1 PH.

2.06 FABRICATION

A. Complete all brackets or connections and openings for air receiver and vessels prior to testing in manufacturer's plant.
   1. No field welding or drilling permitted.

2.07 SOURCE QUALITY CONTROL

A. Air Receivers and Vessels:
   1. Test and stamp in accordance with ASME code.

2.08 MAINTENANCE MATERIALS

A. Filter Element:
   1. Provide a minimum of six (6) filter replacement elements for each filter type.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with Section 40 05 05 – Equipment: Basic Requirements.

B. Install products in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. See Section 01 95 00 – Commissioning Requirements.

B. Employ and pay for services of manufacturer's representative to:
   1. Inspect final installation.
   2. Supervise startup and perform final adjustments.

3. Instruct Project Representative for a minimum of 8 HRS on operation and maintenance procedures.
4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 40 90 10

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes a supervisory control and data acquisition (SCADA) system and the associated control strategies.

B. Related Sections include but limited to:
   1. 01 95 00 - Commissioning Requirements.
   2. 23 09 00 – Instrumentation and Control for HVAC System.
   3. 33 52 19 – Diesel Fuel Dispensing System.
   4. 26 32 14 – Engine Generators: Diesel.
   5. 26 36 00 –Transfer Switches.
   6. 33 40 00 – Storm Drainage System.

1.02 REFERENCES

A. Comply with the requirements of Section 01 09 05 – Reference Standards and as listed herein. The following is a list of standards referenced in this Section:
   1. NEMA ICS 1-3000: General Standards for Industrial Control and Systems.
   2. NEMA ICS 1.1-1984: Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control.
   3. NEMA ICS 12.1-1977: Industrial Control and Systems: Profiles of Networked Industrial Devices – Part 1 General Rules.
   4. NEMA/EIA 232-F-1997: Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange.
   5. TIA/EIA 422-A-1994: Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
   6. King County SCADA and PLC Standards.

1.03 DEFINITIONS AND ACRONYMS

A. I/O: Input/Output.

B. BAS: Building Automation System.

C. MCP: Main Control Panel (a component of the SCADA system).

D. OIT: Operator Interface Terminal (a component of the SCADA system).

E. PLC: Programmable Logic Controller (a component of the SCADA system).

F. P&ID: Process & Instrumentation Diagram.

G. System Integrator (SI): The entity responsible for the construction and programming of the PLC & SCADA system.

H. SCADA: Supervisory Control and Data Acquisition.

I. WAN: Wide area network.

J. CHRLF: King County Cedar Hills Regional Landfill.

1.04 SYSTEM DESCRIPTION

A. The SCADA system provides status monitoring and control of selected systems and processes.
   1. The system hardware configurations are detailed on the Drawings.
   2. The programming narratives are provided in the control strategies narratives in paragraph 3.03.
   3. The facility controls contained in the SCADA system operate independently from outside systems and provide complete functionality when operated as a standalone system.
   4. The SCADA system provides an Ethernet communication link to the BAS that allows the BAS to monitor selected facility systems and initiate control directives to designated facility systems.
      a. Provide Ethernet connection to the BAS.
      b. Programming of the BAS is covered in Section 23 09 00 – Instrumentation and Control for HVAC Systems.
   5. The SCADA system provides an Ethernet communication link to the King County Cedar Hills Regional Landfill (CHRLF) that allows the CHRLF SCADA system to monitor selected facility systems and initiate control directives to designated Factoria RTS.
      a. Programming for systems and equipment at the CHRLF is by others.

B. Control loops for input and output points from the SCADA system may involve installation of components or wiring from multiple entities on a single control loop.

C. Color Schemes: Unless otherwise noted, the following color formats shall be provided in the base programming of control system displays:
   1. Running: Green.
   2. Stopped: Red.
   3. Idle: Gray.
   4. Fault: Yellow.
   5. Alarm: White lettering with Red Background.
   6. Warning: Black lettering with Amber Background.
   7. Valve Open: Green.
   8. Valve Closed: Red.
   9. Loss of Communications: Black Lettering with Cyan Background.
   10. Pipe with flow: Green.

