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PROJECT MANUAL – TECHNICAL SPECIFICATIONS

DIVISION 2 - SITE WORK

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SECTION 02010
SUBSURFACE INVESTIGATION

1. **GENERAL**
   1.1 RELATED WORK SPECIFIED ELSEWHERE
      A. Job Site Administration: Section 01043
      B. Construction Photographs: Section 01380
      C. Inspection Services: Section 01420
      D. Dewatering: Section 02140
      E. Shoring: Section 02150
   1.2 SOILS REPORTS
      A. Any data on soil and/or subsurface conditions shown in the Plans or Specifications is not to be taken as a representation, but is based on limited information and is at best only an opinion; consequently, such data cannot be considered precise or complete and there is no guarantee as to its completeness, accuracy, or precision.
      B. Additional Investigation:
         1. Contractor should visit the site and acquaint himself with site conditions before submitting a bid and the submission of a bid will be prima facie evidence that he has done so.
         2. Prior to bidding, Contractor may make his own subsurface investigations to satisfy himself with site and subsurface conditions.
   1.3 QUALITY ASSURANCE
      A. The Contractor shall readjust work performed that does not meet technical or design requirements.
      B. The Contractor shall make no deviations from the Contract Documents without specific and written approval of the Owner.
      C. The Contractor shall be responsible for obtaining approval from responsible agency or property owner before performing any exploratory excavations.

* * * END OF SECTION * * *

SECTION 02050
DEMOLITION

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Site Clearing: Section 02110
     - B. Grading: Section 02210
     - C. Excavating, Backfilling and Compacting for Utilities: Section 02222
     - D. Pavement Repair and Resurfacing: Section 02575
   - 1.2 PROTECTION
     - A. Streets, roads, adjacent property and other work to remain shall be protected throughout the work.
     - B. Pavement may be cut only where authorized and only to the extent specified.
     - C. Anything not identified to be demolished or removed, damaged by Contractor's operations, shall be replaced as new by Contractor at Contractor's expense.
   - 1.3 CUTTING PAVEMENT, CURBS AND WALKS
     - A. Unless specified otherwise by the authority having control over the pavement, curbs and walks, cutting and replacement shall be as specified in Section 02575.
   - 1.4 PRIVATE DRIVEWAYS, CULVERTS AND MISCELLANEOUS
     - A. Pipe laying operations in certain areas may necessitate temporary removal of mail boxes, private driveways, drains, service lines, conduits, etc. to facilitate construction. In the event that the Contractor finds it necessary to remove the above mentioned items, it is to be understood that it will be his responsibility to restore these items in a manner equal to their original condition. The Contractor shall maintain adequate temporary provisions for domestic deliveries and utilities service and access to firefighting equipment.
     - B. The preceding requirement will be the same for any temporary removal of road culverts, whether under state, county or private jurisdiction.
     - C. The cost of the above described work shall be included in the price bid for pipe and no additional compensation shall be made to the Contractor.
     - D. The Contractor shall make every effort to prevent blocking private driveways for more than a reasonable time and shall make such driveways immediately accessible on order of the Owner.
   - 1.5 REMOVAL OF STRUCTURES
     - A. The Contractor shall raze, remove, and dispose of all buildings and foundations, structures, fences, and other obstructions that are indicated in the drawing.
     - B. Remove foundations to a depth of at least 5 feet below finished ground elevation or subgrade elevation, whichever is lower.
     - C. Break up basement floors to promote drainage.
     - D. Fill basements or other cavities left by the removal of structures to match the level of surrounding ground.
     - E. When salvageable material is to remain the Owner's property, the Contractor shall remove it and deliver it to site designated by the Engineer or project documents. Any material not designated as the Owner's property will belong to the Contractor. The Contractor shall store or dispose of such material at suitable disposal site or at his storage yard.
     - F. Work crews shall be provided with proper protective clothing and equipment.
     - G. Waste and abandoned asbestos materials and materials, clothing, etc. used in asbestos handling and removal shall be disposed of in a manner consistent with the regulations and provisions cited above.

H. All costs associated with the demolition and abandonment of asbestos material shall be considered incidental to the work; no additional compensation will be made to the Contractor.

I. The Contractor (person or organization removing asbestos with certified asbestos workers) shall assume ALL risk and all liability for the removal and disposal of the asbestos and the Contractor shall comply with all federal, state and local laws, statutes and regulatory agency regulations and requirements including but not limited to the requirements relating to environmental pollutants and the requirements relating to the removal and disposal of asbestos. The Contractor shall insure that the asbestos removal is pursuant to all state and federal laws and regulations. The Contractor shall be responsible for any and all fines or penalties which may be levied due to the Contractor's violation of any of the aforementioned laws and regulations.

1.6 ASBESTOS REMOVAL

A. The Contractor shall conduct all work related to existing asbestos materials in accordance with WISHA safety regulations and provisions of WAC 296-62-077, WAC 295-65 and the requirements of the regional air pollution control authority. Advance notice of work on asbestos materials may be required.

B. Work crews shall be provided with proper protective clothing and equipment.

C. Waste and abandoned asbestos materials and materials, clothing, etc. used in asbestos handling and removal shall be disposed of in a manner consistent with the regulations and provisions cited above.

D. All costs associated with the demolition and abandonment of asbestos material shall be considered incidental to the work; no additional compensation will be made to the Contractor.

E. The Contractor (person or organization removing asbestos with certified asbestos workers) shall assume ALL risk and all liability for the removal and disposal of the asbestos and the Contractor shall comply with all federal, state and local laws, statutes and regulatory agency regulations and requirements including but not limited to the requirements relating to environmental pollutants and the requirements relating to the removal and disposal of asbestos. The Contractor shall insure that the asbestos removal is pursuant to all state and federal laws and regulations. The Contractor shall be responsible for any and all fines or penalties which may be levied due to the Contractor's violation of any of the aforementioned laws and regulations.

* * * END OF SECTION * * *

SECTION 02110
SITE CLEARING

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Demolition: Section 02050
     - B. Grading: Section 02210
     - C. Excavating, Backfilling and Compacting for Utilities: Section 02222
   - 1.2 PROTECTION
     - A. Streets, roads, adjacent property and other work to remain shall be protected throughout the work.
2. **PRODUCTS**
   - 2.1 MATERIALS
     - A. Materials shall be at the Contractor's option.
3. **EXECUTION**
   - 3.1 SURVEY STAKING IN UN-CLEARED EASEMENTS
     - A. Centerlines of utility lines shall be flagged prior to clearing and it shall be the Contractor's responsibility to set his own offsets for clearing limits.
     - B. When the clearing is done, the survey for the utility construction shall be accomplished as per Section 01050.
     - C. If the controls or stakes are damaged or destroyed, the cost of replacement shall be at the expense of the Contractor.
   - 3.2 CLEARING
     - A. Clearing work shall be performed within the confines of the area indicated on the Drawings, or in the Specifications.
     - B. Debris resulting from said clearing shall be disposed of by the Contractor and the right-of-way cleaned up in a neat and workmanlike manner.
     - C. No logs, stumps, rocks, etc., shall be left lying in the right-of-way or on adjacent property without specified written approval by the Owner.
     - D. All trees shall be felled within the area to be cleared except those marked to be left standing, or required by easement stipulations or by contract to be left standing. Trees shall be close cut parallel to the ground, removed and disposed of at the expense of the Contractor.
     - E. No trees or shrubbery in public right-of-way shall be cut except by approval of the Engineer.
   - 3.3 GRUBBING
     - A. All trees or stumps within five (5) feet of the pipeline shall be removed.
     - B. Grubbing will be performed where designated on the drawings or as specified herein and shall include removal from the ground of all stumps, roots, buried logs and other vegetation not otherwise provided for and the removal and disposal of the refuse.
     - C. In areas to be filled to a depth of three (3) feet or more above the natural ground all tree stumps and brush shall be cut off not more than three (3) inches from the ground and removed.
     - D. Where unsuitable surface material is to be removed, complete grubbing will be required.
   - 3.4 DAMAGED VEGETATION
     - A. Neatly trim torn limbs and trunk and severed roots.
     - B. Apply wound paint to above-ground wounds.
     - C. Remove and replace in kind all vegetation damaged extensively.

3.5 DISPOSAL

A. Contractor shall comply with all laws and rules that govern burning and shall secure necessary permits.
B. When burning is permitted, it shall be done under the constant care of competent watchmen such that surrounding property or vegetative cover is not damaged.
C. Contractor may sell any saleable material.
D. Material not burned or sold shall be hauled to a disposal site secured by the Contractor at his expense.

* * * END OF SECTION * * *

SECTION 02140
DEWATERING

1. **GENERAL**
   1.1 RELATED WORK SPECIFIED ELSEWHERE
      A. Temporary Controls: Section 01560
      B. Subsurface Investigations: Section 02010
      C. Excavating, Backfilling and Compaction for Utilities: Section 02222
      D. Sedimentation Control: Section 02275
   1.2 QUALITY CONTROL
      A. It shall be the sole responsibility of the Contractor to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
      B. The Contractor shall employ an independent qualified Professional Engineer with experience in similar dewatering problems to review and approve the Contractor's proposed method of dewatering and to at least weekly, inspect the Contractor's operations and provide a report to the Engineer.
      C. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
      D. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points should be established and observed at frequent intervals to detect any settlement which may develop. Should significant settlement be observed, recharge wells could be placed between the structure and the trench and water pumped under pressure back into the soil.
      E. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

2. **PRODUCTS**
   2.1 EQUIPMENT
      A. Before operations begin, the Contractor shall have available on the site of work sufficient pumping equipment and/or other machinery to ensure that the operation of the dewatering system can be maintained.

3. **EXECUTION**
   3.1 METHODS
      A. Dewatering shall be done by such method as the Contractor may elect.
      B. Dewatering, sufficient to maintain the groundwater level at or below the surface of trench bottom or base of the foundation gravel shall be accomplished prior to excavation and placing of pipeline or concrete. The dewatering operation, however accomplished, shall be carried out so that it does not destroy or weaken the strength of the soil under or alongside the excavation.
      C. The normal water table shall be restored to its natural level in such a manner as to not disturb the pipe, its foundation and structures.
      D. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sand packed and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check by the Contractor shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
      E. Dewatering of the excavations shall be considered as incidental to the construction and all costs thereof shall be included in various unit contract prices in the Bid Form.

F. Dispose of water so as not to cause injury to public or private property or to cause a nuisance or menace to the public and in accordance with the requirements of regulatory agencies.
G. Construction of temporary facilities to dispose of water shall be incidental to the construction.
H. Permanent piping systems shall not be incorporated in the dewatering system.

* * * END OF SECTION * * *

SECTION 02150
SHORING

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Excavating, Backfilling and Compacting for Utilities: Section 02222
   - 1.2 QUALITY ASSURANCE
     - A. Where the depth of excavation exceeds 20 (twenty) feet the Contractor's shoring systems shall be designed and inspected by a registered professional engineer with experience in the work, all in accordance with federal, state and local safety requirements (the most stringent requirement prevailing).
     - B. Where the depth of excavation is less than 20 (twenty) feet, the Contractor shall provide, place and maintain responsibility for shoring, sheeting, bracing, sloping or otherwise support the sides of trenches and excavations, including embankments by a means of sufficient strength to protect employees. Such shoring and associated responsibilities shall be in accordance with federal, state and local safety requirements (the most stringent requirement prevailing).
   - 1.3 SUBMITTAL
     - A. For shoring systems to be used for depth of excavation greater than 20 (twenty) feet, submit material indicating compliance with federal, state and local safety requirements for shoring systems. Specifically, the material shall indicate that such systems have been designed by a registered professional engineer with experience in the work.
   - 1.4 COMPETENT PERSON
     - A. The Contractor shall be exclusively responsible for providing the services of the Competent Person as referenced in Section 296-155-650 Washington Administrative Code (WAC), relating to excavation, trenching and shoring.
     - B. The Contractor shall be exclusively responsible for providing the services of a registered professional engineer for the design of the trench protective system as required in WAC Section 296-155-657.
     - C. Representatives of the Owner and Engineer shall not be required to perform the roles of Competent Person or registered professional engineer as defined in WAC 296-155.

2. **PRODUCTS**
   - 2.1 SHORING SYSTEMS
     - A. Materials used shall be at the Contractor's option.

3. **EXECUTION**
   - 3.1 SAFETY REQUIREMENTS
     - A. Shoring shall be placed in accordance with federal, state and local safety requirements (the most stringent requirement prevailing)
   - 3.2 SHORING SYSTEMS
     - A. Unless otherwise provided, the Contractor shall provide all shoring systems needed to protect the work, adjacent property and improvements, utilities, pavement, etc., and to provide safe working conditions in the trench.
     - B. Removal of any or all shoring systems from the trench shall be accomplished in such a manner as to fulfill all of the above requirements and shall also be accomplished in such a manner as to prevent any damage to the work.
     - C. Damages resulting from improper shoring or from failure to shore shall be the sole responsibility of the Contractor.

D. Whether shoring systems shall be left in place or removed shall be at the option of the Contractor, provided that removal of any and all shoring used in trench or structure excavation shall be accomplished in the manner as to prevent the settlement of the pipes or other work and to prevent increased backfill loading which might overload the pipe or walls of the structure.
E. Shoring shall be removed to a minimum of 5 feet below the final grade.
F. Should the Owner order that any shoring be left in place, the Contractor shall not remove the same but will receive payment for the materials left in place at the market value thereof.

3.3 SPECIAL REQUIREMENT FOR FLEXIBLE PIPE

A. Shoring to be removed, or moveable trench shields or boxes, shall be located at least 2 pipe diameters away from the pipe if the bottom of the shoring, shield or box extends below the top of flexible pipe, unless a satisfactory means of reconsolidating the bedding or side support material disturbed by shoring removal can be demonstrated.
B. Damages resulting from improper shoring or failure to shore shall be the sole responsibility of the Contractor.

* * * END OF SECTION * * *

SECTION 02210
GRADING

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Subsurface Investigation: Section 02010
     - B. Demolition: Section 02050
     - C. Site Clearing: Section 02110
     - D. Excavating, Backfilling, and Compacting for Utilities: Section 02222
     - E. Riprap: Section 02274
   - 1.2 QUALITY CONTROL ASSURANCE
     - A. Soils and Backfill: Moisture density standard ASTM D1557 or AASHTO T-180 method unless otherwise specifically approved.
     - B. In place Density Determination: Sandcone method ASTM D1556 or Nuclear method ASTM D2922.
     - C. Classification of Soils ASTM D2487.
     - D. Quality control monitoring of subgrade backfill and embankment materials and construction by certified independent laboratory approved by Engineer, secured and paid for by the Contractor.
   - 1.3 SUBMITTALS
     - A. Import backfill gradation and moisture density compaction curve test reports.
     - B. Embankment and native backfill materials gradations and moisture density standards curve test reports.
     - C. Certification of gradation and compliance with referenced standards, and moisture density standards test reports.
     - D. Density test results in approved format.

2. **PRODUCTS**
   - 2.1 NATIVE MATERIAL FOR EMBANKMENT
     - A. Selected soil free from roots or other organic material, debris, or frozen material.
     - B. Maximum size to 6 inches with no stone larger than 4 inches in upper 6 inches of fill.
     - C. Free of excess moisture.
     - D. Processed to uniform moisture and texture necessary to obtain specified density.
   - 2.2 IMPORT MATERIAL FOR EMBANKMENT
     - A. Conform to Section 02222 for Backfill Gravel.
   - 2.3 TOP SOIL
     - A. Conform to Section 02990.
   - 2.4 WASTE MATERIAL
     - A. Foreign materials, buried rubble, abandoned pipes and native soil materials that cannot be processed to uniform moisture and texture necessary to achieve specified densities shall be disposed of by the Contractor at the appropriate waste site.
     - B. Approved waste site shall be provided by the Contractor.

3. **EXECUTION**
   - 3.1 WORK SEQUENCE
     - A. Notify Engineer of any discrepancies between contractual requirements and site conditions prior to start of work.
     - B. Maintain backfill embankment and subgrade zones or lifts open until approval of testing is secured from the Engineer. Any work covered up prior to approval shall be excavated and reconstructed at Contractor's expense.

C. Prior to pipe installation construct embankments a minimum of 12 inches above pipe crowns and trench for all pipelines. Mounding over pipelines will not be permitted.
D. Work in inclement wet weather at Contractor's risk.
E. Any materials which become unstable as the result of improper selection of techniques, equipment, or operations during inclement wet weather shall be replaced at Contractor's expense with imported material for embankment.
F. Excavations and embankment shall be accomplished in such a manner that drainage is maintained at all times.

3.2 STOCKPILING NATIVE MATERIALS FOR REUSE

A. Material suitable for topsoil shall be deposited in protected, maintained piles separate from other materials and readily available.
B. Upon completion, all material storage areas shall be restored to substantially their original condition.

3.3 EXCAVATION

A. Remove all materials required regardless of type or character.
B. Excavate to lines and grades shown on the drawing.
C. Transport all materials to embankment areas or to waste as required.

3.4 PREPARATION OF GROUND SURFACE FOR FILL

A. All vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish, and other unsuitable materials within the area upon which fill is to be placed, shall be stripped or otherwise removed before the fill is started.
B. Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed, shall be plowed, stepped (benched), or broken up in such manner that the fill material will bond with the existing surface.
C. The original ground surface shall be plowed or scarified to a depth of at least six (6) inches and compacted as specified herein.
D. Soft, wet soils shall be excavated and replaced or allowed to dry before placing fill.

3.5 EMBANKMENT

A. Construct of materials specified, conditioned to proper moisture and texture necessary to assure specified densities.
B. Loose thickness lifts not to exceed 8 inches.
C. Maintain drainage at all times.
D. Construct to grades shown on the Drawings.

3.6 COMPACTION

A. Compact each lift to 95% of maximum density at optimum moisture content.

3.7 FINISH ELEVATIONS

A. Contours illustrated are intended as a general guide to achieve proper aesthetics and drainage control.
B. Control grid and spot elevations to be established by Contractor.
C. Vary control grid spacing to accurately define slope, rounding of mounds and depressions.
D. Field staking of certain intermediate grid points at locations where slopes are uniform may, at Engineer's discretion, be eliminated.
E. Finished surface shall be smooth, compacted and free from irregular surface change so as to drain readily.
F. The degree of finish shall be that ordinarily obtainable from blade grader operations, except as otherwise specified. The finished surfaces not to be paved shall be not more than 0.15 feet above or below the established grade or approved cross section. All areas to be paved shall be finished as required for pavement subgrade.

3.8 DENSITY TEST RECORD DOCUMENTATION

A. Location of horizontal and vertical grid and datum.
B. Density and percent of referenced standard computation.
C. Material description and appropriate compaction control standard.

3.9 DENSITY TEST FREQUENCY

A. Foundation embankment under structures and pipelines, top two feet of road subgrade, and 10 foot wide backfill zone around structures for each one foot of vertical embankment or backfill height, conduct one test for every 300 square feet.
B. Other embankment under structures and pipelines, top two feet of road subgrade, and 10 foot wide backfill zone around structures for each one foot of vertical embankment or backfill height, conduct one test for every 600 square feet, except as required by Section 02222.
C. Additional tests as required by the Engineer, if tests indicate compaction deficiency.

* * * END OF SECTION * * *

SECTION 02222
EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

1. GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Subsurface Conditions: Section 02010
B. Demolition: Section 02050
C. Site Clearing and Grubbing: Section 02110
D. Grading: Section 02210
E. Excavating, Backfilling and Compacting for Structures: Section 02221
F. Sedimentation Control: Section 02275
G. Water Lines: Section 02660
H. Existing Utilities/Facilities Underground and Overhead: Section 02760
I. Shoring: Section 02150

1.2 CLASSIFICATION

A. All excavation is unclassified unless separate bid item is included in bid form.
B. The terms earthwork or excavation include all materials excavated or removed regardless of material characteristics.
C. The Contractor shall make his own estimate of the kind and extent of materials which will be encountered in the excavation.

1.3 QUALITY CONTROL ASSURANCE

A. Soils and Backfill: Moisture density standard ASTM D1557 or AASHTO T-180 method unless otherwise specifically approved.
B. In place Density Determination: Sandcone method ASTM D1556 or Nuclear method ASTM D6938.
C. Classification of Soils: ASTM D2487.
D. Quality control monitoring of subgrade backfill and embankment materials and construction by certified independent laboratory approved by Engineer and secured and paid for by the Contractor.

1.4 SUBMITTALS

A. Import aggregate gradation and moisture density relationship curves.
B. Embankment and native backfill materials gradations and moisture density relationship curves.
C. Certification of gradation and compliance with referenced standards and moisture density relationship curve standards.
D. Density test results in approved format.
E. At any time the Contractor shall change the source and/or stockpile from which materials are obtained, certificates of gradation for these new sources will also be required. The Contractor shall make allowances in his unit prices bid for these items to cover expenses incurred in having this certification made and no additional compensation will be allowed.
F. During construction, the Owner may elect to have further gradation testing completed on the materials being furnished by the Contractor. This testing will be at the expense of the Owner, however, the Contractor shall provide material samples as may be necessary to complete this testing and these material samples will be furnished from material available on the job site or from the Contractor's source and/or supplier.
G. Controlled Density Fill (CDF): Furnish a certificate with each truckload of CDF product delivered to the site, indicating the composition and quality of the mix. Include size and weight of each aggregate, amount of cement, amount of water and amount and kind of any additives.

2. PRODUCTS

2.1 CRUSHED ROCK

A. Crushed rock shall be manufactured from ledge rock, talus, or gravel. The materials shall be uniform in quality and substantially free from wood, roots, bark, and other extraneous material and shall meet the following quality test requirements:

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

B. Crushed rock shall meet the following requirements for grading and quality:

	Percent Passing by Weight	
Sieve Size	Base Course	Top Course and Keystone
1¼"	100	
1"	80-100	
¾"		100
⅝"	50-80	
½"		80-100
No. 4	25-45	46-66
No. 40	3-18	8-24
No. 200	7.5 max.	10.0 max.
% Fracture	75 min.	75 min.
Sand Equivalent	40 min.	40 min.

C. The fracture requirement shall be at least one fractured face and will apply to the combined aggregate retained on the No. 4 sieve in accordance with field operating procedures for AASHTO TP 61.

D. The portion of crushed rock retained on a No. 4 sieve shall not contain more than 0.15 percent wood waste.

2.2 GRAVEL BEDDING

A. Gravel bedding shall consist of crushed, processed, or naturally occurring material that is granular and well-graded. It shall be free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact and shall meet the following quality and gradation, when tested in accordance with ASTM D422:

Sieve Size	Percent Passing by Weight
¾"	99-100
⅜"	70-100
No. 4	55-100
No. 40	10-55
No. 200	3.0 max.
Sand Equivalent	35 min.

2.3 BACKFILL GRAVEL

A. All backfill gravel to be furnished under this Contract shall consist of naturally occurring screened or crushed gravel.

B. Gravel shall be essentially free from wood waste or other extraneous or objectionable materials.

C. Gravel shall have such characteristics of size and shape that it will compact readily, and the maximum particle size shall not exceed ⅔ of the depth of the layer being placed.

D. Gravel shall meet the following requirements for grading and quality:

Sieve Size	Percent Passing by Weight
2 ½ "	75-100
No. 4	22-100
No. 200	0-10

Dust Ratio	⅔ max.
Sand Equivalent	30 min.

E. Gravel material retained on a No. 4 sieve shall contain not more than 0.2 percent by weight of wood waste.

2.4 SELECT NATIVE MATERIAL

A. Material shall be selected soil free from roots or other organic material, debris, or frozen material.
B. The maximum size of the material shall be 6 inches with no stone larger than 4 inches in the upper 6 inches of fill.
C. Native material shall be free of excess moisture.
D. The material shall be processed to the uniform measure and texture necessary to obtain the specified density.

2.5 TRENCH FOUNDATION GRAVEL

A. At least two basic trench bottom conditions commonly cause problems: (1) where silty soils or fine sandy soils are encountered, they will usually flow in the presence of a stream of water, and (2) where clays, peats, or other soft materials are encountered, they may become saturated with water, but do not usually break down into fine particles and flow as do the silts or sands mentioned above.
B. Trench foundation gravel shall be used when over-excavation, as described in the Pipe Foundations paragraph under Execution in this section, is required.
C. Condition (1) material: Where Condition (1) is encountered, the following trench foundation gravel has been found by experience usually to be adequate: clean bank run sand and gravel, free from dirt, roots, topsoil, and debris and containing not less than 35% retained on a No. 4 sieve and with all stones larger than 2 inches removed. Such gravel shall only be used in a dry trench bottom, free from quicksand or running sand.
D. Condition (2) material: Where Condition (2) is encountered, Class A or Class B trench foundation gravel has been found by experience usually to be adequate. Other material may, however, be found more desirable by the Contractor:

	Percent Passing by Weight	
Sieve Size	Class A	Class B
2½”	98-100	95-100
2”	92-100	75-100
1½”	72-87	30-60
¾”	27-47	0-5
⅜”	3-14	—
No. 4	0-5	—

1. Trench foundation gravel shall contain no pieces larger than 5 inches, measured along the line of greatest dimension.

2.6 FILTER ROCK

A. Filter rock shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
1”	100
¾”	95-100
⅜”	10-55
No. 4	5 max.
No. 200	0-1.5

B. Rock material retained on a No. 4 sieve shall contain not more than 0.2 percent by weight of wood waste.
C. For drain rock, see Section 02221.

