SECTION 33 05 26 - UTILITY IDENTIFICATION

This Section includes pipe markers for direct-buried site utility piping and conduit.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicts among requirements.

This Section includes the term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Considerations for information needed to coordinate this Specification Section with Drawings.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipeline marker posts.
2. Metal utility markers.
3. Plastic utility markers.
4. Marking flags.
5. Plastic ribbon tape for placement above direct-buried utility.
6. Trace wire for placement above direct-buried utility.

1.2 RELATED SECTIONS:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

A. Section 31 23 17 - Trenching: Backfilling considerations for installation of underground pipe markers.

B. Section 31 23 23 - Fill: Backfilling considerations for installation of underground pipe markers.

C. Section 33 11 13 - Public Water Utility Distribution Piping: Piping, valves, and appurtenances requiring identification marking.

Commented [JW1]: We do not have this in our specifications library. Verify with Technical Lead.

D. Section 33 11 16 - Site Water Utility Distribution Piping: Piping, valves, and appurtenances requiring identification marking.

E. Section 33 31 10 - Sanitary Utility Sewerage Piping: Piping, valves, and appurtenances requiring identification marking.

F. Section 33 31 13 - Public Sanitary Utility Sewerage Piping: Piping, valves, and appurtenances requiring identification marking.

G. Section 33 33 00 - Low Pressure Utility Sewerage: Piping, valves, and appurtenances requiring identification marking.

H. Section 33 34 00 - Sanitary Utility Sewerage Force Mains: Piping, valves, and appurtenances requiring identification marking.

I. Section 33 41 10 - Storm Utility Drainage Piping: Piping, valves, and appurtenances requiring identification marking.

J. Section 33 41 13 - Public Storm Utility Drainage Piping: Piping, valves, and appurtenances requiring identification marking.

Commented [JW2]: We do not have this in our specifications library. Verify with Technical Lead.

1.3 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer's catalog information for each product required.

Include following Paragraph for submission of physical samples for selection of finish, color, texture, and other properties.

C. Samples: Submit [one] <_____> [pipeline marker post] [, utility marker] [, marking flag] [, 10 feet (3 m) of ribbon tape] [, and] [10 feet (3 m) of trace wire].

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate Paragraphs for additional certifications.

E. Qualifications Statement:

Coordinate following Subparagraph with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of tagged valves.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Extra Stock Materials:

Insert desired quantity of each product.

1. Furnish [<_____> pipeline marker posts] [, <_____> utility markers] [, <_____> marking flags] [<_____> rolls of ribbon tape] [, and] [<_____> rolls of trace wire].

1.6 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

A. Perform Work according to <_____> standards.

1.7 QUALIFICATIONS

Coordinate following Paragraph with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

PART 2 PRODUCTS

2.1 PIPELINE MARKER COSTS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description:

1. Material: High-density polypropylene.

2. Diameter: 3-1/2 inches (89 mm).

3. Length: 72 inches (1.8 m).

4. Color: [White] <_____>.

5. Embedment: T-anchor.

C. Visibility Enhancer:

1. Material: Polyethylene.

2. Length: 24 inches (610 mm).

3. Diameter: 3-3/4 inches (95 mm).

4. Color: <_____>.

5. Text: <_____>.

2.2 UTILITY MARKERS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Metal:

1. Material: [Bronze] <_____>.

2. Diameter: 2 inches (51 mm).

3. Stem: 3/4 by 2 inches (19 by 51 mm).

4. Text: <_____>.

C. Plastic:

1. Material: <_____>.

2. Type: <_____>.

3. Diameter: 2 inches (150 mm).

4. Text: <_____>.

2.3 MARKING FLAGS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description:

1. Material: [Polyethylene] <_____>.

2. Minimum Size: 2-1/2 by 3-1/2 inches (64 by 89 mm).

3. Wire Stem: 21 inches (530 mm).

4. Color: <_____>.

5. Text: <_____>.

2.4 RIBBON TAPE

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description:

1. Material: [Polyethylene] <_____>.

2. Brightly colored, continuously printed.

3. Minimum Size: 6 inches (150 mm) wide by 4 mils (0.10 mm) thick.

4. Manufactured for direct burial service.

5. Imprint: <_____> in large letters.

Consider following Article for nonmetallic pipe.

2.5 TRACE WIRE

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [As specified in Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

4. Description:

a. Conductor: Magnetically detectable.

b. Covering: [Clear] [Brightly colored] plastic, imprinted with <_____> in large letters.

******** [OR] ********

5. Description:

a. Wire: Unshielded [10-AWG] [10-gauge] (2-mm-thick) THWN insulated copper.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pipeline Marker Posts, Utility Markers, and Marking Flags: As recommended by Manufacturer.

B. [Ribbon Tape] [Trace Wire]:

1. Continuous [over top of pipe] [buried 6 inches (150 mm) below finish grade, above piping] [buried <_____> inches (<_____> mm) below finish grade, above piping].

2. If multiple pipes occur in common trench, locate [tape] [wire] above centerline of trench.

3. Coordinate with trench Work as specified in Section [**31 23 17 - Trenching**] [**31 23 23 - Fill**] <_____-_____>.

******** [OR] ******

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

C. Installation Standards: Install Work according to <_____> standards.

END OF SECTION

SECTION 33 05 50 - EXISTING PIPE ABANDONMENT

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the removal of existing buried piping and abandonment in place of existing buried piping.

B. Section includes:

1. Pipe removal.
2. In-place abandonment of pipe.

C. Related Sections:

1. Section 03 60 00, Grouting.
2. Section 31 23 16, Excavation.
3. Section 31 23 17, Trenching.
4. Section 31 23 19, Dewatering.
5. Section 31 23 23, Fill.
6. Section 31 23 24, Flowable Fill.

1.2 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Piping Abandonment Plan:

1. Identify locations specified for pipe abandonment.
2. Provide method to be utilized to abandon the pipe, including whether the pipe will be left in place or removed in its entirety.

C. Non-Shrink Grout: Product data in accordance with Section 03 60 00, Grouting.

D. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the work described herein.

B. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the work and requirements of the General Provisions.

1.4 PROTECTION OF EXISTING WORK

A. Carefully examine the Contract Documents to determine the extent of the work of this Section.

B. Carefully coordinate the work of this Section with all other work and construction.

C. Take all necessary precautions to prevent damage to existing facilities or utilities which are to remain in place and be responsible for any damages to existing facilities or utilities, which are caused by the operations.

1.5 REPAIR OF DAMAGE

A. Work procedures shall provide for safe conduct of the work; careful removal and disposition of materials and equipment; protection of facilities, utilities and property which are to remain undisturbed; coordination with existing facilities and utilities to remain in service.

B. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired to acceptance of Engineer.

C. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

1.6 EXISTING CONDITIONS

A. If the pipe material contains any hazardous materials, such as asbestos, requiring special handling upon removal, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 OWNERSHIP OF EXISTING MATERIALS

A. All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from pipe removal work shall become the property of the Contractor at the place of origin, unless otherwise specified in the Drawings or by the Engineer.

2.2 CONTROLLED LOW STRENGTH MATERIAL

A. As specified in Section 31 23 24, Flowable Fill.

PART 3 EXECUTION

3.1 PIPE REMOVAL

A. Where identified on the Drawings, remove, and dispose of all pipe material and associated appurtenances.

1. All fire hydrants, air release valves service lines and appurtenances being abandoned shall be removed to 36 inches below finished grade.

2. Existing service line appurtenances, including valve and meter boxes, shall be removed to 36 inches below finished grade.

B. All exposed ends of pipes and fittings to remain in service shall be capped or plugged with an appropriate ductile iron blind flange, cap or plug and restrained.

1. A pipe shall be considered in service if it is possible to flood the pipe with water by opening valves in the water system.

C. All excavation and backfilling associated with pipe removal shall be performed in accordance with 31 23 17, Trenching.

3.2 IN-PLACE ABANDONMENT OF PIPING

A. Where identified on the Drawings, abandon pipe in place.

B. All exposed ends of pipes being abandoned in place shall be cut and plugged with a minimum of two (2) feet of non-shrink grout.

C. Prior to placing grout, roughen interior pipe surface and apply epoxy bonding agent.

3.3 FILLING PIPE WITH CLSM

A. Where identified on the Plans, pipes greater than 12 inches in diameter to be abandoned-in-place shall be filled with CLSM.

B. CLSM shall be placed in a manner to ensure complete filling of the pipe, leaving no cavities or voids.

C. Install hot taps, saddles, fill lines and appurtenances as necessary for pumping CLSM from the surface into the pipe being filled.

D. CLSM shall be pumped up grade from fill lines rigidly connected to the pipes being filled.

E. Placement of CLSM by free flowing (non-pumped) methods will not be acceptable.

F. Fill lines shall be located at elevations lower than the pipe being filled.

G. As the CLSM is being placed, use other fill lines as view ports to ensure complete filling of the pipes.

H. Relocate pumping equipment as necessary to complete filling of the pipes.

I. Excavate and cut access holes in the pipes as necessary to complete filling operations.

J. Perform pipe filling operations in a manner to eliminate all air pockets.

K. Submit volume calculations for CLSM placed in each filled segment of piping to verify that pipelines have been completely filled.

3.4 CLEANUP

A. During and upon completion of work of this Section, promptly remove all unused tools and equipment, surplus materials, and debris.

B. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 33 11 10 - WATER UTILITY DISTRIBUTION AND TRANSMISSION PIPING

This Section includes pipe materials and accessories normally used with municipal potable and non-potable water utility distribution and transmission systems. Review gray highlighted text to determine design requirements and edits needed for this specification to align with specific project requirements.

This specification covers both buried ductile iron (DI) and polyvinyl chloride (PVC) pipe and fitting materials. Steel and high-density polyethylene (HDPE) pipe systems are covered under their own specification. See 33 31 10, Sanitary Utility Sewerage Piping for gravity sewer applications and 33 34 00 Sanitary Utility Sewerage Force Mains. Additionally, this specification does not cover Purple Pipe reuse water distribution systems.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

For sewer applications use 33 31 10, Sanitary Utility Sewerage Piping for gravity sewers applications and 33 34 00 Sanitary Utility Sewerage Force Mains for pressure sewer applications.

A. Work under this Section applies to furnishing and installation of pipe materials, fittings, and appurtenances normally encountered with water distribution [and] [or] [transmission systems], including [non-]potable water and fire water systems.

B. Section includes:

1. Pipe and fittings
2. Flexible couplings
3. Flanged coupling adapters
4. Insulating flanged joints
5. Tapping sleeves and valves
6. Flexible expansion joints
7. Bedding and cover materials
8. Geomembrane for gas line crossings
9. Concrete thrust blocks

C. Related Requirements:

1. General

a. Furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents.

b. Each buried piping system shall be complete, with all necessary fittings, valves, accessories, lining and coating, testing, excavation, backfill and encasement, to provide a functional installation.

c. Piping layouts shown on the Drawings are intended to define the general layout, configuration, and routing for pipe, as well as the size and type of piping to be installed. The piping plans are not pipe construction or fabrication drawings.

d. The Contractor shall cause the Supplier of pipes, valves, fittings, and appurtenances to coordinate piping installation such that all equipment is compatible and is capable of achieving the performance requirements specified in the Contract Documents.

e. It is the Contractor's responsibility to develop the details necessary to construct all piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, valves, gaskets, fittings, appurtenances etc., for a complete and functional system.

D. Related Sections:

Each of the following listing of sections referenced in this Section; coordinate and edit list for Project conditions. EDIT FOR YOUR PROJECT AS NEEDED. Remove if not included in Part 2 or as called out on the Drawings. Renumber if necessary.

1. Section 03 11 00, Concrete Work
2. Section 13 47 13, Cathodic Protection
3. Section 31 05 13, Soils for Earthwork
4. Section 31 05 16, Aggregates for Earthwork
5. Section 31 23 16, Excavation
6. Section 31 23 17, Trenching
7. Section 31 23 23, Fill
8. Section 31 23 24, Flowable Fill
9. Section 33 05 64, Precast Concrete Valve Vaults and Meter Boxes
10. Section 33 12 13, Water Service Connections
11. Section 33 12 16, Water Utility Distribution and Transmission Valves
12. Section 33 12 19, Fire Hydrants
13. Section 33 13 00, Testing and Disinfecting of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

Select only one AASHTO standard based upon input/standards of client.

If no preference is standard, standard is T99.

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

OR

2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
3. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
4. ASME B31.10 - Standards of Pressure Piping

C. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5. ASTM A536 - Standard Specification for Ductile Iron Castings.