11. Pipe without flow: Gray.
12. Instantaneous values for flow, level, and other analog signals: white or contrasting color to background. Colors shall be consistent across all screens.
13. Totalized values for flow, level, and other analog signals: white or contrasting color to background. Colors shall be consistent across all screens.

D. Graphics on control system displays shall be provided in a graphical format to the minimum level of detail shown on the Drawings.

E. Provide method to change screens to see all applicable controls and monitored points from a manned location.

F. Text and graphical configuration of the system shall be of sufficient size, contrast, and thickness to be identifiable and legible by persons with normal vision at the installed operators distance for the screens provided.

G. Where analog devices are monitored the analog value shall be displayed in both numerical and graphical format on the control system displays.

H. Seismic Restraint Requirements:
1. Attachments to structural elements of the building for permanent systems shall comply with the requirements of the applicable codes.

I. The control strategies in Paragraph 3.03 provide the System Integrator with direction on programming for the SCADA system.

J. The Drawings detail the required SCADA equipment, including I/O cards, racks, panels, monitored points, controlled points, lights, and switches.

1.05 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 – Submittal Procedures for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
1. Product Data for each component.
2. Shop Drawings depicting the SCADA main control panel, wire chases within the panel, panel relays, terminal blocks, and power supplies.
    a. Panelboard Shop Drawings shall be based on the SCADA main control panel on the electrical Contract Drawings.
3. Samples control screen screenshot diagrams.
4. Control loop diagrams and descriptions for each loop in system.
    a. Ensure that tag numbers cross reference with loop diagrams and tag numbers shown on instrument Specification forms.
    b. Where tag numbers are not assigned, the control integrator shall coordinate with the Project Representative for numbering consistency and assign tag numbers.
    c. Describe each element and include appropriate tag number in parenthesis.

d. When additional elements are necessary, use and assign tag number not in conflict with others and in accordance with King County SCADA and PLC Standards.

5. Tag Name Database: Provide complete annotated tag name database for all physical, internal and virtual I/O points.

   a. Provide complete annotated ladder logic printouts and programming for each ladder component annotated with a description and point name.

   b. Provide memory map with tag name references for all points and registers specified for communication to or from the BAS or off-site SCADA system at the CHRLF.

   c. Coordinate I/O functionality, alarm priority (status, alarm, and shutdown), event log, log frequency, trending requirements, engineering units and operational function on a point by point basis with the Project Representative.

   d. Provide tag name database in accordance with King County Standards.

C. Quality Assurance Submittals:
   1. Documentation of System Integrator's qualifications.
   2. Provide I/O test logs that document each I/O point was individually tested from the SCADA system PLC card to the PLC panel terminal strip at the panel fabricator shop prior to shipping and that the tested I/O point operated properly.
   3. Provide I/O test logs that document each I/O point was individually tested from the SCADA system to the installed I/O end device as a complete system and that the tested I/O point operated properly.
   4. Test reports showing that each programmed control strategy operates as specified.

D. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Section 01 73 00 – Operation and Maintenance Manuals. Include the following:

      a. Operating Instructions with description and illustration of all hardware and software provided.

      b. License listing for all software licenses provided.

      c. Annotated ladder logic printouts.

      d. Annotated memory map printouts.

      e. Two (2) CD-ROM/DVD-ROM soft copies of the final version of all installed software and programming.

         1) Soft copies shall be categorized on the storage media by device.

         2) Provide soft copy program for the PLC, and each interface screen separately on the storage media device.

f. Provide PLC programming software and license to the Project Representative.

g. Provide interface screen software and license to the Project Representative.

2. Site Acceptance Test Documentation:

a. Provide complete testing binder with all components and sign offs in a single location. Provide finalized testing document with sign offs in hard copy and electronic format to the Project Representative at the completion of testing.

3. Documentation of delivery of spare parts and maintenance materials.

4. Extended Warranty: Provide two executed copies of the Extended Warranty required by this Section in accordance with the provisions of Section 01 78 00 – Closeout Procedures.

1.06 QUALITY ASSURANCE

A. The System Integrator shall have been in business under the same name for a minimum of 5 years providing integration, configuration, and programming for SCADA systems similar in scope and complexity to the system specified.

B. The System Integrator shall be UL Certified 508A Industrial Control Panels and UL certified 698A Intrinsically Safe Extensions.

