SECTION 02317
TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SCOPE

A. The work under this Section consists of furnishing all labor, equipment and materials and performing all operations in connection with the trench excavation and backfill required to install the site utilities, including all pipelines, electrical conduits, and duct banks as shown on the plans and as specified.

B. Excavation shall include the removal of any tree stumps, brush, debris or other obstacles which remain after the clearing and grubbing operations, which may obstruct the work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install the pipe and appurtenances in conformance with the lines and grades shown on the plans and as specified.

C. Backfill shall include the filling and compaction of the trenches and excavations up to the surrounding ground surface or road grade at crossing.

D. The trench is divided into five specific areas:

1. Foundation: The area beneath the bedding, sometimes also referenced to as trench stabilization.
2. Bedding: The area above the trench bottom (or foundation) and below the bottom of the barrel of the pipe.
3. Haunching: The area above the bottom of the barrel of the pipe up to a specified height above the bottom of the barrel of the pipe.
4. Initial Backfill: The area above the haunching material and below a plane 12-inches above the top of the barrel of the pipe.
5. Final Backfill: The area above a plane 12-inches above the top of the barrel of the pipe.

E. The choice of method, means, techniques and equipment rests with the Contractor. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man-made improvements to be protected, available easement or right-of-way and prevailing practice in the area.

1.02 RELATED SECTIONS

A. Geotechnical report

B. Site Preparation: Section 02200.

C. Erosion and Sedimentation Control: Section 02370

1.03 GENERAL

A. The elevations shown on the Drawings as existing are taken from the best existing data and are intended to give reasonably accurate information about the existing elevations. They are not precise and the Contractor shall become satisfied as to the exact quantities of excavation and fill required.

B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.

C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments, and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.

D. The Contractor shall control grading in a manner to prevent surface water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Free access must be provided to all fire hydrants and meters.

E. Tests for compaction and density shall be conducted by the Engineer or by an independent testing laboratory selected in accordance with Section 01450 of these Specifications.

1. The soils testing laboratory is responsible for the following:
    a. Field compaction testing shall be based on using the maximum dry density determined by the Standard Proctor Compaction Test in accordance with ASTM D 698.
    b. Determination of in-place backfill density shall be done in accordance with ASTM D 1556, "Density and unit weight of Soil In Place by the Sand-Cone Method", ASTM D 2937, "Density of Soil In Place by the Drive-Cylinder Method" or ASTM D 2922, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)".
    c. Test frequency for trenches and confined areas of 1 test per two foot vertical lift for every 100 linear feet.
    d. Inspecting and testing stripped site, subgrades and proposed fill materials.

2. Contractor's duties relative to testing include:
    a. Notifying laboratory of conditions requiring testing.
    b. Coordinating with laboratory for field testing.
    c. Providing representative fill soil samples to the laboratory for test purposes. Provide 50 pound samples of each fill soil.

3. Inspection
   a. Earthwork operations, suitability of excavated materials for fill and backfill, and placing and compaction of fill and backfill is subject to inspection. Engineer will observe earthwork operations.
   b. Foundations and shallow spread footing foundations are required to be inspected by an engineer to verify suitable bearing and construction.

F. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, and shall be conducted in a manner acceptable to the Engineer.

G. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains. The Contractor shall be responsible for providing all services, labor, equipment, and materials necessary or convenient to the Contractor for completing the work within the time specified in these Contract Documents.

H. SAFETY

Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavation, Trenching & Shoring" as described in OSHA publication 2226.

PART 2 PRODUCTS

2.01 SOILS CLASSIFICATIONS

Bedding materials listed here include a number of processed materials plus the soil types defined according to the Unified Soil Classification System (USCS) in ASTM D 2487, Standard Method for Classification of Soils for Engineering Purposes. (See below for description of soil classification). These materials are grouped into five broad categories according to their suitability for this application:

A. Class I - Angular, 1/4 to 1 1/2 inches (6 to 40 mm) graded stone, including such as coral, slag, cinders, crushed shells and crushed stone. Note - The size range and resulting high voids ratio of Class I material make it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of other embedment materials into the Class I material. When such migration is possible, the material's minimum size range should be reduced to finer than 1/4 inch (6 mm) and the gradation properly designed to limit the size of the voids.

B. Class II - Coarse sands and gravels with maximum particle size of 1 1/2 inch (40 mm), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class. Note - Sands and gravels which are clean or borderline between clean and with fines should be included. Coarse-grained soils with less than 12% but more than 5% fines are neglected in ASTM D2487 and the USCS and should be included. The gradation of Class II material influences its density and pipe support strength when loosely placed. The gradation of Class II material influences its density and pipe support strength when loosely placed. The gradation of Class II material may be critical to the pipe support and stability of the foundation and embedment if the material is imported and is not native to the trench excavation. A gradation other than well graded, such as uniformly graded or gap graded, may permit loss of support by migration into void spaces of a finer grained natural material from the trench wall and foundation.

C. Class III - Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types SM, GC, SM, and SC are included in this class.

D. Class IV - Silt, silty clays and clays, including inorganic clays and silts of not to high plasticity and liquid limits. Soil Types MH, ML, CH, and CL are included in this class. Note- Caution should be used in the design and selection of the degree and method of compaction for Class IV soils because of the difficulty in properly controlling the moisture content under field conditions. Some Class IV soils with medium to high plasticity and with liquid limits greater than 50% (CH, MH, CH-MH) exhibit reduced strength when wet and should only be used for bedding, haunching and initial backfill in arid locations where the pipe embedment will not be saturated by ground water, rainfall and/or exfiltration from the pipeline system. Class IV soils with low to medium plasticity and with liquid limits lower than 50% (CL, ML, CL-ML) also require careful consideration in design and installation to control moisture content but need not be restricted in use to arid locations.

E. Class V - This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than 1 1/2 inch (40 mm) in diameter, and other foreign materials. These materials are not recommended for bedding, haunching or initial backfill.

DESCRIPTION OF EMBEDMENT MATERIAL CLASSIFICATIONS

SOIL CLASS	SOIL TYPE	DESCRIPTION MATERIAL CLASSIFICATION
Class I Soils *	---	Manufactured angular, granular material, 3/4 to 1 1/2 inches (6 to 40 mm) size, including materials having regional significance such as crushed stone, or rock, broken coral, crushed slag, cinders, or crushed shells.
Class II Soil **	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	SW	Well-graded sands and gravely sands, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	SP	Poorly graded sands and gravelly sand, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
Class III Soil ***	GM	Silty gravels, gravel-sand-silt mixtures. 50% or more retained on No. 200 sieve.
	GC	Clayey gravels, gravel-sand-clay mixtures. 50% or more retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
	SM	Silty sands, sand-silt mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
	SC	Clayey sands, sand-clay mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
Class IV Soils	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
	CH	Inorganic clays of high plasticity, fat clays. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.

SOIL CLASS	SOIL TYPE	DESCRIPTION MATERIAL CLASSIFICATION
Class V Soils	OL	Organic silts and organic silty clays of low plasticity. Liquid limit 50% or less. 50% or less. 50% or more passes No. 200 sieve.
	OH	Organic clays of medium to high plasticity. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	PT	Peat, muck and other highly organic soils.

* Soils defined as Class I materials are not defined in ASTM D2487.
** In accordance with ASTM D2487, less than 5% pass No. 200 sieve.
*** In accordance with ASTM D2487, more than 12% pass No. 200 sieve. Soils with 5% to 12% pass No. 200 sieve fall in borderline classification, e.g. GP-GC.

2.02 PIPE BEDDING CLASSES

A. Class A Bedding shall consist of a continuous concrete cradle as determined by the Engineer.

B. Class B Bedding: The pipe shall be bedded with No. 57 stone bedding material placed on the trench foundation. The bedding shall have a minimum thickness beneath the pipe of 4 inches or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the side to the springline. Initial backfill from the pipe horizontal centerline to a level not less than 12 inches above the top of the pipe and shall be bedding material or carefully placed native soil, compacted to 90% of Standard Proctor Density. The final backfill of the soil to ground surface shall be compacted to the specified density.

C. Class C Bedding: The pipe shall be bedded in No. 57 stone bedding material placed on the trench foundation. The bedding shall have a minimum thickness beneath the pipe of 4 inches or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth the outside diameter of the pipe. Initial backfill between the top of haunching and a point 12 inches above the top of pipe shall be compacted to 90% of Standard Proctor Density. The final backfill of the soil to ground surface shall be compacted to the specified density.

D. Crushed stone utilized for bedding and haunching shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

2.03 TRENCH FOUNDATION MATERIALS

When unsuitable material is encountered and extends more than 6 inches below the pipe. Crushed stone shall be utilized for trench foundation (trench stabilization) and shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I

(limestone, marble or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be between No. 57 and No. 4, inclusive or Class I material.

2.04 FILTER FABRIC

A. Filter fabric associated with bedding shall be a UV stabilized, spunbonded, continuous filament, needle punched, polypropylene, nonwoven geotextile.

B. The fabric shall have an equivalent open size (EOS or AOS) of 120 - 70. The fabric shall also conform to the minimum property values listed in the following table:

Fabric Property	Unit	Test Procedure	Average Value	
			Typical	Minimum
Weight	oz/yd^2	ASTM D 3776	8.3	
Thickness	mils	ASTM D 1777	105	
Grab Strength	lbs.	ASTM D 4632	240	210
Grab Elongation	%	ASTM D 4632	>50	50
Tear Strength	lbs.	ASTM D 4533	100	85
Mullen Burst	psi	ASTM D 3786	350	320
Puncture Resistance	lbs.	ASTM D 4833	115	100
Permittivity	sec^{-1}	ASTM D 4491	1.7	
Water Permeability	cm/sec	ASTM D 4491	0.4	
Water Flow Rate	gpm/ft^2	ASTM D 4491	120	
UV Resistance (500 hrs)	%	ASTM D 4355	>85	
PH			2 – 13	

C. If ordered by the Engineer, the filter fabric manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of 10 days during initial pipe

installation.