2.7 RIGID INSULATION

A. Insulation shall be closed-cell, extruded polystyrene foam.

B. The insulation shall have a typical five year aged thermal conductivity, k factor of 0.2 Btu/hr/sq.ft./°F/in when tested at 75° F mean temperature in accordance with ASTM C518.
C. Minimum compressive strength of 25 psi when tested in the vertical direction in accordance with ASTM D1621.
D. Maximum water absorption of 0.3% by volume when tested in accordance with ASTM C272.

2.8 CONTROLLED DENSITY FILL (CDF)

A. CDF shall be a mixture of Portland cement, fly ash, aggregates, water, and admixtures proportioned to provide a non-segregating, self-consolidating and free-flowing material which will result in a hardened, dense, non-settling and excavatable fill.
B. CDF shall be used as fill above utilities wherever non-settling backfill is required or as a hydraulic barrier between coarse and fine grained soil.
C. CDF shall be a mixture of Portland cement, fly ash, aggregates, water, and admixtures which have been batched and mixed in accordance with Section 6-02.3 of the WSDOT/APWA Specifications. Materials are as follows:

1. Portland Cement	AASHTO M 85 OR WSDOT/APWA 9-01
2. Fly Ash	Class F
3. Aggregates	WSDOT/APWA 9-03.1(2)B
4. Water	WSDOT/APWA 9-25
5. Admixtures	WSDOT/APWA 9-23.6

D. CDF shall be used in the following proportions for one cubic yard. Batch weights may vary depending on specific weights of aggregates.
E. Maximum gallons of mixing water per cubic yard: 50.
F. Lbs. of cement per cubic yard: 50.
G. Lbs. of fly ash per cubic yard: 250.
H. Lbs. of dry aggregate per cubic yard, Class 1 or 2 sand as per WSDOT/APWA 9-03.1(2)B: 3200.
I. CDF shall be batched to provide a flowing, non-segregating mix with a slump between 6” to 8”.

3. EXECUTION

3.1 TRENCHING

A. Material shall be excavated from trenches and piled adjacent to the trench and maintained so that the toe of the slope of the spoil material is at least 3 feet from the edge of the trench or hauled from the trench to an approved disposal or storage site.
B. Material shall be piled within the construction easement or specified working area so that the excavated material does not obstruct any private or publicly traveled roadways.
C. Free access shall be provided to all fire hydrants, water valves and meters, and clearance shall be left to enable the free flow of storm water in all gutters, conduits, and natural watercourses.
D. Ledge rock, boulders, or stones shall be removed to provide a minimum clearance of 6 inches under and around the pipe to be installed.
E. Contractor shall keep excavations free of water in accordance with Section 02140.
F. Contractor is responsible for shoring in accordance with Section 02150.

3.2 TRENCHING FOR WATER LINES

A. Trenching shall be dug to true and smooth bottom grades in accordance with the lines given by the Engineer.

B. All trench excavation shall be sufficient to provide a minimum of 36 inches of cover over the top of the installed water main.
C. Trench excavations where pipe is to be laid shall be sufficient to provide a minimum width of 12 inches greater than the nominal diameter of the pipe, or 24 inches, whichever is greater, unless otherwise approved by the District Engineer.
D. Trench widths shall not exceed 30 inches maximum or 1.5 times outside diameter of the pipe plus 18 inches whichever is greater.
E. Standard excavation equipment shall be adjusted so as to excavate the narrowest ditch possible.
F. Depth of trenching for water mains shall be such as to give a minimum cover of 36 inches over the top of the pipe unless otherwise specified.
G. Deeper excavation may be required due to localized breaks in grade, or to install the new main under existing culverts or other utilities where necessary.
H. Where profile of pipeline and ground surface is shown on the Plans, pipeline shall be laid to elevation shown, regardless of depth.
I. Excavation shall be to such depth that the minimum cover over the valve nuts shall be one foot.
J. The length of trench excavated in advance of pipe laying shall be kept to a minimum and in no case shall length of open trench exceed 400 feet unless specifically authorized by the Engineer.
K. Trenches shall be over excavated below the specified grade to provide for bedding material specified.

3.3 PIPE FOUNDATIONS

A. Where the trench bottom is in a material which is unsuitable for foundation or which will make it difficult to obtain uniform bearing for the pipe, excavate below the bottom of the pipe zone. Backfill the trench to the bottom of the pipe zone with approved material and compact to 95% max density. If firm, native material is not present within three feet below the bottom of the pipe zone and a stable foundation cannot be provided in accordance with Standard Detail entitled "Foundation Gravel and Backfill"., contact the Inspector for further guidance on foundation stabilization.
B. Proper preparation of foundation and placement of foundation material, where required, shall precede the installation of all pipe.
C. Proper preparation includes bringing the native trench bottom and/or the top of the foundation material to a uniform grade so that the entire length of pipe rests firmly on suitable, properly compacted material.
D. Gravel to be used for foundation purposes shall be of a type and gradation to provide solid compact bedding in the trench. Because trench conditions vary, foundation gravel requirements will change.
E. Neither approval nor disapproval of the foundation material proposed by the Contractor shall relieve him of his responsibility to provide adequate pipe foundation and to guarantee his work as elsewhere required by the Contract.
F. Unsuitable material for foundation purposes below the depth required for the specified bedding shall be removed and replaced with suitable foundation gravel.
G. Excavated materials shall be disposed of at an approved waste site and all costs involved in the excavating and wasting of this material shall be considered as incidental to the foundation item, except that excavation more than 2 feet below the pipe invert shall be classified as extra excavation and paid for at the Extra Excavation unit bid price.

3.4 PIPE BEDDING

A. Placement of gravel bedding in the pipe zone shall be as specified in the section regarding the pipeline being constructed.

3.5 BACKFILLING

A. Gravel bedding to 6 inches over the top of the pipe shall be completed before backfilling operations are started.
B. The Contractor shall take all necessary precautions to protect the pipe from any damage, movement or shifting. In general, backfilling shall be performed by pushing the material from the end of the trench into, along and directly over the pipe so that the material will be applied in the form of a rolling slope rather than by side filling which may damage the pipe. Backfilling from the sides of the trench will be permitted after sufficient material has first been carefully placed over the pipe to such a depth as to protect the pipe.
C. Compaction equipment used above the pipe zone shall be of a type that does not injure the pipe.
D. Provide for the proper maintenance of traffic flow and accessibility as may be necessary.
E. Make adequate provisions for the safety of property and persons.
F. Temporary shoring shall be removed unless specifically authorized in writing.
G. Dewatering shall be continued until the trench is completely backfilled.
H. Brush, stumps, logs, planking, disconnected drains, boulders, etc., shall be removed from the material to be used for backfilling the trench.
I. Where native material excavated is unsuitable for trench backfill, backfill gravel, or specified material shall be placed.
J. The unsuitable material shall be removed to an approved disposal area. Backfill gravel shall be used for backfill only where original material is unsuitable and upon approval by the Engineer.
K. Where it is required that a blanket of import material be placed on top of the native backfill, the backfill shall be placed to the elevations shown on the Plans, or to the elevation the Engineer may direct, and shall be leveled to provide for a uniform thickness of the import material. Compaction of the native material shall be as required by the Owner.
L. Backfill Gravel: Wherever a trench is excavated in a paved roadway, sidewalk or other area where minor settlements would be detrimental and where the native excavated material is not suitable for compaction as backfill, the trench shall be backfilled to such depth as the Engineer may direct with backfill gravel or specified material.
M. Controlled Density Fill: Controlled density fill shall be placed as shown on the drawings or wherever mechanical compaction cannot be achieved due to physical space and/or clearance limitations (not allowing access for mechanical compaction equipment) and where additional excavation to provide the required space and/or clearance is not practical or possible. CDF shall be used as fill above utilities wherever non-settling backfill is required as directed by the Owner.

3.6 GENERAL COMPACTION REQUIREMENTS

A. Requirements of this section shall apply unless more stringent requirements are established by the local agency involved.
B. When working in an existing traveled roadway, restoration and compaction must be achieved as the trench is backfilled so as to maintain traffic.
C. Trench backfill under roadway shall be mechanically compacted to 95% of maximum density.
D. When working in areas outside of the right-of-way or on easements, backfill compaction shall be achieved throughout the entire depth of the trench by mechanical compaction to 90% density.

3.7 MECHANICAL COMPACTION

A. Method of compaction shall be at Contractor's option.

B. The Contractor shall be responsible to provide the proper size and type of compaction equipment and select the proper method of utilizing said equipment to attain the required compaction density.
C. In place compaction tests may be made. Contractor shall remove and re-compact material that does not meet specified requirements.

3.8 INSULATION BOARD INSTALLATION

A. Prior to placement of the insulation board, the subgrade shall be leveled and compacted to provide a smooth, firm foundation.
B. Insulation board shall be placed 12 inches above the pipe line whenever shown on the drawing.
C. The insulation shall be 2 feet wide and extend 5 additional feet along the length of pipe after minimum cover has been achieved.
D. Insulation shall be anchored prior to backfilling using a minimum of two 6-inch by 3/8-inch wooden skewers per board, driven at an angle to the vertical and flush to the surface of the insulation.
E. Layering of insulation to obtain the specified thickness shall be allowed as long as all joints are overlapped at least 6 inches.

3.9 CONTROLLED DENSITY FILL (CDF)

A. Haul excavated material immediately to waste, install and bed pipe per Section 02660 and other applicable sections.
B. Mix and deliver CDF in commercial concrete ready mix trucks. CDF shall be discharged from the mixer by any reasonable means (which does not segregate the material) into the area to be filled.
C. Contain CDF at either end of the excavation by bulkhead or earth fill.
D. Place CDF using suitable equipment to avoid injury to or displacement of installed utility lines, manholes, and other structures. CDF shall not be placed on frozen ground.
E. Vibrate fill with concrete vibrators during placement for complete consolidation, 95% minimum.
F. Provide steel plates to span utility trench and prevent traffic contact with the CDF for at least 12 hours, but not more than 24 hours or until fill has set sufficient to prevent rutting.
G. Placement of CDF shall be scheduled during favorable weather conditions. At the time of placement, CDF must have a temperature of at least 40° F. Mixing and placing shall stop when the temperature is 38° F or less and falling. Each filling stage shall be as continuous an operation as practical.

* * * END OF SECTION * * *

SECTION 02275
SEDIMENTATION CONTROL

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Grading: Section 02210
     - B. Excavating, Backfilling and Compacting for Utilities: Section 02222
     - C. Landscape Restoration: Section 02990
   - 1.2 QUALITY CONTROL
     - A. Conform to regulatory requirements.
     - B. Sedimentation control systems depicted on drawings are intended to be minimum requirements to meet anticipated site conditions.
   - 1.3 SCHEDULE
     - A. Required sedimentation control facilities must be constructed and in operation prior to land clearing and/or other construction to ensure that sediment-laden water does not enter the natural drainage system or otherwise be discharged from the site.
     - B. Sediment facilities shall be maintained in a satisfactory condition until such time that clearing and/or construction is completed and potential for on-site erosion has passed.
     - C. The implementation, maintenance, replacement and additions to erosion/sedimentation control systems shall be the responsibility of the Contractor.

2. **PRODUCTS**
   - 2.1 PLANTING MATERIALS
     - A. Refer to Section 02990
   - 2.2 STRAW
     - A. Be in an air dried condition free of noxious weeds, weed seeds, and other materials detrimental to plant life.
     - B. Be seasoned before baling or loading and shall be acceptable to the Engineer.
   - 2.3 JUTE MATTING
     - A. Be of a uniform open plain weave of unbleached, single jute yarn treated with a fire retardant chemical.
     - B. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than 1/2 of its normal diameter.
     - C. Furnished in rolled strips 48 inches wide by approximately 50 yards long.
     - D. Average weight of 0.92 pounds per square yard with an allowable tolerance of plus or minus 1 inch in width and 5% in weight.
   - 2.4 FILTER FABRIC
     - A. Filter fabric for the erosion protection barriers shall be Mirafi 140, or equivalent.
   - 2.5 WIRE
     - A. Wire for the erosion protection barriers shall be 2 x 2 mesh, 14 gauge galvanized wire.
   - 2.6 SUPPORT POSTS
     - A. Support posts for the erosion protection barriers shall be 2 inch by 4 inch, Doug-FR No. 1 or better wood posts or 1-1/2 inch by 48 inch medium weight steel fence posts.
   - 2.7 CLEAR PLASTIC COVERING
     - A. Clear plastic covering for protection of slopes and cuts shall meet the requirements of the NBS Voluntary Product Standard, PS 17 for Polyethylene sheeting having a minimum thickness of 6 mil.
   - 2.8 SEDIMENT RETENTION WATTLE
     - A. Wattles shall be a straw-filled tube of flexible netting material exhibiting the following properties. It shall be a machine-produced tube of compacted rice straw that is

Certified Weed Free Forage, by a manufacturer whose principle business is wattle manufacturing. The netting shall consist of seamless, high-density polyethylene and ethyl vinyl acetate and contain ultra violet inhibitors

3. EXECUTION

3.1 EROSION CONTROL

A. Erosion control provisions shall meet or exceed the requirements of the local agency having jurisdiction.
B. When provisions are specified and shown on the Drawings, they are the minimum requirements.
C. Contractor shall not permit sediment laden waters to enter drainage facilities or be discharged from the site.
D. As construction progresses and seasonal conditions dictate, more siltation control facilities may be required. It shall be the responsibility of the Contractor to address new conditions that may be created and to provide additional facilities over and above minimum requirements as may be required.

3.2 SILTATION/SEDIMENTATION PONDS

A. Siltation/sedimentation ponds shall be installed on site to de-silt all stormwater or water pumped from excavations.
B. If additional siltation control is required, check dams or silt fences may be placed in ditches receiving stormwater from areas disturbed by construction.
C. Siltation/sedimentation ponds shall be constructed in accordance with the requirements of the agencies having jurisdiction over the project area and/or the facilities that will receive discharge from siltation/sedimentation ponds.

3.3 FILTER FABRIC FENCES

A. Filter fabric fence shall consist of filter fabric fastened to wire fabric with staples or wire rings.
B. Wire shall be fastened to posts set at 4-foot centers.
C. Fabric shall be buried into ground approximately 8 inches to prevent silt from washing under fabric.
D. Fence shall be located to catch silt and prevent discharge to drainage courses.

3.4 STRAW BALE FILTER

A. Installed in drainage way to catch silt.
B. Dig bales into ground approximately 6 inches and stake in place with 2 wooden stakes in each bale.
C. Bales to extend above anticipated surface of stream.

3.5 SEDIMENT RETENTION WATTLE

A. Install wattles in the trench, insuring that no gaps exist between the soil and the bottom of the wattle. The ends of adjacent wattles should be tightly abutted so that no opening exists for water or sediment to pass through. Alternately, wattles may be lapped, 6" minimum to prevent sediment passing through the field joint.
B. Wooden stakes should be used to fasten the wattles to the soil. When conditions warrant, a straight metal bar can be used to drive a pilot hole through the wattle and into the soil.

3.6 PLACING JUTE MATTING

A. Seed and fertilizer shall be placed prior to placing of matting.
B. Jute matting shall be unrolled parallel to the flow of water. Where more than 1 strip of jute matting is required to cover the given area, it shall overlap the adjacent mat a minimum of 4 inches. The ends of matting shall overlap at least 6 inches with the upgrade section on top.
C. The up-slope end of each strip of matting shall be staked and buried in a 12-inch wide by 6-inch deep trench with the soil firmly tamped against the mat. Three stakes

per width of matting (1 stake at each overlap) shall be driven below the finish ground line prior to backfilling of the trench.

D. The Engineer may require that any other edge exposed to more than normal flow of water or strong prevailing winds be staked and buried in a similar manner.
E. Check slots shall be placed between the ends of strips by placing a tight fold of the matting at least 6 inches vertically into the soil. These shall be tamped and stapled the same as upslope ends. Check-slots must be spaced so that one check slot or one end occurs within each 50 feet of slope.
F. Edges of matting shall be buried around the edges of catch basins and other structures as herein described. Matting must be spread evenly and smoothly and in contact with the soil at all points.
G. Matting shall be held in place by approved wire staples, pins, spikes or wooden stakes driven vertically into the soil. Matting shall be fastened at intervals not more than 3 feet apart in 3 rows for each strip of matting, with 1 row along each edge and 1 row alternately spaced in the middle. All ends of the matting and check slots shall be fastened at 6-inch intervals across their width. Length of fastening devices shall be sufficient to securely anchor matting against the soil and driven flush with the finished grade.

3.7 PLACING CLEAR PLASTIC COVERING

A. Clear plastic covering shall be installed on erodible embankment slopes as shown in the plans or as designated by the Engineer.
B. The clear plastic covering shall be installed immediately after completion of the application of roadside seeding.
C. The Contractor shall maintain the cover tightly in place by using sandbags or tires on ropes with a minimum 10-foot grid spacing in all directions. All seams shall be taped or weighted down full length. There shall be at least a 12-inch overlap of all seams.
D. The Contractor shall be responsible to immediately repair all damaged areas.
E. The clear plastic covering shall be replaced or removed within 6 months of installation.

3.8 EXISTING DRAINAGE FACILITIES

A. Should a storm sewer or culvert become blocked or have its capacity restricted due to discharge siltation from Contractor's operations, the Contractor shall make arrangements with the jurisdictional agency for the cleaning of the facility at no additional expense to the Owner.

3.9 DRAINAGE DIVERSION

A. Contractor shall divert the surface runoff water around the site as may be required.
B. Drainage shall be restored to condition existing prior to construction unless otherwise shown on the Drawings.

* * * END OF SECTION * * *

SECTION 02300
PIPE BORING AND JACKING

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Sanitary Sewers: Section 02730
   - 1.2 REQUIREMENTS OF CONTROLLING AGENCY
     - A. All work shall be done in accordance with the requirements of the road or railroad agency in control of the facility being bored or jacked.

2. **PRODUCTS**
   - 2.1 MATERIALS
     - A. All materials selected by the Contractor shall meet the minimum requirements of the controlling agency or the construction requirements.
     - B. Where casing size and thickness is shown on drawing it is minimum size and thickness permitted. Contractor is permitted to use larger size or thicker walled casing if in his opinion; it is required because of soil or other job conditions. Contractor shall make his own determination regarding casing requirements.
     - C. Minimum thickness of casing wall shall meet requirement of road or railroad agency involved.

3. **EXECUTION**
   - 3.1 INSTALLATION OF ENCASING PIPE
     - A. Where shown on the Plans, the Contractor shall install the pipe in a large encasing pipe.
     - B. The encasing pipe shall be installed by jacking, tunneling, augering or by a combination of these methods.
     - C. The encasing pipe shall normally extend from ditch line on each side of the pavement or as shown on the drawings or in the road permit. No excavation shall be made closer than 6 feet from the edge of the pavement or as directed by the road or railroad agency. Exact length shall be approved by the road or railroad agency involved.
     - D. During jacking, augering, or tunneling operations, care shall be exercised to prevent caving ahead of the pipe which will cause voids outside the pipe. If voids occur, the Contractor shall backpack the voids with sand and pea gravel and fill the voids with a pumped Portland cement grout.
   - 3.2 TUNNELING
     - A. Tunneling will not be allowed except by the liner plate method and unless approved by the road or railroad agency involved.
     - B. Liner plates shall be assembled and installed in accordance with the manufacturer's instructions and specifications and in accordance with accepted tunneling methods using poling plates or shields of a strength equal to that of the liner plates.
   - 3.3 CARRIER PIPE INSTALLATION
     - A. The pipeline shall be skidded into position inside the casing pipe using suitable skids and blocked into position.
     - B. The annular space between the carrier pipe and the casing pipe or tunnel liner shall be filled by sluicing or blowing sand or pea gravel into the space unless otherwise specified. Care shall be exercised to ensure that the entire space is filled and that the pipe is not disturbed during the placement of the backfill between the pipe and the casing.

C. The Contractor shall remove the carrier pipe and reinstall it if the pipe is not within the tolerances shown on the drawings and as specified.

* * * END OF SECTION * * *

SECTION 02575
PAVEMENT REPAIR AND RESURFACING

1. **GENERAL**
   1.1 RELATED WORK SPECIFIED ELSEWHERE
      A. Traffic Regulation: Section 01570
      B. Demolition: Section 02050
      C. Site Clearing: Section 02110
      D. Excavation, Backfilling, and Compacting for Utilities: Section 02222
   1.2 QUALITY ASSURANCE
      A. Qualifications of Asphalt Concrete Producer: Use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot mix, hot laid asphalt concrete.
   1.3 PAVING QUALITY REQUIREMENTS
      A. General: In addition to other specified conditions, comply with following minimum requirements:
         1. Comply with requirements of Road Agency having jurisdiction.
         2. Provide final surfaces of uniform texture, conforming to required grades and cross-sections.
         3. Patches shall match existing grade and cross-section unless otherwise directed by the Road Agency.
         4. Pavement cuts parallel to street alignment shall be restored for the full width in accordance with agency specifications.
         5. Unsatisfactory restoration work shall be redone promptly by the Contractor. This includes immediately replacing failed patches.
         6. Cleanup of excavation and debris material shall be accomplished concurrently with the burying operation. At no time shall debris and excavation extend along a line for more than three hundred (300) feet.
         7. Any temporary restoration work shall be made permanent within thirty (30) calendar days from the date of the temporary restoration.
      B. Surface Smoothness:
         1. Test finished surface of each asphalt concrete course for smoothness, using a 10 foot straight edge applied parallel to and at right angles to centerline of paved areas.
         2. Surfaces will not be acceptable if exceeding 0.25 inch in 10 feet unless more rigid requirements are established by the Road Agency.
   1.4 SUBMITTALS
      A. Certify that materials comply with specification requirements.
      B. Certificate to be signed by asphalt concrete producer and Contractor.
      C. Submit concrete mix design.
   1.5 JOB CONDITIONS
      A. Weather Limitations:
         1. Construct only when temperatures are above minimum specified in State Highway Standard Specifications unless waived by Road Agency having jurisdiction.
         2. Do not construct pavement or base when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.
      B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.
      C. Traffic Control:

1. Maintain vehicular and pedestrian traffic during paving operations, as required for other construction activities.
2. Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety and to cause the least interruption of work.
3. See Section 01570 for additional requirements.

1.6 ROAD AND STREET RESTORATION REQUIREMENTS

A. The Contractor's responsibility as to road restoration shall include, but not be limited to, proper backfill and compaction of excavation, shaping and general restoration of the roadway, restoration of public and private improvements when damaged by construction, restoration of drainage facilities, scarification of existing surfacing, if required, removal of debris and surplus material and all other requirements of these Specifications. In addition, upon completion of the above restoration, backfill gravel or crushed rock shall be placed where required, in the opinion of the Engineer.

B. Unless otherwise specifically authorized by the authority responsible for the roadway, the final grade and cross-section shall conform to applicable Road Agency standard cross sections. In case of existing private roads, they shall conform to the roadway that existed prior to construction. The removal and disposal of existing materials necessary to fulfill the above requirements shall be considered incidental to the construction and the costs thereof shall be included in the items for which payment is provided.

C. Manhole rings, valve boxes and monument cases shall be adjusted as necessary to be flush with the restored surface.

D. The Contractor shall comply with all requirements of all permits for installation of pipelines in authorized right-of-way.

E. The Contractor will place and maintain sufficient and proper lights and barricades at all locations on roads not accepted by the Road Agency involved.

F. After completion of pipeline installation the Contractor shall clean up drainage ditches and restore all existing drainage structures that he may have damaged during the course of construction. He shall also comply with all drainage requirements of the agency involved upon which the agency's acceptance of the roads is conditioned.

G. The Contractor shall restore any private improvement on road right-of-way including, but not limited to, culverts, driveways, curbs, sidewalks, parking strips, parking areas, or other permanent improvements, whether or not a permit for such improvements has been obtained.

H. On streets where the pipeline is located on the shoulder alongside existing bituminous or concrete surfacing, no payment shall be made for cost of restoring street surfacing which may be damaged by the Contractor's operations. If the Engineer requires crushed rock spread on the shoulder it shall be paid under the crushed rock bid item.