C. Subject to compliance with the Contract Documents, the following System Integrators have the capabilities to design, build, integrate and install the control panels in this facility:

1. Technical Systems Inc., 2303 196th St SW, Lynnwood, WA 98036, www.TSIControls.com Phone (425) 775-5696.

2. Quality Controls Corporation, 5015 208th St SW, Ste. 1B, Lynnwood, WA 98036, www.qualitycontrolscorp.com Phone (425) 778-8280, Fax: (425) 778-4541.

3. L2 Systems LLC, 3322 16th Street, Everett, WA 98201-1912, www.l2systemsllc.com/ Phone: (425) 258-2402, Fax: (425) 258-2439.

4. Systems Interface, Inc., 22125 17th Ave SE, Ste. 111, Bothell, WA 98021-7406, http://www.l2systemsllc.com/ Phone (425) 481-1225, Fax (425) 481-2115.

D. Contractor to hire **Harris Group**, 200 West Thomas Street Ste. 200, Seattle, Washington 98105, Phone (206) 494-9400 www.harrisgroup.com as the sole source automation service provider to:

1. Program and test programmable logic controllers and installed I/O modules off site at the integration facility.

2. Test each I/O point to the panel field wiring terminal strip or device where the device is provided on the panel.

3. Provide test report to Project Representative prior to delivery to the project site documenting that each I/O point has was successfully tested and the correct programmed register in the PLC activated or monitored the I/O point.

4. Test each I/O point on site as a complete installed system from the SCADA system to the end device with all components installed.

5. Make corrections as required to demonstrate complete operation and monitoring to the end device.

E. System Configuration Planning Meetings: Schedule a minimum of three (3) four (4)-hour system configuration planning meetings with the Project Representative and other Owner staff responsible for the King County SCADA system.

F. Equipment and installation shall meet the minimum construction and functionality recommendations outlined in the following standards: NEMA ICS 1-3000, NEMA ICS 12.1, NEMA/EIA 232-F, TIA/EIA 422-A, and King County SCADA and PLC Standards.

1.07 PROGRAMMING SOFTWARE

A. Utilize Rockwell Automation RSLogix 5000 Enterprise Standard Edition Programming Software.

B. King County approved version -No exception or substitutions.

1.08 DOCUMENTATION

A. Provide complete documentation of all programs. Utilize all of the available documentation services available through the RSLogix Programming Software. All application programs shall be fully commented. Program databases shall be fully expanded and shall include a comments field.

B. All PLC programs shall be fully documented. Include references to Drawings, original rung comments and requirements defined in the King County's "PLC Installation and Programming Guidelines Manual".

1.09 PROGRAMMING LANGUAGE

A. King County has standardized on Ladder Logic language for programming the PLC. All programs shall utilize Ladder Logic language and RSLogix 5000 programming software. In addition, Function Block Language may be used sparingly for analog signal processing with written permission from King County. Specifically forbidden are the use of Structured Text language and Sequential Function Charts without written permission from King County. Time spent by the Contractor to correct programming that is not compliant with the programming software and programming language defined in this Section will be at the Contractor's expense and shall not affect the project schedule or milestone dates.

1.10 SOFTWARE REVISIONS

A. Provide a formal revision tracking procedure for all software being submitted and delivered to the Project Representative. The revision tracking procedure shall contain information necessary to track all changes, ensure revisions are properly tested, documented, and incorporated into the final program. The revision tracking procedure shall track submitted programs, reference Project Representative's comments, show date program was saved, date of all revisions and reference to material used for the program revisions.

B. The revision tracking procedure shall ensure that only fully tested, fully documented and properly revised software is loaded into the PLC for delivery.

1.11 SOFTWARE FUNCTIONS

A. All calculations and control functions shall reside in the PLC and shall not be implemented in the operator interface devices.

B. Provide common functions and software structures among programs for the facilities.

C. Provide PLC programs capable of performing the following functions at a minimum:
   1. Analog input processing and conversion to engineering units.
   2. Discrete input processing for alarms and interlocks.
   3. Discrete output processing for Alarm generation to local annunciators and other equipment.
   4. Pump Sequence selection (Lead, 1st Follow, 2nd Follow, etc.).
   5. Pump Start/Stop and Speed control.
   6. Proportional+ Integral+ Derivative (PID) control algorithm processing, with setpoints entered locally or transmitted from the SCADA system.
   7. Analog Output processing for control loop outputs.
   8. Real-time clock for scheduling of control functions and tasks.
   9. Display of process data on Operator Interface.