D. Filter fabric shall be Polyfelt TS 700, Trevira 1125 or SuPac 7-MP.

2.05 BEDDING AND HAUNCHING MATERIALS

A. Crushed stone utilized for bedding and hunching shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

B. Earth materials shall be suitable materials selected from the trench excavation. Suitable materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, earth bedding and haunching materials shall be moistened to facilitate compaction by tamping.

2.06 INITIAL BACKFILL

A. Initial backfill material shall be earth materials or crushed stone as specified for bedding and haunching materials. Soil shall be tamped to 90% of Standard Proctor Density (ASTM D698).

B. Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench. Suitable materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this Section.

2.07 FINAL BACKFILL

A. Final backfill material shall be general excavated earth materials, shall not contain rock larger than 2-inches at its greatest diameter, cinders, stumps, limbs, man-made wastes and other unsuitable materials. If materials excavated from the trench are not suitable for use as final backfill material, provide select material conforming to the requirements of this Section.

B. In areas not used for streets or driveways, carefully refill in layers not exceeding 8 inches in thickness and thoroughly tamp with hand tamps to one foot above the top of the pipe. Finish filling by machine without tamping. As trench settles, bring back to grade by adding more material. Maintain trenches in safe condition

at all times. Restore all special grassing and shrubbery, fences, etc., to original condition. The remaining backfill shall be thoroughly compacted in 8 inch layers to at least 95% (percent) of the Standard Proctor Density (ASTM D698).

C. In streets, roadways and driveways, carefully refill in layers not exceeding 8 inches in thickness and thoroughly tamp with hand tamps to one foot above the top of the pipe. The remaining backfill shall be thoroughly compacted in 8 inch layers to at least 98% (percent) of the Standard Proctor Density (ASTM D698).

D. Backfilling and tamping work in state highway right-of-ways and streets under jurisdiction of the State Highway Department will be in accordance with the State of Georgia Department of Transportation "Policy and Procedure for Accommodation of Utilities".

2.08 CONCRETE

Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.09 FLOWABLE FILL

Flowable fill, where required for trench backfill, shall meet the requirements of Georgia Department of Transportation Standard Specifications, Section 600 for Excavatable or Non-Excavatable type.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Locate, identify, and protect utilities that remain and protect from damage. The contractor is required to contact the Utilities Protection Center, Inc. in the State of Georgia call 1-800-282-7411 prior to any excavation or construction. Additional information is available at www.gaupc.com. The contractor shall first, Call Before You Dig. Second, Wait the Required Amount of Time. Third, Respect the Marks and Lastly, Dig With Care.

C. Notify utility company to remove and relocate utilities.

3.02 TRENCH EXCAVATION

A. Notify of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches O.D of pipe plus two feet minimum or O.D. of pipe plus four feet maximum wide enough to allow installation and inspection of utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.

G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume.

H. Remove excavated material that is unsuitable for re-use from site.

I. Stockpile excavated material to be re-used in areas designated on site.

J. Remove excess excavated material from site.

K. In areas not used for streets and in unpaved streets, maximum trench width shall be the pipe diameter plus 24 inches. Protect all trees, shrubs and structures. Protect all fences and replace those damaged/removed with like kind. Keep work and equipment within easement limits. Repair and replace any damage.

L. Paved streets shall have a maximum trench width of pipe diameter plus 24 inches. Shore and brace trench walls as necessary to prevent damage to existing paving. Do not cut existing sidewalk, or curb and gutter without approval by the Engineer. Use rubber tired equipment only on streets. Repair and replace all damage. Saw cut all pavements for smooth edge on replacement.

3.03 DEWATERING REQUIREMENT

A. The Contractor may use any dewatering method he deems feasible so long as it results in working in the dry and stable soil conditions.

B. The Contractor shall conform and meet all conditions, obtain necessary permits and requirements of the regulatory agencies that have jurisdiction.

C. It is the intent of these specifications that an adequate dewatering system be installed to lower and control the groundwater in order to permit excavation, construction, grading and the placement of fill materials, all to be performed under dry conditions. The dewatering system shall be adequate to pre-drain the water-bearing strata above and below the bottom of the excavation.

D. The Contractor shall be solely responsible for the arrangement, location and

depths of dewatering system necessary to accomplish the work described under this section of the specifications. The dewatering shall be accomplished in a manner that will reduce the hydrostatic head below any excavation to the extent that the water level in the construction area are a minimum of two (2) feet below the prevailing excavation surface and any surface to be compacted; will prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation strata; will maintain stability of the sides and bottom of the excavation; and will result in all construction operations being performed in the dry.

E. The Contractor shall promptly dispose of all water removed from the excavations in such a manner as will not endanger public health, damage public or private property, or affect adversely any portion of the work under construction or completed by him or any other Contractor. Contractor shall obtain written permission from the Owner for any property involved before digging ditches or constructing water courses for the removal of water.

F. The disposal of water from the dewatering system shall meet the requirements of all regulatory agencies having jurisdiction.

G. If the dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system, then loosening of the foundation strata, or instability of the slopes, or damage to the foundations or structures may occur. The supply of all labor and materials, and the performance of all work necessary to carry out additional work for reinstatement of the structures of foundation soil resulting from such inadequacy or failure shall be undertaken by the Contractor subject to the approval of the Engineer, and at no additional expense to the Owner.

3.04 ROCK EXCAVATION

A. Definition of Mass Rock (only for payment purposes where payment is on a unit quantity basis): Any material which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (comparable to Caterpillar D 8K or comparable to Caterpillar 973 front-end loader, and occupying an original volume of at least one cubic yard). The Engineer shall be the sole determinate as to the limits to which the material is classified as rock.

B. Definition of Trench Rock (only for payment purposes where payment is on a unit quantity basis): Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 225 or equivalent), and occupying an original volume of at least one-half (1/2) cubic yards.

C. Excavation: Where rock is encountered within excavation for structures, it shall be excavated to the lines and grades indicated on the Drawings or as otherwise directed by the Engineer. The Contractor shall be responsible for obtaining any blasting permits required.

D. Blasting: Blasting operations shall be conducted in accordance with all existing

ordinances and regulations. All structures shall be protected from the effects of the blast. Blasting shall be performed and supervised by qualified and licensed workers. Dispose of excavated rock in accordance with applicable federal, state, county and local regulations.

E. If excess excavation is made or the material becomes disturbed so as to require removal below final subgrade elevations or beyond the prescribed limits, the resulting space shall be refilled with concrete in accordance with Section 2.08 of this Specification

3.05 SHEETING, BRACING AND SHORING

A. Trench Shield: A trench shield or box may be used to support the trench walls. The use of a trench shield does not necessarily preclude the additional use of bracing and sheeting. When trench shields are used, care must be taken to avoid disturbing the alignment and grade of the pipe or disrupting the haunching of the pipe as the shield is moved. When the bottom of the trench shield extends below the top of the pipe, the trench shield will be raised in 6-inch increments with specified backfilling occurring simultaneously. At no time shall the trench shield be "dragged" with the bottom of the shield extending below the top of the pipe or utility.

B. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the utility and adjacent property. Leave sheeting in place when in the opinion of the Engineer it cannot be safely removed or is within three feet of an existing structure, utility, or pipeline. Cut off any sheeting left in place at least two feet below the surface.

C. Sheet piling within three feet of an existing structure or utility shall remain in place, unless otherwise directed by the Engineer.

3.06 TRENCH FOUNDATION AND STABILIZATION

A. The bottom of the trench shall provide a foundation to support the utility and its specified bedding. The trench bottom shall be graded to support the utility and bedding uniformly throughout its length and width.

B. If, after dewatering as specified above, the trench bottom is spongy, or if the trench bottom does not provide firm, stable footing and the material at the bottom of the trench will still not adequately support the utility, the trench will be determined to be unsuitable.

C. If in the opinion of the Engineer the undisturbed material at the trench bottom constitutes an unstable pipe foundation, then the Contractor shall replace such unstable materials with crushed stone.

D. If the crushed stone does not provide adequate foundation, then the trench shall be excavated to a depth of at least two feet below the specified trench bottom. The over excavation shall be filled with No. 4 foundation stone to the bottom of the

bedding stone or the over excavation shall be lined with filter fabric, with the fabric being supported along the sides of the trench to a point above the top of the utility. The trench shall then be filled with No. 57 foundation stone to the top of the pipe and the filter fabric shall be overlapped above the pipe and stone.

3.07 BEDDING AND HAUNCHING

A. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders or large dirt clods.

B. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to maintain the pipe at the proper elevation. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except at joints.

C. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.

D. After the pipe section is properly placed, add the haunching material to the specified depth. The haunching material shall be shovel sliced, tamped, vigorously chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders or dirt clods.

E. Gravity Pipelines and Accessories: Lay PVC (plastic pipe) gravity sewer pipe with minimum Class B bedding. Lay all other gravity sewer pipelines with Class C bedding, unless shown or specified otherwise. All trenches under paving, concrete, etc. shall be placed in Class B bedding only.

F. Bedding for storm drain piping shall be as specified in Section 02635 Storm Drainage Piping.

G. Manholes: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole. Place and compact crushed stone bedding material to the required grade before constructing the manhole.

H. Pressure Mains

Bedding and haunching for pressure pipe shall be with Class II or III soils compacted to 90% of standard proctor density. All trenches under paving, concrete, etc. shall be placed in Class B bedding only.

I. Excessive Width and Depth

1. If the trench is excavated in excess of the pipe diameter plus two feet, provide the next higher bedding type.

2. If the trench is excavated to excessive depth, provide foundation stone to the bottom of the bedding material.

J. Compaction: Bedding and haunching materials under pipe, manholes and accessories shall be compacted to a minimum of 95 percent of the maximum dry density, unless shown or specified otherwise.

3.08 CONCRETE ENCASEMENT FOR PIPELINES

Where concrete encasement is shown on the Drawings for pipelines not under structures, excavate the trench to provide a minimum of 6-inches clearance from the bell of the pipe. Lay the pipe to line and grade on concrete blocks. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 6-inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

3.09 CONCRETE ENCASEMENT FOR ELECTRICAL DUCT BANKS

A. Install top of duct bank minimum 18-inches below finished grade with plastic warning tape 12-inches below finished grade.

B. Terminate conduit in end bell at manhole entries.

C. Stagger conduit joints in concrete encasement 6-inches minimum.

D. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than four feet on center to provide conduit spacing as indicated. Securely anchor conduit to prevent movement during concrete placement.