Select only one ASTM standard based upon input/standards of client.

ASTM D698 test methods correspond with AASHTO T99

ASTM D1557 test methods correspond with AASHTO T180.

6. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

OR

7. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

8. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

9. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

10. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

11. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

12. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

13. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

14. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast

7. AWWA C153 - Ductile-Iron Compact Fittings

8. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe

9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

11. AWWA C606 - Grooved and Shouldered Joints

12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves

F. NSF International (NSF):

1. NSF Standard 61 - Drinking Water System Components – Health Effects

2. NSF Standard 372 - Drinking Water System Components – Lead Content

3. NSF 600 - Health Effects Evaluation and Criteria for Chemicals in Drinking Water

G. International Organization for Standardization (ISO)

1. ISO 8179-1:2017 Ductile iron pipes, fittings, accessories and their joints – External zinc-based coating – Part 1: Metallic zinc with finishing layer.

1.3 SUBMITTALS

A. Section 01 33 00, Submittal Procedures.

B. Product Data: Submit data on pipe materials, pipe fittings, restrained joint systems, and accessories.

Request Layout Schedule, Shop Drawings for transmission main work. This requirement is generally intended for transmission mains 24-inch diameter and larger.

C. Shop Drawings: Indicate piping layout, including piping specialties.

1. Layout Schedule for applicable segments of proposed transmission main alignment. Schedule shall include layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, pipe supports, and any special provisions required for assembly.

D. Lining and coating data.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer’s handling, delivery, storage, and installation requirements.

G. Field Quality-Control Submittals:

1. Pipeline hydrostatic testing plan.

2. Indicate results of Contractor-furnished tests and inspections.

H. Preconstruction Photographs:

1. Submit digital files of colored photographs of Work areas and material storage areas.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for submittals.

B. Record Drawings:

1. Record actual locations of piping mains, valves, connections, thrust restraints, appurtenances, and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.

3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.

Include following Paragraph only when requested by Owner or Project Funding Agency. Update as required to meet funding requirements. Otherwise, delete.

4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

B. Markings:

1. Pipes and Fittings: Mark each pipe and fitting at plant. Include date of manufacture, Manufacturer's identification, specification standard, inside diameter of pipe, dimension ratio as applicable, pipe class as applicable, pipe number for laying purposes as applicable, and other information required for type of pipe.

2. Bolting materials (washers, nuts, and bolts) shall be marked with material type.

C. Testing:

1. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Industry Specifications and Standards.

1.6 MATERIAL DELIVERY, STORAGE, AND HANDLING

A. In accordance with the Manufacturer's written recommendations and as specified in these Contract Documents.

B. Pipe, specials, and fittings delivered to Project Site in damaged condition will not be accepted.

C. Storage:

1. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

2. Pipe and fittings shall not be stored on rocks, gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

3. Do not store materials in direct sunlight.

4. For storage in cold weather, locate products to prevent coating from freezing to ground.

5. Gaskets: Do not allow contact with oils, fuels, petroleum, or solvents.

D. Handling:

1. Pipe and appurtenances shall be handled in accordance with Manufacturer's recommendations or requirements contained in this section or subsequent sections dealing with the specific pipe material, whichever is more stringent.

2. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.

3. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.

4. Flange gasket surfaces shall have securely attached metal, hardboard, or wood protection.

5. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

6. Under no circumstances shall pipe materials be dropped or dumped into the trench.

E. Pipe Plugs:

Provide and install a cap or plug on each end of pipe during transportation and onsite storage to protect linings and coatings from debris. Install watertight plug-in end of installed pipe at the end of the workday, when active pipe installation is delayed for more than an hour and when ground water is present.

PART 2 PRODUCTS

2.1 WATER PIPING

A. General

1. All piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.

2. All coatings and materials specified herein which may come in contact with potable water shall conform to National Sanitation Foundation (NSF) Standard 61, 372 and 600.

Modify the following Paragraph to reflect actual Project conditions and requirements, if different.

3. Minimum Pressure Ratings: Unless otherwise specified herein or shown on the Drawings, the minimum working pressure rating of all water works materials specified herein shall be 1-1/2 times the operating pressure or 150 pounds per square inch (psi) minimum.

4. Gaskets:

   a. Gaskets in contact with potable water shall be NSF 61 certified.

If Project is for non-potable water or has unique conditions a different gasket material may be required. For example, if the water has hydrocarbon contamination or potential for contamination, specify Nitrile Butadiene Rubber (NBR) gaskets. Consult Consor Tech Practice Leader, Pipelines another resource for the different material applications is McWane Ductile.

   b. Material: Styrene Butadiene Rubber (SBR) [Nitrile Butadiene Rubber (NBR)] [Ethylene Propylene Diene Terpolymer (EPDM)] [Polychloroprene (CR)] [Fluorocarbon (FKM)] composition.

   c. Mechanical and Proprietary Restrained Joints; Water Service: conforming to the requirements of ANSI/AWWA C110/A21.10, C111/A21.11, or C153/A21.53 shall be of a design that causes the gasket to deflect approximately 30 percent during assembly of the mechanical joint. The gasket material shall be certified to meet the requirements of NSF/ANSI 61 and NSF/ANSI 372 and conform to the requirements of ANSI/AWWA C111/A21.11, section 11-6.4, of the latest revision.

   d. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.

Select ductile iron (DI) or polyvinyl chloride (PVC) piping materials from following Paragraphs based on Project requirements. If bidding both products competitively, keep both materials in Section.

Steel and high density polyethylene (HDPE) pipe require their own specifications outside of Section 33 11 10.

B. Ductile Iron (DI) Pipe:

1. Centrifugally cast, conforming to AWWA Standard C151.

2. Coating:

   a. Asphaltic exterior coating in accordance with AWWA Standard C151.

Zinc coating should be used in conjunction with V-BIO enhanced polyethylene wrap. Zinc coating specified when corrosive soils are present or as required by Owner. Consult corrosion protection specialist or Consor Tech Practice Leader, Pipelines.

   b. Zinc exterior coating in accordance with ISO 8179.

3. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.

In following Subparagraph, specify double thickness of interior pipe lining ONLY when standard of the Owner. This is NOT standard.

   a. Double thickness.

Specify thickness class or pressure class as required by Owner or Project.

4. Pipe Thickness Class:

   a. Comply with AWWA C151.

   b. Class 52, unless shown to be greater on the Drawings.

      1) The Contractor shall be aware ductile iron piping with thickness class greater than Class 52 may have long fabrication and supplier lead times. The Contractor shall be responsible for coordinating product submittal and delivery times accordingly such as not to delay construction.

Use the following Gauged Pipe Subparagraph only on projects with piping 24-inch diameter or greater.

Specify gauged pipe for larger diameter piping and as required by the Project. Some jacking of the pipe may be required for larger diameters to achieve roundness to accommodate installation. Repair of mortar lining may be required following jacking.

5. Gauged Pipe:

   a. All ductile iron pipe 24-inch diameter or greater to be cut in the field shall be gauged full length. The select piping shall meet the outside diameter standard dimensions and tolerances required for spigot ends along the full length of pipe to within 2 feet of the bell end.

   b. In addition to pipe supplied for anticipated cutting, a minimum of 5 percent of each size of piping 24-inch diameter or greater shall be provided gauged full length as described above.

   c. Pipe shall be externally marked, in Manufacturer's color, indicating gauged pipe.

6. Pipe Corrosion Protection:

Coatings are only used for projects with large underground vaults that require corrosion protection for exposed piping within the vault.

   a. Coatings: See Section 09 90 00, Painting and Coating, for details on coating requirements.

   b. Polyethylene Encasement:

In some instances, double or triple bagging (16-mil or 24-mil) may be specified where additional corrosion protection is needed, check with corrosion specialist.

      1) Comply with AWWA C105.

      2) Polyethylene film shall be minimum 8-mil thick virgin linear low-density polyethylene (LLDPE).

      3) Secure in place with 10-mil polyethylene tape.

If you have a Corrosion Engineer on the project, confirm if you can exclude V-BIO

4) V-BIO Enhance Polyethylene Film shall be minimum 9-mil thick and provided where specified or shown on the Drawings.

Include if project includes a cathodic protection system, which requires input from a Corrosion Engineer.

c. Insulating Flanges:

1) Complete with bolt insulators, dielectric gasket, bolts, nuts. Bolt insulating sleeves shall be provided full length between insulating washers. Contractor shall be responsible for fit-up of all components of insulated flange assembly to provide a complete functioning installation. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of all required washers, flanges, and gasket.

2) Flange Insulating Kits:

a) Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.

b) Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).

c) Insulating Washers: Plated, hot-rolled steel, 1/8-inch thick.

(1) Provide two washers per bolt for flange diameters equal to or less than 36-inch.

(2) Provide four washers per bolt for flange diameters larger than 36-inch.

d) Manufacturers and Products:

(1) Dielectric Flanges:

(a) Allied Corrosion Industries, Marietta, GA.

(b) Advance Products and Systems, Lafayette, LA.

(c) Or equal.

7. Joints:

a. Joint types shall be provided as identified on the Drawings and as required for the application.

b. Deflection:

Confirm if the Owner has a different maximum pipe deflection. Consor's recommendation is conservative. Needs to be confirmed during design.

1) The maximum pipe deflection shall not exceed one-half of the Manufacturer's stated joint deflection allowance.

c. Mechanical Joints:

1) Comply with AWWA C111.

d. Push-on Joints:

1) Comply with AWWA C111.

2) Manufacturers:

a) Tyton Joint by U.S. Pipe Company and McWane.

b) Fastite Joint by AMERICAN (American Cast Iron Pipe Company).

c) Or equal

e. Restrained Joints:

1) Joint restraint for pipe shall be accomplished with an integral lock mechanism, except as may be otherwise specified.

a) Any such system shall be a manufacturer's standard proprietary design, shall be as recommended by the Manufacturer for the application, and shall be performance proven.

2) Restraining components:

a) Ductile iron complying with AWWA C110 and/or C153, with the exception of a manufacturer's proprietary design dimensions.

b) Push-on joints for such fittings shall comply with AWWA C111.

3) Manufacturers:

Review Owner preferences with respect to list of approved systems. There are others that can be considered based on project requirements.

a) For pipe larger than 12-inch:

(1) "TR Flex", McWane and U.S. Pipe Company.

(2) "Flex-Ring", AMERICAN (American Cast Iron Pipe Company).

(3) "HDSS", U.S. Pipe Company.

(4) Or equal.

b) For pipe 12-inch and smaller:

(1) "Field-Lok", U.S. Pipe Company.

(2) "Fast Grip", AMERICAN (American Cast Iron Pipe Company).

(3) "TR Flex", McWane and U.S. Pipe Company.

(4) "Flex-Ring", AMERICAN (American Cast Iron Pipe Company).

(5) "HDSS", U.S. Pipe Company.

(6) "Piranha", Romac Industries, Inc.

(7) Or equal.

c) For all pipe sizes:

Confirm if Owner requires American made. Likely to get better made joint restraint systems.

(1) Wedge-type Restraint System – "MEGALUG", EBBA Iron, Inc. or equal.

(a) Where any restrained joint system requires the use of a wedge-type mechanical restraint gland for restraint, the glands shall be provided in quantities as may be required and shall be considered incidental to the joint restraint system.

(b) Wedge-type mechanical restraining glands shall not be used to restrain the plain end of plain end ductile iron or cast-iron fittings.

4) "Foster Adaptor", Infact Corporation:

a) Where specified, mechanical joint (MJ) valves and fittings shall be connected using a bolt-through positive restraint mechanism manufactured of ductile iron conforming to ASTM A536, 65-45-12.

b) The positive restraint device shall connect the valves and/or fittings at a linear distance not to exceed three (3) inches and without attachment to pipe.

c) The device shall come complete with all accessories, including standard styrene butadiene rubber (SBR) MJ gaskets conforming to the latest revision of AWWA C111/ASTM F-477 and weathering steel (Corten) bolts conforming to AWWA C111/A21.11 and ASTM A242.

d) Nuts for 3 through 12-inch sizes shall be SAE Grade 5 steel with black oxide coating. Nuts for 14-inch and larger adaptors shall be heavy hex Corten steel conforming to ASTM A242.

e) MJ positive restraining device shall be supplied with NSF 61, 7-mil. fusion bonded epoxy conforming to AWWA C116/A21.16-09 as well as the coating, surface preparation and application requirements of ANSI/AWWA C550.

f) The device shall be used with standard mechanical joint fittings (AWWA C110 or C153) and valves and shall be Infact Corporation Foster Adaptor or equal.

f. Flanged Joints:

1) Flat faced, complying with AWWA C111 and C115, unless otherwise specified.

2) Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.

3) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.

Ductile iron flange joints manufactured and installed per AWWA standards for 24 inches and smaller may be rated as high as 350 psi with the use of specially designed gaskets. Performance testing required. See Section 4.3.2 of AWWA C111 for further info.

4) Pressure rating of flange joints shall not exceed the rating of the pipe or fitting of which they are a part, and the maximum pressure rating of the joint shall be 250 psi.

If ductile iron flanges with ANSI B16.1 Class 250 dimensions are required to obtain a higher working pressure rating than 250 psi for your project, coordinate with the Water TPGL.

5) Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.

6) Threaded flanges:

a) Ductile iron pipe spools with threaded flanges shall conform to AWWA C115.

b) Installed only on pipe with a minimum Class 53 wall thickness.

7) Buried flanges:

a) Flanged connections shall not be buried unless shown as such on the Drawings.

b) Buried flanges shall be wrapped with 2 layers of 10-mil tape along edges of flanges.

8) Gaskets:

This covers 150# flanges and maximum 250 psi test pressure. If Class 250 flanges or higher test pressure are required for your project coordinate with the Water TPGL for direction/application of different materials.

a) Full faced, composed of SBR and 1/8-inch thick, hardness 80 (Shore A), rated to 180 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D 1330, Grades 1 and 2, and NSF 61 certification.

b) Ring gaskets for flange joints 14 inches and larger, and/or specify a gasket with annular rings, like a Toruseal, Flange-Tyte gasket, or equal.

C. Polyvinyl Chloride (PVC):

1. All PVC pressure pipe shall be manufactured with an integral bell design capable of receiving an elastomeric gasket.

2. All PVC pressure pipe shall be dimensionally compatible with standard cast/ductile iron fittings produced according to AWWA C110 or AWWA C153, as applicable.

Two methods are permitted for PVC deflection: allowable longitudinal bending, angular joint deflection. Confirm if the Owner has a different maximum pipe deflection. Consor's recommendation is conservative. Needs to be confirmed during design.

3. Deflection:

   a. PVC pressure pipe may be deflected both horizontally and vertically at the joints and by longitudinal bending after assembly.

   b. The maximum pipe deflection shall not exceed one half of the Manufacturer's stated allowance for longitudinal bending and joint deflection.

4. Joints:

   a. Solvent-cement couplings are not permitted.

5. Gaskets: Comply with ASTM F477.

6. Size: 4-inch through 12-inch diameter

   a. Comply with AWWA C900, DR 14, Class 305, unless shown otherwise on the Drawings or specified elsewhere.

7. Size: 14-inch through 48-inch diameter

   a. Comply with AWWA C900, DR 18, Class 235, unless shown otherwise on the Drawings or specified elsewhere.

There are proprietary PVC restrained joint system available through JM Eagle Loc 900 and Certa-Lok.

8. Restrained Joints:

   a. For push-on pipe joint at pipe bells:

      1) Material:

         a) Body: Ductile iron. Comply with ASTM A536.

         b) Bell Restraint Systems: Corten steel tie rods.

      2) Coatings: Shop-applied liquid epoxy.

      3) Construction:

a) A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.

b) System shall be designed for a minimum 2 to 1 safety factor.

4) Manufacturers:

a) 4-inch through 12-inch diameter: EBAA Iron, Inc. - Series 1900 Bell Restraint Harness.

b) 14-inch through 48-inch diameter: EBAA Iron, Inc. - Series 2800 Bell Restraint Harness.

b. At mechanical joint fittings:

1) Material: Ductile iron. Comply with ASTM A536.

2) Coatings: Shop-applied liquid epoxy.

3) Construction:

a) Restraint accomplished by a restraint device consisting of a follower gland utilizing multiple gripping wedges.

b) The restraint system shall have a sufficient number of fastening bolts to connect the ring to the mechanical joint.

c) System shall be designed for a minimum 2 to 1 safety factor.

4) Fasteners:

a) T-bolts and nuts: High strength, low alloy steel.

b) Comply with AWWA C111.

5) Manufacturers:

a) EBAA Iron, Inc. - MEGALUG, Series 2000PV

b) Romac Industries, Inc. – 470 Series Pipe Restraining System

2.2 FITTINGS

A. Material: Ductile iron, complying with AWWA Standard C110.

1. Fittings conforming to AWWA C153. AWWA C110 fittings are also acceptable.

B. Fittings used for joining ductile iron and PVC pipe shall be of the type, size, and strength designated on the Plans, elsewhere in the specifications.

1. Fittings shall be mechanical joint, push-on type, flanged or plain-end as required and shown on the Drawings.

2. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.

C. Pressure ratings: As specified for joining pipe above and as shown on the Drawings.

D. Coating and Lining:

1. Asphaltic exterior coating in accordance with AWWA Standard C110.

Specify double thickness for lining of fittings if specified for the DI piping.

2. Cement Mortar Lining: Comply with AWWA C104, [double thickness].

3. Wax Tape Coating System (Field Coating): Petrolatum wax tape coating system where specified or shown on the Drawings:

a. General: Apply a wax tape coating system generally per AWWA C217 and consists of three parts: surface primer, wax-tape, and outer covering. All three parts shall be the product of the same manufacturer.

b. The primer shall be a blend of petrolatum, plasticizer, and corrosion inhibitors having a paste like consistency. It shall have a pour point of 100-degrees F to 110-degrees F and a flash point of 350-degrees. Use Trenton Wax-Tape Primer or equal.

c. The wax-tape shall consist of a synthetic-fiber felt, saturated with a blend of high melt microcrystalline wax, solvents, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces and which firms up after application. The tape shall have a saturant pour point between 125-degrees F and 130-degrees F and a dielectric strength equal to a minimum of 100-volts per mil. Tape thickness shall be 50-mils to 90-mils in 6-inch-wide rolls. Use Trenton No. 1 wax-tape or equal.

d. The outer covering shall consist of two layers of a plastic wrapper at total of one 150 gauge or three 50 gauge wound together as a single sheet. The plastic wrapper material shall consist of clear polyvinylidene chloride, high cling membranes wound together as a single sheet. Use Trenton Poly-Ply or equal.

E. Following information cast upon fittings:

1. Manufacturer's identification.

2. Country of manufacture.

3. Pressure rating.

4. For bends, number of degrees and/or fractions of a circle.

F. Owner may require additional metallurgical documentation or other certifications.

For exposed applications design team may need to consider 304 SS bolts, nuts, and washers.

2.3 NUTS, BOLTS, AND WASHERS

A. All bolts shall have heavy hex head with heavy hex nuts.

B. For operating pressures greater than 150 psi:

1. Bolts: Steel alloy composition. Comply with ASTM A193.

2. Nuts: Comply with ASTM A194, Grade 2H.

3. Washers: Comply with ASTM F436.

C. For operation pressures of 150 psi or less:

1. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.

2. Nuts: Comply with ASTM A563A, Heavy Hex.

3. Washers: Comply with ASTM F844.

D. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.

2.4 FLEXIBLE COUPLINGS

A. General

1. All flexible couplings shall be constructed to inside diameters that properly fit the connecting pipes.

2. The Contractor shall be responsible for selecting sleeve lengths appropriate to the application, subject to review and approval of the Engineer, recognizing that longer sleeves allow for larger deflections and may ease installation.

Based upon size of piping, system pressures, and other requirements in Project, different flexible couplings may be required.

Edit the listings below to suit Project.

B. Flexible Couplings:

1. Description:

a. Comply with AWWA C219.

b. Type: Bolted, sleeved.

c. Configuration: Straight, transition, or reducing as shown in the Drawings.

d. Center rings and end rings: Ductile iron. Comply with ASTM A536.

e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

f. Bolts and nuts: High strength low alloy steel. Comply with AWWA C111.

g. Lining and coating: Factory-applied fusion bonded epoxy.

h. Working pressure: Up to 260 psi.

2. Manufacturers:

a. For 2-inch to 24-inch diameter:

1) Romac Industries, Inc. – Style 501 or equal.

b. For 12-inch diameter and larger:

1) Romac Industries, Inc. – 400 Series or equal.

C. Insulating Flexible Couplings:

1. The Contractor shall be responsible for selecting couplings appropriate to the application, subject to review and approval of the Engineer, recognizing that different pipe materials will require specific sizing and material selection for couplings.

2. Description:

a. Comply with Flexible Coupling specifications above.

b. Insulating Boot: Ethylene propylene diene monomer (EPDM) compounded for water service. Comply with ASTM D2000.

3. Manufacturers:

a. For 4-inch to 14-inch diameter:

1) Romac Industries, Inc. – Style IC501 or equal.

b. For 12-inch to 96-inch diameter:

1) Romac Industries, Inc. – Style IC400 or equal.

Specify proper Restrained Flexible Couplings based on information below.

Romac Restr Flex Coupling for 12-inch to 48-inch diameter ductile iron pipe.

Pressure ratings:

12-inch-16-inch: 350 psi working pressure, 500 psi test pressure

18-inch-48-inch: 250 psi working pressure, 400 psi test pressure

EBAA Iron Restr Flex Coupling:

4-inch to 12-inch for DI, C900 PVC, Steel, HDPE, or combination thereof.

14-inch to 36-inch for DI, C905 PVC, or combination thereof.

D. Restrained Flexible Couplings:

1. Description:

a. Body: Steel. Comply with ASTM A36.

b. Restrained gland: Ductile iron. Comply with ASTM A536, Grade 65-45-12.

c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

d. Bolts and nuts: All-thread rod, at a minimum complying with ASTM A193 Grade B7. Nuts per ASTM A194 Grade 2H.

e. Lining and coating: Factory-applied fusion bonded epoxy.

f. Working pressure: [250] [350] psi. Test pressure: [400] [500] psi.

2. Manufacturers:

a. Romac Industries, Inc. – Style 400RG.

b. EBAA Iron – 3800 MEGA-COUPLING.

c. Or equal.

2.5 FLANGED COUPLING ADAPTERS

A. Flanged Coupling Adapters:

1. All flanged coupling adapters shall be constructed to diameters that properly fit the connecting plain end pipe and the flanged fitting.

2. Description:

a. Comply with AWWA C219.

b. Flange: AWWA Class D [E][F] Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles.

c. End ring and body:

1) Steel. Comply with ASTM A36.

2) Ductile iron. Comply with ASTM A536, Grade 65-45-12.

d. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

f. Bolts and nuts: High strength low alloy steel bolts and nuts. Comply with AWWA C111 composition requirements.

g. Lining and coating: Factory-applied fusion bonded epoxy.

h. Working pressure rating: Equal to the maximum rating of the flange.

3. Manufacturers:

a. Romac Industries, Inc.

1) Style FCA501 or equal.

Maximum working pressure rating: 260 psi.

a) For 3-inch to 16-inch diameter.

2) Style FC400 or equal.

a) For 12-inch to 96-inch diameter.

For Restrained FCA:

Romac RFCA 3-inch to 24-inch diameter DUCTILE IRON pipe.

EBAA Iron MEGAFLANGE: 3-inch to 48-inch PVC and DI pipe.

B. Restrained Flanged Coupling Adapters:

1. Description:

a. Gland and flange body: Ductile iron. Comply with ASTM A536.

b. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

d. Restraining bolts and lugs: Ductile iron. Comply with ASTM A536.

e. T-bolts, Bolts, and nuts: High strength low alloy steel. Comply with AWWA C111 composition requirements.

f. Lining and coating: Factory-applied fusion bonded epoxy.

2. Manufacturers:

a. Romac Industries, Inc. – RFCA Restrained Flanged Coupling Adapters.

b. EBAA Iron – MEGAFLANGE Restrained Flange Adapter.

c. Or equal.

2.6 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Description:

a. Type: Dual compression.

b. Material:

1) Body: Stainless steel, Type 304.

2) Flanged outlet: Stainless steel, Type 304.

c. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class 150, and MSS SP-60.

d. Outlet Gasket:

e. Provide with Type 304 stainless steel test plug.

f. Nuts, bolts, and washers: Stainless steel, Type 304.

2. Manufacturers:

Check against Owner preferences.

a. Romac Industries, Inc. – Model STS 420

b. JMC Industries, Inc.

c. Or equal.