D. Provide Operator Interface programming that allows adjustment of loop setpoints, timer and counter presets, and loop tuning parameters.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 60 00 – Product Requirements.

1.13 EXTENDED WARRANTY

A. In accordance with Section 01 78 00 - Closeout Procedures, provide an Extended Warranty for the Work of this Section:
   1. The Warranty Period for Work of this Section is five (5) years commencing on the date of Substantial Completion against defects in materials and workmanship, and agreeing to repair or replace components that fail during the Warranty Period.

1.14 SYSTEM STARTUP

A. System Integrator shall provide field startup and testing support as necessary to demonstrate full system functionality in compliance with the P&ID diagrams and the control strategies.
   1. Coordinate with other disciplines and the contractor to test each system and work with the contracting team to make corrections necessary for full system functionality.
   2. System Integrator shall include a minimum of 40 HRS time for startup assistance.

3. Where startup support is completed in less than the specified minimum number of hours the remaining unused hours up to the specified minimum number of hours will be added to the hours specified for field training of users and operators.

1.15 COMMISSIONING

A. System Integrator shall provide commissioning support and materials to meet the requirements of Specification Section 01 95 00 - Commissioning.

B. System Integrator shall provide commissioning support to fully test each control strategy and configuration as defined on the P&ID diagrams.
   1. Testing for commissioning shall be conducted in the field following the installation of all components associated with the design control or monitoring functionality.

1.16 SITE ACCEPTANCE TESTING

A. Provide a detailed site demonstration to demonstrate the installed control system meets the contract documents performance requirements for each control strategy, control point, and P&ID.
   1. Provide a testing summary for each control strategy describing the test, what will be witnessed to show proper operation, and providing for Project Representative sign off for witnessing the tests proper completion and functionality.
   2. Provide a testing summary for each I/O point described on the P&ID's that are not specifically addressed in the control strategies to demonstrate operations in compliance with the project documents. Include a field demonstration, description of will be witnessed to show proper operation, and provide for Project Representative sign off for witnessing the tests proper completion and functionality.
   3. Prepare test and demonstration methods to show that the points transmitted or received from the BAS or from Cedar Hills operate properly. Demonstrate proper operation and coordinate witnessing and sign off by the Project Representative.

B. The System Integrator shall prepare the site acceptance testing procedures, formats, and documentation.

C. The System Integrator shall conduct and lead the testing procedures in coordination with the Project Representative.

D. Test systems for proper operation in the field, with all components, wiring, and terminations installed, prior to requesting Project Representative sign off to witness proper operation.

E. Schedule Project Representative sign off shall be structured to witness demonstration of multiple control strategies on a single test day. Structure schedule for Project Representative witnessing of proper operation demonstration to occur on no more than 4 business days.

F. Provide three weeks advance notice to Project Representative prior to scheduling a demonstration test day. Requests shall be submitted in writing and acceptance or request to reschedule will be provided to the Contractor in writing.

G. Modify systems as required to show proper operation of systems in compliance with the Contract Documents.

1.17 SPARE PARTS AND MAINTENANCE MATERIALS

A. Extra Materials: Provide five spares of each fuse type, and lamp type installed.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The PLC provided shall be Allen Bradley to match current King County Standards:
   1. This PLC is pre-established King County Standard hardware.
   2. No Approved Equal.

2.02 ACCEPTABLE PRODUCTS

A. Provide Allen Bradley Control Logix PLC.

B. No exceptions or substitutions.

C. Provide system topology using Allen Bradley communication topologies and protocols that include Allen Bradley, Ethernet, DF-1 radio/Telco, DH-485 DH + and RIO communications networks.

D. SCADA screens directly connected to the SCADA network shall be touch screen format and shall be provided with all graphics and programming necessary to incorporate the controls and monitoring to fully depict the layout and configuration as shown on the P&ID diagrams and described in the control strategies narratives.
   1. Provide screens with a site plan showing monitored equipment locations with active links to the system monitored, and overall alarm indication.