I. All streets in the construction area as well as any unpaved streets used by Contractor's trucks or any other equipment hauling material to and from the area, whether within the construction area or adjacent thereto, and any unpaved streets used as detours during the construction shall be serviced with self-propelled pickup street sweepers to prevent the transport of sediment and other debris off the project site. Street sweepers shall be designed and operated to meet air quality standards

J. It is specifically understood and agreed that the Contractor is responsible for complying with all requirements of the Road Agency necessary to obtain written acceptance of the roads by the agency concerned, and for such work the Contractor will be paid only for the items included in this Contract.

K. Until accepted in writing by the Road Agency, the Contractor will maintain all roads in a condition satisfactory to the agency concerned. This shall include periodic

grading of all streets on which traffic is allowed wherever in the opinion of the Engineer, such grading is required. A suitable motor grader shall be available for this work.

L. Any settlement which occurs during the first year after final contract acceptance shall be repaired by the Contractor at his expense.

2. PRODUCTS

2.1 CRUSHED ROCK

A. Crushed rock shall be as specified in Section 02222.

2.2 ASPHALT CONCRETE PAVEMENT

A. Asphalt concrete pavement shall conform to the Technical Requirements of the state highway department in which the project is located for plant mix asphalt concrete unless otherwise set forth in the Special Provisions or if superseded by the local Road Agency.

2.3 ASPHALT TREATED BASE

A. Asphalt treated base shall conform to the Technical Requirements of the state highway department in which the project is located for asphalt treated base unless otherwise set forth in the Special Provisions or if superseded by the local Road Agency.

2.4 CONCRETE

A. Concrete specifications shall meet the requirements of the local Road Agency.

3. EXECUTION

3.1 GENERAL PAVEMENT REPAIR REQUIREMENTS

A. Pavement patching shall be scheduled to accommodate the demands of traffic and shall be performed as rapidly as possible to provide maximum safety and convenience to public travel.

B. The placing and compaction of the trench backfill, and the preparation and compaction of the subgrade shall be in accordance with the requirements of Section 02222 of these Specifications.

C. Prior to trench excavation in pavement surfaces, straight vertical trim lines shall be cut in order to minimize breakage and cracking of the remaining surfacing.

D. Before the patch is constructed all pavement cuts shall be trued so that the marginal lines of the patch will form a rectangle with straight edges and vertical faces.

E. After completion of the patches, the entire roadway surface shall be cleaned by brooming or such other methods as may be required. The early completion of this phase of the restoration is required, not only to facilitate public relations, control dust and traffic problems, but also to prevent the further break-up and cracking of the existing asphalt mat. If, in the opinion of the Engineer, the Contractor is not diligently pursuing the work in such a manner as to place the patch as soon as reasonably possible, the Contractor may be required to re-trim and remove any and all cracked areas in such a manner to produce a straight uniform edge.

F. Finished grade and cross section of patch shall match grade and cross-section of existing pavement.

G. All incidental work required to complete the patching of street surfaces as specified, including joints where required, shall be considered as incidental to the patching and the costs thereof shall be included in the items for which payment is provided.

3.2 ASPHALT CONCRETE PAVEMENT TRENCH PATCH

A. Preparation:

1. As soon after compacting the trench backfill and placing and compacting backfill material, where required, the Contractor shall place and compact crushed rock in

the trench area to a minimum depth of four (4) inches or depth to match the original cross-section, whichever is greater.

2. A tack coat of asphalt applied at the rate of 0.02 to 0.08 gallon per square yard of retained asphalt shall be applied through the use of mechanical equipment to all surfaces on which any course of asphalt concrete is to be placed or abutted. The spreading equipment shall be capable of uniformly distributing asphalt materials over any area in controlled amounts and shall be equipped with hand operated spray equipment for use only on inaccessible and irregularly shaped areas.
3. The tack coat shall be a heated cutback asphalt, or emulsified asphalt, mixing grade. The emulsified asphalt may be mixed with water at the rate of 1 to 2 parts water to 1 part of emulsified asphalt.
4. If a temporary trench patch has been used it shall be removed and disposed of properly.

B. Two Lift Patch:
1. Immediately after completion of placing the base course, the Contractor shall place a two inch minimum compacted thickness of asphalt concrete surfacing.
2. A single lift of asphalt shall be at least 1 ½" thick and not more than 3 ½" thick.
3. The Contractor may substitute an equal amount of asphalt treated base for crushed rock and first lift of asphalt concrete.
4. When ordered by the Owner or when required in the Special Provisions, the Contractor shall begin the placement of the second lift. A tack coat shall be placed over the patch area. Asphalt concrete modified so that maximum size aggregate is 1/2 inch shall be placed over the tack coat. Prior to rolling, the aggregate in the asphalt concrete shall be hand raked back from the edges and rolled in such a manner to produce a uniform "feather" edge over the existing surface. The minimum compacted thickness of the second lift over the trench area shall be 1 ½".
5. Where excess settlement of the first patch occurs, a leveling course shall be used to prevent the thickness of the second lift from exceeding 2 ½" thickness.
6. The edge of the patch shall be sealed by painting with a cutback asphalt or CSS-1 emulsion and immediately covered with sand and heated.

C. Single Lift Patch:
1. Immediately after completion of placing the base the Contractor shall place a two-inch minimum thickness of asphalt concrete surfacing.
2. If the existing pavement is more than two inches the asphalt concrete shall be of the same depth as the existing pavement, depths greater than 3" shall require a Two Lift Patch as described in paragraph B above..
3. The edge shall be hand raked to produce a smooth edge where the patch abuts the existing pavement.
4. The thickness shall be adjusted so that a smooth uniform grade exists after rolling.
5. The edge of the patch shall be sealed by painting with a cutback asphalt or CSS-1 emulsion and immediately covered with sand and heated.

3.3 CEMENT CONCRETE PAVEMENT PATCH

A. After the subgrade for the pavement has been compacted and constructed to line and grade, the cement concrete pavement patch shall be placed, compacted and struck off to the grade of the adjacent pavement.
B. Minimum thickness shall be eight inches or the thickness of the existing pavement plus two inches, whichever is greater.
C. Through and dummy joints shall be placed and edged to match existing joints.
D. The surface shall be finished and brushed with a fiber brush.

E. Approved curing compound shall be placed on the finished concrete immediately after finishing.
F. Concrete used in patches shall be in accordance with Section 03300 unless Type III cement is required because of urgency of opening the street to traffic.

3.4 RIGID TYPE PAVEMENT RESURFACED WITH ASPHALT CONCRETE

A. Cement concrete patch shall be placed as specified above for cement concrete pavement patch except that the surface of the cement concrete portion of the patch shall be left low enough to accommodate the asphalt portion of the patch. Brush finishing will not be required.
B. Curing shall be accomplished with an asphalt emulsion cut back with water.
C. Asphalt concrete or bituminous plant mix shall not be placed until the day after the cement concrete has been placed.
D. The edges of the existing asphalt pavements and castings shall be painted with hot asphalt cement or asphalt emulsion immediately before placing the asphalt patching material.
E. The asphalt concrete pavement shall then be placed leveled and compacted to conform to the adjacent paved surface.
F. All joints between the new and original asphalt pavement shall be painted with hot asphalt or asphalt emulsion and be covered with dry paving sand before the asphalt solidifies.

3.5 ASPHALT CONCRETE PAVEMENT

A. Full width asphalt concrete pavement shall conform to the Technical Requirements of the standard specifications of the State Highway Department in which the project is located.
B. After the subgrade has been properly prepared and compacted, a minimum of two inches of Hot Mix Asphalt shall be placed and compacted.
C. If the existing pavement is more than two inches thick, asphalt concrete shall be of the same depth as existing pavement prior to construction.
D. The edges of the existing asphalt pavements and castings shall be painted with hot asphalt cement or asphalt emulsion immediately before placing the asphalt patching material.
E. The asphalt concrete pavement shall then be placed, leveled, and compacted to conform to established cross-section and grade and to match adjacent paved surface.
F. The edge of the new pavement shall be sealed by painting with a cutback asphalt or CSS-1 emulsion and immediately covered with sand and heated.

3.6 ASPHALT CONCRETE OVERLAY

A. Before construction of an asphalt concrete pavement overlay on an existing surface, all fatty asphalt patches, grease drippings, and other objectionable matter shall be removed from the existing pavement. Excess asphalt joint filler shall be removed and pre-molded joint filler shall be removed to at least ½ inch below the surface of the existing pavement. Existing pavement or bituminous surfaces shall be thoroughly cleaned by sweeping to remove dust and other foreign matter.
B. Prior to placing asphalt concrete, a tack coat shall be applied using heated cut back asphalt or emulsified asphalt at the rate of 0.02 to 0.05 gallons per square yard.
C. When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross section as required by the Road Agency involved. Pre-leveling of uneven or broken surfaces over which asphalt concrete is to be placed is required and may be accomplished by the use of asphalt concrete placed with a motor patrol grader, a paving machine, by hand raking, or by a combination of these methods. After placement, the asphalt concrete used for pre-leveling shall be compacted with rollers.

D. When asphalt concrete pavement is to be constructed over an existing paved or oiled surface, in addition to the preparation as outlined hereinbefore, all holes and small depressions shall be filled with an appropriate class of asphalt concrete mix. The surface of the patched area shall be leveled and compacted thoroughly. All previous patches that have settled shall be pre-leveled so that depth of overlay does not exceed two inches in thickness.
E. After preparation of the base a one inch minimum compacted full width layer of asphalt concrete shall be placed on top of an existing paving surface. Surfacing shall be placed in such a manner as to prevent disturbing existing drainage. Surfacing shall be feathered out as required to meet existing driveways, catch basins, traffic control pads, street intersections, etc., and shall include thickened edge paving where it is now existing.
F. The edges of the overlay shall be sealed by painting with a cutback asphalt or CSS-1 emulsion and immediately covered with dry sand and heated.

3.7 BITUMINOUS SURFACE TREATMENT REPLACEMENT

A. Unless otherwise specified, all light bituminous surface treatment shall be replaced with a one inch asphalt concrete overlay over a crushed rock base.
B. Base shall consist of four inches of crushed rock.

3.8 CRUSHED ROCK

A. Existing crushed rock shall be replaced with new material.
B. Thickness of course shall be as directed by the Owner.
C. When the utility line is along the shoulder of a roadway, the Contractor may be directed to place a course of crushed rock along shoulder of the roadway. Thickness shall be as required by the Road Agency.
D. During dry periods, the Engineer may require water sprinkling prior to and during the placement of crushed rock. The cost of such sprinkling shall be included in the unit bid for crushed rock.

3.9 TEMPORARY TRENCH PATCH

A. The Contractor may be required to furnish and install a temporary trench patch only when specifically directed by the Owner or as provided on the Plans.
B. Area to be patched shall be cleaned out and graded to the bottom of the base course. Any loose asphalt shall be removed.
C. Place a patch consisting of 2-inch minimum course of crushed rock base and a 2-inch minimum course of cold asphalt plant mix placed over the trench area.
D. Both the base and surface course shall be placed and compacted so that the finished surface will match the grade and cross-section of the existing pavement.
E. Surface of pavement shall be cleaned of all dirt and debris before opening to traffic.
F. The Contractor shall maintain temporary patch until the permanent patch is installed.

3.10 CEMENT CONCRETE CURBS AND GUTTERS

A. The concrete in the curbs and gutters shall be air entrained concrete in accordance with the requirements of the WDSOT Standard Specifications for Road Bridge and Municipal Construction Section8-14 (current edition).
B. Side forms shall rest throughout their length on firm ground and shall be full depth of the curb. They shall be either metal of suitable gauge for the work or surfaced "construction" grade lumber not less than two (2) inches (commercial) in thickness. Forms shall be cleaned and well oiled prior to use. Forms used more than one time shall be cleaned thoroughly and any forms which have become worn, splintered, or warped shall not be used again. Forms shall be adequately supported to prevent deflection or movement.
C. The foundation shall be watered thoroughly before the concrete is placed.
D. Concrete shall be well tamped and spaded or vibrated in the forms.

E. Exposed surfaces shall be finished full width with a trowel and edger. Remove forms of all roadway face of curbs within 24 hours or placement of concrete and treat with a float finish. The curb and gutter finish shall meet the Road Agency requirements.
F. Joints shall be spaced to match joints in the abutting pavement. If the abutting pavement is not jointed or the curb or gutter is not abutting pavement, joints in the curb and gutter shall be spaced at 15 foot intervals. These joints shall be 1/8 inch minimum thickness and constructed to a minimum depth of 1 inch by sawing or scoring with a tool which leaves the corners rounded and destroys aggregate interlock to a depth specified. Expansion joints, filled to full cross-section with filler 1/4 inch thick shall be placed in the curb and gutter to match joints in the abutting pavement, at structures, curb returns and where shown in the plans.
G. Cure for 72 hours by one of the methods specified in Section 03300.
H. Curb and gutter may be constructed by the use of slip form equipment provided the completed curb or gutter retains its shape, grade, and line. Finishing, joints, and curing shall be as provided above.
I. Top of the form shall not depart from grade more than 1/8 inch when checked with a 10 foot straight edge. Alignment shall not vary more than 1/4 inch in 10 feet.

3.11 ASPHALT CONCRETE CURBS AND GUTTERS

A. Placed, shaped and compacted true to line and grade, with machine capable of shaping and compacting the materials, to the required cross-section.
B. Provide tack coat of asphalt applied to the surface upon which asphalt concrete curb is to be placed immediately prior to placing of curb.

3.12 CEMENT CONCRETE SIDEWALKS

A. The concrete in the sidewalks shall be air entrained concrete in accordance with the requirements of the WDSOT Standard Specifications for Road Bridge and Municipal Construction Section 8-14 (current edition).
B. Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.
C. The foundation shall be brought to the grade required and well wetted before placing the concrete.
D. Place concrete in the forms and strike off with a heavy iron shod straight edge, trowel surface smooth with a steel trowel as soon as surface can be worked. After troweling and before jointing or edging, the surface of the walk shall be lightly brushed in a transverse direction with a soft brush. On grades of over 4%, the surface shall be finished with a stipple brush.
E. Joints shall be constructed at the locations and of the sizes as required by the Road Agency.
F. Cured for at least 72 hours by means of moist burlap or quilted blankets. Exclude all traffic, both pedestrian and vehicular, during curing period.

3.13 PAVEMENT MARKINGS

A. The Contractor shall restore any and all pavement striping and traffic buttons damaged during construction under this Contract.
B. Restoration shall be in accordance with the current standards of the Road Agency involved.
C. Cost of restoration of pavement striping and traffic buttons shall be incidental to pavement restoration.

3.14 ADJUSTING MANHOLES TO GRADE

A. The Contractor shall adjust manhole castings to final grade by adding concrete rings and/or mortar under the casting and patching with asphalt concrete. Paving adjusting rings will not be used unless specifically authorized by the road agency.
B. The Contractor shall exercise extreme care in preventing foreign material from entering the manhole.
C. All manholes shall be adjusted to grade after the asphalt concrete surfacing has been placed. Disturbed area around cover shall be patched and sealed to the satisfaction of the Road Agency having jurisdiction.
D. The Contractor shall take care not to extend the manholes above finished grade.
E. In concrete pavement areas, castings shall be adjusted to grade prior to concrete placement.

3.15 ADJUSTING MONUMENT CASES AND VALVE BOXES TO GRADE

A. Monument cases and/or valve boxes shall be adjusted to final grade and patched with asphalt concrete or cement concrete to match the roadway material and as designated by the Road Agency.
B. Adjustment shall be made after the resurfacing.
C. Patching around monument cases and/or valve boxes shall be done to the satisfaction of the Road Agency having jurisdiction.
D. Valve boxes shall be adjusted to the satisfaction of the utility having jurisdiction.
E. The Contractor shall take care not to extend the monument cases and/or valve boxes above the finished grade.
F. In concrete pavement areas, castings shall be adjusted to grade prior to concrete placement.

* * * END OF SECTION * * *

SECTION 02610
PIPE AND FITTINGS

1. GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Excavating, Backfilling and Compacting for Utilities: Section 02222
B. Water Lines: Section 02660

1.2 QUALITY ASSURANCE

A. Testing by Manufacturer:
   1. Manufacturer shall test all materials as required by these Specifications and the standards referenced.
   2. Manufacturer shall submit to the Engineer two (2) copies of all test results which shall include a certification that materials to be delivered are represented by the samples tested and that such delivered materials meet or exceed the specification requirements.
   3. No material shall be delivered until test results and certifications are in the possession of the Engineer.
   4. Engineer shall have free access to all testing and records pertaining to material to be delivered to the job site.
   5. The Engineer may elect to be present at any or all material testing operations.
B. Joint tests are intended for qualification of joint design and shall be considered to be a qualification test to establish the adequacy of the manufacturer's joint design. The manufacturer shall certify that tests have been performed within the last year with pipes equivalent in size and design and that they have passed the test enumerated in the specifications. Tests may be waived for pipes of different strength class if joint design is the same as the pipe tested.
C. Qualifications:
   1. HDPE pipe jointing shall be performed by personnel trained in the use of thermal butt-fusion or sidewall fusion equipment. Personnel directly involved with installing HDPE pipe shall receive training in the proper methods for handling and installing the HDPE pipe.
   2. Each thermal butt-fusion or sidewall fusion machine operator shall demonstrate his ability prior to insertion operations by fusing two pieces of pipe together in the presence of the Engineer. A fused joint with a minimum of 6 inches of pipe on either side shall be furnished to the Engineer for testing as the Owner may elect. The cost for any testing of the joint shall borne by the Owner.

1.3 SUBMITTALS

A. The Contractor shall submit the following to the Owner within ten calendar days of the award date of the contract, or as otherwise noted:
   1. Manufacturer certification that all furnished material is manufactured, sampled, tested and inspected in accordance with these specifications. An authorized agent of the manufacturer shall sign the certification.
   2. Manufacturer’s literature for all pipe, fittings, couplings, adapters, and other materials to be furnished for the project.
   3. Fusion machine operators shall have attended and successfully completed a training course sponsored by the pipe manufacturer. A written copy of such training certification shall be provided to the Engineer with the installation plan and schedule.

2. PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE/FITTINGS

A. All pipe/fitting sizes shown on plans are iron pipe size (IPS) nominal diameters unless otherwise indicated.

B. Unless otherwise specified, all HDPE pipe/fittings shall have a minimum standard dimension ratio (SDR) of 11.

C. HDPE pipe/fittings shall be co-extruded from PE 3608 or PE 4710 virgin resins meeting the specifications as defined in ASTM D3350. Pipe shall be manufactured in accordance with AWWA C906 and ASTM F714.

D. HDPE pipe/fitting material shall be high-density, extra-high molecular weight polyethylene pipe conforming to ASTM D3350 with a cell classification of 345464C.

E. Additives may be used provided pipe/fittings still meet the requirements of ASTM D2837.

F. Pipe/fittings shall contain no recycled compound except that generated within the manufacturer's own plant from resin meeting the same specifications from the same raw material supplier.

G. Pipe/fittings shall be manufactured in accordance with AWWA C906 and ASTM F714. Lettering shall be legible and permanent under normal conditions of handling and storage. Pipe/fittings shall be clearly and frequently marked with the following information:

1. Name/trademark of pipe manufacturer.
2. Nominal pipe size.
3. Standard Dimension Ratio (SDR).
4. PE 4710.
5. Manufacturing standard reference.
6. Production code from which date and location of production can be determined.
7. Nominal pressure.
8. Raw material.

H. Gasketed electrofusion HDPE saddles shall be per ASTM F1055 for use with pipe conforming to ASTM D2513/3035, F714 and with butt fittings conforming with ASTM D3261 as applicable. Saddles shall be produced with PE PE 4710 grade polyethylene resin which complies with ASTM D3350.

2.2 DUCTILE IRON PIPE

A. All ductile iron pipe and fittings shall be manufactured in the United States of America unless otherwise approved by the District. All other products manufactured outside of the United States of America shall provide address of manufacturing plant and origin of material certification.

B. For underground pressure pipelines (water main and sewer force main), conform to AWWA C150/C151 and shall be Pressure Class 350, unless otherwise specified. For above grade pressure pipelines (pump stations), conform to AWWA C150/C151 and shall be thickness Class 52, unless otherwise specified. For gravity pipelines, conform to ASTM A746 and shall be thickness Class 50, unless otherwise specified.

C. Joints shall be mechanical joint or push-on joint and shall conform to AWWA C111 (ANSI A21.11).

D. Ductile iron pipe 12 inches and smaller shall have push-on joints with restraining gaskets approved by the manufacturer for use only with their pipe unless otherwise stated. Gaskets shall be manufactured by:
   1. U.S. Pipe, Field Lok 350® (for Tyton joint pipe)
   2. McWane, Sure Stop 350® (for Tyton joint pipe)
   3. American Cast Iron Pipe Co, FastGrip® (for Fastite joint pipe)
   4. District approved equal
E. Pipe and fittings shall have a cement mortar lining conforming to AWWA C104 (ANSI A21.4).
F. Pipe shall be manufactured by
   1. U.S. Pipe
   2. Acipco
   3. Griffin
   4. Pacific States

2.3 POLYVINYL CHLORIDE COLAMINATED (PVCO) PRESSURE PIPE (4 INCHES AND OVER)
A. Conform to AWWA C909 as identified on the plans..
B. Outside diameter equal to ductile iron pipe and with gasket bell ends.
C. Pressure Class 230 psi or higher, pipe stiffness minimum of 80 psi
D. Joints shall be fully restrained by mechanical means or restraining gasket, “Rieberlok” or approved equal.
E. Bear the seal of the National Sanitation Foundation for potable water pipe.
F. All PVCO water pipe shall be considered flexible conduit.

2.4 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE (4 INCHES AND LARGER)
A. Conform to AWWA C900.
B. Outside diameter equal to ductile iron pipe and with gasket bell ends.
C. Minimum wall thickness shall be equal to or greater than dimension ratio (DR) of 18 (150 psi) unless otherwise specified.
D. Joints shall conform to ASTM D3139 using a rubber gasket conforming to ASTM F477.
E. Bear the seal of the National Sanitation Foundation for potable water pipe.
F. All PVC water pipe shall be considered flexible conduit.

2.5 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE (UNDER 4 INCHES)
A. Conform to ASTM D2241.
B. Pipe material shall be PVC 1120, PVC 1220 or PVC 2120.
C. Minimum wall thickness shall be equal or greater than a standard dimension ratio (SDR) of 21 unless otherwise specified.
D. Pipe shall bear the National Sanitation Foundation Seal for use to transport potable water.
E. Joints shall conform to ASTM D3139 using a rubber gasket conforming to ASTM F477.

2.6 MECHANICAL JOINT FITTINGS
A. Mechanical joint fittings shall be ductile iron compact per AWWA C153.
B. Ductile iron fittings shall conform to ANSIAWWA C110A21.10 and/or ANSIAWWA C153A 21.53, NSF 61, and asphaltic coating per ANSIAWWA A21.4C104.
C. Fittings shall be of a pressure rating equal to or greater than 250 psi unless otherwise required due to site specific conditions.
D. Fittings shall have the following information cast upon them

1. Manufacturer's identification
2. Country of manufacture
3. Pressure rating
4. Number of degrees or fractions of a circle (bends)
5. The District may require additional metallurgical documentation or other certifications.

E. Fitting joints shall have mechanical joint (MJ) ends, except where specifically shown or detailed otherwise. Mechanical joint components shall be in accordance with AWWA C111.

F. Bolts shall be T-head bolts, constructed from corrosion-resistant, high-strength low-alloy steel that conforms to ANSIAWWA C111A21.11 and coated with a ceramic-filled fluorocarbon resin that can hold up in highly corrosive soil conditions. Nuts shall conform to the same coating requirements.

G. All mechanical joints shall be restrained with
1. Mechanical joint restraint shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of AWWA C110. The restraints shall be Series 1100 epoxy coated restraint devices as manufactured by EBAA Iron, Inc., or District approved equal. Restraints shall be polyethylene wrapped to prevent backfill materials from entering wedge gripping area.
2. The joint restraint ring and wedge components shall be constructed of grade 65-45-12 ductile iron conforming to ASTM A536. Wedges shall be heat-treated to a minimum Brinell Hardness Number of 370. The dimensions of the follower gland shall be compatible with joint bells conforming to ANSIAWWA A21.11C111 and ANSIAWWA A21.52C153.
3. Joint restraint shall be listed by Underwriters Laboratories (UL) and shall be Factory Mutual approved.

2.7 FLANGED FITTINGS

A. Flanged fittings shall conform to ANSIAWWA C110A21.10 and shall be faced and drilled Class 125 flanges that match ANSI B16.1 fittings.