B. Tapping Valves:

1. Resilient wedge gate valves specified in Section 40 05 51.15, Gate Valves.

2.7 FLEXIBLE EXPANSION JOINTS

A. Description

1. Installed at locations indicated on the Drawings.

2. End connections: As shown on the Drawings.

3. Material: Ductile iron, AWWA C153.

4. Working pressure: 350 psi, minimum.

5. Construction:

   a. An expansion joint designed and cast as an integral part of a double ball and socket type flexible joint.

   b. Manufactured of ductile iron, conforming to requirements of AWWA C153 and ASTM A536.

   c. Deflection: Minimum of 15 degrees deflection per ball.

   d. Expansion:

      1) 12-inch diameter and under: 8-inch.

      2) Greater than 12-inch diameter: 16 inches.

The following paragraph specifies the use of Force-Balanced expansion joints for your project. This, however, may not be required for your project. We specify force-balanced flexible expansion joints when it is not possible to place a horizontal bend near a standard Flex-Tend. A standard Flex-Tend will typically expand under the high pressures seen in the hydrostatic testing and placing a thrust block at a nearby horizontal bend will help to reduce this potential for expansion. If you have a straight run of pipe for a good distance after the Flex-Tend, you will want to specify the force-balanced configuration. Otherwise, DELETE the following paragraph.

   e. The flexible expansion joint unit shall not impart a thrust force while under internal pressure.

   f. Each flexible expansion joint shall be hydrostatically tested to the Manufacturer's published pressure rating prior to shipment.

   g. Lining: All interior "wetted" parts shall be shop-lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be holiday tested with a 1500-volt spark test conforming to said specification.

   h. Coating: Coal tar epoxy.

6. Quality Assurance: Hydrostatically tested to Manufacturer's published pressure rating prior to shipment.

7. Appropriately sized polyethylene sleeves, meeting AWWA C105 requirements, shall be included for direct bury applications.

B. Manufacturers

   1. EBAA Iron, Inc. – Flex-Tend or equal. Force Balanced Flex-Tend where specified or shown on the Drawings.

2.8 UNDERGROUND PIPE MARKERS

A. Marking tape, as specified in Section 31 23 17, Trenching.

2.9 UNDERGROUND ELECTRONIC LOCATING MATERIALS

A. Tracer wire, as specified in Section 31 23 17, Trenching.

2.10 CONCRETE ENCASEMENT, CRADLES AND THRUST BLOCKS

A. Concrete:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.

2. Type: reinforced, air entrained as shown on the Drawings.

3. Compressive Strength: Minimum 3,000 psi at 28 days.

4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00, Concrete Reinforcing.

2.11 BEDDING AND COVER MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown on the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown on the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

a. Material type varies by location, as shown on the Drawings.

See local or State DOT requirements for soil classifications.

b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown on the Drawings.

See local or State DOT requirements for soil classifications.

c. Subsoil Type S1 [and/or S2], as specified in Section 31 05 13, Soils for Earthwork.

2.12 GEOMEMBRANE FOR GAS LINE CROSSINGS

A. Furnish 40 mil reinforced geomembrane with 300V/mil dielectric strength and minimum 150# puncture resistance and 150# tensile strength. Geomembrane shall be XR-5 as manufactured by Seaman Corporation or equal.

2.13 ACCESSORIES

A. Concrete for Thrust Restraints: As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Manhole and Cover: As specified in Section 33 05 13, Manholes.

C. Miscellaneous Steel Rods, Bolt, Lugs, and Brackets:

1. Comply with ASTM A36 or ASTM A307.

2. Grade A carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing utility water main size, location, and invert are as indicated on the Drawings.

3.2 PREPARATION

A. Preconstruction Site Photos:

1. Take photographs along centerline of proposed pipe trench; minimum one photograph for each [50] [__] feet of pipe trench.

2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.

3. Include Project name, date taken, and sequential number of each photograph in physical log or CD.

B. Inspection:

1. All pipe sections, specials, and jointing materials shall be carefully examined for defects.

2. No piping or related materials shall be laid that are known to be defective. Any defective piece installed shall be removed and replaced with a new pipe section in a manner satisfactory to the Engineer at the Contractor's expense.

3. Defective material shall be marked and removed from the job site before the end of the day.

C. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube end to full pipe diameter, and remove burrs.

2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.

3. Grind edges smooth with beveled end for push-on connections.

4. Prior to assembly of field cut pipe, the reference mark shall be re-established with a pencil or crayon. The location of the reference mark at the proper distance from the bevel end shall be in accordance with the Manufacturer's recommendations.

D. Remove scale and dirt on inside and outside before assembly. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, blowing out with compressed air, or washing to remove all foreign matter.

E. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Bedding:

1. Excavation:

a. Excavate pipe trench as specified in Section 31 23 17, Trenching for Work of this Section.

b. All pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.

c. Remove large stones or other hard matter which could damage pipe or impede consistent pipe bedding backfilling or compaction.

d. Trench base shall be inspected prior to placement of pipe.

e. Hand trim excavation for accurate placement of pipe to elevations as indicated on the Drawings.

2. Dewater excavation as specified in Section 31 23 19, Dewatering to maintain dry conditions and to preserve final grades at bottom of excavation.

3. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.

4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent of maximum density.

B. Piping:

Include the proper AWWA reference section in the following Subparagraph:

AWWA C600 for ductile iron piping

AWWA C605 for PVC piping.

1. Install pipe according to AWWA [C600] [C605].

2. Handle and assemble pipe according to Manufacturer instructions and as indicated on the Drawings.

3. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

4. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.

5. Sanitary Sewer Separation:

a. Install new water lines and appurtenances in compliance with local and state regulations governing the horizontal and vertical separations between water and sewer facilities.

b. Variance:

1) If a variance is proposed due to requested design revisions or if an existing facility has been installed at a different location or elevation than indicated on the Plans, submit written proposal for review and approval by the Engineer.

2) Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and corrective measures proposed.

3) Each variance will be considered on a case-by-case basis.

4) Review Time: Allow a minimum of 5 working days review and response to each proposal.

6. Install ductile iron fittings according to AWWA C600.

7. Joints:

   a. Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining.

   b. Lubricants, primers, adhesives, etc. shall be used as recommended by the Pipe or Joint Manufacturer's specifications.

   c. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint.

   d. Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing.

   e. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.

8. Flanged Joints: Not to be used in underground installations except within structures, unless shown otherwise on the Drawings.

Include the following paragraph for PVC pipe installation.

9. Deflection:

   a. PVC pressure pipe may be deflected both horizontally and vertically at the joints and by longitudinal bending after assembly.

   b. The maximum pipe deflection shall not exceed one half of the Manufacturer's stated allowance for longitudinal bending and joint deflection.

   c. Set a laser, string line, or other approved alignment guide along the centerline of previously installed pipe to the point where pipe joint deflection is required. The approved alignment guide shall extend to the end of the proposed subsequent pipe length. A measurement will be taken from the alignment guide to the centerline of the subsequent pipe length to determine the amount of pipe joint deflection proposed. Measured deflection shall not exceed the specified allowable deflection for the purposes of aligning the pipe.

10. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb. Re-lay pipe that is out of alignment or grade.

11. High Points:

    a. Install pipe with no high points, unless otherwise shown on the Drawings.

    b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by the Engineer.

12. Bearing:

    a. Install pipe to have bearing along entire length of pipe.

    b. Excavate bell holes to permit proper joint installation where necessary or as directed by Engineer.

    c. Do not lay pipe in wet or frozen trench.

13. Prevent foreign material from entering pipe during placement.

14. Install pipe to allow for expansion and contraction without stressing pipe or joints.

15. Close pipe openings with watertight plugs during Work stoppages.

16. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

17. Install access fittings to permit disinfection of water system performed under Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

18. Cover:

    Check client standards on required cover. Minimum cover is 36 inches, though some clients require 42 inches or 48 inches over new mains.

    a. Establish elevations of buried piping with not less than [36] [__] inches of cover.

    b. Measure depth of cover from final surface grade to top of pipe barrel.

    Include the following subparagraph for all projects including installation of PVC piping.

19. Pipe Markers:

    a. Install as specified in Section 31 23 17, Trenching.

C. Tapping Sleeves and Valves:

1. As indicated on Drawings and according to Manufacturer instructions.

D. Polyethylene Encasement:

1. Encase piping in polyethylene [**where indicated on the Drawings**] [**as directed in Section 13 47 13, Cathodic Protection**] to prevent contact with surrounding backfill material.

2. Comply with AWWA C105.

3. [**Encasement shall be two (2) layers of 8 mil polyethylene encasement, V-bio, by US Pipe.**]

E. Thrust Restraints:

1. Provide valves, tees, reducers, bends, caps, and plugs with concrete thrust blocks at locations shown on the Drawings and as required to facilitate testing of lines.

2. Pour concrete thrust blocks against undisturbed earth.

3. Locate thrust blocks to ensure that pipe and fitting joints will be accessible for repair.

4. Provide thrust restraint bearing area on subsoil as shown in details on the Drawings.

5. Install tie rods, clamps, setscrew retainer glands, or restrained joints.

6. Protect metal-restrained joint components against corrosion with polyethylene film or wax tape as specified herein.

7. Avoid encasing mechanical and flanged joints in concrete. Provide clearance between concrete and mechanical and flange joints to allow future bolt removal.

F. Backfilling:

1. Backfill of piping systems shall be as specified in Section 31 23 17, Trenching.

G. Testing and Disinfection of Potable Water Piping System:

Review this procedure for compliance with local code requirements.

1. In accordance with [**AWWA C600**] [**AWWA C605**], AWWA C651 and as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

2. All chlorinated water used in disinfection of the water main shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the [**Oregon State Department of Environmental Quality (DEQ)**] [**Washington State Department of Ecology (DOE), see local and state specific requirements and provide appropriate agency reference for the state in which the project is located**] [__] prior to discharge into any storm drainage system or open drainage way.

3. No chlorinated water shall be discharged into a storm drainage system or open drainage way without a dechlorination under a plan meeting [**DEQ's**] [**DOE's**] [__] requirements.

3.4 FIELD QUALITY CONTROL

A. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

END OF SECTION

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION AND TRANSMISSION VALVES

This Section is to be used in conjunction with 40 05 51.15 - Gate Valves & Section 40 05 51.18 - Butterfly Valves.

The naming convention for the Section, based on industry standards, is Water Utility Distribution Valves; however, the specifications are similar to transmission piping systems.

Edit highlighted text to fit Project.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes valves and valve boxes for installation with buried water distribution and transmission main, including fire hydrants and tapping sleeves.

B. Section Includes:

1. Valves.
2. Valve boxes.
3. Valve operator extensions.

C. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section, as well as Sections required to describe complete system or assembly requirements. Delete sections not needed for Project and renumber if necessary.

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints
2. Section 33 11 10 - Water Utility Distribution and Transmission Piping: Piping trenching, backfilling, and compaction requirements.
3. Section 33 12 13 - Water Service Connections: Pipe materials, fittings, and service connection appurtenances and installation requirements.
4. Section 33 12 19 - Fire Hydrants: Execution requirements for fire hydrants.
5. Section 33 13 00 - Testing and Disinfecting of Water Utility Piping: Flushing and disinfection requirements.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys

3. ASME 1.20.1 - General Purpose Pipe Threads (Inch)

B. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service

3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants

4. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

C. ASTM International (ASTM):

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects

2. NSF 372 - Drinking Water System Components - Lead Content

1.3 COORDINATION

A. The Contractor shall cause the Supplier of valves to coordinate installation such that all pipes, valves, fittings, appurtenances, and equipment are compatible and capable of achieving the performance requirements specified in the Contract Documents.

Insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate. If not required, delete.

B. Coordinate Work of this Section with <_____> standards and utilities within construction area.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Lining and coating data.

F. Valve Labeling: Schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the valve.

G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

See if Owner would like Tools; otherwise, delete.

A. Tools: Furnish [one tee wrench] [<_____> tee wrenches] of required length to Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, maximum working pressure, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, American National Standards Institute (ANSI), ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

E. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves and accessories for shipment according to applicable AWWA standards.

B. Seal valve and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

E. Handle products carefully to prevent damage to interior or exterior surfaces.

F. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT WEDGE GATE VALVES

A. As specified in Section 40 05 51.16, Gate Valves.

B. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

Double-disc gate valves are not a standard specification.

Only use where required by Owner; otherwise replace text with "Not Used".

2.3 DOUBLE-DISC GATE VALVES

A. As specified in Section 40 05 51.16, Gate Valves.

B. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

Metal-seated gate valves are not a standard specification.

Only use where required by Owner; otherwise replace text with "Not Used".