E. Where duct bank passes beneath footings or slabs, excavate to provide a minimum of 6-inches clearance between the conduits and the structure. Backfill to the base of the structure with concrete.

3.10 INITIAL BACKFILL

A. Fill up to subgrade elevations unless otherwise indicated.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction

density.

E. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

G. Correct areas that are over-excavated.

1. Thrust bearing surfaces: Fill with concrete.
2. Other areas: Use general fill, flush to required elevation, compacted to minimum 98 percent of standard proctor dry density.

H. Compaction Density Unless Otherwise Specified or Indicated:

1. Under paving, slabs-on-grade, and similar construction: 98 percent of standard proctor density.
2. At other locations: 95 percent of standard proctor density.

3.11 FINAL BACKFILL

A. Backfill to contours and elevations indicated using suitable materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

H. Compaction Density Unless Otherwise Specified or Indicated:

1. Under paving, slabs-on-grade, and similar construction: 98 percent of standard proctor density.
2. At other locations: 95 percent of standard proctor density.

I. Reshape and re-compact fills subjected to vehicular traffic.

3.12 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.13 CLEAN-UP

A. Leave unused materials in a neat, compact stockpile.

B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 02510
WATER PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE

A. Provide all labor, materials, equipment and incidentals necessary to construct, pressure test and disinfect all potable water piping, fittings and appurtenances as shown on the Construction Drawings and as specified herein.

B. Site piping covered under this Section shall begin at the outside face of structures and buildings, except where there is no joint at the outside face, then site piping shall begin not more than two feet beyond the face of the structure or building. Piping covered under this section shall also include piping within miscellaneous vaults such as meter and backflow prevention vaults.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02317 - Trench Excavation and Backfill.

B. Section 02445 - Jack and Bore Crossings.

C. Section 02511 - Valves, Meters, and Accessories.

D. Section 02532 – Sanitary Sewers

E. Section 03305 – Cast-In-Place Concrete.

1.03. SUBMITTALS

Complete product data and engineering data, including shop drawings, shall be submitted.

1.04 TRANSPORTATION AND HANDLING

A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification. Pipe handled on skids shall not be rolled or skidded against the pipe on the ground.

B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front end loader. Do not use material damaged in handling. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior coatings or internal lining of the pipe. Do not use chains in handling pipe, fittings and appurtenances.

1.05 STORAGE AND PROTECTION

A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.

B. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.

D. Stored mechanical and push-on joint gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

E. Mechanical-joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

PART 2 PRODUCTS

2.01 PIPE

A. DUCTILE IRON PIPE

Shall be Pressure Class 350 from 4" to 24" diameter unless otherwise shown on the plans and shall conform to AWWA C151/ANSI A21.51, latest revision.

Ductile iron pipe, specials, and fittings shall have an approved exterior asphaltic coating ANSI/AWWA C151/A21.51 and an approved interior coating of standard cement lining with an asphaltic seal coating, 1 mil in accordance with AWWA C104/ANSI A21.4.

The seal coat shall not impair the potability or impart color, taste, odor, phenols, toxicity, caustic alkalinity, or have deleterious effect to the water shall be certified to meet the requirements of ANSI/NSF Standard 61. Each pipe shall bear a mark denoting its class. All pipe shall be manufactured within the limits of the continental United States.

B. POLYVINYL CHLORIDE PIPE (C900)

PVC pipe shall be Underwriters' Laboratories approved and listed and must meet all requirements of ASTM D2241 and bear the seal of conformance to NSF61. PVC pipe used for water mains shall be blue in color only. It shall meet or exceed AWWA C900 with the following supplemental specifications:

PVC pressure pipe 4" to 12" shall be DR 18, Class 150 unless otherwise shown on the plans and shall conform to AWWA C900, latest designation, made from compounds meeting standard code designation PVC 1120 and shall meet or exceed all requirements of ASTM D2241. Couplings, bells, gaskets and lubricants to be used with PVC pipe shall also conform to AWWA C900 requirements. Pipe shall have ductile iron pipe equivalent outside diameters. Each joint of pipe shall be marked with the nominal size and OD Base, material code designation, dimension ratio number, AWWA pressure class, AWWA designation number, manufacturer's name or trademark and production record code, and seal of the National Sanitation Foundation verifying the suitability of the pipe material for potable water service. Gaskets and lubricants shall be of proper size and shape and suitable for potable water and shall be furnished as required by the pipe manufacturer.

Pressure pipe 24" and larger shall be ductile iron see Section 02510-2.

Pressure pipe less than 4" shall be Polyethylene Pipe, 200 psi, DISR-7CTS. Pipe 4" to 12" shall be Class 150 with Dimension Ratio 18 or lower (thicker).

PVC Pressure Pipe 14" and larger shall be Class 235 C905 DR18.

PVC Pressure Pipe 6" to 12" shall be Class 150 C-900 DR18
The contractor shall furnish manufacturer's affidavit certifying that the pipe meets AWWA C900 latest designation standards. Size and class shall be as called for in the Bid Form or plans.

C. HIGH DENSITY POLYETHYLENE PIPE (C906)

This specification covers the requirements of high density polyethylene water transmission and distribution pipe in sizes 4" to 36" joined by means of zero leak-rate heat-fusion, and approved mechanical joints, meeting the specifications and requirements of American Water Works Association Standard C906.

The polyethylene pipe and fittings shall be made from virgin resins exhibiting a cell classification of PE 345464C as defined in ASTM D3350-Type III, Grade PE34 with an established hydrostatic-design-basis of 1600 psi for water at 73 Degrees F. The resin shall be listed by the PPI (Plastic Pipe Institute) in its pipe-grade registry Technical Report (TR) 4, "*Listing of Plastic Pipe Compounds*".

Pipe and fittings must be marked as prescribed by AWWA C906 and NSF 14 & 16. Pipe markings will include nominal size, OD base (i.e. 12" ductile iron pipe

sizing, DIPS), dimension ration, pressure class, WPR, AWWA C906, manufacturers name, manufacturer's production code including day, month, year extruded, and manufacturer's plant and extrusion line; and NSF logo.

The wall thickness shall follow the Dimension Ration (DR) system prescribed in AWWA C906. Laying lengths are 40 ft standard. The pipe is to be joined by heat fusion, flanges or other mechanical joint systems proven for HDPE pipes. Both pipe and fittings must be NSF listed by the manufacturer with the pipe bearing the "NSF" logo or mark. HDPE shall be the DR as shown on plans and/or in the bid form. The DIPS longitudinal color stripe pattern shall have three equally spaced pairs of **BLUE** color stripes extruded in to the pipe OD. The pipe shall be Driscoplex 4000 or approved equal. Size and class shall be as called for in the Bid Form or plans.

E. COPPER TUBING

Type K copper 3 inches and smaller shall conform to AWWA Specification 7S-CR, ASTM Specifications B-88, and Federal Specification WW-T-799. All service lines from the main to the meter up to 1" shall be copper tubing. Service lines from 1-1/4" up to 3" can be copper tubing or HDPE water service tubing as defined below.

F. PLASTIC SDR 9 HDPE WATER SERVICE TUBING (C901)

Polyethylene Copper Tube Size Water Service Tubing - 3 inches and Smaller may be used in lieu of copper tubing except as defined above. Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-02 with a cell classification of PE:345464C. Pipe shall have a manufacturing standard of ASTM D2737 (CTS). Pipe shall be DR 9 (200psi WPR) @ 73.4 degrees F unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, and per AWWA C901, have nominal burst values of three times the Working Pressure Rating (WPR) of the pipe. Pipe shall also have the following agency listing of NSF 61. The pipe shall be Driscoplex 5100 Ultra-Line or approved equal.

G. WATER SYSTEM MATERIALS

All materials utilized in the construction of the water system shall be new. Used water mains that meet these standards may be used again after the pipe has been thoroughly cleaned and restored practically to its original condition.

2.02 JOINTS AND GASKETS

A. PUSH-ON JOINTS

1. DIP Push-on joints shall conform to AWWA C111/ANSI A21.11 (latest revision) - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings. Details of the joint design shall be in accordance with the manufacturer's standard practice such as "Fastite", "Bell-Tite," "Tyton," or equal joints. Gasket material shall be standard styrene butadiene copolymer (SBR).

   Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.
2. PVC Push-on joints shall be an elastomeric gasketed joint. Insertion and lubrication of the elastomeric gasket in the annular groove must be as recommended by the manufacturer.

B. RESTRAINED JOINTS

Restrained joints for DIP shall be obtained by the installation of "Field Lok", "TR Flex", "Fast-Grip", "Flex-Ring", MEGALUG by EBAA Iron, Inc. or approved equal. These restraint glands shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

Tyton Joint Pipe with "Field Lok Gaskets", Fastite Pipe with "Fast-Grip Gaskets" or DIP or PVC Pipe with EBAA Iron, Inc. pipe restraints or approved equal.

All underground creek crossings and jack and bores with steel casing shall use "Field Lok" or "Fast-Grip" restrained joints.

C. FLEXIBLE JOINTS

Flexible joints shall be American Pipe "Flex-Lok", Clow "Ball and Socket", U.S. Pipe "Usiflex", EBAA Iron Inc. FLEX-900 or approved equal. Piping shall have a minimum working pressure rating of 250 PSI and a minimum allowable joint deflection of 15°.

D. MECHANICAL JOINTS

Mechanical joints for DIP and PVC shall consist of a bolt joint of the stuffing box type as detailed in AWWA C110/ANSI A21.10 (latest revision) and described in AWWA C111/ANSI A21.11 (latest revision) - Rubber Gasket Joints shall be SBR rubber and conform to AWWA C111/ANSI A21.11 (latest revision).

E. FLANGED JOINTS

Flanged joints shall conform to AWWA C110/ANSI A21.10 (latest revision). Gaskets shall be SBR rubber per ANSI/AWWA C111/A21.11. This rubber compound is NSF 61 certified for contact with potable water or other approved quality shall be used in all flanged joints. The bolts and nuts shall conform in dimensions to the American Standard heavy series.