B. Flanged fittings allowed under ANSIAWWA C110A21.10 are ductile or gray iron.

C. Flange bolts and nuts shall be constructed from corrosion-resistant, high-strength low-alloy steel that conforms to ANSIAWWA C111A21.11 and coated with a ceramic-filled fluorocarbon resin that can hold up in highly corrosive soil conditions.

D. Bolts for flange fittings shall be full-nut installation (i.e., three full threads showing past nut).

E. Coat threads on bolts and nuts with a food grade anti-seize material to prevent thread galling and torque to manufacturer's recommended torque where stainless steel bolts and nuts are approved for use by District Engineer.

F. Buried flanged fittings shall be fully wrapped with three layers of 8 mil polyethylene sheet secured with polyethylene tape.

G. Gasket material for flanged joints in ductile iron pipe shall consist of 1/8-inch thick, full-face one-piece, rubber gaskets conforming to Section 4 of ANSIAWWA C207 and ANSI B16.21, and shall conform to NSF 61 standards. Gaskets shall have one or more annular ring molded into the gasket to improve gasket performance.

H. The gasket shall be cut with holes to pass bolts.

I. Gasket material shall be free of corrosive alkaline or acidic ingredients.

J. Lining and coating shall conform to Section 3.2.B.5 and 3.2.B.6.

K. Flange coupling adapters shall be installed with strict adherence to manufacturer's torque limitations during installation and shall be manufactured by
1. Romac, Alpha Style Couplings
2. EBAA Iron, Megaflange

3. District approved equal

2.8 THREADED BRASS PIPE

A. Brass Pipe used shall be schedule 40 seamless red brass and shall conform to ASTMB43. Pipe shall be male iron pipe thread (MIPT) on both ends.

2.9 FLEXIBLE COUPLINGS

A. Use for connection between plain end pipe of same or different material.
B. Sleeve: Gray iron ASTM A126 Class B or ductile iron ASTM A536. Ends have a smooth inside taper for uniform gasket seating.
C. Followers: Ductile iron ASTM A536.
D. Gaskets: Grade 30 specially compounded rubber of all new materials.
E. Bolts and nuts: High strength low alloy steel with heavy, semi-finished hexagon nuts to AWWA C111 (ANSI-A21.11).

2.10 WATER SERVICE PIPE

A. Copper Tubing:
   1. Copper tubing shall conform to the requirements of ASTM B88, Type K, annealed. Use for connection between plain end pipe of same or different material.
   2. The tubing shall be coupled using flare-type compression fittings, conforming to the requirements of AWWA C800, minimum 150 psi working pressure.
B. Polyethylene Pipe:
   1. Polyethylene Pipe to be used for water service lines 2 inches in size and smaller shall conform to the requirements of AWWA C901 Class 160 psi manufactured with PE 4710 material.
   2. Bear the seal of the National Sanitation Foundation for potable water pipe.
   3. Joints shall be made in accordance with the manufacturer's recommendations. Solvent welded pipe joints will not be permitted.
C. Polybutylene Pipe:
   1. Polybutylene pipe to be used for water service lines 2 inches in size and smaller shall conform to the requirements of AWWA C902 Class 160 psi.
   2. Bear the seal of the National Sanitation Foundation for potable water pipe.
   3. Joints shall be made in accordance with the manufacturer's recommendations. Solvent welded pipe joints will not be permitted.
D. Compression Couplings:
   1. Compression couplings for use in connecting plain end water service pipes shall be applicable for the type of pipe being coupled.
   2. Compression couplings shall have armored gaskets when similar metal pipes are being joined.
E. Insulating Couplings:
   1. Insulating couplings shall be required at any point of connection of two dissimilar metallic pipes (i.e., copper to galvanized iron or steel).

2.11 WATER SERVICE MATERIALS

A. Tapping Sleeves and Saddles
   1. Tapping sleeves shall be stainless steel as specified in below Tapping sleeve gaskets shall be one piece with a minimum working pressure of 250 pounds per square inch(psi). Tapping sleeves shall be manufactured for the size and type of pipe to be installed.
   2. Branch outlet from tapping sleeve shall be a minimum of Schedule 10 material thickness and shall have a test plug.
   3. Saddles shall be used for taps 2" and smaller. Saddles shall be nylon coated ductile iron with stainless steel strap as specified in the table below.

Acceptable Tapping Material

Tap Size	Sleeve/Saddle Types	PSI Rating
Taps Larger Than 2" on DI or PVC main:	Ford FTSS	250
	JCM 432	250
	JCM 452 Stainless Steel with Outlet Seal	250
Size by Reduced Size Only	Muller H-304	250
	Romac SST III (W/ Stainless Steel Flanges) Only allowed on 4"-8" Or Equal	250
1" Taps on 8" or smaller DI or PVC main	Romac 101NS or Smith Blair	
1" Taps on DI or PVC Mains Larger than 8"	Romac 202NS or Smith Blair	
1" Taps on 12" or smaller HDPE mains	Romac 202N-H or fusible saddle	150
2" Taps on all DI or PVC Mains	Romac 202NS or Smith Blair	
2" Taps on 12" or smaller HDPE mains	Romac 202N-H or fusible saddle	150

See Standard Detail Number 3.

B. Meter Boxes and Covers
   1. Meter boxes for 1-inch water services shall be
      a. In area with rolled curb or meter box in driveway, use Carson Heavywall Box #BCF-1324 with Reader Lid #BCF -1324-RLA
      b. In area with vertical curb or meter box behind sidewalk, use Carson Standard Plastic Meter Box #1220-12L with Reader Lid
   2. Meter boxes for 2-inch water services shall be precast concrete Fogtite NO. 3 stacked two high with a solid concrete Fogtite No. 3 Lid with Reader Lid. If the Meter Box is located in a high traffic area an alternate may be needed and approved by the district.
   3. Refer to standard detail 4.
   4. Depending on the elevation difference between the meter and the proposed building to be served, the District may require a gate valve or backflow prevention device on the customer side of the meter at the meter box.

C. Corporation Stops:
   1. Corporation stops for service lines and sample stations shall meet the requirements of ANSIAWWA C800, have AWWA taper (cc) thread inlet and compression connection outlet, and a minimum pressure rating of 250 psi. All corporation stops shall be ball valves. Ground key type corporation stops will not be accepted.
   2. Corporation stops for 1-inch copper service lines on ductile iron main line shall

have AWWA taper (cc) thread inlet and compression connection outlet and shall be Ford FB1000xCTS Grip Joint or Mueller B-25008N, or District approved equal.

3. Corporation stops for 2-inch copper services shall have male iron pipe thread (MIPT) inlet and outlet and be Ford FB500-7-NL, or District approved equal.
4. Corporation stops for combination air release valve (CARV) shall have MIPT inlet and outlet and be Ford FB500-7-NL, see Details 3 and 16.

D. Meter Stops:
   1. Meter stops shall be angle pattern with lock wings.

2.12 POLYPROPYLENE CORRUGATED PLASTIC PIPE (PP-CPP)

A. This specification describes 12- through 30-inch polypropylene corrugated plastic pipe (PP-CPP) for use in storm culvert, casing or as shown on the plans.
B. PP CPP shall have a smooth interior and annular exterior corrugations.
   1. 12- through 30-inch (300 to 750 mm) dual wall pipe shall meet ASTM F2736.
   2. Pipe shall have a minimum pipe stiffness of 46 psi when tested in accordance with ASTM D2412
   3. Manning's "n" value for use in design shall be 0.012.
C. Pipe joints shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2736.
D. Joints shall be watertight according to the requirements of ASTM D3212, with the addition of a 15-psi pressure requirement. Spigot shall have two gaskets meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gaskets are free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
E. Pipe shall have a reinforced bell with a polymer composite band installed by the manufacturer.
F. Fittings and connections shall provide a watertight connection according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477.
G. To ensure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field testing any pipe material.
H. Polypropylene compound for pipe and fitting production shall be an impact modified copolymer meeting the material requirements of ASTM F2736 or ASTM F2764.
I. Installation shall be in accordance with ASTM D2321 and manufacturer's published installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameters, the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level – refer to manufacturer's literature for more information.

2.13 RESTRAINED COUPLINGS

A. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
B. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

C. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6” gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
D. For Ductile Iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
E. The flange adapter shall be the SERIES 2100 MEGAFLANGE adapter as produced by EBAA Iron, Inc., or approved equal.

2.14 SLEEVES AND MECHANICAL COUPLINGS

A. Full-body sleeves for buried service shall be ductile iron with mechanical joint components. Sleeves shall be manufactured for the size and type of pipe to be installed. Mechanical joint sleeve gaskets shall conform to ANSIAWWA C111A21.11. Couplings shall be
   1. Dresser
   2. Smith Blair
   3. Alpha Style couplings by Romac
   4. District Approved Equal
B. Mechanical couplings shall be ductile iron with rubber rings and bolts and nuts in accordance with section 3. Couplings shall be manufactured for the size and type of pipe to be installed. Couplings shall be
   1. Dresser
   2. Smith Blair
   3. Romac
   4. District Approved Equal

2.15 REPAIR CLAMPS, BANDS, AND SLEEVES

A. Repair clamps for abandoning existing water main connections or for repairing existing water mains shall be stainless steel, with one-piece gaskets. Repair clamps shall have a minimum working pressure of 250 psi and shall be manufactured to match the size and type of the pipe to be repaired.
B. Clamps shall be
   1. Model 131 by JCM
   2. Model FS2 by Ford
   3. 500 series by Mueller
   4. Model 257 by Smith-Blair
   5. Model SS1 by Romac
   6. District approved equal

2.16 CASING PIPE, SPACERS, AND SEALS

A. Casing Pipe
   1. Casing pipe shall be smooth steel conforming to ASTM A36 with minimum yield strength of 36,000 psi.
   2. The minimum wall thickness shall be as required by the jurisdiction governing the highway, railroad, or stream bed under which the casing will be installed. In no case shall the casing wall thickness be less than 14-inch.
   3. Engineer shall provide cathodic protection design for casing pipe as needed. Confirm with District Engineer as casing may serve different purposes.
B. Spacers
   1. Casing spacers shall be 12” wide, two-piece construction, and all stainless steel.
   2. The spacer shall have a minimum of four runners through 12” pipe size, six runners through 36” sizes and seven runners through 48” sizes to secure carrier pipe within the casing and to resist movement of the pipeline.
   3. Casing spacers shall be as manufactured by

a. Cascade Manufacturing
b. Calpico Inc.
c. District approved equal

C. Casing seals shall be Model “C” custom pull-on casing ends, as manufactured by Calpico, Inc., or District approved equal.
D. See standard detail 30

2.17 POLYETHYLENE ENCASING

A. Polyethylene film shall be manufactured of virgin polyethylene material confirming to the requirements of ASTM D1248 Polyethylene Plastics Molding and Extrusion Materials.
B. Polyethylene film shall have a minimum nominal thickness of 0.008 m (8 mils). The minus tolerance of thickness shall not exceed 10 percent of the nominal thickness.
C. Tube size for each pipe diameter shall be as listed below:

Nominal Pipe Diameter	Flat Tube Width
3	14
4	16
6	20
8	24
10	27
12	30
14	34
16	37
18	41
20	45
24	54
30	67

D. Where specified, encasement shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE) fused into a single thickness of 8-mils. The inside surface of the wrap shall be infused with a blend of antimicrobial biocide to mitigate microbiologically influenced corrosion (MIC) and a volatile corrosion inhibitor to control galvanic corrosion. Encasement shall be V-Bio or District approved equal. Polyethylene encasement shall conform to the values shown in the following table.
E. Polyvinyl chloride (PVC) tape shall be 2-inch wide, adhesive-backed, 10-mil black adhesive tape, Christy’s Pipe Wrap Tape, or District approved equal.
F. Where specified, encasement shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE) fused into a single thickness of 8-mils. The inside surface of the wrap shall be infused with a blend of antimicrobial biocide to mitigate microbiologically influenced corrosion (MIC) and a volatile corrosion inhibitor to control galvanic corrosion. Encasement shall be V-Bio or District approved equal. Polyethylene encasement shall conform to the values shown in the following table.

Polyethylene Encasement Minimum Acceptable Values

Properties	Values
Tensile Strength – MD	4300 psi
Tensile Strength - TD	3800 psi
Dielectric Strength	800 V/MIL
Impact Resistance	800 grams
Tear Strength – MD	2550 grams force
Tear Strength - TD	3184 grams force
Minimum Thickness	8 mils

G. Polyvinyl chloride (PVC) tape shall be 2-inch wide, adhesive-backed, 10-mil black adhesive tape, Christy's Pipe Wrap Tape, or District approved equal.

H. Under no circumstances shall the Contractor allow sharp, heavy pieces of material to drop directly onto the pipe or the tamped material around the pipe. Special care shall be taken to protect polyethylene encasement.

2.18 DETECTABLE LOCATOR TAPE

A. The tape shall consist of a minimum 5.0 mil thickness, clear, inert polyethylene plastic which is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil, with a minimum 1/3-mil metallic foil. The tape shall be at least three inches (4") in width and shall be reverse printed using a diagonally striped design for maximum visibility and meet APWA color-code standard for identification of buried utilities. The tape shall have printed thereon the following or similar as commercially available:

"CAUTION - BURIED WATERLINE BELOW"

The identifying lettering shall be minimum 1" high and repeated continuously the full length of the tap. In no instance shall the spacing of the individual segment of the identifying message be greater than eighteen inches (18").

B. Detectable locator tape shall be installed 18 inches above the pipe it identifies. The backfill shall be sufficiently leveled so that the tape will be installed on a flat surface. The tape shall be centered in the trench and laid flat with printed side up. Caution shall be exercised to avoid displacement of tape and to ensure its integrity. The remainder of the trench is then backfilled in accordance with applicable specifications.

C. Tape shall have a minimum strength of 1,750 psi lengthwise and 1,500 psi cross wise.

D. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect from corrosion.

E. Warning tape shall be installed directly above the pipe centerline at an elevation equal to the top of the pipe zone material unless otherwise directed by the District Engineer.

2.19 TRACER WIRE

A. Tracer wire shall be used for non-conductive pipe and service lines, pipes deeper

than 8 feet, or for critical water mains as required by District Engineer.

B. Provide permanent, bright-colored blue, continuous locate tracer wire consisting of a tin coating and copper conductor with polyethylene insulation. Locate wire shall be 10 gauge. Core material shall be comprised of high-tenacity, woven polyester with water blocking yarns encapsulated in a 30 mil, blue high-density polyethylene (HDPE) jacket providing corrosion resistance, flexibility, impact strength and 1,800 pounds (lbs.) tensile strength. Tracer wire shall not conduct an electrical current when struck by lightning and shall be designed for direct burial applications. When splices and lateral connections are made, only manufacturer's recommended connectors shall be used.
C. Directional Drill, Pipe Bursting or any other Trenchless Technology pipe installation method shall require a minimum of 7x7 stranded wire with a minimum break load rating of 4,500 lbs.
D. Tracer wire and connectors shall be TRACE-SAFE TM Water Blocking Tracer wire and related connectors, manufactured by NEPTCO, Inc. and produced in the U.S., or District approved equal.
E. Locate stations for tracer wire shall be located inside standard traffic-rated valve boxes with a "KCWD90 Locate" cast into the cover as indicated in Standard Detail 309 and 402 . Locate stations or risers shall meet the requirements of the tracer wire manufacturer for compatibility with their product.
F. Wired nuts shall be waterproof type.
G. Split bolts shall be brass.
H. Locate clips shall be TRACE-SAFE TM, TS-19-LC locate clip with cap; or approved equal.
I. Install tracer wire in accordance with manufacturer recommendations and do not splice wire unless splice and housing for splice meet the manufacturer's requirements.
J. Extend tracer wire to surface with a riser and install within a valve box for access. Tracer wire shall not be installed within the same valve box as an operational valve. Risers for access to tracer wire shall be installed at the frequency necessary to obtain readable conductive signals or a maximum of 1,000 feet.
K. A successful conductivity test for all installed tracer wire will be necessary prior to acceptance of the system
L. Tracer wire must be installed on all water mains. Tracer wire must be suitable for direct bury and be 10 AWG with 30-mil HDPE jacket colored blue. Trace wire must be continuous. When allowed by the inspector, splices must use Copperhead Industries, LLC connector, part #3WB-01 or equal.

3. EXECUTION

3.1 INSTALLATION

A. Install pipe in accordance with specification section for pipeline being installed.

3.2 CUTTING THE PIPE

A. Cut pipe for inserting valves, fittings, or closure pieces in a neat manner without damaging the pipe, coating, or lining and so as to leave a smooth end at right angles to the axis of the pipe. Do not flame cut.
B. Cut ductile iron pipe with milling type cutter or saw.
C. Dress cut ends of push on joint pipe by beveling, as recommended by the manufacturer.

3.3 CLEANING PIPE AND FITTINGS

A. For ductile iron pipe joints, clean the outside of the spigot and the inside of the bell

with a wire brush. Remove all lumps, blisters, and excess coating from the bell and spigot ends of each pipe.

B. Wipe all dirt, grease, and foreign matter from fittings and the ends of MJ pipe and push-on joint pipe.

3.4 FUSION JOINING HDPE

A. All HDPE pipe shall be joined by thermal butt-fusion or sidewall fusion per manufacturer's recommendations and ASTM D2657. The pipe manufacturer shall submit a certificate of compliance stating that the proposed fusing equipment is in compliance with their requirements.

B. Contractor shall identify means of joining one pipe to another and details for installation prior to beginning work. Joining and installation details shall be subject to the Owner's approval. Threaded or solvent–cement joints and connections are not permitted.

C. Joints shall have weld strength equal to or greater than the tensile strength of the pipe/fittings. All joints shall have sufficient strength to withstand handling and load stresses normally encountered during and following installation of the pipe.

D. HDPE pipe/fittings shall be joined into continuous lengths above grade on site whenever possible. Pipe shall be joined on site in appropriate working lengths near the insertion pit. HDPE pipe shall be assembled and stored where accesses to homes, businesses, mailboxes, etc. are not disrupted.

E. Contractor shall pre-assemble as much pipe as possible before beginning insertion process. If additional pipe is needed, pipe shall be joined as it is being inserted.

F. Pipe lengths shall be stored in a manner and location as to protect the pipe from scouring, gouging, or other damage. Internal scouring and external cuts or abrasion deeper than 10% of the wall thickness or pipe sections found to be out of round shall not be used as replacement pipe.

G. The joints shall be leak proof, thermal, butt-fused joints. All fusing shall be done using tools recommended by the pipe supplier and approved by the Owner. Operators shall be certified by the pipe manufacturer. The fusing machine shall have hydraulic pressure control for fusing two pipe ends together. The ends of pipe shall be trimmed to form perpendicular faces prior to fusing. The heating plate on the fusing machine shall be electrically heated and thermostatically controlled and shall contain a temperature gauge for monitoring temperature. The heating plate shall be subject to periodic inspection, using a temperature stick, to assure even heating.

H. Joints between pipe sections shall be smooth on the inside. Internal projection beads shall be removed from each pipe joint prior to installation of the pipe. Joints between pipe sections shall not exhibit internal beads that protrude into the pipe more than ¼-inch. The bead remnants shall be removed from the pipe prior to installation and disposed of.

I. Two joints, selected at random by the Owner from the first total of 1,000 feet shall be tested in compliance with ASTM D638 to ensure that the tensile strength of yield of the butt fusion joints equals or exceeds that of the pipe. The test specimen shall be obtained by cutting the liner pipe at least twelve inches on each side of the field made joint. One additional test shall be made for each additional 1,000 feet of line or portion thereof.

J. The butt-fused joint shall provide true alignment between the joined pipes and shall have uniform roll back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be inspected prior to insertion and shall be subject to

acceptance by the Owner. All defective joints shall be cut out and replaced at no cost to the Owner.

K. Fusion saddle tees shall be reinstated by attaching a molded branch saddle fusion saddle tee to the HDPE main using thermal sidewall fusion or electrofusion sewer saddle tees. Install molded branch fusion saddle tees using procedures and equipment as referenced in manufacturer's written installation instructions. Prior to installation of tees, sewer main pipe shall be less than 5% ovality. Water main pipe exceeding 5% ovality shall be re-rounded or replaced before installing tees at no additional cost to the Owner.

3.5 TAPPING SLEEVES

A. Coordinate with Inspector at least 48 hours prior to tapping. Inspector shall be onsite to witness tapping.

B. Tapping sleeves shall be installed per the manufacturer's instructions. Generally, the installation process for tapping ductile iron or cast-iron pipe shall be as follows

1. Clean all dirt, corrosion, and other foreign material from the pipe surface.
2. Verify pipe diameter and tapping sleeve size.
3. Tapping sleeve gasket shall be one-piece.
4. Apply pipe joint lubricant to pipe and gasket.
5. Place the saddle section of the sleeve on the pipe and mate the band section with the saddle section. Ensure that gasket is properly positioned and that no foreign material is trapped between the pipe and gasket.
6. Install lug bolts, position the sleeve, and hand tighten the lug bolts to hold the unit in place. Ensure that flange face is level for proper installation of valve.
7. Tighten the bolts according to the manufacturer's recommended sequence to the recommended torque and verify final torque several times throughout the installation process.
8. Install flange gasket, attach tapping valve per manufacturer's instructions, and support the assembly with blocking and shims.
9. Pressure test the valve and sleeve assembly and check for leaks.
10. Verify proper bolt torque, assembly alignment, and cutter size.
11. Attach the drilling machine to the tapping valve and support entire assembly with blocking and shims.
12. Tap pipe, close valve, and verify bolt torque on tapping sleeve.
13. Open tapping valve slightly to flush any foreign material and provide pipe coupon to Inspector.
14. Wrap tapping sleeve and valve in three layers of 8-mil polyethylene. Extend polyethylene wrap a minimum of 6 inches beyond the valve and tapping sleeve.
15. Ensure that all pipes and valves are fully supported with compacted crushed rock bedding prior to backfilling.

3.6 APPLYING POLYETHYLENE ENCASEMENT TO BURIED PIPE AND FITTINGS

A. Install polyethylene encasement per ANSIAWWA C105A21.5 Method A, Modified DIPRA Method for Wet Trench Conditions. Cut polyethylene tube 2-feet longer than the length of pipe to receive the encasement. Provide a 1-foot minimum overlap for each adjacent pipe joint. Prior to placing the pipe into the trench, raise the pipe section with a fabric type sling or padded cable, and remove all soil and other debris from the pipe exterior. Slip the polyethylene tube over the spigot end of the pipe. Bunch up the tube in accordion fashion between the spigot end and the supporting sling holding the pipe.

B. Place the pipe on blocks with slackened sling in place so the polyethylene encasement can be spread over the entire barrel of the pipe.

C. Pull the loose polyethylene tube on the pipe snugly around the pipe barrel. Fold excess material over at the top of the pipe and secure the fold with circumferentially or spiral wrapped polyethylene tape at 2-foot maximum intervals along the length of the pipe.
D. Lower the pipe section into the trench and seat the spigot end into the bell of the previously installed pipe. Ensure that the polyethylene encasement is not stabbed into the previously installed pipe. Provide a shallow hole in the pipe bedding at the bell to facilitate the joint overlap. Ensure soil or bedding material does not become trapped on the exterior of the pipe between the pipe and the polyethylene encasement. In addition, ensure that soil or bedding material is not allowed to enter the pipe interior.
E. Remove the sling from the pipe leaving 1-foot of bunched up polyethylene tube at each end of the pipe for joint overlap.
F. To make joint overlap, pull the polyethylene tube from the bell end of the previously laid pipe over the spigot end of the current pipe and fold the tube around the pipe and secure with three circumferential wraps of 2-inch-wide plastic adhesive tape or a plastic tie strap. Then pull the bunched-up polyethylene tube on the spigot end over the wrapped pipe joint to the bell end. Fold polyethylene tube and secure with tape as previously described.
G. Install the next section of pipe in the same manner
H. Wrap all copper air and vacuum valve lines, copper service lines, copper sampling station lines with PVC adhesive tape, half lapped, for a minimum of three feet from the main. Wrap all corporation stops.
I. Wrap valves and fittings by pulling the bunched-up polyethylene tube (where installed) from the adjacent pipe over the bells or flanges of the valve or fittings. Secure the tube to the valve or fitting body with 2-inch-wide adhesive tape wrapped around the body of the valve or fitting. Then wrap the valve or fitting with three layers of 8-mil flat sheet of polyethylene. Place the sheets under the valve or fitting and fold in half. For valves, extend the sheet to the valve stem and secure the sheet in place with 2-inch adhesive tape. Secure the sheets with tape around the valve stem below the operating nut and around the barrel of the connecting pipe to prevent the entrance of soil. Make sure the wrap does not impede movement of operating nut. For fittings, wrap and overlap the adjoining pipe a minimum of 1-foot and secure in placed with 2-inch-wide adhesive tape. Pour concrete anchor and thrust blocks, if any, after the wrap is in place.