2.4 SOLID WEDGE, METAL SEATED GATE VALVES

A. As specified in Section 40 05 51.16, Gate Valves.

B. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.5 RUBBER-SEATED BUTTERFLY VALVES

A. As specified in Section 40 05 51.18, Butterfly Valves.

B. Operation:

1. All buried valves shall be provided with 2-inch square operating nuts.

C. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

D. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.6 ACTUATORS

A. Unless otherwise indicated, all valves shall be furnished with manual actuators.

B. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

C. All gear-assisted valves that are buried and submerged shall have the actuators hermetically sealed and grease-packed.

D. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

2.7 VALVE BOXES

A. Provide all buried valves with valve boxes, covers and risers.

B. Valve Boxes:

1. Materials: Cast iron.

2. Construction:

a. Walls not less than 3/16-inch thick at any point.

b. Internal diameter not less than 5 inches.

3. Type: Two-piece extension.

4. Manufacturers:

Check Owner preference.

a. Olympic Foundry.

b. Brooks Products.

C. Covers:

1. Construction:

a. Prevents dislodging and rotation from traffic.

b. Allows a hand-held pry bar to be applied for easy removal.

2. Materials: Cast iron.

3. Lid Inscription: [WATER] [W].

4. Manufacturers: Matching that of valve box.

D. Riser:

1. Polyvinyl Chloride (PVC) Pipe:

a. ASTM D3034, SDR 35 PVC.

b. White, Schedule 40, 8-inch diameter.

c. Length as shown on details in the Drawings.

2.8 VALVE OPERATOR EXTENSIONS

A. As shown in the Drawings.

B. Provide operator extensions to a maximum of 12 inches below grade where depth to valve exceeds 36 inches.

2.9 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect from damage utilities to remain.

D. Access:

1. All valves shall be installed to provide easy access for operation, removal, and maintenance.

2. Avoid conflicts between valve operators and above grade construction such as structural members or handrails.

E. Valve Accessories:

1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.

2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.2 INSTALLATION

A. General:

1. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as shown in the Drawings and as specified herein.

2. Valves shall be firmly supported to avoid undue stresses on the pipe.

3. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment, where applicable.

B. Perform trench excavation, backfilling, and compaction as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Install valves in conjunction with pipe laying.

D. Set valves plumb.

E. Provide buried valves with valve boxes installed flush with finished grade.

1. Valves installed out of paved or otherwise hard-surfaced areas shall be set in a concrete pad at finished grade.

2. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick.

F. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.3 FIELD QUALITY CONTROL

A. Pressure test valving for water distribution system according to AWWA C600 and in accordance with Section 33 13 00, Testing and Disinfection of Water Utility Piping.

The following paragraph is only required for projects with large valves and on all transmission main projects. Delete if not needed.

If used, edit highlighted text to fit Project.

B. Field Testing of Valves:

1. All valves 24-inch diameter or larger[, and all in-line transmission main valves,] shall be pressure and leakage tested at the Site and shall pass the field testing prior to installation.

2. Valves shall be tested at 1.5 times normal operating pressure, 150 pounds per square inch (psi) minimum.

3. No valve shall be accepted for installation that fails to pass the field pressure test. Any valves failing field pressure tests shall be replaced by the Contractor at no additional cost to the Owner.

4. Engineer shall witness field testing.

If Project is large and/or complex, with a variety of valve sizes and types and types of accessories, it is recommended to include a Schedule of Valves following this Section. Provide as follows by example.

3.4 ATTACHMENTS

A. The attachments listed below, following "END OF SECTION", are part of this Section.

1. Attachment 1 – Schedule for Buried Valves.

END OF SECTION

Consider following example when developing Valve Schedule.

SCHEDULE FOR BURIED VALVES							
VALVE NUMBER	LOCATION	DESCRIPTION	VALVE TYPE	MEDIA	SIZE	OPERATOR	REMARKS
V-121	Reservoir Inlet Line	Pump P-110 Discharge	Check	RW	16-inch	-----	-----
V-114	Western Pipeline - Sta. 35+05	Entrance to RWS Vault	Gate	RW	12-inch	Manual	OPEN-CLOSE

SECTION 33 12 19 - FIRE HYDRANTS

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section addresses dry-barrel fire hydrants used in water supply service.

B. Section includes:

1. Fire hydrants used in water main installations.

C. Related Sections:

1. Section 03 11 00 – Concrete Work
2. Section 31 05 16 - Aggregates for Earthwork
3. Section 31 23 17 - Trenching
4. Section 33 13 00 – Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C502 - Dry-Barrel Fire Hydrants
2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

B. National Fire Protection Association (NFPA):

1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.3 COORDINATION

A. All hydrants supplied for the Project shall be of like kind from a single manufacturer.

1.4 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Product Data: Submit Manufacturer's latest published literature, including illustrations, installation and maintenance instructions, and parts lists.

C. Shop Drawings: Submit description of proposed installation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of fire hydrants and service valves.

B. Operation and Maintenance Data: Submit data for hydrants.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare hydrants and accessories for shipment according to AWWA standards.

B. Seal hydrant and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or potential damage.

2. Do not store materials directly on ground.

E. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Manufacturers:

Check client preference. Most Owners specify the following Mueller hydrant.

1. Mueller Company, Super Centurion Model A-423

B. Dry-Barrel Breakaway Type:

1. Comply with AWWA C502.

2. Body: Cast iron.

3. Valve: Compression type.

4. Burial Depth: As indicated on Drawings.

5. Inlet Connection Size: 6 inches (150 millimeters).

6. Valve Opening: 5-1/4 inches (133 millimeters) in diameter.

7. End Connections: Mechanical joint or bell end.

8. Bolts and Nuts: Galvanized steel.

9. Interior Coating: Comply with AWWA C550.

10. Direction of Opening: Counterclockwise unless otherwise indicated.

C. Hose Connections:

1. One 4-1/2-inch diameter pumper, two 2-1/2-inch diameter hose nozzles.

2. Obtain thread type and size from local fire department.

3. Attach nozzle caps by separate chains.

D. Finishes:

1. Primer and two coats of enamel.

2. Color: R-1317, Safety Yellow.

2.2 NSF INTERNATIONAL (NSF) REQUIREMENTS

A. All fire hydrants must be NSF/ANSI Standard 61 certified and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.

2.3 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 11 00, Concrete Work.

B. Aggregate: Aggregate for hydrant drainage as specified in Section 31 05 16, Aggregates for Earthwork.

2.4 OUT OF SERVICE COVERS/OUT OF SERVICE RINGS

A. Provide orange plastic bag with reflective tape, or red plastic hydrant out of service rings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify location and size of hydrants from Drawings. Final location of hydrants to be determined by Engineer in the field.

B. Obtain clarification and directions from Engineer prior to execution of Work.

C. If installing a hydrant on an existing water system, verify invert elevation of existing piping is as indicated on Drawings prior to excavation and installation of fire hydrant.

3.2 PREPARATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect from damage utilities to remain.

D. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Owner and Engineer not less than 48 hours in advance of proposed utility interruption.

2. Do not proceed without written permission from Engineer.

3. Only District staff shall operate valves in existing system.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 17, Trenching.

B. Install pier support block and drainage gravel for fire hydrants; do not block drain hole.

1. Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

2. Place textile fabric to cover drain rock prior to placement of backfill.

3. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.

C. Set fire hydrants plumb with pumper nozzle facing roadway.

D. Set fire hydrants with centerline of pumper nozzle 18 inches (450 millimeters) above finished grade, and with safety flange not more than 6 inches (150 millimeters) nor less than 2 inches (50 millimeters) above grade. Install hydrant extensions where required and as approved.

E. Paint hydrants according to color scheme of local authorities having jurisdiction. Touch up paint after hydrant installation and testing.

F. After hydrostatic testing, flush hydrants, and check for proper drainage.

G. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

A. Pressure test water distribution system according to AWWA C600 and Section 33 11 10, Water Utility Distribution and Transmission Piping, Field Quality Control.

3.5 CONCRETE HYDRANT PADS

A. When hydrant is place within sidewalks, form and pour-in-place 36-inch by 36-inch by 6-inch, 4,000 pounds per square inch (psi) concrete pad around the hydrant after the hydrant has been installed and set to grade.

B. Center hydrant pad on the hydrant. Set hydrant pad so top of pad is flush with surrounding surface, or as directed by the Engineer.

C. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than 1-foot in any one direction.

3.6 OUT-OF-SERVICE HYDRANT PADS

A. To indicate that the fire hydrant is NOT operational, secure reflective tape, an orange plastic bag over the entire hydrant assembly or an approved out-of-service cover.

B. An out-of-service ring may also be used in addition to the bag or cover in case of removal of the cover.

C. Maintain the plastic bag up until the waterline is accepted by the Owner.

END OF SECTION

SECTION 33 13 00 - TESTING AND DISINFECTION OF WATER UTILITY PIPING

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes hydrostatic pressure testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.

B. Section Includes:

1. Pressure testing and disinfection of potable water distribution and transmission piping systems and appurtenances.
2. Testing and reporting of results.

C. Related Sections:

1. Section 33 11 10 - Water Utility Distribution and Transmission Piping
2. Section 33 12 16 - Water Utility Distribution and Transmission Valves
3. Section 33 12 19 - Fire Hydrants
4. Section 33 12 13 - Water Service Connections

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites
2. AWWA B301 - Liquid Chlorine
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
5. AWWA C651 - Disinfecting Water Mains
6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

A. Section 01 33 00 –Submittals Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Engineer a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:

1. Testing schedule.

2. Hydrostatic Testing Plan:

   a. Narrative of the proposed process.

   b. Proposed equipment to be used.

   c. Disposal location for excess water used to fill mains.

3. Disinfection Plan:

   a. Narrative of the proposed process.

   b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.

   c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.

   d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.

   e. Proposed plan for testing chlorine levels throughout the length of pipeline.

4. Proposed testing locations.

5. Proposed plan for water conveyance, including flow rates.

6. Proposed plan for water control.

7. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.

8. Proposed measures to be incorporated in the Project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

A. Disinfection Report:

1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.

3. Test locations.

4. Name of person collecting samples.

5. Initial and 24-hour disinfectant residuals in treated water in parts-per million (ppm) for each outlet tested.

6. Date and time of flushing start and completion.

7. Disinfectant residual after flushing in ppm for each outlet tested.

1.5 QUALITY ASSURANCE

A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future functions.

B. All temporary thrust restraint and equipment and facilities required for hydrostatic testing will be considered incidental.

C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Engineer.
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as needed and required for the testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Engineer, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.

2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 HYDROSTATIC TESTING OF WATER PIPING

A. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.

B. No section of the pipeline shall be hydrostatically tested until backfill has been placed, compacted, and passed required density testing and all field-placed concrete or mortar has attained full strength.

1. At the Contractor's option, early strength concrete may be used when the full-strength requirements conflict with schedule requirements.

2. All such substitutions and installations shall be approved by the Engineer prior to installation.

C. Provide 72-hour notification to the Engineer and Owner prior to conducting hydrostatic testing.

1. Provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner's existing system during hydrostatic testing and disinfecting procedures.

2. The Contractor shall not operate any part of the existing water systems.

D. Pipe Filling:

1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.

2. Take all required precautions to prevent entrapping air in the pipes.

3. Allow for natural absorption of water by the lining of the pipe to occur.

4. Apply specified test pressure by pumping.

E. Testing of Mains:

1. Ductile Iron: In accordance with AWWA C600.

2. Polyvinyl chloride (PVC): In accordance with AWWA C605.

3. General:

If Project has specific minimum pressure testing values, this is the place to provide the information.

a. Tests shall be conducted under a hydrostatic test pressure not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, minimum [150] <___> psi, unless otherwise shown in the Drawings.

b. In no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.

c. Testing shall be performed by applying the specified test pressure by pumping.

d. Once the test pressure has been attained, the pump shall be valved off.

e. The test will be conducted for a 2-hour period with the allowable leakage not to exceed the value as calculated per the Allowable Leakage formula below.

f. During the test period, there shall be no appreciable or abrupt loss in pressure.

4. Allowable Leakage:

a. Flanged Joints: Pipe, fittings, and valves with flanged joints shall be completely watertight. No leakage allowed.

b. Mechanical or Push-on Joints: Pipe, fittings, and valves with rubber gasketed joints shall have a measured loss not to exceed the rate given in the following Allowable Leakage formula:

$$AL = \frac{LD(P)^{1/2}}{148{,}000}$$

In the above formula:

AL = Allowable leakage, in gallons per hour
L = Length of pipe tested, in feet
D = Nominal diameter of pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch.