"KWIK" or Uni-Flange adaptors for plain and pipe shall be used only when authorized by the Engineer. Set screws shall be self-torquing or be properly torqued during installation with a torque wrench.

F. FUSION JOINTS

1. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic representation of the fusion cycle shall be part of the Quality Control records.
2. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
3. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.
4. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

G. THREADED FLANGE JOINTS

These joints shall be in accordance with AWWA C115/ANSI A21.15. All flanges shall have a taper pipe thread (NPT) in accordance with ANSI B2.1, Pipe Threads (except dryseal), adapted to DIP and CIP outside diameters.

H. COPPER AND HDPE SERVICE PIPE

Use brass flare fittings or compression joints for copper and "Double 'O' Seal" Central Plastics Co. transition fittings for HDPE.

2.03 PIPE FITTINGS AND SPECIALS

A. DIP FITTINGS AND SPECIALS

Shall be manufactured in the USA. Mechanical joint fittings 4 inches through 24 inches shall conform to either AWWA C110 or AWWA C153 (Compact Fittings). Minimum pressure rating for fittings shall be 350 psi. All other fittings shall conform to AWWA C110. Unless otherwise noted on the plans, fittings for underground installation shall be mechanical joint conforming to AWWA C111, and fittings for above ground installation shall be flanged conforming to ANSI B16.1 Class 125. Minimum pressure rating for fittings shall be 250 psi. Fittings and specials shall be completed with rings, bolts, gaskets, etc., for joints.

B. POLYVINYL CHLORIDE PIPE

Fittings used on 4" thru 16" PVC Pipe transitions shall be mechanical or restrained joints as manufactured by American Pipe, U.S. Pipe, Clow or EBAA Iron Inc.

C. POLYETHYLENE PIPE (HDPE)

1. Butt Fusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02, and approved for AWWA use. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
2. Electrofusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
3. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D3261. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

D. BRASS NIPPLES AND BRASS PIPE FITTINGS (DOMESTIC MADE):

Threads shall be cleanly cut with sharp tools and the jointing procedure shall conform to the best practice. Before jointing, all scale shall be removed from pipe by some suitable means. After cutting, all pipe shall be screwed together with an application for graphite and engine oil, Teflon tape, or other sealing compound applied to all threads and once a joint has been screwed on it shall not be backed

off unless the threads are re-cleaned and new compound or Teflon tape applied. Unions shall be installed at every connection to the supply line.

E. VALVES:

All 8-inch or larger gate valves that are installed on the reclaimed transmission line(s) and /or tie into a major transmission line shall be installed in a manhole. All Gate Valves that are located at the entrance of subdivision or other development that tie into a transmission line shall be installed in a manhole. All other Gate Valves can be installed in a cast iron valve box with a concrete collar and concrete valve marker post.

PART 3 EXECUTION

3.01 EXISTING UNDERGROUND UTILITIES AND OBSTRUCTIONS

A. The plans indicate utilities and obstructions that are known to exist according to the best information available to the Owner.

B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.

1. Expose the facility, for a distance of at least 100 feet in advance of pipeline construction, to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
2. Avoid utility damage and interruption by protection with means or methods recommended by the utility owner.

C. Conflict with Existing Utilities:

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed piping does not permit safe installation of the piping by the use of sheeting, shoring, tying-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the piping to avoid horizontal conflicts if the new alignment complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. Where such relocation of the piping is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed piping does not permit the crossing without immediate or potential future damage to the utility, main, service, or the piping. The Contractor may change the proposed grade of the piping to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory

agencies requirements after written request to and subsequent approval by the Engineer.

D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

E. Water and Sewer Separation:

1. Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sanitary sewer, storm sewer or sewer manhole. The distance shall be measured edge-to-edge. When local conditions prevent a horizontal separation of 10 feet, the water main may be laid closer to a sewer (on a case-by-case basis) provided the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. It is advised that the sewer be constructed of materials and with joints that are equivalent to water main standards of construction and be pressure tested to assure water-tightness prior to backfilling.
2. Water mains crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer. At the crossings, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible (bisected at the point of crossing). Special structural support for the water and sewer pipes may be required.
3. When local conditions prevent a vertical separation of 18 inches and/or less than 10 feet of horizontal separation, the sewer passing over or under water mains shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water-tightness prior to backfilling. At the crossings, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible (bisected at the point of crossing).
4. When water mains cross under sewers, additional measures shall be taken by providing:
    a. a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main;
    b. adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains;
    c. that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer; and,
    d. both the sewer and the water main shall be constructed of water pipe materials and subjected to hydrostatic tests, as prescribed in this document. Encasement of the water pipe in concrete shall also be considered.
5. No water main shall pass through, or come in contact with, any part of a sanitary sewer manhole.

F. Surface Water Crossings:

Surface water crossings, both over and under water, may present special concerns and should be discussed with the Division before the final plans are prepared.

1. At above water crossings, the pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repairs or replacement.
2. At underwater crossings, a minimum of two (2) feet of cover shall be provided over the pipe.
3. The installation of ductile iron pipe with restrained push-on joints and encased in concrete, may be considered with the prior approval of the Engineer. Otherwise, when crossing water courses which are greater than 15 feet in width, only pipes of special construction, having flexible, watertight joints shall be installed.
4. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair (valves shall be easily accessible and not subject to flooding); the valve closest to the supply source shall be in a manhole.

5. Sampling taps shall be installed at each end of the crossing, and permanent taps shall be made for testing and determining leaks.

3.02 INSTALLATION IN TRENCH

A. Proper and suitable tools and appliances for safe and convenient handling and installing of pipe and fittings shall be used. Great care shall be taken to prevent pipe coatings from being damaged, particularly cement linings on the inside of D.I.P. pipes and fittings. Any damage shall be remedied as directed. All pipe and fittings shall be carefully examined by the Contractor for defects just before installing and no pipe or fitting shall be installed which is defective.

B. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.

C. Water mains shall be installed on a 4" Class II or III select natural material bedding as specified in Section 02317 Trench Excavation and Backfill with O.D./2 haunching. The compaction for bedding and haunching shall be 90% of Standard Proctor Density as determined by (ASTM D698). Pipe shall not be installed within 6 inches of rock. In trench rock conditions, a minimum of 6 inches of sand or approved suitable soil shall be placed on rock prior to pipe installation. Trenches shall be kept free of water.

D. Where bends and tees occur in pressure mains, the Contractor will pour a block of concrete at the bend or tee as detailed on the Plans. The block shall consist of 3000 psi concrete, and shall be of size and shape as shown on the plans or as

directed by the Engineer. The Contractor may use forms or either walls to mold the "thrust block;" however, if earth walls are used they shall be cut true to shape with all excess earth removed and the work shall be done in such a manner that no loose earth will become mixed with the fresh concrete. Thrust restraint shall be provided at all points where hydraulic thrust may develop. This will include providing reaction blocking, tie rods or joints designed to prevent movement to all bends, tees, valves, plugs, hydrants and other points where thrust may develop. The Engineer shall inspect all thrust blocks prior to them being covered.

E. All ductile iron pipe laid underground shall be mechanical joint pipe and fittings or "push-on" type joint unless otherwise shown on the plans or directed by the Engineer.

F. All water mains laid underground shall have a minimum of 42 inches of cover above the top of the pipe unless otherwise shown on the plans, or unless otherwise directed by the Engineer.

G. All water mains laid under existing sewers, storm drains, culverts, structures, etc., shall have a minimum clearance of 18 inches between the outside wall of the water pipe and the outside surface of the existing pipe or structure.

3.03 PIPE JOINTING

A. MECHANICAL AND RESTRAINED JOINTS

Clean spigot and bell of foreign material and apply soapy water containing chlorine solution before slipping gasket and gland over spigot end of pipe. Small side of gasket and lip of gland must face the socket. Paint gasket with soapy solution and place spigot end of pipe securely home in socket. Push gasket evenly into position in socket, slide gland into position and tighten bolts with fingers.

Tighten bolts to uniform tightness with ratchet wrench by tightening bottom bolt and then top bolt. Thereafter, all bolts shall be tightened in sequence of 180 degrees apart until all bolts are within the range of torque recommended by the manufacturer.

B. PUSH-ON JOINTS

Jointing shall be made with rubber gaskets and lubricant furnished by the manufacturer in strict accordance with the manufacturer's recommendations. Prepare field cut pipe by filing 1/8 inch 30 degree bevel on pipe end to avoid injuring gasket.

C. THREADED FLANGE JOINTS

Insert recommended manufacturer's gasket and tighten bolts to uniform tightness with ratchet wrench by tightening bottom bolt and then top bolt. Thereafter, all

bolts shall be tightened in sequence of 180 degrees apart until all bolts are within the range of torque recommended by the manufacturer.

D. POLYVINYL CHLORIDE PIPE

Do not thread PVC pipe. When threads are necessary, adaptors will be used. Use strap wrenches to couple threaded PVC pipe fittings and use lubricant recommended by pipe manufacturer.

Avoid excessive torque and do not score pipe. Use couplings furnished with pipe for fittings and install in strict accordance with the manufacturer's recommendations.

E. POLYETHYLENE PIPE (HDPE)

Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic representation of the fusion cycle shall be part of the Quality Control records.

3.04 MISCELLANEOUS CONSTRUCTION

A. CONNECTIONS TO EXISTING MAINS

These shall be made at the locations shown on the plans or as directed by the Engineer.

When existing gate valves on the distribution system must be shut off in order to make connections, this work will be done by the Contractor with approval of the Owner. Whenever the Contractor elects to proceed with a connection without a complete shut-off, this work will be done without additional cost to the Owner.

When an existing main has been cut or a plug removed for a connection, the work of making a connection shall proceed without interruption until complete at no increase in contract price.

Connections to existing mains shall be governed by all applicable provisions of these specifications. The contractor shall locate, excavate and cut the existing main, remove the section of old pipe, rework the trench, connect the new pipe with the old and set necessary specials and valves as shown on the plans or as directed by the Engineer. Tapping sleeves, crosses and valves may be used at the option of the Contractor at no addition to the contract price. All necessary

precautions shall be taken to brace valves and mains under pressure to prevent blowouts.