3.7 REPAIRING POLYETHYLENE ENCASEMENT

A. All efforts shall be made to install the polyethylene encasement free of tears, breaks or other defects. Polyethylene encasement with excessive holes shall require replacement of the damaged section at the District’s discretion. Repair minor rips and tears in the installed polyethylene with PVC tape.

3.8 TAPPING METHOD FOR POLYETHYLENE ENCASED PIPES

A. Remove section of polyethylene encasement from the area that will be tapped. Secure free ends of polyethylene encasement on either side of the removed section by wrapping three layers of polyethylene adhesive tape circumferentially around the pipe.
B. Install tapping sleeve or saddle and valve as normal to the area of the pipe clear of polyethylene encasement. Make the tap as required.
C. After the tap has been made, inspect work and make repairs as necessary., Applying Polyethylene Encasement to Buried Valves and Fittings to encase the tapping sleeve or saddle and tapping valve.

3.9 A. INSTALLATION OF SERVICE CONNECTIONS

A. Trench excavation and backfill shall conform to Section 2.
B. Service Saddles
   1. Thoroughly clean the pipe surface and apply a suitable gasket lubricant per the manufacturer's instructions.
   2. Position the saddle body over the pipe, install the straps, install the nuts to finger tight, and check to ensure that the gasket is seated flat onto the pipe face.
   3. Tighten the nuts evenly in 20 lb increments to the manufacturer's recommended torque specifications.

3.10 COPPER TUBING INSTALLATION

A. Copper tubing shall be cut with square ends, reamed, cleaned, and made up tightly.
B. Install copper tubing in full length segment without joints where possible. Where joints are required, use approved compression fittings.
C. Care shall be taken to prevent the tube from kinking or buckling on short radius bends. Kinked or buckled sections of copper tube shall be cut and the tube spliced with the proper brass fittings at the Contractor's expense.

3.11 METER BOX INSTALLATION

A. Meters and meter boxes shall be installed as shown in Standard Details or as directed by the District Engineer.
B. Finish grade of completed meter enclosure shall allow a minimum of one inch and a maximum of four inches clearance from the top of the meter to the meter box.
C. Meter boxes shall be set or constructed plumb, with the top set horizontally. Grade adjustments of the meter boxes shall be done using standard extension sections for the box specified.
D. Lightly compacted earth backfill shall be placed inside of the meter boxes to depth indicated. Backfill around meter boxes as specified for adjoining pipe. Provide adequate space to allow for sidewalk installation.

3.12 METER INSTALLATION

A. Meter shall be centered horizontally in the meter box such that meter can be read from the smaller box opening.
B. Prior to connection of the meter, the angle valve shall be opened, and the service line flushed of all foreign materials.
C. Depending on the elevation difference between the meter and the proposed building to be served, the District may require a gate valve or backflow prevention device on the customer side of the meter at the meter box.
D. Disinfection and hydrostatic tests shall be performed on the service connections and pipes.

* * * END OF SECTION * * *

SECTION 02640
VALVES

1. **GENERAL**
   1.1 RELATED WORK SPECIFIED ELSEWHERE
      A. Excavating, Backfilling and Compacting for Utilities: Section02222
      B. Pipe and Fittings: Section 02610
   1.2 QUALITY ASSURANCE
      A. Testing by Manufacturer:
         1. Manufacturer shall test all materials as required by these specifications and the standards referenced.
         2. Manufacturer shall submit to the Engineer copies of all test results which shall include a certification that materials to be delivered are represented by the samples tested and that such delivered materials meet or exceed the specification requirements.
      B. NSF 61 Certification
         1. All valves shall be certified to NSF 61 to be suitable for contact with potable water. All wetted materials shall be suitable for potable water service with line content containing chlorine or chloramines.

2. **PRODUCTS**
   2.1 GATE VALVES - (UNDER 12 INCHES)
      A. Conform to AWWA C509.
      B. Iron body, bronze stem, resilient wedge.
      C. O-ring stuffing box.
      D. Open counter-clockwise unless otherwise specified.
      E. Non-rising stem type.
      F. Equipped with a 2 inch standard operating nut.
      G. Mechanical joint suitable for installation with the type and class of pipe being used or flanged where detailed.
      H. All flange faces shall be machined. Flanges shall be drilled to straddle vertical centerline.
      I. Interior and exterior fusion bonded epoxy coating conforming to ANSIAWWA C550 and C116A21.16. Average dry film thickness shall be a minimum of 10 mils.
      J. Valves shall operate with greater than 18 turns.
      K. Only gate valves from the following manufacturers shall be provided for installation in the District's facilities
         1. Kennedy
         2. M & H
         3. Mueller Co.

   2.2 GATE VALVES - (12 INCHES AND LARGER)
      A. Conform to applicable provisions of Article 2.1 for gate valves under 12 inches and the following additional requirements.
      B. Arranged for operation in the horizontal position.
      C. Equipped with bronze tracks fastened into a groove or slot within the valve body casting, together with bronze rollers, shafts, bushings and scrapers.
      D. Gears shall be cut tooth steel gears, housed in heavy cast iron extended type grease cases.
      E. Equipped with bypass of the size adopted as standard in the AWWA specification.
      F. Provide three certified copies of performance tests, as specified in Section 5 of AWWA C509 to the Engineer for review.

2.3 BUTTERFLY VALVES

A. Conform to AWWA C504, Class 150B.
B. Suitable for direct burial.
C. Mechanical joint or push on joint suitable for installation with type and class of pipe being used or flanged where detailed.
D. Standard O-ring shaft seal.
E. Operator shall be traveling nut or worm gear type, sealed, gasketed, permanently lubricated for underground service, grease packed, and designed to withstand submersion in water to a pressure of 10 psi.
F. Operator shall be designed to withstand a minimum of 300 foot-pound (ft-lb) torque.
G. Equipped with a standard 2 inch operating nut.
H. Open counter-clockwise.
I. The number of turns required to move the disc from a fully opened position to a fully closed position shall meet the minimum number of turns listed in the table below. For valves larger than 18-inch, submit number of turns to District Engineer for approval.

Minimum Number of Turns

Size	Number of turns to open/close
4”	15
6”	15
8”	15
12”	20
16”	30
18”	40

1.

J. Flanges shall be drilled to match fittings.
K. Only butterfly valves from the following manufacturers shall be provided for installation in the District's facilities
   1. Clow Valve Company
   2. East Jordan
   3. M & H Valve Company
   4. Mueller Co.
   5. Pratt
   6. Val-Matic

2.4 OPERATOR EXTENSIONS

A. If the operating nut is deeper than 48 inches below finished grade, provide steel operating extensions to bring the operating nut to 24 – 30 inches below the ground or pavement surface.
B. The operator extension shall have a steel rock guard to allow centering of the stem in the valve box. Rock guard shall be located directly below the top operator nut and no less than six feet apart if the extension is eight feet or more in length. Add additional rock guards as necessary.
C. Refer to **Standard Detail 12** for typical valve operator extension.

2.5 VALVE BOXES

A. Provide for all buried valves.
B. Valve boxes shall be one piece cast iron East Jordan Iron Works 8555 and cover shall be EJIW 6800 with WATER cast into the top, or approved equal.

C. Lengths suitable for the particular project or as specified.
D. Base corresponding to size of valve.
E. Valve boxes shall be raised to grade for final overlay. No risers will be allowed.
F. Soil pipe cut to length as required shall be used as a spacer for the lower portion of the valve box. Length of spacer shall be as required depending on depth to operating nut.
G. Provide a 4 inch thick by 4 foot wide asphalt or concrete collar around valve box covers in unimproved areas, landscape areas, and easements.
H. A foam ring used as a cushion between the valve and valve box.
I. See **Standard Detail 12**.

2.6 VALVE MARKER POST

A. Shall be Triview Flex 66 (BLUE) with applicable warning label, or approved equal.
B. Stencil the size of the valve and the distance in feet and inches to the valve on the face of the post, using neatly stenciled white enamel numbers, 1” in height.
C. See **Standard Detail 13**.

2.7 AIR RELEASE VALVE

A. Designed to operate with potable water under pressure to allow entrapped air to escape from the pipeline.
B. Body and cover: Cast iron conforming to ASTM A48, Class 30.
C. Floats: Stainless steel conforming to ASTM A240 and designed to withstand 1,000 psi pressure.
D. Seats: Buna N rubber.
E. Internal Parts: Stainless steel or bronze.
F. Designed to withstand 300 psi pressure with normal operating pressure under 100 psi.
G. Manufactured by APCO or equivalent with following listed orifice sizes:

Model No.	Size of Valve	Large Orifice	Small Orifice
143C	1"	1"	5/64"
145C	2"	2"	3/32"
147C	3"	3"	3/32"

H. Vault shall be precast concrete meter box or utility vault as indicated on the detail.

2.8 COMBINATION AIR AND VACUUM RELEASE VALVES

A. The valve inlets shall have iron pipe threads. The combination air and vacuum release valves shall be Valmatic or Crispin for all water mains of 12-inch diameter and smaller.
B. Type of combination air and vacuum release valves for water mains with diameters larger than 12-inches shall be determined and approved by the District Engineer.
C. The pipe used for the air release valve assemblies shall be brass or Harco DI nipples at the inlet and shall conform to Standard Detail 18.
D. Enclose valves with two concrete meter boxes stacked together. Meter boxes shall Fogtite number 2 with solid concrete cover 17” x 28” id or District approved equal.
E. Set top of box flush with grade
F. See **Standard Detail 16.**

2.9 CURB STOP BALL VALVE

A. Curb stops shall be brass ball valve type with compression fittings when connecting to copper tubing, and female iron pipe thread (FIPT) when connecting to brass piping.

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2.10 PRESSURE REDUCING VALVES

A. Valves shall be Cla-Val Model 90-01 as manufactured by Cla-Val Co., or District approved equal.
B. The PRV shall be a hydraulically operated, diaphragm-actuated, globe pattern valve, equipped with a resilient, synthetic rubber disc forming a tight seal against a single removable seat insert.
C. Diaphragm
    1. The diaphragm shall not be used as a seating surface. No packing glands, stuffing boxes, or valves with pistons are permitted.
    2. Repairs shall be possible without removing the valve from the pipeline.
    3. The diaphragm assembly shall be fully guided at both ends by bearings in the valve cover and seat. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.
D. The pilot control shall be a direct-acting, adjustable, spring-loaded, normally-open diaphragm valve, designed to permit flow when controlled pressure is less than the spring setting. A fixed orifice shall be included in the control system. Pilot controls shall be bronze (ASTM B62).
E. Pressure sustaining features may be required on PRVs as determined by the District Engineer.
F. The main valve and body shall be of ductile iron construction. The main valve trim shall be stainless steel.
G. Pilot systems shall have an adjustment range of 30-300 psi or as directed by the District Engineer.
H. The PRV shall be furnished with an internal and external 12 mil protective coating which shall conform to NSF 61.
I. Valves shall accommodate at least 100 psi greater than the normal upstream working pressure in case of surge. District Engineer shall determine working pressures as described in in conjunction with the District's existing network of pressure zones. Anti-Cavitation Trim may be required as determined by the District Engineer.

2.11 PRESSURE RELIEF VALVES

A. Valves used for pressure relief shall meet all of the requirements for Pressure Reducing Valves.

2.12 'H' STRAINERS

A. Strainers shall be Model X43H manufactured by Cla-Val, or District approved equal.
B. Strainers shall be Class 125 or 250 as applicable for the system pressure. Strainers shall have flanged connections.

2.13 VALVE VAULT HEATER

A. Provide when insulated vault is specified.
B. Conform to requirements of National Electric Code (NEC) latest edition.

2.14 TAPPING SLEEVE AND VALVE ASSEMBLY

A. Furnished with flanged inlet end connections having a machined projection on the flanges to mate with a machined recess on the outlet flanges of the tapping sleeves and crosses.

B. Outlet ends shall conform in dimensions to the AWWA Standards for hub or mechanical joint connections, except that the outside of the hub shall have a large flange for attaching a drilling machine.
C. Seat opening of the valves shall be larger than normal size to permit full diameter cuts.
D. Tapping sleeves shall be cast iron, stainless steel, epoxy coated steel, or other approved materials.

3. EXECUTION

3.1 GATE VALVE OR BUTTERFLY VALVE INSTALLATION

A. Valves shall be accurately set at places designated on the drawings.
B. Inspect each valve for defects.
C. thoroughly clean valves of all foreign material.
D. Adjust stuffing boxes to ensure water tightness without binding the stem.
E. Set valve and valve box plumb.
F. Set lower casting of valve box so that it is supported by a Styrofoam collar not less than 2 inches in thickness.
G. Wrap valve body with polyethylene encasement, secured with polyethylene tape prior to backfilling.
H. Place the foam ring on the top of the valve bonnet so the operating nut sticks through the center.
I. Center the valve boxes and set plumb over the operating nuts of the valves. Valve boxes shall not rest on the valve body. Set the valve box covers flush with the surface of the finished pavement or surrounding grade.
J. If a valve box extension is required, cut the soil pipe to the required length. Place the bell end on the valve box bottom and slide the valve box top over the soil pipe.
K. Backfill shall be the same as specified for the adjacent pipe. Place backfill around the valve boxes and thoroughly compact to a density equal to that of the adjacent trench, avoiding damage to or displacement of the valve box. Misaligned valve boxes shall be excavated, centered, set plumb, and backfilled at the Contractor's expense.
L. Tamp backfill around valve box to a minimum distance of 3 feet on all sides or to face of trench.
M. Where the valve is located in an unpaved area, the Contractor shall pour a concrete or asphalt pad around the valve box which shall be flush with existing grade. The pad shall be 4 inches thick by 4 feet wide and shall be placed on a base of four inches of compacted crushed rock.
N. Valve boxes shall be installed in conformance with **Standard Detail 12**.
O. Set valve box cover flush with surface.

3.2 VALVE MARKER POST

A. Where required, set valve marker post at edge of right-of-way opposite the valve.
B. Leave 18 inches of post exposed above grade.

3.3 INSTALLATION OF COMBINATION AIR RELEASE VALVE

A. Install in accordance with standard detail.
B. Locate so that high point of water main is vented.
C. Pipe between main and valve shall slope upward.
D. Locate valve adjacent to property line unless otherwise indicated.

3.4 INSTALLATION OF COMBINATION AIR AND VACUUM RELEASE VALVE

A. Install in accordance with standard detail.
B. Locate so that high point of water main is vented.
C. Pipe between main and valve shall slope upward.
D. Locate valve adjacent to property line unless otherwise indicated.
E. Thoroughly compact the gravel beneath the box and set the box so that it conforms to the elevation of the ground.
F. Place solid concrete bearing block beneath swing joint.
G. Allow at least six inches of clearance between the top of the air and vacuum release valve and the top of the box.
H. All piping from the water main to the valve shall have an ascending slope of 2 – 3% up to the air release valve inlet to permit escape of any entrapped air.
I. Pressure test and disinfect air valve assemblies in conjunction with the pipeline.
J. See **Standard Detail 16**.

3.5 INSTALLATION OF DOUBLE CHECK VALVES AND REDUCED PRESSURE VALVES

A. Installation Location
   1. Double Check Valve Assemblies (DC) and Reduced Pressure Valve Assemblies (RP)of size 2 1/2-inch and smaller shall be installed at the water service connection on the customer side of the water meter. Assemblies must not be immersed in water and must be protected from freezing during cold weather.
   2. DCs and RPs of size 3-inch and larger shall be installed in a vault or aboveground housing at the water service connection on the customer side of the water meter.

B. Below-Grade Vault Installation
   1. Below ground vaults must conform to Section 3.3 and Section 7.
   2. Inlet and outlet pipe spools shall be ductile iron, flange by plain end. The assembly must be flanged, and the connection between the downstream piping and the backflow assembly must be made with a flanged coupling adapter.
   3. Clearance
      a. Clearance between the assembly and interior vault wall shall be a minimum of 12 inches.
      b. Clearance between the test cock side of the assembly and the interior vault wall shall be a minimum of 24 inches.
      c. Clearance from the bottom of the backflow assembly to the floor shall be a minimum of 12 inches and the device must be supported with stand-on pipe supports.
      d. When outside stem/screw and yoke (OS&Y) rising stem valves are used, clearance from a fully opened stem to the top of the vault lid shall be a minimum of three inches.
   4. The vault must have adequate drainage to prevent the assembly from becoming submerged in water.
   5. RPs and RPDAs must have an approved bore-sighted drain to daylight with a rodent screen.
   6. If a bore-sighted drain to daylight is not feasible for a DC or DCDA installation, then a sump pump will be required. Refer to Section 7.2.E.
   7. Plugs shall be installed on test cocks of below-ground installations, with no dissimilar metals.

C. Above Grade Installation
   1. The assembly must have the District Engineer’s approval.
   2. The inlet and outlet pipe spools shall be ductile iron, flange by plain end. The assembly must be flanged.

3. Underground 90° bends shall be restrained with mechanical joint restraint as described in Section 3.2. Above ground 90° bends shall be flanged.
4. The backflow assembly must be installed horizontal and plumb.
5. The enclosure shall be installed on a concrete slab with a minimum thickness of six inches and a minimum compressive strength of 3,000 psi. The slab shall be poured on a 4-inch leveling course of 34-inch crushed, compacted rock.
6. Clearance
    a. Clearance between the assembly and interior vault wall shall be a minimum of 12 inches.
    b. Clearance between the test cock side of the assembly and the interior vault wall shall be a minimum of 24 inches.
    c. Clearance from the bottom of the backflow device to the floor shall be between 12 and 60 inches.
    d. For approval, submit drawings to the District Engineer showing required clearances.
7. The backflow assembly shall be supported by stand-on pipe supports.
8. The enclosure shall include an adequate bore sighted drain hole.
9. The enclosure shall be insulated or have a heat source to maintain enclosure at 40 °F. The assembly shall be easily accessible.
10. All structures and wiring shall comply with local building codes.

3.6 INSTALLATION OF DOUBLE CHECK DETECTOR ASSEMBLIES AND REDUCED PRESSURE DETECTOR BACKFLOW ASSEMBLIES

A. General Requirements
    1. Double Check Detector Assemblies (DCDAs) and Reduced Pressure Detector Backflow Assemblies (RPDAs) of size 3-inch and larger shall be installed in accordance with Standard Details 801 through 803.
    2. Assemblies of size 2 1/2-inch and larger shall be flanged.
    3. Unless otherwise specified, the backflow assembly, concrete slab, piping, and all associated parts shall conform to Section 3.3 and all applicable Standard Details.

B. Detector Meters
    1. Detector meters shall be installed with all RPDAs, DCDAs, and any other applicable assemblies.
    2. The detector meter shall be a Badger Recordall® Cold Water Bronze Model 25 (58-inch by 34-inch) that complies with ANSIAWWA Standard C710. The meter shall be provided with a Badger Recordall® Transmitter Register with an ORION Remote Transmitter.
    3. The meter must have a plastic lid and plastic shroud, utilize a bayonet style connector between the register and meter, and be provided with a Torx seal screw to secure the register to the meter. The meter shall measure water flow in cubic feet.
    4. The Orion Remote Transmitter shall be provided with a 25-foot length of cable prewired at the factory. The transmitter shall be mounted with an L-bracket inside the vault.

C. Below Grade Vault Installation
    1. The backflow assembly and associated below ground installation components shall meet all of the requirements for Double check valves and Reduced Pressure Valves.

D. Above Ground Installation
    1. Installation shall meet all of the requirements for Double check valves and Reduced Pressure Valves.

3.7 INSTALLATION OF PRESSURE VACUUM BREAKERS, SPILL-RESISTANT VACUUM BREAKERS, AND ATMOSPHERIC VACUUM BREAKERS

A. General Requirements
   1. An approved Pressure Vacuum Breaker (PVB), Spill-Resistant Vacuum Breaker (SVB), or Atmospheric Vacuum Breaker (AVB) shall be installed above grade with Approved Air Gaps

B. General Requirements
   1. All air gaps must be approved by the District's Cross Connection Control Specialist.
   2. The air gap shall provide a physical separation between the free-flowing discharge end of a potable water supply pipeline and an open or non-pressure receiving vessel.
   3. The air gap size shall be a minimum of twice the diameter of the supply pipe, as measured vertically above the overflow rim of the vessel, and in no case shall be less than one inch.
   4. The air gap shall be installed away from walls or other obstructions that may restrict the air flow into the outlet pipe and nullify the air gap effectiveness.

3.8 BLOCKING

A. Provide blocking for valve not connected to fitting with bolted connection.

3.9 TESTING

A. Test valves along with pipeline in which they are installed.

* * * END OF SECTION * * *

SECTION 02645
HYDRANTS

1. **GENERAL**
   1.1 RELATED WORK SPECIFIED ELSEWHERE
      A. Inspection Services: Section 01420
      B. Excavating, Backfilling and Compacting for Utilities: Section 02222
      C. Pipe and Fittings: Section 02610
      D. Valves: Section 02640
      E. Water Lines: Section 02660
   1.2 QUALITY ASSURANCE
      A. Testing by Manufacturer:
         1. Manufacturer shall test all materials as required by these Specifications and the standards referenced.
         2. Manufacturer shall submit to the Engineer two (2) copies of all test results which shall include a certification that materials to be delivered are represented by the samples tested and that such delivered materials meet or exceed the specifications requirements.
         3. No materials shall be delivered until test results and certifications are in the hands of the Engineer.
         4. Engineer shall have free access to all testing and records pertaining to materials to be delivered to the job site.
         5. The Engineer may elect to be present at any or all materials testing operations.

2. **PRODUCTS**
   2.1 FIRE HYDRANTS
      A. Conform to AWWA C502 except as herein modified.
      B. Main valve opening of the hydrant shall be a minimum of 5 inch diameter.
      C. Provide mechanical or flanged joint outlet with an auxiliary gate valve and valve box. Suitable lugs for anchor rods shall be provided.
      D. Fire hydrants shall have nominal 5 1/4-inch main valve openings, have 6-inch bottom connections, and be equipped with two 2 1/2-inch hose connections with national standard threads and one 4-inch pumper connection with Seattle threads.
      E. The pumper nozzle shall be equipped with a 4” Seattle thread by 5” locking Storz adapter.
         1. Storz adapter to be forged and/or extruded 6061-T6 aluminum alloy, hardcoat anodized.
         2. Threaded portion to have no lugs and two set screws 180 degrees apart
         3. Storz face shall be forged and/or extruded 606146 aluminum alloy with anodized hardcoat and synthetic molded rubber gasket.
         4. Storz cap to be attached to hydrant adapter with 18-inch coated stainless steel aircraft cable.
         5. Cap to be connected and disconnected with Storz wrenches only. Torque to be sufficient so cap cannot be removed by hand.
         6. Remove all chains.
      F. One pumper nozzle to match Owner's existing pattern, two (2) - two and one-half inch (2-1/2") hose nozzles shall be provided.
      G. Provide 1 1/2-inch pentagon operating nuts.
      H. Open by turning counterclockwise.
      I. Nozzles and operating nuts shall be identical with the Owner's existing equipment or as elsewhere provided.

J. Nozzles shall be equipped with bronze nipples screwed into the hydrant and locked in place.
K. The normal depth of bury shall be four feet, unless otherwise noted by the district engineer.
L. Provide lugs for shackling rods.
M. Provide sidewalk flange and safety stem coupling which will allow hydrant barrel to separate with minimum damage.
N. Paint with two coats of Farwest Case Yellow PN NO. X3472.
O. The Contractor shall furnish the location of the nearest point at which replacement working parts are stocked.
P. Hydrant barrel extension standard of manufacturer of hydrant provided.
Q. Hydrants shall be as manufactured by:
   1. Kennedy K81
   2. Clow Medallion
   3. Muller Centurion 250
R.
S.

2.2 GUARD POST
A. Precast concrete 8 inches in diameter by six feet long constructed with concrete having minimum strength of 3500 psi.
B. Reinforcing shall consist of minimum of five No. 3 deformed steel bars.

2.3 YARD HYDRANTS
A. Frost Proof Hose Bibbs:
   1. Type: Nonfreezing, exposed head, stop and waste post hydrant with non-turning operating rod with free-floating compression closure valve, drain port, and operating key lock.
   2. Size: 1 inch.
   3. Hose Connection: 1 inch American National straight.
   4. Rating: 150 psi.
   5. End: Screwed.
   6. Casing: Bronze.
   7. Casing Guard: Cast aluminum.
   8. Exposed Head: Bronze.
   9. Interior Parts: All bronze.
B. Curb Stop and Waste Valves:
   1. Type: 90` turn plug, solid tee head, with check and drain port.
   2. Size: Same as line size.
   3. Rating: 150 psi.
   4. Body and Trim: Bronze.
   5. Ends: Screwed.
   6. Operators: Two portable tee wrenches supplied to service all buried yard curb stop and waste valves.
   7. Service Boxes: Cast iron, 2½-inch minimum shaft diameter, cast iron lids marked "Water".