5. Maintaining Pressure:

a. During the test period, operate the pump as required to maintain pressure in the pipe within 5 psi of the specified test pressure at all times.

b. At the end of test period, operate the pump until the specified test pressure is again obtained.

1) The pump suction shall be in a clean, graduated barrel, or similar device or metered so that the amount of water required to restore the test pressure may be accurately measured.

2) Sterilize this makeup water by adding chlorine to a concentration of 25 milligrams per liter (mg/L).

c. The Engineer will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.

d. Each hour's loss stands on its own and will not be averaged.

6. Defects, Leakage, Failure:

a. If the test reveals any defects, leakage in excess of the allowable, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.

b. Correct any visible leakage regardless of the allowable leakage specified above.

c. All leaks shall be repaired in a manner acceptable to the Engineer.

d. The testing of the line shall be repeated until a test satisfactory to the Engineer has been achieved.

3.2 DISINFECTION OF WATER PIPING

A. Disinfection shall be in accordance with the latest version of AWWA C651 following Engineer's acceptance of hydrostatic testing.

B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.

C. Flush all foreign matter from the pipeline, branches, and services.

1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.

2. Flushing velocities shall be at least 2.5 feet per second (fps).

3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

D. Chlorine Application:

1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.

2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.

E. Chlorine Residual:

1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.

2. Adjust the dose rate as necessary to maintain the target dose rate.

F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.

1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Engineer.

2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.

3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.

G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.

1. There is no minimum flushing velocity for this step.

H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.

1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.

Insert correct department

Oregon State Department of Environmental Quality (DEQ)

State of Washington Department of Ecology (DOE)

2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by <_____>.

3.3 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.

B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves, and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.

C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.

D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.

1. During the system startup, the Engineer and Contractor shall visually inspect all new fittings, piping, valves, and appurtenances for evidence of leakage.

2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Engineer.

3.4 FIELD QUALITY CONTROL

A. Bacteriological Sampling and Testing:

1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.

a. The locations for sample collection shall be at the sole discretion of the Owner and Engineer.

b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.

2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:

a. Bacterial Sampling

1) Option A:

a) Take an initial set of samples using sampling site procedures outlined herein.

b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.

c) Both sets of successive samples must pass for the main to be approved for service.

2) Option B:

a) Allow main to sit for a minimum of 24 hours without any water use.

b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.

c) Both sets of samples must pass for the main to be approved for service.

3) Allow 24 hours for the test results for each sample set.

b. Sampling Locations

1) The Owner will take one bacteriological sample from the end of the main and on each branch.

2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.

c. Sample Testing

1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.

d. Evaluating the Test Results

1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Engineer.

2) When two consecutive sample sets test negative (passing)for coliform bacteria, the bacterial testing is complete.

e. Completion of Bacterial Testing

1) Upon completion of bacterial testing, notify the Owner shall notify the Engineer and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

1) If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

Insert correct Authority

For example, Oregon Health Authority

3. Results of the bacteriological testing shall be satisfactory with the <_____> and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 33 31 10 - SANITARY UTILITY SEWERAGE PIPING

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes pipe materials, manholes, and accessories normally used with gravity sanitary sewers.

B. Section includes:

1. Sanitary sewerage pipe and fittings.
2. Pipe markers.
3. Connection to existing manholes.
4. Manholes.
5. Wye branches and tees.
6. Sanitary laterals.
7. Bedding and cover materials.

C. Related Sections:

Edit listing below as needed for Project. Renumber if necessary.

1. Section 03 21 00 - Reinforcing Steel
2. Section 03 11 00 - Concrete Work
3. Section 03 60 00 - Grouting
4. Section 09 80 00 - Protective Coatings
5. Section 31 05 13 - Soils for Earthwork
6. Section 31 05 16 - Aggregates for Earthwork
7. Section 31 23 16 - Excavation
8. Section 31 23 17 - Trenching
9. Section 31 23 23 - Fill
10. Section 33 30 10.13 - Sewer and Manhole Testing
11. Section 33 05 13 - Manholes

Commented [JW1]: We do not have this in our specifications library. Input required from architectural subconsultant, except for tank, pipe, and equipment coatings.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

Select only one AASHTO standard based upon input/standards of client.

If no preference is standard, standard is T99.

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

OR

2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International (ASTM):

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
6. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.

Select only one ASTM standard based upon input/standards of client. ASTM D698 test methods correspond with AASHTO T99

ASTM D1557 test methods correspond with AASHTO T180

7. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

OR

8. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
10. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

11. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

12. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

13. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

14. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

15. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

16. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

17. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

18. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

7. AWWA C153 - Ductile-Iron Compact Fittings.

8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.3 COORDINATION

A. Notify affected utility companies at least 72 hours prior to construction.

1.4 SUBMITTALS

A. Product Data: Submit Manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.

B. Shop Drawings:

1. Indicate layout of sewer system and appurtenances.

2. Show size, materials, components of system, and burial depth.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the Manufacturer.

D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.

E. Manufacturer Instructions:

1. Indicate special procedures required to install specified products.

2. Submit detailed description of procedures for connecting new sewer to existing sewer line.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.

3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.

Include following Paragraph only when requested by Owner or Project Funding Agency. Otherwise, delete.

4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Storage:

1. Store materials according to Manufacturer instructions.

C. Protection:

1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Provide additional protection according to Manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 SANITARY SEWERAGE PIPE AND FITTINGS

Edit pipe and fitting materials to fit Project.

Plastic pipe is most commonly specified in projects. It is typically used for acidic or corrosive waste sewer systems, its ease of jointing, and its relative flexibility in subsoils that are prone to movement.

A. Plastic Pipe:

1. Material:
   a. Polyvinyl chloride (PVC), manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454-B.
   b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.
2. Fittings: PVC.
3. Pipe and fittings 4 inches to 15 inches in diameter:
   a. Comply with ASTM D3034, SDR 35.
4. Pipe and fittings 18 inches and larger in diameter:
   a. Comply with ASTM F679, PS46.
   b. Pipe shall have a minimum stiffness of 46 pounds per square inch (psi).
5. AWWA C900 Pipe:
   a. 4 inches to 12 inches in diameter.
   b. DR 25.
   c. Pipe shall have minimum stiffness of 149 psi.

6. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.

7. Joints:

   a. Integral bell push-on type: Comply with ASTM D3212.

   b. For use with AWWA C900 pipe: Integral bell push-on type: Comply with ASTM D3139.

8. Gaskets:

   a. Factory installed.

   b. Elastomeric gaskets: Comply with ASTM F477.

Ductile iron piping is normally used for applications requiring limited cover, durability, longevity, and resistance to corrosion, acids, gases, and induced subsoil loads. Bell and spigot pipe ends are typically used, but pipe can be specified with plain end for mechanical clamps and gasket joints.

If not needed, replace text with "Not Used".

B. Ductile-Iron Pipe:

1. Comply with AWWA C151.

2. Minimum Special Thickness Class: 52.

3. End Connections: Bell and spigot or plain, as shown in the Drawings.

4. Outside Coating:

   a. Type: Asphaltic coating, minimum 1-mil uniform thickness.

   b. Comply with AWWA C151.

5. Lining:

   a. Cement mortar lined.

   b. Comply with AWWA C104.

Consider specifying use of polyethylene encasement for pipe installation in corrosive soils. Otherwise, delete following Article and renumber.

6. Polyethylene encasement: Comply with AWWA C105.

7. Fittings:

   a. Material: Ductile iron.

   b. Comply with AWWA C153 or AWWA C110.

   c. Lining: Cement-mortar lined according to AWWA C104.

8. Coating:

a. Coat pipe and fittings exposed inside of structures with two coats of bituminous paint to achieve minimum dry film thickness of 6 mils per coat.

b. Material as specified in Section 09 90 00 - Painting and Coating.

9. Joints:

a. Rubber gasket joint devices.

b. Comply with AWWA C111.

Item specified below is as stout as this piping gets. Depending on depth of bury, diameter of pipe and system pressure, it is possible to ease these restrictions. Reinforced concrete pipe is typically used for larger diameter applications, low-pressure applications, or where subsoil pressure requires greater pipe strength than nonreinforced concrete pipe. Sizes range from 12 to 108 inches based on class and wall type. Absorption of moisture may be a concern if using this pipe material.

If not needed, replace text with "Not Used".

C. Reinforced Concrete Pipe:

1. Comply with ASTM C76, Class V, with Wall Type C.

2. Reinforcement: Mesh.

3. End Connections: Bell and spigot.

4. Fittings: Reinforced concrete.

5. Joints:

a. Rubber compression gasket.

b. Comply with ASTM C443.

2.2 FLEXIBLE COUPLINGS

A. Description:

1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.

2. Attachment: Two [Series 300] stainless-steel clamps, screws, and housings.

Commented [BO2]: Where is this defined? Who manufactures? Etc.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

1. Material: Ethylene propylene rubber (EPDM).

2. Comply with ASTM C923.

3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.

2. Strength: Minimum 3,000 psi at 28 days.

3. Air entrained.

4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.5 MANHOLES

A. Description:

1. As specified in Section 33 05 13 - Manholes.

2. Material: Precast concrete.

3. Diameter: As shown in the Drawings.

4. Top: Eccentric cone.

5. Frames and Covers: Watertight cast iron.

Conform to Owner's standards for Cover Inscription.

6. Cover Inscription: [SANITARY SEWER] [S] <_____>.

2.6 MATERIALS

Select bedding and cover material type for Project conditions. If more than one type is required, edit following Paragraph.

CAUTION: Use material "Type" coding from Section 31 05 13 and Section 31 05 16 in this Section for uniformity of reference.

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

a. Material type varies by location, as shown in the Drawings.

b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

c. Subsoil Type S1 [**and/or S2**], as specified in Section 31 05 13, Soils for Earthwork.

2.7 MIXES

A. Grout: As specified in Section 03 60 00, Grouting.

2.8 ACCESSORIES

A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that trench cut, or excavation base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over-excavation in accordance with Section 31 23 17, Trenching.

B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.

C. Protect and support existing sewer lines, utilities, and appurtenances.

D. Utilities:

1. Maintain profiles of utilities.

2. Coordinate with other utilities to eliminate interference.

3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17, Trenching.

2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.

3. Pipe base shall be observed by Engineer prior to placement of the pipe.

4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.

Edit for correct section reference:

If relatively straight forward installation, not too deep, using Section 31 23 17, Trenching should be sufficient.

For more complicated situations, it is recommended that Section 31 50 00, Excavation Support and Protection be developed for Project.

5. Provide sheeting and shoring as specified in Section<_____>.

6. Placement:

   a. Place bedding material at trench bottom.

   b. Level materials in continuous layer not exceeding 6 inches compacted depth.

   c. Compact to 95 percent of maximum density.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.

   a. PVC: Comply with ASTM D2321.

   b. Ductile Iron: Comply with AWWA C600.

   c. Reinforced Concrete: Comply with ASTM C1479.

2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

Verify that drainage system is shown on Drawings or will be included on Shop Drawings.

Indicate location of aggregate types in relation to pipe and pipe bedding, dimensions of cut trench width, and details of connections to other work on Drawings.

Edit for location shown: "Drawings" or "layout drawings" etc.

3. Lay pipe to slope gradients and line as indicated on <_____>.

4. Variations:

   a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.

   b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than1/4-inch.

   c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.

5. Begin at downstream end and progress upstream.

6. Assemble and handle pipe according to Manufacturer's instructions, except as may be modified on Drawings or by Engineer.

7. Make straight field cuts without chipping or cracking pipe.

8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.

9. Assemble pipe joints in accordance with Manufacturer's recommendations/specifications.

10. Cap open ends during periods of Work stoppage.

11. Lay bell and spigot pipe with bells upstream.

Use the following Subparagraph if installing for Project. Otherwise, delete and renumber.

12. Polyethylene Pipe Encasement: Conform to AWWA C105.

13. Backfill and compact as specified in Section 31 23 17, Trenching.

14. Do not displace or damage pipe when compacting.

15. Pipe Markers: As specified in Section 31 23 17, Trenching.

C. Joints:

1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean, and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.

2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.

3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the Pipe Manufacturer.

4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.

5. The pipe is then forced "home" firmly and fully.

6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.

Consider using following Paragraph if no disturbance or reconstruction to existing manhole is to occur.

D. Connection to Existing Manholes:

1. Drilling:

a. Core drill existing manhole to clean opening.

b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.

2. Install watertight neoprene gasket and seal with non-shrink concrete grout.

Check the following Encasement item against Owner's standards.