B. CONCRETE VALVE MARKER POSTS

A concrete valve marker post shall be furnished and installed as directed, with each gate valve (excluding fire hydrant valves). The concrete marker post shall have a four inch minimum square section and a minimum length of 42 inches with beveled edges and containing at least one three-eighths inch diameter bar of reinforcing steel. Markers shall be placed as directed by the Engineer and set so as to leave 18 inches exposed above grade. The exposed portion of the valve markers shall be engraved with the word "WATER". The concrete valve marker shall be painted BLUE.

C. SERVICE CONNECTIONS

Corporation stops and service saddles shall be used for all service connections. They shall have tapered threads for iron or steel pipe and pipe threads for plastic pipe saddles. Use approved tapping machine to make all ductile or cast iron taps.

D. EXPANSION COUPLINGS

Expansion couplings shall be installed where shown on the plans, required or directed. Unless otherwise shown or specified, the pipe couplings shall be of a gasketed short sleeve type, with a diameter to fit the pipe properly.

E. PIPE SLEEVES

Contractor shall furnish and install cast iron wall sleeves or wall pipe as indicated on the plans where cast iron and ductile iron piping connects with or passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors. Wall pipe or sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall sleeves and wall pipes shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.

F. BUILT-IN PIPE AND FITTINGS

Where shown on the plans or where directed, pipe and fittings shall be carefully built into or supported on concrete or brick masonry. Where pipe or fittings are shown through concrete or brick walls, the pipe or fittings shall be carefully supported and the masonry work poured or built against them. Under no circumstances will blocking out of walls be permitted for pipe insertion later.

G. INSTALLATION OR REPAIR

Any pipe, solder or flux which is used in the installation or repair of the public water distribution system shall be lead free with not more than 8.0% lead in pipes

and fittings and not more than 0.2% lead in solders and flux.

3.05 DRILLING AND TAPPING

A. Wherever required, cast iron and ductile iron pipes and fittings shall be drilled and tapped to other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.

B. All tapping shall be carefully and neatly done by skilled workmen with suitable tools.

C. Where connections are made between new and old water piping the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.

D. Under the direction, supervision and observation of the City of Port Wentworth or approved representative.

3.06 PIPELINE DETECTION MARKING

A. All water mains shall be protected by a plastic marking tape placed a minimum of 12 inches above the top of pipe for its full length. The tape shall be similar to Reef Industries Terra Tape Standard. It will have sufficient thickness; tensile strength; elongation and resistance to alkalis, acids and other destructive agents to remain a permanent marker of the line buried below. A message shall be printed on the tape at least every 30 inches "**CAUTION WATER LINE BURIED BELOW**".

B. All non-metallic water mains shall be protected by a metalized foil tape buried a minimum of 12 inches above the top of the pipe for its full length. The foil shall be protected by plastic film laminated on each side. The lamination shall be strong enough to prevent the separation of foil and plastic film. The tape should be similar to Reef Industries' Terra Type Detectable. It shall be inductively locatable and conductively traceable using a standard pipe and cable-locating device. A message shall be printed on the tape every 30 inches "**CAUTION WATER LINE BURIED BELOW**".

C. Tracing Wire shall be single strand #12 AWG, Vinylon – A THWN or THHN or gasoline and oil resistant II VW 600V or AWM.

No. 12 AWG solid plastic-coated copper wire shall be installed on top of all water mains where non-metallic pipe is used and attached by means of securing the wire on top of the water main with a 12-inch long by 2-inch wide piece of duct tape. Attach the wire to the main every ten (10) feet.

Wire shall be bonded at splices with 3M DBY-6 Direct Bury Splice Kit at every connection

The wire shall be laid the entire length of the trench and shall be continuous. The Contractor shall demonstrate continuity in wire through the entire length of the project. At every valve manhole the wire shall be run through the pipe opening, up to the ring and cover, secured at the ring by means of grouting the ring to the top of the manhole. The wire shall continue in the same loop back to the opposite pipe opening, through it and continuing in one continuous loop along the main.

At every fire and post hydrant, the wire shall be run from the main to the hydrant tee, to the gate valve, wrapped around the gate valve once, then run to the bottom of the hydrant flange, up the hydrant, wrapped around it once at the finish grade, then back to the main in one continuous loop, and continuing along the water main.

At every water service lateral, the wire shall be run from the main and corporation stop to the curb stop and attached to the polyethylene pipe by a piece of duct tape wrapped around the wire and tubing. The wire shall be connected to the tracer wire at the main with a single strand from the water main to the curb stop or into the meter box.

The City of Port Wentworth will test all tracer wire prior to acceptance.

3.07 PRESSURE TESTING

A. Hydrostatic testing shall be performed on lines after pipe has been laid and backfilled between joints, all newly laid pipe, or any valved section thereof. The pipe shall be subjected to a hydrostatic gauge pressure of at least (150%) of the rated working pressure of the pipe for two hours and not less than (125%) at the high point per AWWA C600 (DIP) and AWWA C605 (PVC). Working pressure is defined as maximum anticipated sustained operating pressure. In no case shall the test pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.

1. The Contractor shall have the responsibility to ensure that all outlets are closed by valves or plugged and braced to prevent blowouts. Pressurizing equipment shall be constantly monitored or include a regulator or relief valve to avoid over pressurizing and damaging an otherwise acceptable line. No one shall be allowed in manholes, wet wells, valve pits, etc. during testing.
2. To prepare the line for testing, the contractor shall backfill all pipe and provide all reaction blocking before hydrostatic testing. The Engineer may direct the Contractor to leave certain joints and connections uncovered until testing has been completed. All pipe outlets shall be secured to resist the test pressure. Clean out all debris in the pipe.
   The section of pipe under test shall be slowly filled with water and all air shall be expelled from the pipe. If blow-offs are not available at high places, taps at points of highest elevation shall be made before the test and plugged during and after test.
3. Procedure; the specified test pressure, based on the elevation of the lowest point of the line or lowest point of the section under test and corrected to the elevation of the test gauge, shall be applied by means of a gasoline driven test pump connected to the pipe in a manner satisfactory to the Engineer. The Contractor shall meter the amount

of water used during the test. The duration of the test shall be at least two consecutive hours.
The Contractor shall locate and repair any and all leaks that may develop. All exposed pipe, fittings, valves, hydrants, and joints will be carefully examined during the test. Any cracked or defective pipe, fittings or valves A>discovered as a result of this test shall be removed and replaced with sound material, and the test shall be repeated until satisfactory to the Engineer.

B. Allowable leakage. The contractor shall furnish the gauges and measuring device or the leakage test, pump, pipe, connections, and all other necessary apparatus, unless otherwise specified, and shall furnish the necessary assistance to conduct the test. The duration of each leakage test shall be 2 hours, unless otherwise specified. During the test, the pipeline shall be subjected to the pressure stated above. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi of the specified leakage-test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if the leakage is greater than that determined by the formula per AWWA C600 (DIP) and AWWA C605:

1) For DIP use:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:
L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

2) For PVC use:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where:
L = allowable leakage, in gallons per hour
N = number of joints in the length of pipeline tested
D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 10.50 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

3) Hydrostatic Leak Testing for HDPE:

This hydrostatic leak test procedure consists of filling, an initial expansion phase, a test phase, and depressurizing in accordance with **Chevron Phillips Chemical Co. Publication – Technical Note 802 – Leak Testing.**

a) Filling: Fill the restrained test section completely with a test liquid acceptable to the Owner.

WARNING – Ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release and result in death or serious bodily injury. Use equipment vents at high points to remove air.

b) Initial Expansion Phase:
Gradually pressurize the test section to test pressure, and maintain test pressure for three (3) hours. During the initial expansion phase, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

c) Test Phase:
This alternative is applicable when the test pressure is 150% of the system design pressure.
Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain test
pressure for one (1), or two (2), or three (3) hours. If the amount of make-up water needed to maintain test pressure does not exceed the amount in Table 2, no leakage is indicated.

Table 2 Test Phase – Make-Up Water Allowance:

Make-Up Water Allowance for Test Phase – (U.S. Gal/100 ft of pipe)			
Nominal Pipe size (in.)	1-Hour Test	2-Hour Test	3-Hour Test
4	0.13	0.25	0.40
6	0.3	0.6	0.9
8	0.5	1.0	1.5
10	0.8	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.0	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3

d) Depressurizing:

At the conclusion of the test, carefully depressurize the test section by the controlled release of test liquid. The test liquid may need to be drained and its disposal may be subject to regulations.

3.08 STERILIZATION OF POTABLE WATER MAINS

Precaution should be taken when installing pipes, valves, and hydrants to keep them as clean as possible to minimize contamination. After each line between valves has been tested and all necessary repairs made, and the lines flushed clean, water containing not less than 25 parts per million of chlorine shall be fed in the line and allowed to stand 24 hours, after which the lines shall be flushed and samples taken at various points. Water mains shall be disinfected by the continuous feet method. The chlorine solution shall be slowly fed through a suitable device within 10 feet of the point of filling the new main. Care should be taken in filling the mains so that all air pockets are eliminated so as to permit intimate contact of the disinfection agent with the entire inside diameter of the pipe. The water and chlorine solution should be slowly fed until 25 mg/l free chlorine is throughout the main. An acceptable method is by preparing a 1% chlorine solution using sodium hypochlorite or calcium hypochlorite. For example, one pound of calcium hypochlorite to 8 gallons of water will produce a 1% solution. The required amount of chlorine to produce a 25 mg/l concentration per 100 feet of pipe is as follows:

Pipe Diameter	**1% Chlorine Solution (gal.)**
4"	0.16
6"	0.36
8"	0.65
10"	1.02
12"	1.44
16"	2.60

The disinfection solution shall be allowed to remain in the lines for not less than 24 hours. At the end of the 24-hour period, all portions of the main shall show a chlorine residual of not less than 10 mg/l. The highly chlorinated water shall be drained to a sanitary sewer or neutralized with an approved chemical prior to draining to other than a sanitary sewer.

Disinfection of the new mains and the disposal of the heavily chlorinated water, following the disinfection, shall be accomplished in accordance with the latest edition of AWWA Standard C651. There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water and other contaminating materials may be discharged or drawn into the system.