3. EXECUTION

3.1 SETTING HYDRANTS
A. Hydrants shall be inspected in the field upon arrival to ensure proper working order.
B. Hydrants shall be installed in accordance with the standard detail.
C. Hydrants shall not be installed within 3 feet of a travelled roadway.

D. Place hydrant carefully to avoid damage to the pier block. Lower hydrant and appurtenances into the excavation by means of a crane, slings, or other suitable tools or equipment to prevent damage to the materials and protective coatings and linings. Jointing procedures shall conform to Section 4.3 of ANSIAWWA C600.
E. After hydrant is in place and connected to the pipeline, place temporary blocks to maintain the hydrant in a plumb position during subsequent work.
F. Pier block and hydrant bottom shall be installed prior to placing drain rock. Drain rock shall be separated from undisturbed native soil and backfill with geotextile fabric. The drain rock pocket shall be not less than ½ yard, and the top of drain rock shall be six inches above the hydrant drain opening. Once drain rock is in place bring remaining geotextile fabric over the top of the drain rock. Use enough geotextile fabric to wrap entirely around the drain rock with a minimum of one-foot overlap. Do not connect drainage system to sewer.
G. A minimum 3-foot radius unobstructed working area shall be provided around all hydrants.
H. Sidewalk flange shall be set 2 inches above finished grade.
I. Hydrants shall be set on concrete blocks. Block shall be a minimum of 4-inch by 8-inch by 16-inch.
J. Hydrant drain shall waste into a pit of 1-1/2-inch minimum washed rock situated at the base of the hydrant as shown in the detail.
K. Geotextile fabric shall be placed around drain rock and shall be nonwoven polypropylene fabric such as Mirafi 140N as manufactured by TenCate or District approved equal.
L. Hydrant laterals less than 50 feet long shall consist of a section of 6-inch ID, fully restrained joint, pipe from the main to the hydrant and shall include an auxiliary gate valve set vertically and placed in the line as indicated in the detail.
M. Hydrant branches over 50 feet long shall consist of a section of 8-inch ID, fully restrained joint, pipe and include required reducer to connect to hydrant.
N. Hydrants shall be restrained as shown in the detail. Shackle rods shall be cleaned and painted after installation with 2 coats of asphalt varnish, or with such other bituminous paint as may be approved by the Engineer.
O. The exposed portion of the hydrant shall be painted with one field coat. The type and color of the paint will be designated by the Owner.
P. Blue reflective markers shall be Type 1 as described in Section 9-21.1 of Standard Specification, shall meet the requirements of Uniform Fire Code (UFC) Section 1001.8. The hydrant shall be stenciled in 2” high letters with the distance to the foot valve in feet. See Standard Detail 4
Q. Any new or existing hydrant not in service shall be identified by covering with a burlap or plastic bag.
R. Install guard posts (bollards) only where specifically directed by the District.
S. Improperly positioned hydrants shall be disconnected and relocated at the Contractor's expense.
T. The upper exposed portion of the hydrant shall be thoroughly cleaned and painted with two coats of Farwest Case Yellow PN No. X3472 paint.
U. Hydrant connections up to but not including the hydrant shall have the same coating as the water main to which they are connected. Hydrants connected to polyethylene encased water main shall have the polyethylene wrap terminate at the buried hydrant connection. The hydrant barrel shall be wrapped in polyethylene encasement from bury line to 6 inches below concrete block according to detail 4 . Drain holes below ground shall not be encased in polyethylene wrap.

3.2 RESETTING OR RELOCATING EXISTING HYDRANTS

A. Conform to applicable requirements for setting new hydrants.
B. Material requirements to be adjusted to field conditions.

3.3 HYDRANT BARREL EXTENSIONS

A. Provide where required due to placement of main at greater than normal depth or for adjustment to surface grade.

3.4 TESTING

A. Test hydrants along with pipeline on which they are installed.

* * * END OF SECTION * * *

SECTION 02660
WATER LINES

1. GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Field Engineering: Section 01050
B. Inspection Services: Section 01420
C. Dewatering: Section 02140
D. Shoring: Section 02150
E. Excavating, Backfilling and Compacting for Utilities: Section 02222
F. Pipe and Fittings: Section 02610
G. Valves: Section 02640
H. Hydrants: Section 02645
I. Existing Utilities/Facilities Underground and Overhead: Section 02760

1.2 QUALITY ASSURANCE

A. Testing Before Acceptance:
   1. The Engineer may require that the first section of pipe, not less than 1,000 feet in length, installed by each of the Contractor's crews, be tested in order to qualify the crew and/or the material.
   2. Pipe laying shall not be continued more than an additional 1,000 feet until the first section has been tested successfully.

B. Final Acceptance:
   1. Prior to final inspection all pipelines shall be flushed and cleaned of all debris, disinfected and hydrostatically tested.
   2. Any corrections required shall be made at the expense of the Contractor and the line retested.

2. PRODUCTS

2.1 BEDDING MATERIALS

A. Conform to Section 02222.

2.2 ALTERNATE PIPE MATERIALS

A. Pipe used for water line construction may be either high density polyethylene (HDPE), ductile iron, or polyvinyl chloride pressure pipe as specified in Section 02610 unless otherwise specified.
B. Pipe for water services shall be as indicated on the plans and as specified in Section 02610.
C. When ductile iron pipe is specified, no substitute is permitted.

2.3 TRACER WIRE

A. Tracer wire shall be copper clad steel wire with BLUE hdpe insulation as specified in Section 02610.

3. EXECUTION

3.1 BEDDING FOR RIGID PIPE

A. Bedding for rigid pipe except ductile iron shall be as specified in Section 02222.
B. Unless otherwise ordered, bedding for ductile iron may be native bedding material, free of stones.
C. Bedding shall be carefully placed under and over the pipe and to a depth of at least six (6) inches.
D. Shall be thoroughly rammed and tamped around the pipe with the proper tools, so as to provide firm and uniform support over the full length of all pipe, valves and fittings.
E. Care shall be taken to prevent any damage to the pipe or its protective coating.

3.2 BEDDING FOR FLEXIBLE PIPE

A. Material to be used for bedding for flexible pipe shall be sand/gravel material as specified in Section 02222.
B. Bedding shall be placed in more than one lift. The first lift is to provide at least 4-inch thickness under any portion of the pipe and shall be placed before the pipe is installed, and shall be spread smoothly so that the pipe is uniformly supported along the barrel.
C. Subsequent lifts of not more than 6-inch thickness shall be installed to 6 inches over the crown of the pipe and individually compacted to 90 percent of maximum density.

3.3 PIPE LAYING

A. Pipe laying shall be done in accordance with the Specifications and instructions of the manufacturer of the kind of pipe used.
B. Tools designed especially for installing each particular type and kind of pipe shall be used.
C. All HDPE pipe shall be joined by thermal butt-fusion or sidewall fusion per manufacturer's recommendations and ASTM D2657 as further specified in Section 02610.
D. Check the grade with a straight edge before laying each section of pipe and correct if necessary. Pipelines intended to be straight shall not deviate from straight alignment at any joint in excess of one inch horizontally or vertically between the pipe ends.
E. At each joint or bell, dig trench of ample dimensions in the bottom and sides of the trench to allow the joint to be properly made and to permit easy visual inspection of the entire joint.
F. Provide ample means of removing all water entering the trench. Do not lay pipe in water or when, in the opinion of the District Engineer or Inspector, trench conditions are unsuitable.
G. Do not drop pipeline materials into the trench. Carefully lower all pipe and appurtenances into the trench by means of a crane or other suitable equipment to prevent damage to materials and protective coatings.
H. Unless otherwise directed, lay pipe with bell end facing in the direction of the laying. For lines on steep slopes, face bells upgrade only.
I. Do not allow any foreign material to enter the pipe during storage or placement in the trench.
J. Joint lubricant shall be supplied by the pipe manufacturer. Joint lubricant shall be non-toxic, water soluble, and certified to meet NSF 61.
K. Short Lengths and Field Cut Joints:
    1. Short lengths of pipe supplied by the manufacturer shall be used to provide the proper spacing of valves, tees or special fittings.
    2. Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter.
    3. Pipe ends shall be square with the longitudinal axis of the pipe and shall be reamed and otherwise smoothed so that good connections can be made.
    4. Threads shall be cleanly cut.
    5. Flaring of copper tubing shall be accurately and smoothly done.
    6. All operations for any connection shall be carefully done in accordance with the manufacturer's instructions.
L. Laying of Pipe on Curves:
    1. Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflections at the joints or by the use of shorter lengths of pipe.
    2. When pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment.

3. Where field conditions require deflection or curves not anticipated by the Plans, the Contractor shall use deflected joints, short lengths or special fittings as required. No additional payment will be made for laying pipe on curves as shown on the Plans or for field changes involving pipe deflected at the joints. When special fittings not shown on the Plans are required to meet field conditions, additional payment will be made for fittings.
4. Maximum deflections at pipe joints and laying radius for various pipe lengths shall be 80% of recommended by the pipe manufacturer.

M. Contamination Prevention:
1. Pipe, fittings and valves shall be carefully cleaned of all dirt and foreign material as they are placed.
2. Open ends of pipe and fittings shall be plugged with a temporary watertight plug whenever work is stopped and/or when water in the trench threatens to enter the pipe.
3. Groundwater shall be excluded from the pipe at all times.
4. Particular care shall be exercised to guard against the entrance of sewage into the water line trench during the course of construction. All sewer lines, house side sewers or other subsurface drains should be located prior to excavation. Adequate provision shall be made for the flow of sewers, drains, and other water courses during construction.

N. Condition of Pipe and Fittings:
1. The interior of all pipe, fittings and other accessories stockpiled on the project shall be kept free of dirt and other foreign matter at all times.
2. Each pipe, fitting or other accessory shall be carefully inspected and thoroughly cleaned of any dirt or foreign matter that might be present on the inside.
3. Cleaning shall be accomplished prior to lowering the pipe or other accessories into the trench.
4. Care shall be taken to keep materials internally clean after the pipe is placed in the trench.

3.4 TRACER WIRE

A. All non-metallic pipe and service lines shall be installed with tracer wire wound around the pipe to enhance the owner's ability to locate the line after burial.
B. Tracer wire shall be spliced, bonded and otherwise connected per manufacturer's recommendation.

3.5 BLOCKING AND BRACING

A. Blocking and bracing of the pipe and fittings shall be placed so as to secure bearing on undisturbed earth.
B. Blocking and bracing size shall be determined by the Contractor and shall be of sufficient proportions and installed so as to withstand the required test pressure and operating conditions.
C. Concrete shall be placed in back of all fittings with unbalanced thrust. Pre-cast blocking shall not be used.
D. Fittings shall be wrapped in three layers of 8-mil polyethylene sheet secured with polyethylene tape prior to concrete placement.
E. Blocking shall not be covered up without its having been seen by the Engineer.
F. Blocking shall be formed so that bolts, joints, gaskets, and flanges of adjacent joints are clear of the concrete and so that bolts and joints can be dismantled without removing the concrete.
G. At tees and crosses where future mains connect, a pre-cast concrete brick may be used between fittings and thrust block.

H. Straddle blocks shall be poured monolithically against the pipe and undisturbed native soil.
I. Straddle blocks shall be poured around a minimum of two EBAA 1100SDB, or District approved equal, mid-span retainer glands.
J. Ensure that no unrestrained joints exist between the straddle block and pipe sections or fittings that are to be restrained.
K. Ensure concrete straddle blocks have cured sufficiently before removing pipe sections or fittings or otherwise inducing a load on the straddle block.
L. Unless otherwise called for in the Bid Form, the cost of furnishing and installing all blocking shall be included in the price bid per lineal foot of pipe or lump sum bid if unit prices are not required.

3.6 CONNECTION TO EXISTING WATER MAINS

A. An approved backflow prevention assembly (double check valve assembly or better) must be used on the supplying water line when filling the new water main during disinfection and flushing. The assembly and supply piping must be removed or isolated during hydrostatic pressure testing of the new main.
B. Type of connections shall be as shown on the Drawings.
C. Wet tap connections made without shutting off the existing line shall be made unless otherwise approved by the Owner.
D. Connections to the existing water main shall not be made without first making the necessary arrangements with the Owner in advance.
E. Work shall not be started until all of the materials; equipment and labor necessary to properly complete the work are assembled on the site.
F. When work is once started on this connection, it shall proceed continuously without interruption and as rapidly as possible until completed. No shut-off of mains will be permitted overnight or over weekends or holidays.
G. If the connection to the existing system involves turning off the water, the Contractor shall be responsible for notifying the residents affected by the shut-off. The Owner will advise which owners are to be notified.
H. The Contractor may be required to perform the connection during times other than normal working hours.
I. The Contractor shall not operate any valves on the existing system without specific permission of the Owner.
J. The types of connections are varied and suggested pipe arrangements have been shown on the Plans. In general, they involve deflecting new pipe to match the existing pipe alignment and utilization of necessary fittings and new pipe. For the installation of these connections, the surfaced portion of the road shall not be penetrated unless the connecting point is directly under it. For connection by any other method, the Contractor shall furnish a detailed sketch for approval not less than one week prior to the expected construction.
K. Interior of pipe and fittings used in making connections shall be swabbed or sprayed with a 1% solution of hypochlorite before they are installed.
L. Exterior of main shall be cleaned and interior surface of tapping sleeve shall be dusted with calcium hypochlorite powder before tapping sleeve is installed.
M. Installation of tapping tee shall be tested with air or water at a minimum pressure of 100 psi before cutting into the existing line.
N. Any replacement pipe used for cutting into existing mains shall be same material and strength as existing pipe except that ductile iron may be substituted for other materials.

3.7 EXISTING SYSTEM MAINTENANCE

A. The Contractor shall acquaint himself with all aspects of the existing system prior to starting construction on new mains. Pertinent information concerning existing system may be obtained from the Owner and from the Owner's records.
B. Materials, fittings, pumps, equipment and qualified personnel must be available on the project at all times during construction, so that in the event of damage to or disruption of the existing water system service there will be immediate repair and restoration by the Contractor. Any unnecessary delay in repairs or service restoration due to Contractor's failure to adhere to these requirements shall be reason to immediately suspend any further new main installation until repairs are completed to the Owner's satisfaction.
C. Existing water services shall be located by the Contractor prior to beginning work so that it may be properly protected and maintained in service during construction and during the changeover from the existing pipes to the pipe installed under this Contract.

3.8 SERVICE CONNECTIONS

A. Service connections to water mains shall be made using saddles of the size and type suitable for use with the pipe being installed.
B. Ductile iron Class 52 or thicker may be direct tapped with a corporation stop.
C. The depth of trenching for service connection piping shall be such as to provide cover over the top of the pipe as shown on the service detail.
D. Particular care shall be exercised to assure that the main is not damaged by installation of the service line.
E. Service lines shall be cut using a tool or tools specifically designed to leave a smooth, even, and square end on the piping material to be cut. Cut ends shall be reamed to the full inside diameter of the pipe.
F. Where shown in the plans, existing water service connections shall be reconnected to the new water mains installed under this Contract using the materials specified. The location of water service connections shall be verified in the field by the Contractor.
G. Pipe materials used to extend or replace existing water service lines shall be in accordance with utility’s standard details for new service.
H. Insulating couplings shall be used at any connection between galvanized steel or iron pipe and copper pipe.
I. Contractor shall arrange his work to minimize interruptions of water service to existing water customers.
J. Line shall be installed, tested and disinfected up to point of connection prior to interruption of service.
K. Customer shall be notified prior to shutting off service. Time that water is shut off shall be held to a minimum.

3.9 HYDROSTATIC PRESSURE TEST (FOR DI AND PVCO PIPE ONLY)

A. Water mains and appurtenances (including water service connections on new water mains) shall be tested in sections of convenient length under a hydrostatic pressure equal to 100 psi in excess of that under which they will operate.
B. The pumps, gauges, plugs, saddles, corporations, miscellaneous hose and piping, and measuring equipment necessary for performing the test shall be furnished and operated by the Contractor.
C. Pipeline shall be backfilled sufficiently to prevent movement of pipe under pressure.
D. Thrust blocks shall be in place and time allowed for the concrete to cure before testing.
E. Procedure:
    1. The mains shall be filled with water and all air removed prior to starting the test.

2. The test shall be accomplished by pumping the main up to the required pressure; stop the pump for fifteen (15) minutes, and then pump the main up to the test pressure again.
3. The quantity of water required to restore the pressure shall be accurately determined by pumping through a positive displacement water meter with a sweep unit hand registering 1 gallon per revolution. The meter shall be approved by the Engineer.
4. Acceptability of the test will be determined by two factors:
   a. The quantity of water lost from the main shall not exceed the number of gallons per hour as determined by the formula:

$$L = \frac{ND(P)^{0.5}}{7{,}400}$$

in which

L = Allowable leakage, gallons/hour
N = No. of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, psig

   b. There shall not be an appreciable or abrupt loss in pressure during the fifteen (15) minute test period.
5. Gauges used in the test shall be accompanied with satisfactory certifications of accuracy from a laboratory approved by the Engineer.

F. All tests shall be made with the hydrant gate valves open and pressure against the hydrant valve. After the test has been completed, each gate valve shall be tested by closing each in turn and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure comes against the valve being checked.
G. Sections to be tested shall normally be limited to 1,500 feet.
H. Prior to calling out the Engineer to witness the pressure test, the Contractor shall have all equipment set up completely ready for operation and shall have successfully performed the test to assure himself that the pipe is in a satisfactory condition.

3.10 HYDROSTATIC PRESSURE TEST (FOR HDPE PIPE ONLY)

A. Perform tests in accordance with ASTM F2164 and on reasonable lengths of pipe. Sections to be tested shall normally be limited to 1,500 feet.
B. The pumps, gauges, plugs, saddles, corporations, miscellaneous hose and piping, and measuring equipment necessary for performing the test shall be furnished and operated by the Contractor.
C. Pipeline shall be backfilled sufficiently to prevent movement of pipe under pressure. The water, pipe, and soil shall be allowed to thermally stabilize before the test is conducted.
D. Thrust blocks shall be in place and time allowed for the concrete to cure before testing.
E. The leak testing shall not exceed the maximum hydrostatic test pressure of 150% of the normal HDPE pipe pressure rating measured at the lowest elevation in the section.
F. Remove or isolate any components that may be damaged by pressure testing. Isolated equipment shall be vented.
G. The test duration shall not exceed eight (8) hours from the time of initial pressurization until piping is depressurized. If the testing is not completed within 8 hours, the pipe must be depressurized and allowed to relax for 8 hours prior to re-pressurizing pipe for renewed testing.
H. Leak testing shall be conducted using clean water as the testing medium.

I. The Contractor shall vent all trapped air from the segment of piping being tested prior to initiating the leak test. Pressure testing against closed valves is not acceptable.

J. Leak testing shall incorporate two phases:
   1. Initial expansion phase:
      a. Gradually pressurize to test pressure of 1.5 times the system design pressure and maintain pressure for 3 hours. Add makeup water as necessary each hour for three (3) hours to maintain the target pressure in the section of pipe that is being tested. It is not necessary to monitor the amount of water added during the initial expansion phase.
   2. Testing phase:
      a. Start immediately following initial expansion phase.
      b. Monitor amount of makeup water required to maintain test pressure for one, two or three hours. If the amount of make-up water needed to maintain test pressure does not exceed the amount listed below, no leakage is indicated.

	Make-up Water Allowance for Test Phase (Gallons/100 ft of pipe)		
Nominal pipe size	1 Hour Test	2 Hour Test	3 Hour Test
8-inch	0.5	1.0	1.5
10-inch	0.8	1.3	2.1
12-inch	1.1	2.3	3.4
14-inch	1.4	2.8	4.2
16-inch	1.7	3.3	5.0
18-inch	2.0	4.3	6.5

Portion of Table 3 from PPI Handbook of Polyetheylene Pipe. Test phase make-up amounts for pipe testing at 150% of pipe's rated pressure. For lower pressures, use ratios.

      c. At the conclusion of the testing phase, carefully depressurize the pipeline with the controlled release of water. The water shall be drained and disposed in accordance with the requirements above.
      d. The test documentation provided to the Engineer shall include:
         1) Test medium.
         2) Test pressure.
         3) Test duration.
         4) Test data.
         5) Pressure recording chart or pressure log.
         6) Chart of pressure vs. makeup water added during testing phase.
         7) Pressure at high and low elevations.
         8) Elevation at point test pressure is measured.
         9) Ambient temperature and weather conditions.
         10) Pipe and valve manufacturers.
         11) Pipe specifications and/or standards.
         12) Description of the test section length, location, and components.
         13) Description of any leaks, failures, and their repair/disposition.
         14) Person conducting the test, test times, and test dates.

K. Prior to calling out the Engineer to witness the leak test, the Contractor shall have all equipment set up and completely ready for operation.

L. Should leakage exceed 5% of the test pressure, the leak(s) shall be located and repaired. The pipe shall be retested no sooner than 8 hours after depressurization to confirm that it meets the testing requirements.

3.11 DISINFECTION OF MAINS

A. Before being placed in service, all new water mains and repaired portions of, or extensions to, existing mains shall be chlorinated and a satisfactory bacteriological report obtained.

B. Temporary or permanent physical connections shall not be allowed between the existing distribution system and non-disinfected pipelines constructed under this Contact without a State Department of Health approved backflow preventer (double check valve assembly or better) temporarily installed in the connecting line.

C. Prior to disinfecting the newly installed waterline, flush all foreign matter from the pipeline. Coordinate flushing activities with Inspector at least 24 hours in advance of flushing.

D. Main sterilization shall be accomplished by either of the following two methods at the Contractor's option. No other method of sterilization will be accepted by the Engineer, unless, prior to use, the Contractor obtains written approval from the Engineer.

E. Method No. 1:

1. A chlorine gas-water mixture, or dry chlorine gas may be applied by means of a chlorinator, or the gas may be fed directly from a chlorine cylinder equipped with the proper devices for regulating the flow, and the effective diffusion of gas within the pipe. Use of the chlorinator is preferred to direct feed from the cylinder.
2. The preferable point of application for the chlorinating agent is at the beginning of the pipeline extension, or any valved section thereof, and through a corporation cock inserted in the horizontal axis of the pipe. The water injector for delivering the gas-water mixture into the pipe may be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. In a new system, application may be at the pumping station, elevated tank, stand pipe, or reservoir.
3. Water from the existing distribution system, or other source of supply, shall be controlled to flow very slowly into the newly laid pipeline during application of the chlorine. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion that the rate of water entering the newly laid pipe will be at least 50 parts per million.
4. Back pressure, causing a reversal of flow in the pipe being treated, shall be prevented.
5. Treated water shall be retained in the pipe at least twenty-four (24) hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least twenty-five (25) parts per million.
6. In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.
7. Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity, until the replacement water throughout its length, upon test, shows the absence of chlorine or in the event chlorine is normally used in the source of supply, until the tests shall show a residual not in excess of that carried by the system.
8. Should the initial treatment prove ineffective; the chlorination procedures shall be repeated until tests show that the water sample from the newly laid pipe conforms to the requirements of this specification.

F. Method No. 2:

1. A mixture of either calcium or sodium hypochlorite of known chlorine content and water may be substituted as an alternative for liquid chlorine. (Typical commercial products of this type are HTH, Perchloron, Clor, Purex, etc.).

2. Prepare a solution containing approximately 5% available chlorine by weight, in the case of HTH or Perchloron, at 70% available chlorine, use 6 pounds per 10 gallons of water. In the case of Clor, at 15% available chlorine, add 2 parts of water to 1 part of Clor. For other strength compounds, adjust dilutions accordingly.
3. To prepare the chlorine compound-water mixture, first make a paste, and then thin to slurry, to ensure getting all active ingredients into solution. The prepared solution shall be injected by means of a hypo-chlorinator, or hand or engine operated pump. Retention time, parts per million and pumping into the newly laid pipe shall follow the conditions outlined under Method No. 1 for chlorine applications.
4. Provisions for flushing and bacteriological testing under this alternative shall be the same as those described in Method No. 1 above.

G. Before placing the lines in service, a satisfactory report or approval shall be received by the Owner on samples collected from representative points in the new system.

H. Sterilized sample bottles and/or instructions shall be obtained by the Contractor from the laboratory where the samples will be tested unless the Owner directs otherwise. Bacteriological test samples will be taken by the Owner. Corporation stops shall be inserted in the main by the Contractor at all locations required to take bacteriological test samples. If original test samples prove unsatisfactory, a charge of $25.00 will be made for processing each additional sample.