3. Encasement:

   a. Concrete encase new sewer pipe minimum of [**24**] <___> inches to nearest pipe joint.

   b. Use epoxy binder between new and existing concrete.

4. Prevent construction debris from entering existing sewer line when making connection.

E. Manholes:

1. Install manholes as specified in Section 33 05 13, Manholes and Structures.

F. Wye Branches and Tees:

1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.

2. Use standard fittings of same material and joint type as sewer main.

3. Maintain minimum 5-foot separation distance between wye connection and manhole.

4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.

5. Mount saddles with solvent cement or gasket and secure with metal bands.

6. Lay out holes with template and cut holes with mechanical cutter.

G. Sanitary Laterals:

1. Construct laterals from wye branch to terminal point at right-of-way or where otherwise shown in the Drawings.

2. Where depth of main pipeline warrants, construct riser-type laterals from wye branch.

3. Minimum Depth of Cover over Piping: 2 feet.

4. Minimum Separation Distance between Laterals: 5 feet.

5. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral.

6. Marker Stake:

   a. Install temporary marker stake extending from end of lateral to 12 inches above finished grade.

   b. Paint top 6 inches of stake with fluorescent orange paint.

H. Backfilling:

1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.

2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

A. Request inspection by Engineer prior to and immediately after placing bedding.

B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

2. Pipe Testing: As specified in Section 33 30 10.13, Sewer and Manhole Testing.

3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 41 10 - STORM UTILITY DRAINAGE PIPING

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes pipe materials and accessories normally used with gravity storm drainage sewers.

B. Section includes:

1. Storm drainage piping
2. Piping accessories
3. Connection to existing manholes
4. Catch basins and area drains
5. Cleanouts
6. Bedding and cover materials

C. Related Sections:

1. Section 03 11 00 – Concrete Work
2. Section 03 60 00 - Grouting
3. Section 31 05 13 - Soils for Earthwork
4. Section 31 05 16 - Aggregates for Earthwork
5. Section 31 23 16 - Excavation
6. Section 31 23 17 - Trenching
7. Section 31 23 23 - Fill
8. Section 33 30 10.13 - Sewer and Manhole Testing
9. Section 33 05 13 - Manholes

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

Select only one AASHTO standard based upon input/standards of client. If no preference is standard, standard is T99.

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

OR

2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International (ASTM):

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

5. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.

6. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

7. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.

Select only one ASTM standard based upon input/standards of client. ASTM D698 test methods correspond with AASHTO T99

ASTM D1557 test methods correspond with AASHTO T180.

8. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

OR

9. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

10. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

11. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

13. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

14. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

15. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

16. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

17. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

18. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

19. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

6. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.3 COORDINATION

A. Notify affected utility companies at least 72 hours prior to construction.

1.4 SUBMITTALS

A. In accordance with Section 01 33 00, Submittal Procedures.

B. Product Data: Submit Manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the Manufacturer.

D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.

E. Manufacturer Instructions:

1. Indicate special procedures required to install specified products.

2. Submit detailed description of procedures for connecting new storm sewer to existing storm sewer line.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Storage:

1. Store materials according to Manufacturer instructions.

C. Protection:

1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.

2. Block individual and stockpiled pipe lengths to prevent moving.

3. Provide additional protection according to Manufacturer instructions.

1.7 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

Edit pipe and fitting materials listed below to fit Project.

2.1 STORM DRAINAGE PIPING

Plastic pipe is most commonly specified in projects. It is typically used for acidic or corrosive waste sewer systems, its ease of jointing, and its relative flexibility in subsoils that are prone to movement.

If not used replace text with "Not Used".

A. Polyvinyl Chloride (PVC) Pipe:

1. Material:

a. Manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454.

b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.

2. Pipe and fittings 4 inches to 15 inches in diameter, non-pressurized:

a. Comply with ASTM D3034, SDR 35.

3. Pipe and fittings 18 inches and larger in diameter, non-pressurized:

a. Comply with ASTM F679, PS46.

b. Pipe shall have a minimum stiffness of 46 pounds per square inch (psi).

4. AWWA C900 Pipe:

a. At locations shown in the Drawings.

b. Four inches to 12 inches in diameter.

c. DR 25.

d. Pipe shall have minimum stiffness of 129 psi.

5. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.

6. Joints:

a. Integral bell push-on type: Comply with ASTM D3212.

b. For use with AWWA C900 pipe: Integral bell push-on type comply with ASTM D3139.

7. Gaskets:

a. Factory installed.

b. Elastomeric gaskets: Comply with ASTM F477.

Ductile iron piping is normally used for applications requiring limited cover, durability, longevity, and resistance to corrosion, acids, gases, and induced subsoil loads. Bell and spigot pipe ends are typically used, but pipe can be specified with plain end for mechanical clamps and gasket joints.

If not used replace text with "Not Used".

B. Ductile Iron Pipe:

1. Comply with AWWA C151.

2. Minimum Special Thickness Class: 52.

3. End Connections: Bell and spigot or plain, as shown in the Drawings.

4. Outside Coating:

a. Type: Asphaltic coating, minimum 1-mil uniform thickness.

b. Comply with AWWA C151.

5. Lining:

a. Cement mortar lined.

b. Comply with AWWA C104.

6. Fittings:

a. Material: Ductile iron.

b. Comply with AWWA C153 or AWWA C110.

c. Lining: Cement-mortar lined according to AWWA C104.

7. Coating:

a. Asphaltic exterior coating in accordance with AWWA C151.

8. Joints:

a. Rubber gasket joint devices.

b. Comply with AWWA C111.

If not used replace text with "Not Used".

C. High Density Polyethylene (HDPE) Pipe:

1. Double wall, ribbed pipe with smooth interior.

2. Solid pipe, perforated pipe, and fittings shall meet the requirements of ASTM F 405 and F 667

3. Pipe 3 inches to 10 inches in diameter: Comply with AASHTO M 252.

4. Pipe 12 inches to 60 inches in diameter: Comply with AASHTO M 294.

5. Joints: Integral bell push-on type.

6. Manufacturers:

a. ADS, N-12 with ProLink joints, or equal.

If not used replace text with "Not Used".

D. Acrylonitrile-Butadiene-Styrene (ABS) Pipe:

1. Single walled. Comply with ASTM D2680, SDR 23.5.

2. Perforated.

a. Three-eighths-inch diameter holes, 3 inches on center.

3. Inside Nominal Diameter: 4 inches.

a. Minimum Wall Thickness: 0.157 inches.

b. One row of perforations on each side of pipe, approximately 45 degrees above bottom centerline of pipe.

4. Inside Nominal Diameter: 6 inches.

a. Minimum Wall Thickness: 0.235 inches.

b. Two rows of perforations on each side of pipe, approximately 45 degrees above bottom centerline of pipe.

5. Ends:

a. Style: Bell and spigot.

b. Type: Solvent sealed.

6. Fittings: ABS.

7. Joints:

a. Type: Solvent weld.

b. Comply with ASTM D2235.

Item specified below is as stout as reinforced concrete piping gets. Depending on depth of bury, diameter of pipe and system pressure, it is possible to ease these restrictions. Reinforced concrete pipe is typically used for larger diameter applications, low-pressure applications, or where subsoil pressure requires greater pipe strength than non-reinforced concrete pipe. Sizes range from 12 to 108 inches based on class and wall type. Absorption of moisture may be a concern if using this pipe material.

If not used replace text with "Not Used".

E. Reinforced Concrete Pipe:

1. Comply with ASTM C76, Class V, with Wall Type C.

2. Reinforcement: Mesh.

3. End Connections: Bell and spigot.

4. Fittings: Reinforced concrete.

5. Joints:

a. Rubber compression gasket.

b. Comply with ASTM C443.

2.2 FLEXIBLE COUPLINGS

A. Description:

1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.

2. Attachment: Two Series 300 stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

1. Material: Ethylene propylene rubber (EPDM).

2. Comply with ASTM C923.

3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 11 00, Concrete Work.

2. Strength: Minimum 3,000 psi at 28 days.

3. Air entrained.

4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 11 00, Concrete Work.

2.5 MANHOLES

A. Description:

1. As specified in Section 33 05 13 - Manholes and Structures.

2. Material: Reinforced precast or cast-in-place concrete.

3. Diameter: As shown in the Drawings.

4. Top: [**Eccentric**] [**Concentric**] cone. [**As shown in the Drawings.**]

5. Frames and Covers: Watertight cast iron.

6. Cover Inscription: “S”.

2.6 CATCH BASINS AND AREA DRAINS

A. Construction:

Insert either "precast" or "cast-in-place".

Some agencies only allow precast concrete construction; others allow only cast-in-place construction. Check with client standards and select proper construction below.

1. Material: Reinforced <_____> concrete pipe sections.

If cast-in-place is used delete b.

a. Minimum compressive strength of 3,000 psi at 28 days.

b. Precast concrete inlets shall conform to ASTM C913.

2. Joints: Lipped male/female.

3. Nominal Interior Dimensions: As shown in the Drawings.

B. Lids and Frames:

1. Materials: Cast iron.

2. Lid:

a. Removable.

b. Design: Linear grill.

3. Nominal Lid and Frame Size: As shown in the Drawings.

2.7 CLEANOUTS

A. Construction:

1. Per details provided in the Drawings.

B. Lids and Frames:

1. Materials: Cast iron. Meet H-20 load requirement.

2.8 MATERIALS

Select bedding and cover material type for Project conditions. If more than one type is required, edit following Paragraph.

Caution: Use material "Type" coding from Section 31 05 13 and Section 31 05 16 in this Section for uniformity of reference.

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

a. Material type varies by location, as shown in the Drawings.

b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

c. Subsoil Type S1 [**and/or S2**], as specified in Section 31 05 13, Soils for Earthwork.

2.9 MIXES

A. Grout: As specified in Section 03 60 00, Grouting.

2.10 ACCESSORIES

A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that trench cut, or excavation base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over-excavation in accordance with Section 31 23 17, Trenching.

B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.

C. Protect and support existing sewer lines, utilities, and appurtenances.

D. Utilities:

1. Maintain profiles of utilities.

2. Coordinate with other utilities to eliminate interference.

3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17, Trenching.

2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.

3. Pipe base shall be observed by Engineer prior to placement of the pipe.

4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.

If relatively straight forward installation, not too deep, using Section 31 23 17, Trenching should be sufficient.

For more complicated situations, it is recommended that Section 31 50 00, Excavation Support and Protection be developed for Project.

5. Provide sheeting and shoring as specified in Section <_____>.

6. Placement:

   a. Place bedding material at trench bottom.

   b. Level materials in continuous layer not exceeding 6 inches compacted depth.

   c. Compact to 95 percent of the Standard Proctor maximum density by AASHTO T-99.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.

Edit paragraphs below based upon material selection in design.

Renumber if needed.

   a. PVC, HDPE, ABS: Comply with ASTM D2321.

   b. Ductile Iron: Comply with AWWA C600.

   c. Reinforced Concrete: Comply with ASTM C1479.

2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

Verify that drainage system is shown on Drawings or will be included on Shop Drawings.

Indicate location of aggregate types in relation to pipe and pipe bedding, dimensions of cut trench width, and details of connections to other work on Drawings.

Edit for location shown: "Drawings" or "layout drawings" etc.

3. Lay pipe to slope gradients and line as indicated on <_____>.

4. Variations:

   a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.

   b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than 1/4-inch.

   c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.

5. Begin at downstream end and progress upstream.

6. Assemble and handle pipe according to Manufacturer's instructions, except as may be modified on Drawings or by Engineer.

7. Make straight field cuts without chipping or cracking pipe.

8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.

9. Assemble pipe joints in accordance with Manufacturer's recommendations/specifications.

10. Cap open ends during periods of Work stoppage.

11. Lay bell and spigot pipe with bells upstream.

12. Backfill and compact as specified in Section 31 23 17, Trenching.

13. Do not displace or damage pipe when compacting.

14. Pipe Markers: As specified in Section 31 23 17, Trenching.

C. Joints:

1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean, and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.

2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.

3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the Pipe Manufacturer.

4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.

5. The pipe is then forced "home" firmly and fully.

6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.

Consider using following Paragraph if no disturbance or reconstruction to existing manhole is to occur.

D. Connection to Existing Manholes:

1. Drilling:

   a. Core drill existing manhole to clean opening.

   b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.

2. Install watertight neoprene gasket and seal with non-shrink concrete grout.

Check the following Encasement item against Owner's standards.

3. Encasement:

   a. Concrete encase new sewer pipe minimum of [**24**] <___> inches to nearest pipe joint.

   b. Use epoxy binder between new and existing concrete.