E. The SCADA switch shall be Cisco RV082 Dual WAN VPN Router, 8 port minimum or approved equal.

2.03 EQUIPMENT

A. Provide all required equipment to meet the Contract Document requirements including those depicted on the P&ID diagrams and described in the control strategies.
   1. The equipment list described in this Specification Section alone is not a comprehensive list of all SCADA and control equipment.

B. The SCADA system PLC is to be located in the main control panel (MCP).
   1. Provide indicated control switches, indicator lights, and status displays at locations indicated on the Contract Documents.

C. The CHRLF historical data server for SCADA system data is by others.
   1. No additional historical data servers are provided in the scope.

D. There are no SCADA workstations on site. Off site SCADA workstations are by others.

E. There are three SCADA screens directly connected to the SCADA network.

F. Provide controls and control wiring from the MCP to Fuel Station Monitoring Panel, Fire Alarm Control Panel, and control panels and specified instruments and devices depicted on the Process & Instrumentation Diagrams.

G. The facility includes the BAS specified in Section 23 09 00 - Instrumentation and Control for HVAC System.
   1. Provide Eight Port Ethernet 10/100BaseT cabinet mounted switch for the SCADA system interface to the BAS and to the remote Wide Area Network link for the CHRLF monitoring station.
      a. Provide switch meeting the requirements of 2.02D.
      b. The switch shall connect to the following devices: PLC, (3) Panelmate Plus Monitors, BAS, & CHRLF remote SCADA connection.
      c. The PLC network includes communications to the three SCADA monitor panels and the PLC I/O.
      d. The switch shall include integral router and firewall functions to manage access to the SCADA PLC control and data systems.
      e. Configure switch to limit access to other systems.
      f. Provide network control points indicated on the P&ID plans and in the control strategy write-ups.
         1) Failure of the external systems Ethernet communications link shall not compromise the functionality or operation of the PLC SCADA system.

H. Control system displays shall be touch screen industrial type with integral hard drive and 10/100BaseT Ethernet port.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide all required programming, hardware, licenses, interconnections and configurations necessary to complete the indicated programming functionality and interface.

B. Provide SCADA control system that is fully functional as a stand alone system.
   1. Configure controls to maintain operation based on the last provided setpoint or condition should communication to external systems or displays be interrupted.

C. Program and configure the SCADA and PLC system to communicate and control all indicated SCADA devices and points and communicate with the external SCADA and BAS specified on the contract documents.

D. Program the SCADA and PLC system to transfer control points, totalized values, registers, and other software registers indicated on the contract documents including those detailed on the P&ID diagrams, mechanical control sheets, and in the control strategy functionality descriptions.

E. Provide all required memory maps, registers, and control logic to integrate the remote control indicated and to detail I/O point lists for remote monitoring via the BAS and external SCADA systems.

F. Provide complete I/O lists that are fully annotated and include equipment ID tags matching those on the contract documents.

G. Provide, programming, and configuration of two (2) 20 IN touch screen Panel-Mate Plus display units to reside on the PLC control network to monitor and control system performance. One screen shall be in the telephone/data room, and one screen shall be in the TSO room. The screen in the TSO room shall be configured for Monitoring only.

H. Provide Ethernet connection from the SCADA switch to the BAS head end and provide programming in the SCADA system to transmit and receive indicated values, registers, controls, and I/O data to the BAS.

I. Provide Ethernet connections from the PLC to the SCADA switch and from the SCADA switch to the (3) Panelmate Plus monitors.

J. Provide Ethernet connection from the SCADA switch to the WAN for connection to the CHRLF SCADA site.

K. Coordinate all specified configuration and development requirements with the Project Representative.
   1. Coordination shall be achieved with configuration meetings and submittals to establish an acceptable configuration format and operation methods that meet the intent of the Contract Documents.

L. Install and test systems to meet minimum recommended guidelines outlined in NEMA ICS 1.1.

M. Provide an alarm screen with the ability to locally and remotely acknowledge or alarm.
   1. Remote alarm acknowledge shall be configured as an alarm reset over the SCADA Ethernet network via an external Ethernet alarm acknowledge received.
   2. The local acknowledge shall be accessible to the facility user without the need for a ladder or key.