I. Discharge of hypo-chlorinated water to surface waters is strictly prohibited. The environment to which the chlorinated water is to be discharged shall be inspected by the Owner and, if there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to be wasted to neutralize the chlorine residual remaining in the water. Disposal may be made to any available sanitary sewer provided the rate of disposal does not overload the sewer and the disposal is approved by the sewer agency having jurisdiction. The sewer agency shall be given 48 hours advance notice of such disposal. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

3.12 FLUSHING THE MAINS

A. Upon completion of pipe laying, chlorination and pressure testing, all dirt and foreign matter shall be removed by a thorough flushing through all hydrants, blow-offs or other approved means. Each section of newly laid pipe between valves or dead ends shall be flushed independently, and fire hydrants or other dead end appurtenances shall be flushed simultaneously with the parent line. A minimum flushing velocity of 2.5 fps shall be developed in the main.

B. The Contractor shall be responsible for scheduling and organizing his work so as to use flushing water only during off-peak hours and in the most economical manner.

C. Taps required by the Contractor for temporary or permanent release of air, chlorination or flushing purposes shall be provided by the Contractor as a part of the construction of water mains.

D. No flushing shall be performed without the prior approval of the Owner.

E. The Contractor shall provide hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties. De-chlorinate discharged water utilizing best management practices.

3.13 CHLORINATING CONNECTIONS TO EXISTING WATER MAINS AND WATER SERVICE CONNECTIONS

A. The chlorinating procedure to be followed shall be as specified in AWWA Standard C651. All closure fittings shall be swabbed with a very strong chlorine solution at least as strong as liquid household bleach (5-6% Cl).

3.14 PLACING IN OPERATION

A. Upon completion of the work and before its final acceptance, the entire system shall be put in operation under normal pressure and operated at that pressure for a period of not less than ten (10) days by the Contractor.

B. Any leaks or defects in the construction of the system that may develop shall be repaired and the test continued until the system is practically watertight.

C. No provision of this Section shall be construed as waiving any provision of the Contractor's guarantee.

* * * END OF SECTION * * *

SECTION 02760
EXISTING UTILITIES/FACILITIES
UNDERGROUND AND OVERHEAD

1. **GENERAL**

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Extra Payment: Section 13 General Conditions
B. Inspection Services: Section 01420
C. Grading: Section 02210
D. Excavating, Backfilling and Compacting for Utilities: Section 02222

1.2 LEGAL REQUIREMENTS UNDERGROUND FACILITIES

A. The Contractor shall, before commencing excavation in any area, comply with the provisions of revised RCW 19.122 (E25HB 1634) and any other applicable laws relating to or governing the identification, location, marking, and responsibility for protecting and repairing of underground facilities.
B. Whenever there may be a conflict between the provisions of any law and the provisions of these specifications, the provisions of law shall control.

1.3 DEFINITIONS

A. Utility means any facility or item placed above or below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephonic or telegraphic communication, cablevision, electric energy, petroleum products, gas, gaseous vapors, hazardous liquids, or other substances and including, but not limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, and attachments.
B. Pipe zone is defined as extending from the bottom of the required excavation to six (6) inches over the top of the pipe.

1.4 IDENTIFICATION

A. All underground utilities known by the Owner to be in the proposed area of excavation are identified on the project plan.
B. The underground utilities identified on the plans have not and cannot be precisely located by the Owner or its agents or engineers and location is approximate only because such information is within the control of the owners of the underground utilities. The Owner, under this Contract, does not warrant the location of underground utilities.
C. NOTICE: Overhead electrical service lines are generally not shown on the drawings. Electrical transmission lines shown on the drawings are located by point to point, power pole to power pole connections. The transmission cables or wires may be located on either side of the drawing location depending upon the configuration of the crossarms on the power poles or towers. Line voltage is not shown.
D. Other overhead utility lines are generally not shown on the drawings.

1.5 NOTIFICATION

A. It is the responsibility of the Contractor to give notice to the Owner or owners of any utilities known or suspected to be within the area of any proposed excavation or construction activities.
B. The Contractor is responsible to have the locations of underground utilities marked by the utility owners prior to beginning excavation.
C. The Contractor is responsible for determining the extent of any hazard created by electrical power in all areas and shall follow procedures during construction as required by law and regulation. Prior to construction, the Contractor shall meet with

utility owners and determine the extent of hazards and remedial measures and shall take whatever precautions may be required.

D. The Contractor's attention is directed to federal, state, and local safety codes relative to limitations of work in proximity to overhead power lines.

1.6 QUALITY ASSURANCE

A. The Contractor will be required to have available a pipe finder and a person capable in its use and to utilize same to satisfy himself as to the exact location of such underground facilities in the interest of avoiding unnecessary damage, maintenance costs, and to insure continuity of customer service.

B. Contractors shall cooperate with utility owners to aid in locations and maintenance of existing utilities.

1.7 ELECTRICAL TRANSMISSION AND SERVICE LINES

A. Since neither the Engineer nor the Owner can anticipate the construction methods or techniques and equipment to be used by the Contractor in performing the work, the extent of the possibility of the Contractor's equipment and personnel coming in contact with electrical transmission lines cannot be fully anticipated, and there is no representation that all electrical transmission lines are shown on the plans.

B. The Contractor is charged with the responsibility of observing and investigating the presence of any electrical transmission lines which might impinge on his work whether overhead or underground and shall consult with and utilize the information given by utility owners and operators to determine the extent of any hazards and remedial measures required, and follow appropriate safety procedures.

1.8 ABOVE GROUND UTILITIES

A. Existing above ground utilities, whether shown on the drawings or not, shall be maintained, relocated, rerouted, removed and restored as may be necessary by the Contractor in a manner satisfactory to owners and operators of the utilities.

1.9 UTILITY SERVICE LATERALS

A. Minor underground utility service lines, including but not limited to sanitary sewer services, gas services, water services, house or yard drains, and electricity or telephone services and driveway culverts shall be maintained, relocated, rerouted, removed and restored by the Contractor with the least possible interference with such services.

B. Even though the presence of minor underground utility service lines may be deemed changed or differing conditions, in no case shall the interference of such service lines be the basis for extra compensation except in the case of a conflict, not shown on the plans, with sanitary sewer service occurring at an elevation between the top and bottom of the proposed pipeline or structure together with the pipe zone, the Contractor will be reimbursed for costs thereof in accordance with Article 13 of the General Conditions.

1.10 RESTORATION BY UTILITY OWNER

A. The right is reserved by owners of public utilities and franchises to enter upon any street, road, right-of-way, or easement for the purpose of maintaining their property and for making necessary repairs or adjustments caused by the Contractor's operations.

B. The Contractor shall save the Owner harmless of any costs so incurred in restoration of a utility damaged by the Contractor except in special cases outlined above, and subject to the provisions of any law.

1.11 RESTORATION OF DRAINAGE FACILITIES

A. Where it is necessary for drainage facilities to be removed and replaced, existing pipe and catch basins may be reinstalled when approved by the agency having jurisdiction.

B. The materials shall be cleaned.
C. When it is necessary to replace existing pipe or catch basins, the new materials shall be of equal strength and similar design to existing materials.
D. Installation shall be in accordance with the applicable provisions of these specifications.
E. All costs, whether new or existing facilities are installed, shall be considered to be included in the unit prices bid for the various items and no additional payment shall be allowed.

* * * END OF SECTION * * *

SECTION 02990
LANDSCAPE RESTORATION

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Protection of Work and Property: Section 01545
     - B. Grading: Section 02210
   - 1.2 SUBMITTALS
     - A. Duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing laboratory within 6 months before the date of delivery on the project.
     - B. Duplicate copies of certification from grower certifying the grass species and locations of field from which sod was cut.
   - 1.3 JOB CONDITIONS
     - A. Areas landscaped and/or seeded prior to construction shall be restored to their original condition.
     - B. Unless otherwise specified, the Contractor shall have the option of reseeding or resodding lawn areas that are disturbed during construction.
     - C. A cover crop shall be sown in all areas other than landscaped areas that are excavated or disturbed during construction. Cover crop seeding shall follow backfilling operations by not more than three weeks. Weekly seeding shall be required for projects in which all backfilling cannot be completed in three weeks.
     - D. All plants or shrubs within landscaped areas that are damaged during construction shall be replaced with plants equal to that existing prior to construction. Any covenants to stipulations in easements shall be adhered to.
     - E. All areas shown on the Plans to be planted, seeded or sodded shall be accomplished in accordance with this section.

2. **PRODUCTS**
   - 2.1 TOPSOIL
     - A. Topsoil that is required to be furnished by the Contractor from a source other than the area upon which it will be placed shall consist of fertile, friable soil, preferably of a loamy character, typical of the topsoil common to the locality and it shall contain a normal amount of organic matter.
     - B. It shall be obtained from arable land and shall be free from subsoil, refuse and other deleterious substances. It shall be reasonably free from brush, roots, heavy clay, sticks and other litter and shall contain no stones or gravel larger than 1/2 inch in diameter.
     - C. It shall be free of toxic amounts of either acid or alkaline elements and be capable of sustaining healthy plant life.
     - D. It shall be approved by the Engineer before placement.
   - 2.2 SEED
     - A. Grasses and legumes for cover crop seed shall conform to the standards of State Department of Agriculture. Seed shall be furnished in standard containers on which shall be shown the following information:
       1. Common name of seed
       2. Lot number
       3. Net weight
       4. Percentage of purity
       5. Percentage of germination (in case of legumes percentage of germination to include hard seed).

6. Percentage of weed seed content and inert material clearly marked for each kind of seed in accordance with applicable state and federal laws.

2.3 FERTILIZER

A. General:
   1. Fertilizer shall be a standard commercial grade of slow-release organic or inorganic fertilizer of the kind and quality specified herein.
   2. 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.
   3. Fertilizer shall be ground to a fineness as required for the method of application.

B. Fertilizer Ratio:

Nitrogen	10
Phosphorus	4
Potassium	6

2.4 MULCH

A. Wood Cellulose Fiber:
   1. Wood cellulose fiber mulch shall be specially processed wood fiber containing no growth or germination inhibiting factors and shall be dyed a suitable color to facilitate inspection of the placement 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 will become uniformly suspended to form homogeneous slurry.
   3. Each package shall be marked by the manufacturer to show the air dry weight content.

B. Peat:
   1. Peat shall be a natural domestic product of either sphagnum moss, reed or sedge peat, taken from a freshwater site, free from lumps, roots and stones.

C. Straw:
   1. All straw mulch material shall be in an air dried condition free of noxious weeds, weed seeds, and other materials detrimental to plant life.
   2. Straw shall be seasoned before baling or loading.
   3. Straw mulch shall be suitable for spreading with mulch blower equipment.

2.5 SOD

A. Imported Sod:
   1. Sod shall be of first quality turf grass sod composed of acceptable grass mixtures, relatively weed free.
   2. Sod shall be machine cut to a uniform soil thickness not less than 3/4 inch or more than 1 inch. Individual sod pieces shall be cut to a standard width and to an acceptable length which provides for efficient and proper installation.
   3. Sod shall be harvested, delivered and installed within a 48 hour period.
   4. The Contractor, upon request, shall submit one standard piece of sod for the Engineer's approval.

B. Native Sod:
   1. Native sod shall be replaced in the lawn of original removal.
   2. The area of sod to be removed shall be laid out in squares or strips of such size as to provide easy handling and matching. The sod shall then be carefully cut along these lines taking care to keep all cuts straight and strips of the same width. After the sod has been cut vertically, it shall be removed to a uniform depth with an approved type of sod cutter. This operation shall be performed in such manner as to ensure uniform thickness of sod throughout the operation.

3. As the sod scalping proceeds, the sod strips shall be placed in neat piles at convenient locations and from then on they shall be maintained in a damp condition continuously until the sod strips are replaced on the lawn. In no case shall the sod remain in piles longer than 10 days before replacement on the lawn.

2.6 PLANT MATERIALS

A. Plants shall be healthy, in vigorous growing condition, and be guaranteed true to size, name and variety. Nomenclature shall be listed in Standardized Plant Names, Second Edition, 1942.

B. Size and quality shall be equal to existing plants or as shown on the Plans. Plants shall be No. 1, nursery grown, freshly dug, of normal growth and habit, free from diseases and insects.

3. EXECUTION

3.1 LAWN SEEDING

A. All areas to be put into lawn shall have a minimum depth of 8 inches of topsoil.

B. Immediately prior to placing topsoil, the surface area upon which it is to be placed shall be cleaned of objectionable matter and the area shall be smoothed and compacted.

C. The finish grade of all areas to be put into lawn shall be smooth, without visible depressions or mounds and shall be flush with the top of adjoining curbs, walks and drives.

D. After establishing the finish grade, all areas shall be hand raked, rolled and again hand raked, removing all rocks, weeds and debris.

E. Commercial fertilizer shall be applied at the rate of 2 pounds per 1,000 square feet.

F. Lawn seed shall be seeded over all areas to be put into lawn at the rate of 3 pounds per 1,000 square feet.

G. After seeding, ground horticultural peat moss shall be spread 1/4 inch deep with an approved spreader over all seeded areas.

H. The exact time for seeding will be determined by actual weather conditions. The normal satisfactory periods for seeding shall be considered as being between March 1 and May 1 and between September 15 and October 20.

I. When delays in operations carry the work beyond the most favorable planting season, or when weather conditions are such that satisfactory results are not likely to be obtained for any stage of the seeding operations, the Contractor will stop the work and it shall be resumed only when the desired results are likely to be obtained or when approved alternates or corrective measures and procedures are adopted.

J. Maintenance shall commence immediately on planting and the lawn area shall be kept damp for 10 days to 2 weeks. Protect all seeded areas by watering, mowing and replanting as necessary for at least 30 days and as long as necessary to establish a uniform stand of grass, and a minimum of 2 cuttings.

3.2 SOD

A. Prior to placing the strips of sod, the scalped area shall be carefully shaped to proper grade and be thoroughly compacted. Wherever the construction operations have resulted in the placement of unsuitable or poorer soils in the area to be resodded, the surface shall be left low and covered with topsoil.

B. The finished grade, after shaping and compacting the topsoil, shall be thoroughly dampened prior to and immediately before replacing the sod.

C. The sod shall be replaced to the required grade, taking care to butt each piece tightly against the adjacent one.

D. Upon completion, the sod shall be dampened and rolled with a lawn roller.

E. All sod shall be kept moist during the first week after sodding. Water shall be provided for each of the next three weeks to provide a minimum of 2 inches of moisture per week.

3.3 COVER CROP SEEDING

A. Seeding shall not be done during windy weather or when the ground is frozen, excessively wet or otherwise untillable.

B. Seed may be sown by one of the following methods:

1. Hydroseeded which utilizes water as the carrying agent, and maintains continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend and mix into homogeneous slurry of the specified amount of seed and water or 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 which will provide a uniform distribution of the slurry.
2. Blower equipment with an adjustable disseminating device capable of maintaining a constant, measured rate of material discharge that will ensure an even distribution of seed at the rates specified.

C. Grass seed shall be seeded at the rate of 130 pounds per acre.

D. Fertilizer shall be applied at the rate of 90 pounds per acre.

E. Wood cellulose fiber shall be applied at the rate of 1 ton per acre.

F. The exact time for seeding will be determined by actual weather conditions. The normal satisfactory period for seeding shall be considered between March 1 to June 1 and September 1 to November 1 unless otherwise authorized by the Owner except that the Contractor may perform seeding operations from June 1 to September 1 provided that he waters the new grass to the satisfaction of the Owner.

G. When delays in operations carry the work beyond the most favorable planting season, or when weather conditions are such that satisfactory results are not likely to be obtained for any stage of the seeding operations, the Contractor will stop the work and it shall be resumed only when the desired results are likely to be obtained or when approved alternates or corrective measures and procedures are adopted.

H. The Contractor shall protect all seeded areas from erosion until final inspection and acceptance has been made. Areas damaged by erosion shall be repaired by the Contractor at his own expense.

3.4 PLANTING PITS

A. Trees: Vertical sides, flat bottom, circular or square 6-inch minimum planting soil below ball and/or roots, diameter or side dimension 2 feet greater than root system or ball diameter.

B. Shrubs conform to A above except diameter or side dimension 1 foot greater than ball diameter or root.

C. Bulbs, bedding plants and ground cover 12 inches below finished grade.

3.5 PLANTING TREES, SHRUBS, GROUND COVER, BULBS AND BEDDING PLANTS

A. Use planting soil beneath and around cavity between plant ball or roots and pit sides. Tamp base firmly, place plant or tree, tamp soil in layers, thoroughly water each layer, loosen and fold burlap away from top of ball into pit. Fill balance of cavity with planting soil. Soak and continuously maintain adequate moisture.

B. Use approved root transplanting compounds and herbicides for bulbs and plants to prevent disease and assure best plant growth.

C. Leave watering "saucers" around each plant.

D. Support trees immediately after planting by staking and/or guying to maintain trees in plumb position.

E. Apply mulch where shown or noted on the Drawings. Mulch depth shall be 3 inches unless otherwise noted.
F. Fertilize all trees, shrubs and ground covers at time of planting.

3.6 FINAL INSPECTION

A. Final inspection for seeded areas will not be made until thirty (30) days following completion of all seeding, fertilizing, and mulching as specified. Damage caused by the Contractor to areas which have been seeded or sodded shall be repaired and/or replaced by the Contractor at his own expense.

3.7 GUARANTEE

A. Guarantee of planting and seeding shall continue for one year from date of final project acceptance. Contractor shall replace all plants or sod dead or dying within the guarantee period, or reseed lawns and cover crop where required. Guarantee shall include both materials and labor. Replacements shall be the same as originally planted.

* * * END OF SECTION * * *

SECTION 03300
CAST-IN-PLACE CONCRETE

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Testing Laboratory Services: Section 01410
   - 1.2 QUALITY ASSURANCE
     - A. Delivery: Furnish a certificate with each truckload of concrete product delivered to the site, indicating the composition and quality of the mix. Include size and weight of each aggregate, amount of cement, amount of water and amount and kind of any additives included in the concrete, grout fill, or mortar.
     - B. Standards: All current and applicable standards of the following:
       1. American Concrete Institute – ACI 318
       2. Concrete Reinforcing Steel Institute - CRSI
       3. IBC
       4. Other local codes or criteria noted on drawings.
     - C. Concrete consistency:
       1. Test each truckload of concrete for slump. Calibrate each mixer or haul unit to be used by measuring slump near the beginning and near the end of the discharge cycle. Mix units determined by the Engineer to be deficient in mixing capability shall not be used in subsequent deliveries. Slump testing procedures shall be per ASTM C143.
       2. Consistency shall be per values below with tolerance of ± 1 inch.
          a. 3 inches maximum slump for structural elements 12 inches and greater in thickness.
          b. 4 inches maximum slump for structural elements less than 12 inches in thickness and columns.
     - D. Concrete test cylinders:
       1. Prepare a minimum of three test cylinders for each location (slab, wall, column, beam, etc.) for each day's placement or each 50 cu. yd., whichever is greater.
       2. Test set of 3 cylinders as follows:
          a. One at 7 days.
          b. Two at 28 days.
       3. Prepare and test cylinders per ASTM C31 and C39.
     - E. Prior to placement, have available at placement location all tools, cylinder molds, slump cone, rod, curing containers and all other apparatus required for sampling and testing.
     - F. Air-entrained: One test for each mix design.
   - 1.3 SUBMITTALS
     - A. Concrete mix design (for each concrete type used) by independent laboratory, including strength tests of 3 cylinders proportioned to mix design formula.
     - B. Certification of quality of all concrete, mortar, and grout mix design ingredients including admixtures with supporting test data, mill quality control results and all information specified and requested by the Engineer.
     - C. Qualifications of Quality Assurance Control personnel responsible for concrete consistency, strength, air content and all testing.
     - D. Curing materials and methods proposed with certification statements of material's quality.
     - E. Test results, in approved format, at specified intervals for all field sampling and specimens. (Provide a minimum of two copies to the Engineer.)
     - F. Certification of quality and type of epoxy bonding materials.

G. Trip tickets for each load of concrete, grout or mortar indicating weights of all materials and additives used in the batch.
H. Location of construction joints not shown on the plans.

1.4 STORAGE OF MATERIALS

A. Maintain in continuously clean environment and in manner required to maintain homogeneity.
B. Cements, grouts, and mortar containerized and kept in dry humidity environment. Engineer shall reject materials which have hardened or show any evidence of initial hydration.

2. PRODUCTS

2.1 CONCRETE

A. ASTM C94 and mix design approved by Engineer.
B. Compression strength and water cement ratio: The minimum compressive strength and cement content of concrete shall be not less than that shown in the tabulation that follows. The Engineer may order the cement content for any class of concrete to be increased over the quantity specified in the tabulation if it is determined that such increase is necessary to attain the required strength. Such increased quantities of cement, if so ordered, shall be furnished by the Contractor at no additional cost to the Owner.
   1. Class of concrete:

Minimum 28-day Compressive Strength (psi)	Type of Work	Aggregate, Max. Size (in)	Cement, Min. lbs per cu. yd.	Max. W/C Ratio
4,000	Walls, slabs and foundations	1	564	0.45
3,000	Cradles, thrust blocks, and all other uses	1½	517	0.50

   2. Fly ash shall be used at the rate of 100 pounds per cubic yard.
C. Cement ASTM C150:
   1. Type II for all wastewater holding or process structures.
   2. Type I or II for all other structures.
D. Aggregates:
   1. Conform to ASTM C33.
   2. Maximum wear 50% at 500 revolutions, AASHTO T96.
E. Water:
   1. Clear free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.
F. Fly Ash:
   1. In accordance with ASTM C618 and ASTM C311.
G. Admixtures:
   1. Use only those specified in approved mix design.
   2. Air-entrain all concrete unless elsewhere excepted, with agent conforming to ASTM C260. Freshwater concrete air content shall be between 3% and 5% by volume.
   3. Apply in strict accordance with manufacturer's printed instructions.
   4. No chloride contents permitted.
   5. Compatible with coatings specified elsewhere.

2.2 AGGREGATE FOR MORTAR

A. Conform to 2.1 except gradation as follows:

Sieve Size Percent Passing

By Weight	Square Opening
95 - 100	No. 4
80 - 90	No. 8
55 - 97	No. 16
30 - 60	No. 30
12 - 30	No. 50
0 - 10	No. 100

2.3 GROUT

A. For equipment and column bases and drilled-in anchors use no shrink, no staining, pre-mixed grout; Masterflow 713 by Master Builders or equivalent. Mix in accordance with the manufacturer's directions.

B. For fill: Driest consistency practical composed of 1 part Portland cement and 3 parts sand (by volume). Aggregate proportions may be varied slightly to give the most workable mix.

C. For placement at base of walls: one part fine aggregate and one part cement, in a thick cream consistency.

D. Cure in accordance with manufacturer's recommendations.

2.4 CURING MATERIALS

A. Polyethylene sheeting: 0.004 inch thick.

B. Waterproof paper: Polyethylene-coated, Fed. Spec. UU-B-790 Type I, Grades A, B, C, Style 4. Define lap control lines clearly by printed markings.

C. Masonry sand: ASTM C144 (maintained continually moist).

3. EXECUTION

3.1 MIXING AND TRANSPORTATION

A. Ready-mixed concrete: Conform to ASTM C94 Alternate No. 3.

3.2 PLACING

A. Concrete shall not be placed until the Engineer has observed the reinforcement for conformance with the plans and shop drawings.

B. Deliver only in sufficient quantities required for specified time interval use and placement. Discard concrete having initial set before placement. No remixing with water or supplementing with other materials will be permitted once initial set has occurred. Initial set as evidenced by typical hydration characteristics to be determined by Engineer and Contractor quality assurance representative.

C. Place as nearly as possible to final position to avoid segregation of the materials and displacement of reinforcement. Placement shall be completed within 30 minutes after water is first added to the mix. However, at the Engineer's discretion if climatic and temperature conditions are suitable and when the concrete is continually agitated, the time may be extended to 1-1/2 hours.

D. Place no concrete in the absence of or without the permission of the Engineer.

E. Do not change consistency (slump) for a given placement without the Engineer's written permission.

F. Keep open trough and chutes of steel or steel lined, clean and free from coatings of hardened concrete.

G. Do not drop concrete a distance of more than 5 feet unless approved in writing by the Engineer.

H. Do not place concrete in horizontal members or sections until the concrete in the supporting vertical members or sections has been consolidated and a 2-hour period has elapsed since placement in the vertical member to permit shrinkage to occur.