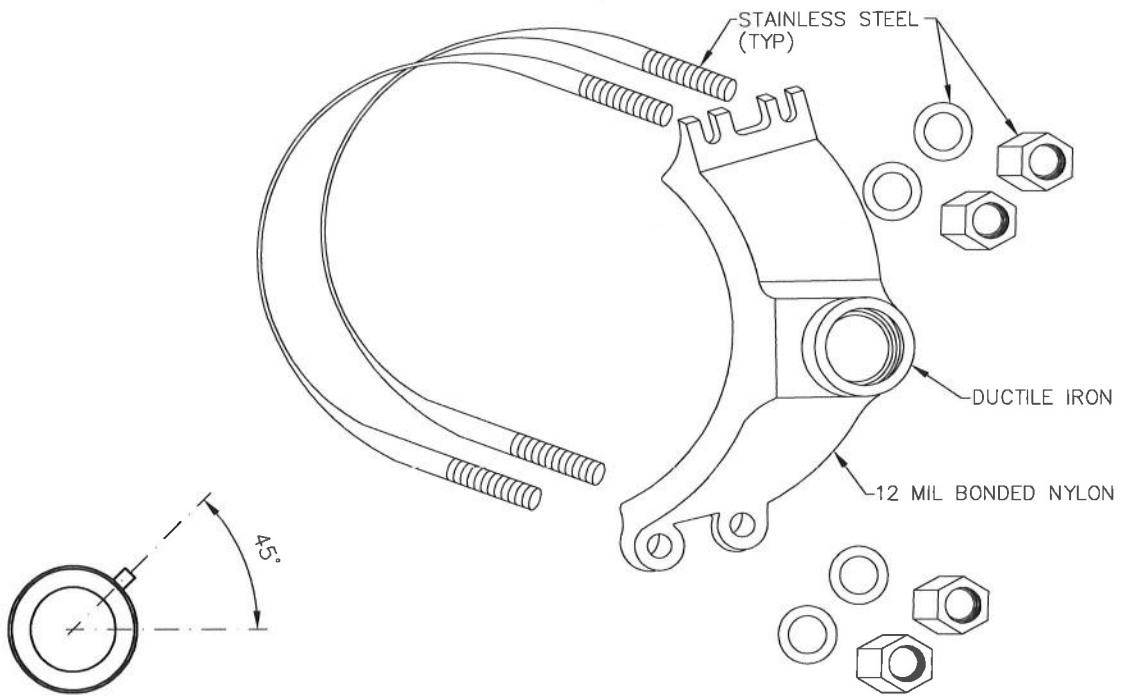
Following chlorination all water shall be flushed from the lines until the replacement water has a chlorine content not more than 0.1 p.p.m. in excess of the residual in the water from the supplying main. Water samples shall be taken by the Contractor and sent to an approved laboratory for bacteriological examination. The lines shall not be placed into service until a satisfactory bacteriological report is received.

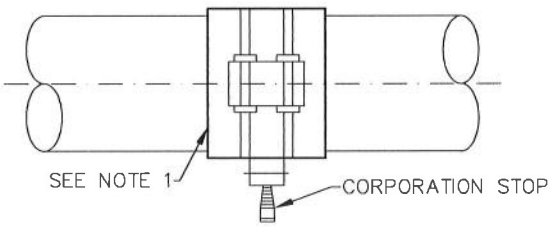
The "**tablet method**" of disinfection which consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is complete **is not allowed.**

3.09 CLEANUP

Remove all surplus materials, tools, excess dirt, rubbish, and debris from the site as installation progresses. Clean as directed by the Engineer. Obtain letter of approval from the State Highway Department covering work installed in areas of State Highway jurisdiction. Contractor to maintain surface of ditches, unpaved streets, road shoulders, sod, grass, and other disturbed surfaces for a period of thirty (30) days thereafter.

END OF SECTION





NOTES:

1. TAPPING SADDLE TO BE DUCTILE IRON WITH TYPE 304 STAINLESS STEEL FORGED DOUBLE STRAPS, STAINLESS STEEL BOLTS, NUTS AND WASHERS. FINISH IS FUSION–BONDED NYLON TO AVERAGE THICKNESS OF 12 MILS.
2. ALL TAPS ON WATER MAIN WILL REQUIRE A TAPPING SADDLE.

1" AND 2" TAPPING SADDLE

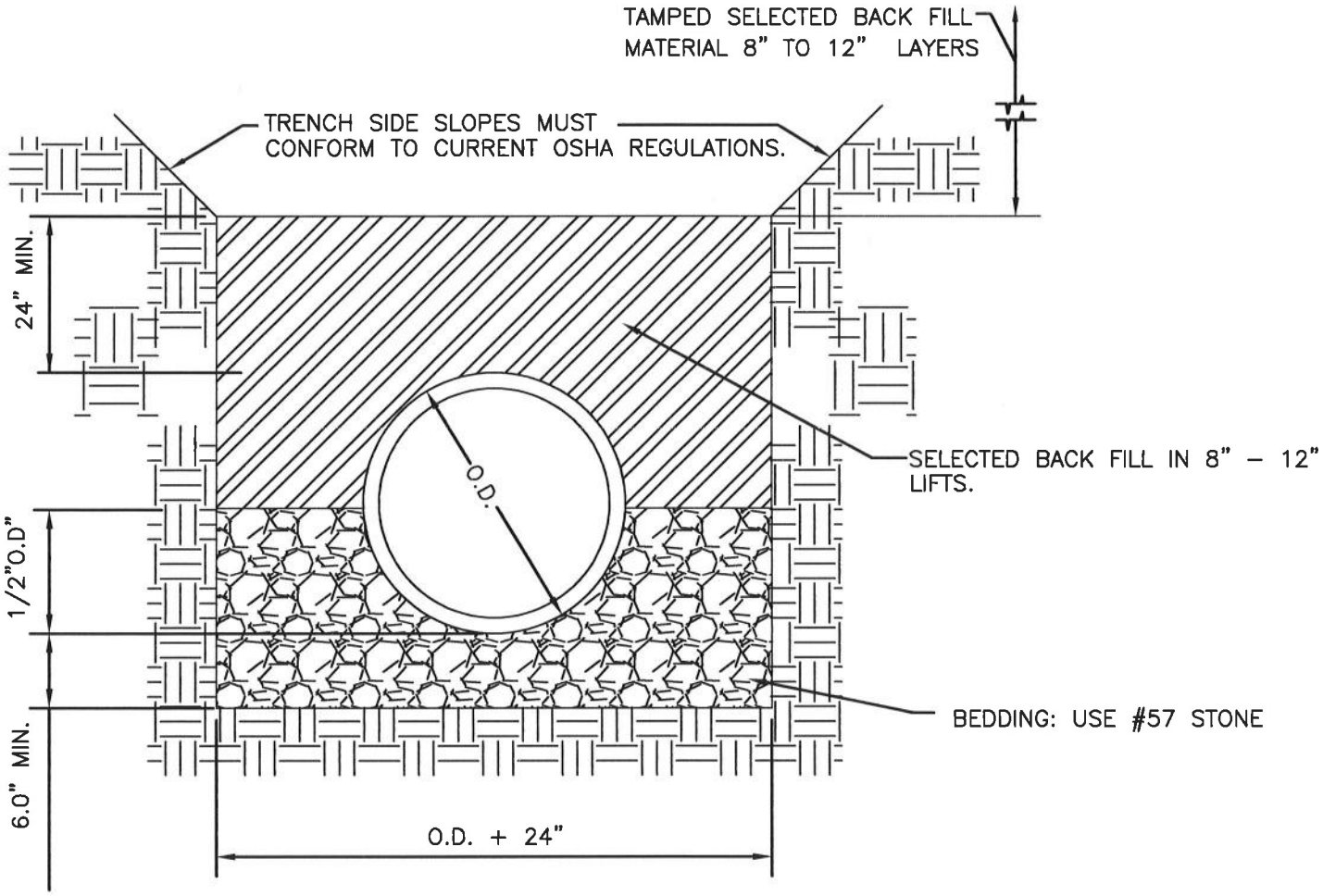
City of Port Wentworth

TECHNICAL DETAILS

W–2

PREPARED BY SAUSSY ENGINEERING, LLC.

SCALE: N.T.S.
DATED: FEBRUARY 2007



PIPE BEDDING

City of Port Wentworth

TECHNICAL DETAILS

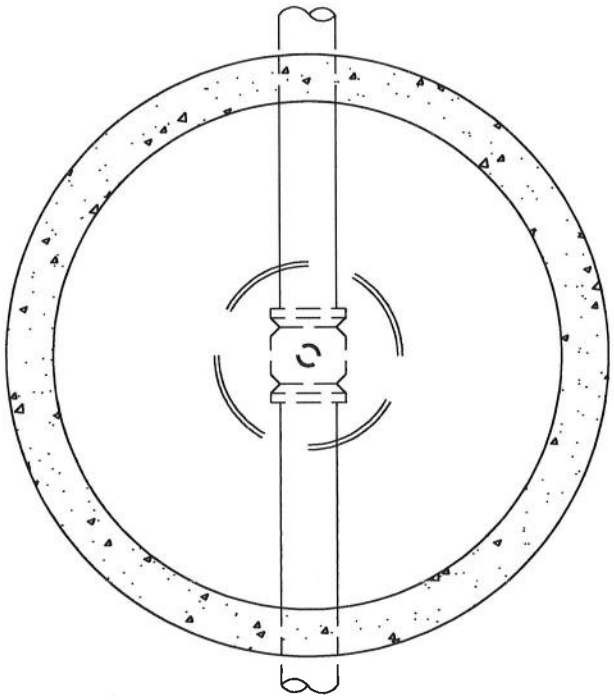
W–8

PREPARED BY SAUSSY ENGINEERING, LLC.