N. The SCADA system includes a Wide Area Network (WAN) interconnection to which allows for control and monitoring of the on site SCADA system from existing off site County SCADA nodes, as well as, allows the on-site SCADA system to control and monitor the operations at the facility.
   1. The existing offsite SCADA nodes include the CHRLF monitoring facility.
   2. The programming of screens, data points, and alarms for the system at the CHRLF is by others.
   3. Provide programming, software, and licenses for the PLC, on-site SCADA screens, alarms, data points, and totalized values specified in this scope of work.
   4. Provide programming necessary to transmit totalized values and data points to/from the BAS or CHRLF.

O. Control loop and strategy descriptions and P&IDs provide the functional requirements of the control loops represented in the Contract Documents.

P. Control loop and strategy descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but are rather intended to supplement and complement the drawings and other Specification Sections.
   1. The control loop or control strategy descriptions shall not be considered equal to a bill of materials.

Q. Terminal Strip and Control Wire Labeling: Provide each terminal strip with a unique label and provide each installed wire with a unique label installed at both ends and at each termination.
   1. Terminal strip and wire labels shall be provided on the SCADA system Shop Drawings provided in the submittal stage.

R. Fuses for control power shall be din rail mounted fuse blocks with indicator light indicating blown fuse.

S. Provide an incoming control panel source breaker and interlock breaker with the external panel access handle such that the panel door will not open unless the handle turns off the incoming panel main power source breaker.
   1. Provide external panel screw bypass operator to bypass the interlock and allow the panel to be opened via screwdriver without de-energizing the control panel. Provide interlock as describe for each SCADA control panel or SCADA I/O panel.

3.02 INSTALLATION

A. Provide instrumentation hardware, programming, licenses, and software as necessary to perform control functions described herein and shown on Drawings.

B. Detail and delineate all control systems and parameters on a process-by-process, loop-by-loop basis:
   1. The control strategies and P&ID Drawings included in the Contract Documents provide generalized control requirements.
   2. Provide programming, software and equipment configuration, and additional registers or software configurations to meet the specified control parameters and requirements.
   3. Provide sufficient detail in the programming annotation to convey complete understanding of operational parameters and control functions provided when examined by a third party.

C. Install system in accordance with applicable codes and regulations, manufacturer's written instructions, and this Section.

D. Coordinate with other disciplines and suppliers to interconnect and complete field wiring and equipment configurations for specified control functions:
   1. Test final configurations for proper operation following installation of all components, wiring, programming, and configurations for all devices and terminations in the control loop or strategy.

E. Program the PLC and SCADA system to operate independent of the status of the Local and WAN connected SCADA servers, and the BAS WAN and Local connections.
   1. The PLC shall be programmed to provide monitoring and control data to the local panel-mate, or equal, screens via a dedicated communications network and to the existing WAN to make the data available for monitoring and control data at the various County remote located SCADA nodes and BAS.

F. The SCADA system is the control interface to the indicated field hardware and equipment.
   1. Refer to the P&IDs provided under the electrical Contract Documents for additional requirements.

G. Maximum value set points, initial set point values and other process data values referenced as user, operator or owner defined shall be coordinated with the Project Representative during the programming phase of implementation.
   1. All unassigned initial values shall be identified and implemented prior to the factory acceptance test.
   2. All values shall be set point assignable from SCADA.

3.03 SCADA SYSTEM CONTROL STRATEGIES

A. Typical of all Flow Meters:
   1. The SCADA system monitors the flow meter to provide an instantaneous reading and provides calculated registers for total daily flow, total weekly flow, total monthly flow, and total annual flow.
   2. Provide memory map of registers to transmit all points to SCADA.

B. Irrigation System Flow Summary:
   1. The SCADA system monitors the flow meter for the irrigation system.
   2. The SCADA system will provide an instantaneous reading and PLC calculated registers for total daily flow, total weekly flow, total monthly flow, and total annual flow.
   3. Provide memory map of registers to transmit all points to SCADA.