4. Prevent construction debris from entering existing sewer line when making connection.

E. Manholes:

1. Install manholes as specified in Section 33 05 13, Manholes.

F. Wye Branches and Tees:

1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.

2. Use standard fittings of same material and joint type as sewer main.

3. Maintain minimum 5-foot separation distance between wye connection and manhole.

4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.

5. Mount saddles with solvent cement or gasket and secure with metal bands.

6. Lay out holes with template and cut holes with mechanical cutter.

G. Catch Basins

1. Form bottom of excavation clean and smooth, and to indicated elevation.

2. Cast-in-place Concrete Construction:

   a. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.

   b. Level top surface of base pad.

   c. Sleeve concrete shaft sections to receive storm sewer pipe sections.

   d. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

3. Mount lid and frame level in grout, secured to top cone section to indicated elevation.

H. Backfilling:

1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.

2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

A. Request inspection by Engineer prior to and immediately after placing bedding.

B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

2. Pipe Testing: As specified in Section 33 30 10.13, Sewer and Manhole Testing.

3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 46 00 - SUBDRAINAGE

This Section includes weep tile drainage system, for building perimeter and under slab on subgrade or fill. This Section includes filter aggregate and filter fabric surrounding weep tile and drainage mat but does not include trench cutting and backfill. Requirements for this section may be dictated by geotechnical report recommendations.

This Section includes provision for Work performed using unit price payment method, when applicable.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the requirements of this specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term Architect/Engineer. "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See the Drawing Coordination Considerations for information needed to coordinate this specification Section with the Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building perimeter drainage system.
2. Retaining wall drainage system.
3. Slab-on-grade drainage system.
4. Filter aggregate [and fabric].
5. Bedding.

B. Related Sections:

1. Section 05 50 00 - Metal Fabrications: Access covers and frames [in floor slab] <_____> to cleanouts in weep drainage system.
2. Section 22 40 00 - Plumbing Fixtures.
3. Section 31 05 13 - Soils for Earthwork.
4. Section 31 05 16 - Aggregates for Earthwork.

5. Section [**31 23 16 - Excavation**]: Excavating for site subdrainage system piping and surrounding filter aggregate.

6. Section [**31 23 23 - Fill**]: Backfilling over filter aggregate, up to [**subgrade elevation**] [**underside of fill under floor slab**] <_____>.

7. Section 33 31 10 - Sanitary Utility Sewerage Piping: Effluent discharge.

8. Section 33 41 10 - Storm Utility Drainage Piping: Connection to [**weep drainage system**] [[**sump**] [**collection**] **<_____> pit**] <_____>.

9. List sections specifying installation of products included in this section and indicate specific items.

10. Section <_____-_____>: Placement of pipe sleeves in concrete [[**sump**] [**collection**] **<_____> pits**] [**foundation walls**].

11. List sections specifying products installed in this section and indicate specific items.

12. Section <_____-_____>: Supply of sewer pipe connection couplings for placement by this Section.

13. Section <_____-_____>: [**Waterproofing**] [**Dampproofing**] with drainage capable protection board at vertical subgrade surfaces.

14. Section <_____-_____>: Sump pump.

15. Section <_____-_____>: Pipe outlet at [**filter bed**] [**swale**] [**French drain pit**] [**municipal ditch**] <_____>.

16. Section <_____-_____>: Concrete [**sump**] [**collection**] <_____> pits.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

Use this article ONLY when work of this section is performed under unit price payment method. Delete this article when payment is by Stipulated Sum/Price.

A. Pipe and Fittings:

1. Basis of Measurement: By linear [**foot**] <_____> (linear [**meter**] <_____>).

2. Basis of Payment: Includes [**hand trimming**] excavating, bedding, pipe, and fittings, [**filter aggregate,**] [**filter fabric,**] connecting to [**municipal [storm] sewer**] [[**sump**] [**collection**] **pit.**] <_____.>

1.3 REFERENCES

List reference standards included within text of this section. Edit the following for Project conditions.

A. ASTM International:

1. ASTM C412 - Standard Specification for Concrete Drain Tile.

2. ASTM C412M - Standard Specification for Concrete Drain Tile (Metric).

3. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe

4. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.4 SUBMITTALS

Only request submittals to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and <_____>.

C. Product Data: Submit data on pipe drainage products, pipe accessories, and <_____>.

D. Manufacturer's Certificate: Certify [Products] <_____> meet or exceed [specified requirements] <_____>.

1.5 SUSTAINABLE DESIGN SUBMITTALS

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.

B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.

Edit material certifications list to suit products specified in this section and Project sustainable design requirements. Specific certificate submittal and supporting data requirements are specified in Section 01 81 13.

1. Materials Resources Certificates:

   a. Certify source and origin for [salvaged] [and] [reused] products.

   b. Certify recycled material content for recycled content products.

   c. Certify source for regional materials and distance from Project Site.

C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1. Provide cost data for the following products:

Edit list of material cost data to suit products specified in this section and Project sustainable design requirements. Specific cost data requirements are specified in Section 01 81 13.

   a. Salvaged, refurbished, and reused products.

   b. Products with recycled material content.

c. Regional products.

d. <_____.>

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record location of pipe runs, connections, cleanouts, and principal invert elevations.

C. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

Use this article to specify compliance with overall reference standards affecting all products and installation included in this section.

A. Perform Work in accordance with [[State] [Municipality] of <_____> [Highways] [Public Work's] standard.]

Include the following paragraph only when cost of acquiring specified standards is justified.

B. Maintain [one copy] [<_____> copies] of [each] document on site.

PART 2 PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

Edit sustainable design requirements to suit content of this section and Project sustainable design requirements specified in Section 01 81 13.

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content [including:] [.]

List materials specified in this section required to have recycled content.

a. <_____.>

2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles (800 km) of Project Site [including:] [.]

List materials specified in this section required to be regional materials.

a. <_____.>

2.2 PIPE MATERIALS

In this article, list manufacturers acceptable for this Project.

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Section 01 60 00 - Product Requirements] [Not Permitted].

******** [OR] ********

B. Furnish materials in accordance with [[State] [Municipality] of <_____> [Highways] [Public Work's] standards.]

Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with Manufacturer's products specified above.

C. Polyvinyl Chloride Pipe: ASTM D2729; plain end, [4] [6] <_____> inch ([100] [150] <_____> mm) inside diameter; with required fittings.

******** [OR] ********

D. Bituminous Fiber Pipe: [Tapered pipe end and coupling] [Split collar or internal coupling] joint; [4] [6] <_____> inch ([100] [150] <_____> mm) inside diameter; with required fittings.

******** [OR] ********

E. Concrete Pipe: ASTM C14 [Standard Quality] [Extra-Quality] [Heavy Duty Extra Quality] [Special Quality], [4] [6] <_____> inch ([100] [150] <_____> mm) inside diameter, with required fittings.

******** [OR] ********

Use pipe (tubing) material described in the following paragraph with caution; coarse backfill materials or improper care with installation can cause tubing to collapse.

F. Corrugated Plastic Tubing: Flexible type; [4] [3] <_____> inch ([100] [75] <_____> mm) diameter, with required fittings.

G. Use [perforated] [unperforated] pipe at subdrainage system; unperforated through sleeved walls.

2.3 SUSTAINABILITY CHARACTERISTICS

Edit sustainable design requirements to suit content of this section and Project sustainable design requirements specified in Section 01 81 13.

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content [including:] [.]

List materials specified in this section required to have recycled content.

a. <_____.>

2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles (800 km) of Project Site [including:] [.]

List materials specified in this section required to be regional materials.

a. <_____.>

2.4 AGGREGATE AND BEDDING

Select one or both of the following paragraphs to reference aggregate or sand materials specified in Section 31 05 16; edit referenced section when special aggregate requirements are required.

Caution: Utilize material "Type" coding from Section 31 05 16 in this section for uniformity of reference.

Select filter aggregate to suit site percolation conditions and aggregate availability. Adjust aggregate size limits and grading to suit.

A. Filter Aggregate [and Bedding] Materials: Fill Type [A1] [A2] [A3] [A4] as specified in Section [31 05 16 – Aggregates for Earthwork] <_____>.

******** [OR] ********

B. Filter Sand [and Bedding] Materials: Fill Type [A6] <_____> as specified in Section [31 05 16 – Aggregates for Earthwork.] <_____.>

C. Impervious Fill Materials: Fill Type <_____> as specified in Section [31 05 13 – Soils for Earthwork.] <_____.>

2.5 ACCESSORIES

Use first paragraph below for perforated plastic or bituminized fiber pipe; use second paragraph for unperforated pipe.

A. Pipe Coupling: Solid [plastic.] <_____.>

******** [OR] ********

B. Joint Cover: [No. [15] [30] asphalt saturated roofing felt] [[10] <_____> mil ([0.25] <_____> mm) thick polyethylene.] <_____.>

C. Filter Fabric: Water pervious type, black [polyolefin] [polyester] <_____>; <_____>.

D. Pipe Sleeve: [Plastic] [Steel] <_____> type for [foundation wall.] <_____.>

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify [trench cut] [excavated base] is ready to receive work and excavations, dimensions, and elevations are as indicated on [shop drawings] [Drawings].

3.2 PREPARATION

Type of correcting materials (fine aggregate, coarse aggregate, or lean concrete) depends on type of subsoil, percolation characteristics, compaction requirements.

A. Hand trim excavations to required elevations. Correct over excavation with [Type [A1] [A4] <_____> aggregate.] [lean concrete.] <_____.>

B. Remove large stones or other hard matter which could damage drainage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

Minimize aggregate bed thickness under pipe so water does not collect under piping and not drain as intended. Thickness of bed will also depend on flatness of trench or excavated cut as well as tolerance of cut slope gradient. Impervious fill is usually used to limit or restrict moisture movement.

A. Place drainage pipe on [clean cut subsoil.] [compacted impervious fill.]

Verify drainage system is indicated on design drawings or will be included on shop drawings. Drawing details should describe location of coarse and fine aggregate in relation to pipe and pipe bedding, dimensions of cut trench width, and details of connections to other work.

B. Lay pipe to slope gradients noted on [Drawings] [shop drawings]; with maximum variation from indicated slope of [1/8] <_____> inch ([3] <_____> mm) in [10] <_____> feet ([3] <_____> m).

Include first paragraph for plain end pipe where joints are loosely butted. Include second paragraph for mechanical jointed perforated pipe.

C. Loosely butt pipe ends. Place joint cover strip [12] <_____> inches ([300] <_____> mm) wide, around pipe diameter centered over joint.

******** [OR] ********

D. Place pipe with perforations facing down. Mechanically join pipe ends.

E. Install pipe couplings.

F. Install [Type [A1] [A4] <_____>] aggregate at sides, over joint [covers] and top of pipe. Install top cover compacted thickness of [12] <_____> inches ([300] <_____> mm).

G. Place filter fabric over leveled top surface of aggregate cover prior to subsequent backfilling operations.

H. Place aggregate in maximum [4] [6] <_____> inch ([100] [150] <_____> mm) lifts, consolidating each lift.

The following paragraph makes direct reference to Section 31 23 23 for backfilling and compaction. Edit paragraph to include specific compaction requirements when criteria in Section 31 23 23 is inappropriate.

I. Refer to Section [31 23 23 - Fill] <_____> for compaction requirements. Do not displace or damage pipe when compacting.

Include the following paragraph when impervious fill is used to limit or restrict moisture movement.

J. Place impervious fill over drainage pipe aggregate cover and compact.

K. Connect to [storm sewer system] [sump pits] <_____> with unperforated pipe [, through installed sleeves].

L. Coordinate the Work with connection to [municipal sewer utility service] <_____> and trenching.

3.4 FIELD QUALITY CONTROL

A. Section [01 40 00 - Quality Requirements] [01 70 00 - Execution and Closeout Requirements]: Field inspecting, testing, and adjusting.

B. Request inspection prior to [and immediately after] placing aggregate cover over pipe.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

3.6 SCHEDULE

Include schedule when unusual site conditions are evident, when drawings do not show details of storm sewer system or when different sizes and locations require description by schedule.

Consider the following examples when developing Project schedule.

A. Perimeter Drainage: At building exterior perimeter, on both sides of dividing fire wall foundation, and surrounding elevator pit foundation walls; drain to collection pit at north-east corner of crawl space.

B. Basement Floor Slab Drainage: Underside of slab, in position pipe in rows 6 feet on center, sloping to drain at 1/4 inch per foot (20 mm/m) to sump pit.

END OF SECTION