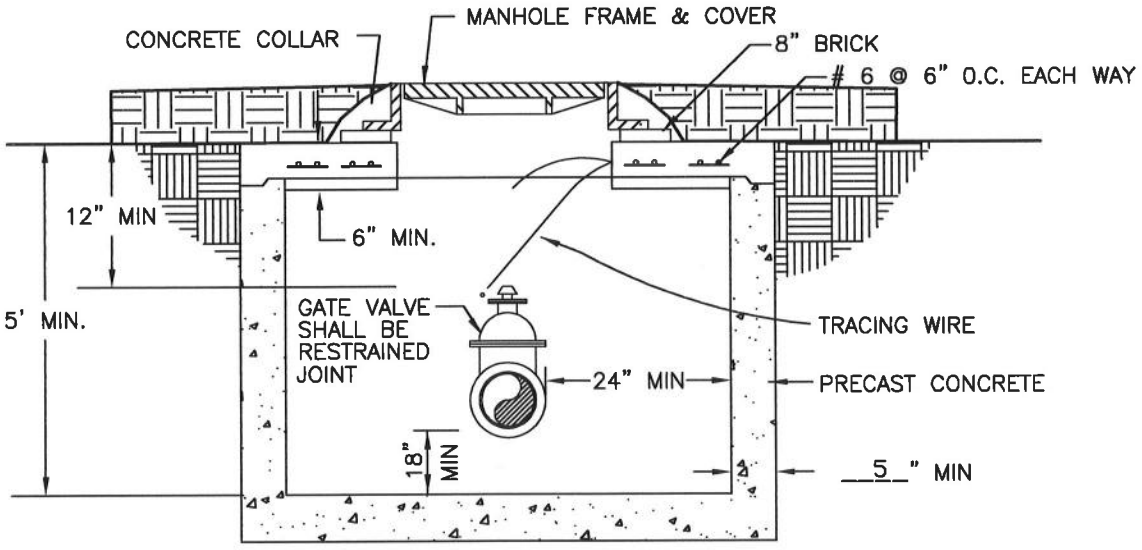
SCALE: N.T.S.
DATED: FEBRUARY 2007

NOTES:

1. MANHOLE FRAME AND COVER SHALL BE NEENAH FOUNDRY CO, CATALOG NO. R-1668, TYPE C, LABELED 'WATER'.
2. THE BOTTOM OF THE MANHOLE FRAME SHALL NOT BE MORE THAN 12" ABOVE THE TOP OF THE MANHOLE STRUCTURE.
3. PRECAST CONCENTRIC CONE RISERS MAY BE USED WHERE REQUIRED FOR DEPTH.
4. THE MANHOLE FRAME AND COVER MUST BE CENTERED OVER THE VALVE.



PLAN



VALVE MANHOLE FOR 8" & GREATER GATE VALVE

City of Port Wentworth

TECHNICAL DETAILS

W-14

PREPARED BY SAUSSY ENGINEERING, LLC.

SCALE: N.T.S.
DATED: FEBRUARY 2007

SECTION 02511
VALVES, METERS AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

Furnish all materials, labor, and equipment to properly install all valves, valve boxes, hydrants, and related accessories at the locations shown on the plans or as directed by the Engineer for the proper completion of the work included under this contract whether shown expressly on the plans or implied by other requirements.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02510 - Water Pipe and Fittings.

B. Section 02531 - Sanitary Sewer Force Main

1.03 SUBMITTALS

Complete product data and engineering data, including shop drawings, shall be submitted to the Engineer in accordance with the requirements of Section 01330 of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All valves shall have the name of the manufacturer, pressure, and size of the valve cast upon the body or bonnet in raised letters.

B. Valves and operating mechanisms shall be of the proper size and dimensions to fit the pipe connections thereto and shall be installed in the position and within the space shown on the plans.

C. All castings, whether bronze, iron or steel, shall be sound and smooth, without swells, lumps, blisters, sand holes or other imperfections and shall be made in accordance with best foundry practice. All materials, unless specifically noted otherwise, shall be of the grade and qualities as established by the specifications of the ASTM listed as follows:

Iron Castings	A126, Grade B
Steel Castings	A216
Stem, Bolts, & Nuts	B21, Grade A, Half Hard
Stem Nut & Yoke Nut	B132, Grade B
Stuffing Box Gland	B62, with some modifications
Bushings	B62, Permissible as approved

2.02 GATE VALVES/BALL VALVES

A. Ball valves 1 inch and smaller shall be designed for a working pressure of not less than 300 psi, domestic made brass, and shall conform to AWWA Standard C 800-89.

B. 2 inch through 3 inch valves: Shall be resilient wedge type rated for 250 psig cold water working pressure. All ferrous components shall be ductile iron or cast iron.

C. Valves 4"-12" shall be in full compliance with AWWA C509 and be UL listed, FM approved. The words "Ductile Iron" or "Cast Iron" shall be cast on the valve or stamped on a permanently attached corrosion resistant metal tag. The wedge shall be ductile iron encapsulated with nitrile rubber or SBR rubber and be symmetrical and seal equally well with flow in either direction. There shall be no exposed metal seams, edges or screws within the waterway.

1. The stem shall be bronze in full compliance with section 4.7 of AWWA C509.
2. Valves shall be NSF Standard 61 certified.
3. Bolting materials shall develop the physical strength requirements of ASTM A307 and may have either regular square or hexagonal heads with dimensions conforming to ANSI B18.2.1. Metric size socket head cap screws therefore are not allowed.
4. Operating nut shall be constructed of ductile iron and shall have four flats at stem connection to assure even input torque to the stem.
5. All gaskets shall be pressure energized O-rings.
6. Stem shall be sealed by three O-rings. The top two O-rings shall be replaceable with valve fully open and while subject to full rated working pressure. O-rings set in a cartridge shall not be allowed.
7. Valve shall have thrust washers located with (1) above and (1) below the thrust collar to assure trouble-free operation of the valve.
8. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly, 250# raised face flanges shall be provided when required.
9. Valves shall be American Flow Control, Mueller, Clow, M&H, or approved equal.

D. Joints: Below ground valves shall be mechanical joint, above ground valves shall be flanged, unless otherwise shown on the plans. Flanged joints shall meet the requirements of ANSI B16.1, Class 125.

E. Opening: The direction of opening in all cases shall be counterclockwise, or to the left. The direction of opening shall be clearly marked with the word "OPEN" and an arrow at least two inches long pointing in the direction of "OPEN". The markings shall appear on the wrench nut base for valves installed below ground and on the handwheel of all valves having handwheels.

F. Position Indicators: All gate valves for above ground service shall be equipped with needle and slot type position indicators with a bronze pointer mounted on a threaded collar moving through the valve range and indicating on a marked plate attached to the valve.

G. Handwheels: Handwheels shall be furnished for all gate valves installed above ground or in valve pits below ground where access to handwheels is provided.

2.03 CHECK VALVES

A. Air cushioned check valves shall prevent backflow and be watertight. Valves shall be designed for the operating head indicated and shall not slam shut on pump shutdown. Valves shall be hinged disc type with cast iron body and cover conforming to ASTM A126, Class B and cast or ductile iron disc. The valve shall have a resilient Buna-N rubber disc seat held in place by a stainless steel follower ring and screws. The body seat shall be stainless steel and replaceable. The flow area shall be greater than or equal to the nominal inlet size. The shaft shall continuous and stainless steel, extending both sides of the body be and be sealed where it passes through the body to prevent leakage. A lever and an easily moved counterweight shall initiate closure and shall be steel or ductile iron. The external, side mounted, adjustable, air cushion cylinder shall cushion closure of the valve and be corrosion resistant. Valves shall be equipped with a 1/2-inch tap at the high point of the valve for bleeding air from the line.

B. Oil cushioned check valves shall prevent backflow and be watertight. Valves shall be designed for the operating head indicated and shall not slam shut on pump shutdown. Valves shall be hinged disc type with cast iron body and cover conforming to ASTM A126, Class B and cast or ductile iron disc. The valve shall have a resilient Buna-N rubber disc seat held in place by a stainless steel follower ring and screws. The body seat shall be stainless steel and replaceable. The flow area shall be greater than or equal to the nominal inlet size. The shaft shall continuous and stainless steel, extending both sides of the body be and be sealed where it passes through the body to prevent leakage. A lever and an easily moved counterweight shall initiate closure and shall be steel or ductile iron. An oil controlled, side mounted cylinder shall provide two speed control closing for the prevention of surge control and water hammer. Each stage shall be independently adjustable and the oil system will be self-contained and separate from the main line media. Valves shall be equipped with a 1/2-inch tap at the high point of the valve for bleeding air from the line.

C. Valve ends shall be flanged, meeting the requirements of ANSI B16.1, Class 125.

D. Valves shall be manufactured by APCO, GA Industries, Crispin or approved equal.

2.04 "DUCKBILL" ELASTOMERIC CHECK VALVES

A. Check Valves are to be all rubber of the flow operated check type with a slip-on connection. The Check Valve is designed to slip over the specified pipe outside

diameter and attached by means of vendor furnished stainless steel clamps. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The valve shall be one-piece rubber construction with nylon reinforcement. In sizes 20" and larger, the bill portion shall be thinner and more flexible than the valve body, and formed into a curve of 180°.

B. Company name, plant location, valve size and serial number shall be bonded to the check valve. Elastomeric duckbill check valve shall be manufactured in the United States of America. A single manufacturer shall provide all elastomer duckbill check valves.

C. All valves shall be "Tideflex" of the Series TF-2 as manufactured by the Red Valve Co., Inc. or approved equal.

2.05 FLAP VALVES

A. Flap valves 8 inches and larger shall have a resilient seat. Valve body and flap shall be cast iron in accordance with ASTM A 126, Class B. The flange shall be drilled for mounting to ASME/ANSI B16.1, Class 125 flange. The valve shall operate without leakage with seating and unseating heads as indicated on the Drawings. Resilient seat shall be wide seating Buna-N or neoprene, bonded in a groove machined into the valve body. Hinge links shall be 304 stainless steel. Each hinge arm shall have two pivot points. A lubrication fitting shall be provided for each pivot. Valves shall be manufactured by Rodney Hunt, Waterman, Hydro Gate or approved equal.

B. Flap valves 6 inches and smaller shall have a bronze seat and brass hinge pins. Valve body and flap shall be cast iron in accordance with ASTM A 126, Class B. Valves shall be manufactured by Troy, Clow or approved equal.