C. Potable Water Flow Summary:
   1. The SCADA system monitors the flow meters for the misting system, the admin building, the transfer station lower level, and the HHW building flow branches.
   2. The PLC will sum all flows on the feeder branches and report the total Potable Water Flow rate as a calculated value.
   3. The SCADA system will provide an instantaneous reading and PLC calculated registers for total daily flow, total weekly flow, total monthly flow, and total annual flow.
   4. Provide memory map of registers to transmit all points to SCADA.

D. Fire Protection Flow Summary:
   1. The SCADA system monitors the flow meters for the HHW building and Admin and Transfer Station Fire Protection flow branches.

2. The PLC will sum all flows on the feeder branches and report the total Fire Protection Water Flow rate as a calculated value.

3. The SCADA system will provide an instantaneous reading and PLC calculated registers for total daily flow, total weekly flow, total monthly flow, and total annual flow.

4. Provide memory map of registers to transmit all points to SCADA.

E. Scale House Water Flow Summary:
   1. The SCADA system monitors the flow meter for the Scale House water feed branch.

   2. The SCADA system will provide an instantaneous reading and PLC calculated registers for total daily flow, total weekly flow, total monthly flow, and total annual flow.

   3. Provide memory map of registers to transmit all points to SCADA.

F. Sanitary Sewer Discharge Flow Summary:
   1. The SCADA system monitors the flow meter on the sanitary sewer discharge line.

   2. The SCADA system will provide an instantaneous reading and PLC calculated registers for total daily flow, total weekly flow, total monthly flow, and total annual flow.

   3. Provide memory map of registers to transmit all points to SCADA.

G. Standby Generator:
   1. SCADA monitors the generator status indication and monitors the automatic transfer switch that starts the generator automatically.

   2. The SCADA system will send an output signal to open the remote fuel tank supply solenoid and start the remote fuel tank pump whenever the generator is starting or running.

   3. Provide low fuel level output contact to fire alarm control panel for low level fuel switch.

   4. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.

H. Fuel Station:
   1. SCADA monitors the fueling station contacts for leak, low level, and less than 24 HRS of fuel remaining level and alarms on all conditions.

   2. The fuel station as a fuel flow meter for fuel being consumed by the generator. The flow signal from this meter is wired to the fueling station monitoring panel and is not monitored by the SCADA system.

   3. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.

I. Electrical Power Systems:
   1. SCADA monitors the UPS for power on, power fail, AC power on and DC power on. Alarms shall be provided on abnormal conditions. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.

J. Air Compressor:
   1. SCADA monitors the air compressor discharge pressure and provides indication of instantaneous pressure and alarms on low pressure.
   2. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.

K. Hot Load Pad:
   1. The normal operating mode of the hot load pad is to have the run off water flowing into the storm drain through the Storm Water Drain Valve (V-110A).
   2. When a hot load is in the facility, V-110A closes and the Wastewater Diversion Valve (V-110B) opens to divert run off to the hot load drain holding tank.
   3. Both valves are located in the Hot Load Valve Vault and will be controlled by the SCADA PLC.
   4. Panel PVCP-T1 provides open and closed indicating lights for each valve.
   5. PVCP-T1 is provided under Division 23 and the mechanical contract drawings. SCADA control wiring to the panel will meet an interposing terminal strip provided in PVCP-T1. Devices on PVCP-T1 are provided under Division 23 and the mechanical Contract Drawings.
   6. The SCADA-based diversion switch, HS-110A, can be activated by any operator to initiate diversion to the hot load drain holding tank. This can also be initiated from any SCADA screen including the screens at the Cedar Hills facility.
   7. The hot load control panel (PVCP-T1) diversion switch, HS-110B, can be pressed by any operator to initiate diversion to the hot load drain holding tank.
   8. Once the hot load run-off has been diverted to the holding tank, the valve positions are locked in until the hot load has been removed and a supervisor determines that it is safe to switch back to the normal operating mode. The RESET button (HS-110C) on the local control panel can be pressed to switch the valves back to direct the run off water into the storm drains. For safety and regulatory compliance, this is the only way to change back to discharging to the storm drain.
   9. SCADA monitors and displays the diversion status, limit switch position contacts for both the storm and wastewater valves and the hot load holding tank level.
   10. The PLC shall be programmed to have one of the two valves open at all times and one of the two valves closed at all times, excluding transition times.
   11. Two outputs are required to change the valve position. One output will initiate a transition to storm while the other will initiate a transition to the holding tank.
   12. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.