I. In walls containing door and window openings, hold up placements at the top and bottom of the openings. Stop other placements at levels to conform to drawing details.
J. Layout and sequence of placing of concrete in monolithic structures shall be as shown on the drawings or approved by the Engineer.
K. Within a placement, deposit concrete in horizontal layers not to exceed 18 inches in depth. Place at rate such that: (1) no concrete surface shall obtain initial set before additional concrete is placed on it and (2) yielding of forms is not so great as to cause the concrete surfaces to exceed the tolerances specified.
L. Unless specified otherwise, place all slabs and finished floors to finish elevation in one continuous operation, except that the Contractor may place a separate finish topping if prior approval is received from the Engineer. Floor and roof slab sectional thicknesses shown are minimum thicknesses. Slopes on floors or roofs shall increase, rather than decrease, slab thicknesses.
M. Where a separate finish topping is placed, increase structural slab thickness by the maximum thickness of the finish topping and maintain finished floor elevation as noted on the drawings.
N. Construction joints:
    1. Locate construction joints as shown on the drawings or as approved by the Engineer.
    2. Locate construction joints so as not to impair the strength of the structure, and only at locations shown on the drawings or approved by the Engineer.
    3. Construct bulkheads to neatly fit reinforcement and water stops and prevent concrete leakage.
    4. Provide water stops or sealants in construction joints where required.
    5. Unless shown otherwise, key all construction joints.
    6. Continue reinforcement through construction joint unless otherwise shown or noted.
    7. Before placing concrete against previously placed concrete, thoroughly roughen and clean by wet sandblasting or green cutting with an air water jet.
        a. Use air water cutting at the proper time after the initial set. Use a high pressure air water jet to expose clean, sound aggregate without undercutting the edges of the larger aggregate. Protect adjacent subgrade when cutting is used on slab edges.
        b. After cutting or sandblasting, rinse the surface until wash water contains no cloudiness. Dispose of wastes from cutting, washing and rinsing so they do not stain or abrade exposed surfaces.
    8. Place concrete continuously to a predetermined construction joint.
O. Care shall be taken in placing concrete through reinforcement so that no segregation of the coarse aggregate occurs. On the bottom of beams and slabs where the congestion of steel near the forms makes placing difficult, a layer of mortar, of the same strength as used in concrete, shall first be deposited in the forms, followed immediately by the concrete. The thickness and use of this mortar layer shall be as approved by the Engineer.
P. Special care shall be taken to prevent splashing forms or reinforcement with concrete. Any hardened concrete or partially hardened concrete on the forms or reinforcements above the level of the concrete already in place shall be removed before proceeding with the work.
Q. Cold weather placement:
    1. Concrete shall be placed only when the temperature is at least 40°F and rising, unless permission to pour is obtained from the Engineer.

2. Material shall be heated and otherwise prepared so that batching and mixing can proceed in full accord with the provisions of this Specification.
3. Suitable means shall be provided for maintaining the concrete at a temperature of at least 50ºF for a period of at least the first 5 days and at a temperature above freezing for the remainder of the specified curing period, except that where high-early strength cement is used, this period may be reduced to 72 hours. The methods proposed for heating the materials and protecting the concrete shall be approved by the Engineer.
4. Salt, chemicals, or other materials shall not be mixed with the concrete for the purpose of preventing freezing. Accelerating agents shall not be used.

R. Hot weather placement:
1. The temperature of fresh concrete at the time of placement during hot weather shall be a maximum of 90°F to prevent an accelerated setting of the concrete.
2. A retarding densifier admixture shall be used when the high expected atmospheric temperature for the day is 85°F or above. Admixture shall be used in accordance with the manufacturer's recommendations.

S. Placing concrete against earth:
1. Unless otherwise called for on the drawings, earth cuts shall not be used as forms for vertical surfaces without the prior approval of the Engineer.
2. Concrete placed on or against earth shall be placed only upon or against firm, damp surfaces free from frost, ice and standing or running water. Concrete shall not be placed upon mud or upon fills until the required compaction has been obtained.

T. Placing concrete slabs:
1. Smooth subgrade surface irregularity with thin film of masonry sand prior to placing vapor barrier.
2. Place vapor barrier on subgrade in maximum widths commercially available. Longitudinal laps: 6 inches minimum. End laps: 2 feet minimum.
3. Edge and side laps must be in continuous contact. Place materials to maintain tight lap contact.
4. Repair any tears in the material.
5. Place concrete without displacing vapor barrier.

3.3 COMPACTING

A. Compact all concrete with high frequency internal vibrators immediately after placing.

B. Use external vibrators for compacting concrete where the concrete is inaccessible for adequate compaction by internal vibrators; construct forms sufficiently rigid to resist displacement or damage from external vibration.

C. Penetrate concrete with a sufficient number of vibrations immediately after it is deposited. Move vibrator throughout the mass so as to thoroughly work the concrete around reinforcement and embedded fixtures and into corners and form recesses. Vibrate the minimum time required to compact the concrete in place and not cause separation of the materials. Concrete shall be compacted to maximum density as determined by tests for yield. Select vibrator size to efficiently accommodate reinforcement clearances.

3.4 CURING AND PROTECTION

A. General:
1. Maintain at site ready to install, before actual concrete placing begins, all equipment and materials needed for optimum concrete curing and protection; maintain extra vibrators on standby in case of malfunction of any unit.
2. Protect finished surfaces or edges from stains, abrasions and breakage during the entire construction period.

3. Protect all concrete from accelerated drying and excessive heat at all times. Close all galleries, conduits and other formed openings through the concrete during the entire curing period and as long thereafter as practicable to prevent drying of concrete by air circulation.
4. Install slab curing covers immediately after initial set or as soon as free water has disappeared from the surface of the concrete after finishing or surfacing.

3.5 REPAIRING CONCRETE

A. Immediately after removal of forms, break back all form ties and inspect concrete surfaces for defects. Complete repair of defects within 48 hours after removal of forms. No repairs shall be made until the defects have been reviewed and method of repair approved by the Engineer.
B. Remove all defective or damaged concrete, including honeycombed, sand streaked or fractured material from the area to be repaired. Chip out areas to one inch minimum depth. Edge shall be squared with the surface to eliminate feather edges.
C. Before placing the repair material obtain Engineer inspection. Clean area free of chipping dust, dried mortar, and all other foreign materials.
D. Keep surfaces to be repaired continuously wet for at least three hours prior to placing new concrete or mortar. No free water on the surface when the repair material is placed.
E. Apply a bonding agent to the area to be repaired before placing repair material. Apply the bonding agent per manufacturer's published instructions attached to container.
F. For all repair surfaces permanently exposed to atmosphere use white cement in proportions found by trial to be effective in producing a color that, in the hardened patch, will match the surrounding concrete surface.
G. Make repairs or patch form tie holes by (1) dry packing, (2) filling with concrete, or (3) plastering with mortar or a combination of all 3 in conformance with the following:
   1. Use the dry pack method for holes at least one inch deep where the depth is equal to, or greater than the smallest surface dimension of the defect, such as cone bolt or form tie holes, and for narrow slots cut for the repair of cracks. Do not use the dry pack method where lateral restraint cannot be obtained. Place and pack dry pack mortar in layers having a compacted thickness of approximately 3/8 inch. Solidly compact each layer over its entire surface by use of a hardwood stick and hammer. Do not use metal tools for compacting. Compact surface just flush with adjacent area. Do not use steel finishing tools or water to facilitate finishing.
   2. Use concrete replacement for (1) holes extending entirely through concrete sections; (2) for holes larger than one square foot and deeper than four inches in which no reinforcement is encountered; (3) for holes larger than 1/2 of one square foot where reinforcement is exposed. Concrete used for replacement shall be of the same strength and mixture as used in the structure except for color matching as specified above.
   3. Use mortar replacement for holes too wide to dry pack and too shallow for concrete replacement and when approved by the Engineer for other conditions not covered above.
H. Cure all repairs with the same methods as new concrete.

3.6 CONCRETE FINISHES AND TOLERANCE

A. General finish:
   1. Finish concrete surfaces to conform to the following table unless otherwise noted on the drawings.
   2. <u>Formed surfaces</u> <u>System</u>
      a. Exterior - exposed and one foot below F4

b. Exterior - below grade F2
c. Interior F4

3. Slabs
   a. Tops of exterior footings in contact with soil or backfill U2
   b. Exterior - except as otherwise noted U5
   c. Interior - walking surface except as otherwise noted (with hardener) U4
   d. Interior - tank and channels U4
   e. Exterior and interior walks on or over structures including interior clarifier slab to receive swept in grout fill U1

B. Formed surfaces: Finishes for formed surfaces shall be as designated below:
   1. Finishing for F1 and F2 finishes consists of concrete repairing only, which is to be completed within 48 hours after forms are removed.
   2. Finishing for F3 and F4 finishes shall immediately follow concrete repairing and be completed within 96 hours after the forms are removed. Except where forms are left in place for the duration of the curing period, finishing shall be done during the curing period, keeping the interruptions to the curing process as short as possible. Where forms left on prevent finishing during the curing period, finishing shall be completed within 48 hours after forms are removed. All finishes shall receive a minimum of 24 hours of curing after completion of the finish. Curing shall be carefully done so as not to disturb or remove any of the mortar.
   3. Finish F1: Rough formed surface with defective concrete repaired and form tie holes and other holes over ½-inch deep filled. Forms may be built with a minimum of refinement and form sheathing may be any material that will not leak mortar or yield beyond specified tolerances when the concrete is vibrated.
   4. Finish F2: Smooth, formed concrete surface with all fins, projections and loose material removed and defective concrete and form tie holes and other holes over ½-inch deep, repaired and filled. Forms in contact with concrete shall be plywood or steel.
   5. Finish F3: Smooth, formed concrete surface with all fins, projections and loose material removed, and defective concrete, form tie holes, air bubble holes, surface pits, holes from defective forms, nail head holes and similar surface defects, repaired and filled. Forms in contact with concrete shall be plywood or steel. Form construction shall be planned so that if any pattern from the forms is left in the concrete surface it will harmonize with the structure or building. All joints shall be horizontal or vertical.
   6. Finish F4: Exceptionally smooth, formed concrete surface with all fins, joint marks, bulges, projections and loose material removed. Sandblast to expose air bubble holes, surface pits and similar minor surface defects. Defective concrete, form tie holes, holes from defective forms, and other holes too large to fill by "sack rubbing" shall be repaired and filled. Finish with sack rubbing as follows:
      a. Thoroughly wet the surface and begin treatment while the concrete is still damp. Use 1 part cement, 2 parts (by volume) of sand which will pass a No. 16 screen, and enough water so that mortar consistency will be that of thick cream. Rub mortar thoroughly over the area with clean burlap or a cork or sponge rubber float to fill all pits, surface holes and air bubble holes. While the mortar in the pits is still plastic, rub the surface with a dry mix of mortar. This dry rub shall remove all excess mortar and place enough dry material in the pits to stiffen and solidify the mortar flush with the surface. No material shall remain on the surface except that within the pits. When the ambient temperature is 85°F or higher, keep the mortar continuously damp by means of a fog spray for 24 hours during the setting period. Take care that the fog

spray does not remove any of the mortar. Break finish for any area only at natural breaks in the finished surface.

b. Rub all surfaces that are to be finish painted with a carborundum stone to provide a smooth texture and to remove any latent material on the surface. Pre-blast walls to remove any residual form oils prior to finishing when walls are to be finish painted.

c. Form requirements shall be the same as Finish F-3.

C. Unformed surfaces:

1. Working on unformed surfaces in various finishing operations shall be held to the minimum required to produce the desired finish. Use of any finishing tool in areas where water has accumulated will not be allowed. Work in these areas shall be delayed until the water has been absorbed, has evaporated, or has been removed by draining, mopping, dragging off with a loop of hose, or by other means. In no case, shall cement or mixture of cement and sand be spread on the surface to absorb excess moisture nor shall such materials or water be added to facilitate trowelling. Joints and edges, unless specified otherwise, shall be carefully finished with edging tools.

2. Finishes for unformed surfaces shall be as designated below:

a. Finish U1: Even, uniform finish. Consolidate level and screed concrete to obtain an even, uniform surface. Surplus concrete shall be removed immediately after consolidation by striking it off with a sawing motion of the straight edge or template across wood or metal strips that have been set as guides. When the surface is curbed use screed strips at approved intervals. For long, narrow stretches of curved surfaces such as on invert paving, a heavy slip form may be used. In the case of extensive flat paving, a paving and finishing machine is preferred.

b. Finish U2: A wood float finish. Follow treatment specified for finish U1 by floating either by hand, or by power driven equipment. Floating to be started after some stiffening has taken place in the surface concrete and the moisture or "shine" has disappeared. Work the concrete no more than necessary to produce a surface known as "wood float finish" which is uniform in texture and free of screed marks. Do any necessary cutting and filling during the floating operations.

c. Finish U3: A steel troweled finish. Follow the treatment specified for the finish U2, except leave a small amount of mortar without excess water at the surface to permit effective trowelling. Start steel trowelling after the moisture film or "shine" has disappeared from the float surface and after the concrete has hardened enough to prevent an excess of fine material and water from being worked to the surface. Trowel with firm pressure that will flatten the sand surface left by the floating and produce a dense, uniform surface free of blemishes, ripples and trowel marks.

d. Finish U4: A hard, steel troweled finish burnished. Follow the treatment specified for finish U3 with additional steel trowelling after the surface has nearly hardened, using firm pressure and trowelling until the surface has a burnished appearance.

e. Finish U5: Broom finish. Follow the treatment specified for finish U3 by roughening the surface immediately after toweling with a fiber bristle broom in a direction perpendicular to the direction of traffic. Broom grooves not more than 1/16-inch deep. After brooming, neatly tool all joints and edges to configuration.

f. Finish U6: Anti-slip finish. Follow the treatment specified for finish U3 and immediately after trowelling, dust 30 to 40 lbs. or regular non-slip aluminum

oxide 14/36 grit abrasive grain uniformly over each 100 sq. ft. of area. Trowel the grit into the surface and after trowelling, brush with a fiber bristle broom in a direction perpendicular to the direction of traffic. Broom grooves not more than 1/16" deep. After brooming neatly tool all joints and edges to configuration.

D. Tolerances:
   1. Unless otherwise required, allowable tolerances for concrete surfaces shall be in accordance with those shown in the table below. Surface irregularities are classified as either "abrupt" or "gradual". Offsets caused by displaced or misplaced form sheathing, lining, or form section or by defective form lumber shall be considered as abrupt irregularities. All others are classed as gradual irregularities. Gradual irregularities shall be measured with a template consisting of a straight edge for plane surfaces and its equivalent for curved surfaces.
   2. The length of the template for testing formed surfaces shall be 5 feet. The length of the template for unformed surfaces shall be 10 feet. Maintain a 5 foot length and 10 foot length steel template on the job site.
   3. Maximum allowable irregularities in concrete:

Finish	Irregularity in Inches	
Designation	Gradual	Abrupt
F1	1	1/2
F2	1/2	1/4
F3	1/4	3/16
F4	3/16	3/16
U1 thru U6	1/8	1/8

3.7 TESTING AND REPAIRING CONCRETE STRUCTURES

A. Testing:
   1. Separately test each individual chamber that will contain liquid by filling to the overflow with water after the 28-day design strength of the concrete has been obtained. Repair any visible leakage. Damp spots that do not run may be acceptable if below ground or not on walls common with pump rooms or passageways.
   2. Allowable leakage not to exceed 0.1% of the volume contained in the chamber in a 24-hour period. Leakage in excess of the allowable amount requires repair to reduce leakage and will be considered to lack water tightness.

B. Repairs:
   1. In the event that the structure is not watertight, outline a procedure for repair prior to proceeding with the repair work. Complete any repairs to new work as per specifications at Contractor expense.
   2. Approved repairs can include, but not necessarily be limited to, one or a combination of the repairs listed below. Use of these techniques is not to be construed as a warranty by the Engineer that the methods outlined will satisfy leakage repair requirements:
      a. Replace defective concrete.
      b. Grout the joint by drilling grout holes to the center of the structural unit and forcing grout into the joint under pressure.
      c. Cut a bevel groove on the pressure side of the joint. Groove: ½- to ¾-inch in width and depth, caulked with epoxy joint sealer in accordance with the manufacturer's instructions.

3.8 UNSATISFACTORY CONCRETE

A. Any concrete placed which fails to meet or exceed the specified strength requirements as determined from molded cylinders or cores, or to meet the density

or surface requirements, or which has been frozen during placing or curing, shall be removed and replaced with satisfactory materials at the Contractor's expense.

B. Method of determining unsatisfactory concrete: Visual appearance characteristic of rain or freeze damage to concrete which is apparent to the Engineer.

* * * END OF SECTION * * *

SECTION 03485
PRECAST CONCRETE VAULTS

1. **GENERAL**
   - 1.1 RELATED WORK SPECIFIED ELSEWHERE
     - A. Shop Drawings, Product Data and Samples: Section 01340
     - B. Concrete: Division 3
   - 1.2 DESCRIPTION
     - A. This section covers furnishing and installation of the precast concrete vaults.
   - 1.3 SUBMITTALS
     - A. Submit complete shop drawings with detailed specifications and data for materials used, parts, devices and other accessories forming part of the vault.
   - 1.4 ADAPTATION OF PRODUCT
     - A. Furnish product readily adaptable for installation and operation in the manner shown on the drawings.

2. **PRODUCTS**
   - 2.1 GENERAL
     - A. The vaults shall be precast as manufactured by Utility Vault Co., or equivalent, with tops modified as shown on the plans.
   - 2.2 DESIGN
     - A. Conform to ASTM C913.
     - B. Designed for 16000 pound wheel load.
     - C. Designed for earth load of 130 pounds per cubic foot.
     - D. Vault Design
       1. Vaults shall be provided for the following items
          - a. Meters and backflow devices larger than two inches in size.
          - b. Pressure reducing valves.
          - c. Other appurtenances as required by the District.
       2. Vaults located within private property shall obtain an easement to a minimum distance of 5 feet beyond the vault in all directions, allowing District staff the ability to access and maintain equipment.
       3. The ladder shall have clearance of at least 30 inches horizontally (in front of ladder) to any obstruction in the vault and 15 inches laterally (beside the ladder), along the entire length of the ladder. Ladder shall comply with OSHA 1910.23 requirements.
       4. Vaults shall be of size sufficient to house the valve or device, ladder, other required equipment, and maintain the required clearances for safety and access. The District Engineer reserves the right to make the final determination on minimum acceptable vault size.
       5. The precast concrete vault shall have clearance of at least 12 inches between the enclosed device and the vault walls, unless otherwise specified within the Standards or by the District Engineer.

   - 2.3 MATERIALS
     - A. Precast Concrete Vaults
       1. Concrete shall have a minimum compressive strength of 4,000 psi and be in accordance with ASTM C858.
       2. The vault shall have precast concrete top, center, extension, and base sections.
       3. Crushed clean drain rock shall be placed and leveled at the bottom of the vault interior to a minimum thickness of 15 inches to allow drainage.

B. Ladders
   1. Vaults shall be equipped with a ladder meeting the requirements of OSHA, as applicable.
   2. Vaults 6-feet and greater in depth shall be equipped with an Old Castle Precast (utility vault) aluminum ladder extension safety post or approved equal.
   3. Ladder extension shall extend 40 inches above the top rung of ladder.
   4. Ladders and accessories shall be fabricated steel with deformed rungs and shall be hot-dipped galvanized after fabrication.
   5. Ladder shall be properly secured with stainless steel hardware of sufficient size according to manufacturer recommendations.

C. Drainage
   1. Provide a minimum 3-inch diameter bore-sighted drain to daylight with rodent screen.
   2. If drain to daylight is not feasible, provide a sump pump.

D. Sump Pumps
   1. Sump pump for meter vaults shall be an automatic hydraulic sump pump assembly, with a normally closed intake valve connected to a free-floating liquid level switch that opens the intake valve when water in the sump reaches a set level. The ejector pump is powered by water pressure in the District main. Hydraulic sump pumps shall not be used in backflow vaults.
   2. Pump shall be wall mounted with the sump pump suction inlet located within an 18-inch diameter PVC pipe placed on the interior floor of the vault and surrounded with crushed rock to a depth of 15 inches. The first 12 inches of the PVC pipe shall be perforated to allow water accumulating in the vault to freely enter the sump.
   3. A double-check valve shall be installed on the pump intake from the District water supply for backflow prevention. Supply water will be provided through a 3/4” tap, corporation stop, and Type K copper tubing. Supply water tap shall be upstream of meter.
   4. Discharge piping shall be 2-inch diameter schedule 40 PVC, routed to an acceptable discharge location as approved by the District Engineer.
   5. Hydraulic sump pump is preferred for meter vaults but a powered option may be used upon District approval. Powered sump pump shall be
      a. Grundfos Model KP250 13 horsepower stainless steel, with a normally open free-floating liquid level switch that closes when liquid level rises.
      b. District approved equal.
   6. Pump shall be equipped with 1-14-inch discharge and miscellaneous piping for discharge including an inline check valve and isolation gate valve (size equal to the discharge line size) downstream of the check valve
   7. Provide power source at a voltage compatible with the sump pump motor. Conduit for power shall be a minimum of 2-feet from any other pipe penetration.

E. Sidewalk Door
   1. The top section of the vault shall be furnished with an aluminum sidewalk door. The model shall be
      a. Bilco Type J or JD
      b. East Jordan Iron Works CHS Series
      c. L.W. Products Type S or D
      d. U.S.F. Fabrication T Series
      e. District approved equal
   2. The door shall be furnished with the following
      a. Channel frame with an anchor flange around the perimeter
      b. 112-inch drain coupling

c. Aluminum diamond plate cover designed to withstand H-20 loading unless approved otherwise by District Engineer.
d. Compression springs to assist operation
e. Automatic hold-open arm with release handle
f. Safety grate only required where directed by District Engineer
g. Stainless steel safety chains are required for all vault's doors. Single door vaults shall have posts opposite of hinged door to support safety chain. Safety chains shall be a minimum height of 34-inches at lowest point including sag, maximum of 39-inches, and shall have a mid-span chain. Chains shall be powder coated orange for visual awareness.
h. Locking hasp
i. Snap lock with removable handle
j. Stainless steel hardware and hinges with stainless steel pins

3. The vault door shall be coated with a non-slip surface having a static coefficient of friction of at least 0.6 for flat surfaces and 0.8 for inclines greater than 4%.
4. Aluminum in contact with concrete shall be coated with bituminous coating.
5. The drain from the sidewalk door shall be stubbed-out to the exterior of the vault.

F. Vault Joints
1. Preformed plastic gaskets for horizontal vault joints shall meet requirements of Federal Specification SS-S-00210.
2. Gaskets shall be
a. Kent Seal No. 2 manufactured by Hamilton Kent Manufacturing Company
b. Ram-Nek by K.T. Snyder Company, Inc.
c. District approved equal

G. Grout and Damp-Proof Coatings
1. Damp-proof the exterior below-grade walls and base with a water-based blend that reacts with the free lime and calcium hydroxides in the concrete to seal the vault. An asphalt compound of brush or spray consistency conforming to Federal Specification ASTM D449 may be used with the District Engineer's approval.
2. Vaults damp-proofed using clear compounds shall be marked in black paint as having received such a coating. The markings shall indicate the type of material used.

H. Interior Paint
1. Contractor to paint interior concrete surfaces white (interior wall and lid bottom). Paint shall be white latex paint.
2. Prior to application of the paint, concrete surfaces shall be free of dust and debris to allow for proper adhesion of the paint.

I.

3. EXECUTION

3.1 INSTALLATION

A. The bottom of the excavation for the vaults shall be fine graded to a plane surface on firm undisturbed subgrade material.
B. Granular pipe bedding material shall be uniformly spread to a depth of 4 inches over the bottom of the excavated area to provide uniform bearing for the vault.
C. Install vault and accessories in conformance with drawings, specifications and recommendations of vault manufacturer unless otherwise instructed in writing by the Engineer.
D. The vault joints, pipeline, and conduit penetrations through walls as shown on the plans shall be sealed watertight. No leakage will be allowed into the vault.

E. Vault Installation
   1. Excavation, base rock, and backfill shall conform to Section 2 of these Standards. If material in bottom of excavation is unsuitable for supporting unit, excavate and backfill to required grade with foundation stabilization.
   2. Place precast vaults in conformance with Standard Details.
   3. Install preformed plastic gaskets for vault sections in accordance with manufacturer's instructions and the following
      a. Carefully inspect precast vault sections to be joined. Do not use sections with chips or cracks in the tongue.
      b. Install gasket material in accordance with manufacturer's instructions. Use only primer furnished by gasket manufacturer.
      c. Completed vaults shall be rigid and watertight.
      d. Top of vault lid shall be one inch above adjacent finished landscape grade. If installed in sidewalk or pavement, vault lid shall be flush with surrounding surface.

F. Pipe Penetrations
   1. Openings in vault walls shall be no larger than 2-inches greater than flange diameter of pipe being installed.
   2. Openings in vault shall be made using a core drill and the penetration shall be sealed using a link seal to keep the vaults as watertight as possible.
   3. Prior to backfilling around vaults, use non-shrink grout to seal all joints, and patch wall areas with rock pockets in excess of 3/16” deep and greater than 3/4” in diameter.

* * * END OF SECTION * * *