13. There is no automatic overriding control from SCADA other than described above.

L. Tipping Floor Rainwater Cisterns:
   1. SCADA monitors the instantaneous level (LT-320) and four level switches (LSHH-320, LSH-320, LSL-320, and LSLL-320) in the Wet Well. The two cisterns and the wet well are hydraulically linked, so the level in wet well will reflect the level in the active cisterns.
   2. Each cistern can be isolated from the process with manual valves.
   3. When a low level is reached, as monitored by LSL-320, a pump disable signal is activated in the control panel (RCP-T2). This will disable the submersible pump (SP-320). This disable signal resets when the level rises above the high level, as monitored by LSH-320.
   4. When SP-320 is disabled, RCP-T2 closes the Cistern Isolation Valve (V-320) and opens the Domestic Water Bypass Valve (V-325). When the water level in the cistern, returns to the high level, SP-320 is enabled and V-320 opens and V-325 closes to return to normal operation.
   5. When SP-320 is enabled, SP-320 will be operated to maintain the pressure set point in the discharge line. The discharge line pressure is measured by the pressure transmitter, PIT-320. The pump will start when the pressure drops below 4.5 PSI and will continue pumping until the line pressure reaches 7 PSI.
   6. When a high-high level is reached, as monitored by LSHH-320, the cistern will be overflowing through the rainwater overflow pipe.
   7. When a low-low level is reached, as monitored by LSLL-320, a system alarm shall be activated to alert the operators of a potential leak. This alarm will activate once and after it is acknowledged, it will not activate again until after the level has risen above the high level. This is to minimize nuisance alarms.
   8. Configure SCADA with an out of service provision so that the operator can set the tank out of service during maintenance without having the low level switch disable the booster pump.
   9. The out of service selection shall also be field selectable from HS321 in RCP-T2.
   10. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.
   11. The initial levels for the level switches are listed below:
      a. Overflow Level: 99.04 FT.
      b. Cistern High Level: 95.67 FT.
      c. Domestic Source: 94.17 FT.
      d. Low Low Level: 93.50 FT.
   12. Field verify levels and adjust as necessary to meet specification requirements. All levels shall be adjustable by the Project Representative.

M. Administration Rainwater Cistern:

1. SCADA monitors the instantaneous level (LT-330) and four level switches (LSHH-330, LSH-330, LSL-330, and LSLL-330) in the cistern.
2. When a low level is reached, as monitored by LSL-330, a pump disable signal is activated in the control panel (RCP-T1). This will disable the submersible pump (SP-330). This disable signal resets when the level rises above the high level, as monitored by LSH-330.
3. When SP-330 is disabled, RCP-T1 closes the Cistern Isolation Valve (V-330) and opens the Domestic Water Bypass Valve (V-335). When the water level in the cistern, returns to the high level, SP-330 is enabled and V-330 opens and V-335 closes to return to normal operation.
4. When SP-330 is enabled, SP-330 will be operated to maintain the pressure set point in the discharge line. The discharge line pressure is measured by the pressure transmitter, PIT-330. The pump will start when the pressure drops below 4.5 psi and will continue pumping until the line pressure reaches 7 psi.
5. When a high-high level is reached, as monitored by LSHH-330, the cistern will be overflowing through the rainwater overflow pipe.
6. When a low-low level is reached, as monitored by LSLL-330, a system alarm shall be activated to alert the operators of a potential leak. This alarm will activate once and after it is acknowledged, it will not activate again until after the level has risen above the high level. This is to minimize nuisance alarms.
7. Configure SCADA with an out of service provision so that the operator can set the tank out of service during maintenance without having the low level switch disable the booster pump.
8. The out of service selection shall also be field selectable from HS331 in RCP-T1.
9. Provide memory map of registers to transmit all points to SCADA and BAS, and provide register to control for control input points.
10. The initial proposed levels for the level switches are listed below:
    a. Overflow Level: 101.23 FT.
    b. Cistern High Level: 99.63 FT.
    c. Domestic Source: 98.13 FT.
    d. Low Level: 97.63 FT.
11. Field verify levels and adjust as necessary to meet Specification requirements. All levels shall be adjustable by the Project Representative.

END OF SECTION