2.06 BUTTERFLY VALVES

A. Butterfly Valves for Liquid Service – 14" and Larger

1. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504 for Class 150B. Valves shall be rated for 150 psi working pressure unless otherwise specified or shown.
2. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. Shafts shall be ASTM A 276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A 536, Grade 65-45-12, ASTM A48 cast iron or ASTM A 126, Grade B cast iron. The resilient valve seat shall be located in the valve body and for valves 30-inch and greater, shall be fully field adjustable and field replaceable.
3. Actuators

    a. Valves for non-buried service, 3 through 8-inches in diameter, shall

be lever operated. The lever shall be capable of being locked in 10 positions. Valves for non-buried service, 10-inches in diameter and larger, shall be handwheel operated.

b. Valves for buried service or non-buried service, 10-inches or greater in diameter shall be equipped with traveling nut or worm gear type, self-locking type manual actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc. Actuators shall be furnished with fully adjustable mechanical stop-limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.

c. Valves shall be equipped with motorized actuators where shown on the Drawings.

4. Operators

   a. Valves for non-buried service, six feet or more above the operating floor shall be furnished with a chainwheel operator and chain for operation from floor level.

   b. Valves for buried service shall be equipped with a valve box and stem extension required to bring the operation nut within 6-inches of finished grade. Valve boxes and extension stems shall be as specified in this Section. Three inch and larger valves shall have two-inch square operating nuts.

   c. Valves shall be equipped with pedestal type operators where shown on the Drawings and as specified in this Section.

5. Valves shall be installed with disc shaft horizontal, except where extended bonnets or levers are used. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water.

6. Valve ends shall be mechanical joint type and meet the requirements of AWWA C111/ANSI 21.11, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125. At the contractor's option, grooved mechanical fittings meeting the requirements of AWWA C606 may be used in lieu of flanged connections in all interior ductile iron piping.

7. Butterfly valves shall be manufactured by Mueller, SPX/DeZurik, Pratt or approved equal.

2.07 PLUG VALVES

A. Valves shall be 90-degree turn, non-lubricated, eccentric type with resilient faced plugs. Design of the valve shall provide that contact between the seat and the plug shall only occur in the final degrees of plug movement. Valves shall be suitable for minimal throttling service and service where valve operation is infrequent.

B. Valves shall be capable of providing drip-tight shut-off up to the full pressure rating

with pressure in flow direction. Pressure ratings shall be established by hydrostatic tests conducted in accordance with ANSI B16.1. Valves shall be rated at a minimum of 150 psi.

C. Valves shall have a port area equal to at least 80 percent of the full pipe area for valves 24-inches and less. Valves 30-inches and greater shall have a port area equal to at least 70 percent of the full pipe area.

D. Bodies shall be cast-iron, conforming to ASTM A 126, Class B

E. Valve ends shall be a mechanical joint type, except where flanged or restrained joint ends are shown on the Drawings. Mechanical joint valves shall have bell ends conforming to applicable requirements of AWWA C111/ANSI A21.11. Flanged joints shall meet the requirements of ANSI B16.1, Class 125. Flanged valves with flange-to-MJ adapters shall not be acceptable in lieu of MJ valves. At the contractor's option, grooved mechanical fittings meeting the requirements of AWWA C606 may be used in lieu of flanged connections in all interior ductile iron piping.

F. Valve seats shall be a raised, welded-in overlay of not less than 90 percent pure nickel, machined to mate with the resilient faced plug. Overlay shall be minimum of 1/8-inch thick.

G. The plug shall be of semi-steel, conforming to ASTM A 126, Class B. The plug facing shall be a synthetic rubber compound of approximately 70 durometer hardness bonded to the plug. Facing material shall be abrasion resistant and suitable for service in sewage and sludge applications.

H. Valves shall be furnished with replaceable, sleeve-type bearings in the upper and lower journals. Bearings shall comply with applicable requirements of AWWA C507. Bearing materials shall have a proven record of service of not less than five years.

I. The valve body shall be fitted with a bolted bonnet incorporating a stuffing box and pull-down packing gland. Packing shall be the split chevron type. Design of exposed valves shall allow visible inspection of the shaft seal, adjustment of the packing, and replacement of the packing, all without disturbing the bonnet or valve operator. The shaft seal shall comply with the requirements of AWWA C504.

J. Actuators

1. Valves for exposed service, 3 through 8-inches in diameter, shall be lever operated.
2. Actuators for buried service and valves 10-inches and larger, shall be equipped with manual operated geared actuators. Geared actuators shall be totally enclosed, oil or grease lubricated, worm and gear type. Shaft seals shall be provided to prevent entry of dirt and water into the actuator. All shaft bearings shall be permanently lubricated bronze bushings. Actuators

shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Construction of actuator housing shall be semi-steel. Gear actuators shall comply with requirements of AWWA C504.

3. Valves for buried service shall be equipped with a valve box and stem extension required to bring the operation nut within 6-inches of finished grade. Valve boxes and extension stems shall be as specified in this Section.
4. Motorized actuators shall be provided where shown on the Drawings.
5. Valves and operators for submerged or buried service shall have seals on all shafts and gaskets on valve operator covers to prevent the entry of water. Operator mounting brackets for submerged service shall be totally enclosed and shall have gasket seals.
6. Valves for non-buried service, six feet or more above the operating floor shall be furnished with a chainwheel operator and chain for operation from floor level.
7. Valves shall be equipped with pedestal type operators where shown on the Drawings and as specified in this Section.
8. Where shown on the Drawings, provide an extended bonnet and mount the gear actuator on top of the extended bonnet.

K. Plug valves shall be manufactured by SPX/DeZurik, Pratt, Clow, Val-matic or approved equal.

2.08 PRESSURE GAUGES

A. For installation on pump discharge as shown on the plans shall be of Bourdon tube design with brass tube and polished steel case, equal to Ashcroft general service gauge, Type 1009. The size shall be 3-1/2 inches with a range of 0 - 160 psi.

B. For installation on the base of elevated water tank riser use Ashcroft: Model No. 35-1032S-20L. The size shall be 3-1/2 inches with a range of 0 - 100 psi.

2.09 VALVE MANHOLE

A. General.
Manholes shall be constructed at such points as designated on the Drawings. Riser and top sections shall be installed level and plumb, such that all manhole steps are in alignment. The top of manholes outside of roads, streets and highways shall be built to grades 2 inches above ground surface, unless otherwise shown. Manholes in roads, streets and highways shall be built to grades shown on the Drawings.

B. Precast Concrete Manholes.
Precast Concrete manholes shall be constructed of reinforced Class "A" Concrete. Walls shall be not thinner than 5 inches, or 1/12 of the inside diameter, which ever is greater. Precast manholes shall meet all requirement of ASTM C478, "Specification for Precast Reinforced Concrete Manhole Sections."

Rings shall be custom made with openings to meet the necessary pipe alignment conditions and invert elevations. All inlets and outlets shall be cast in or core drilled.

Joints and gaskets shall conform to the applicable provisions of ASTM C443, "Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gasket" or Ram-Nek Pre-molded Plastic Joint Sealer. The sealing compound shall not leak at the joints (while being tested, if required, at 10 psi) for a period of 24 hours. Bell and spigot surfaces shall be smooth, accurately formed, and provide a loose, sliding fit, with a clearance between the bell and spigot of not more than 1/6 inch. Precast manholes shall be bedded on not less than 6 inches of compacted crushed stone at the Contractor's expense. The crushed stone shall extend not less than 6 inches outside the walls of the manhole and under the entire length of pipe within the excavation for the manhole.

C. Manhole Castings.
Provide covers with the inscription "RECLAIMED WATER" cast into the cover in lettering at least 2 inches high. Covers shall be 25-3/4 inches in diameter and shall be 2-inches thick at the bearing surface. Frame shall provide a 24-inch clear opening. Manhole covers and frames shall be USF 227, or equal.

2.10 AIR RELEASE VALVES (WATER)

A. Air Release Valves: The air release valve shall automatically release air accumulations from the pipeline due to the action of the float. When the air valve body fills with air, the float falls freely from the orifice to allow the air to escape to the atmosphere. When all the air has been exhausted from the valve body, the float will be buoyed up to seat against the orifice and prevent water from being exhausted from the valve. The valve body and cover shall be constructed of cast iron conforming to ASTM A 126, Class B. A synthetic orifice button shall be affixed to the valve cover to provide a non-corrosive seat for the float. The float shall be constructed of stainless steel. A resilient, Buna-N seat shall be attached to the float for drop-tight closure. The float shall be free floating within the valve body.

B. Air/Vacuum Valve: The air/vacuum valve shall discharge large amounts of air as the pipeline fills and allow air to enter the pipeline as it drains or in the event of vacuum conditions. The valve body and cover shall be constructed of cast iron conforming to ASTM A 126, Class B. The valve shall operate by means of a non-collapsible stainless steel float and Buna-N seat, which seals an orifice. As air enters the valve the float shall drop from the orifice and allow the air to escape. As water rises in the valve, the float will again seal the orifice. The valve will be of such design that the float cannot blow shut at any air velocity including sonic velocity. All working parts shall be of stainless steel. A surge check shall be installed on the inlet to reduce the flow of extremely high velocity water during closing to minimize slam and shock. The rate of closure shall be adjustable. The surge check shall have an ASTM A126, Class B cast iron body and bronze internals.

C. Combination Air Valves: Combination air valves shall combine the features of an air release valve and an air/vacuum valve and shall be of one of the following types:

1. Combination air valves 3 inches and larger shall consist of an air/vacuum valve described in paragraph B. above, with an air release valve described in A. above tapped into its body. The valve shall be of two-piece body design with an isolation gate valve separating the two valves.
2. Combination air valves smaller than 3 inches shall be single body, double orifice, allowing large volumes of air to escape out the larger diameter air and vacuum orifice when filling a pipeline and closes watertight when the liquid enters the valve. During large orifice closure, the smaller diameter air release orifice will open to allow small pockets of air to escape automatically and independently of the large orifice. The large air/vacuum orifice shall also allow large volumes of air to enter through the orifice during pipeline drainage to break the vacuum. The valve body and cover shall be constructed of cast iron conforming to ASTM A 126, Class B. The Buna-N seats must be fastened to the valve, without distortion, for drop-tight shut-off. The float shall be stainless steel. The valve will be of such design that the float cannot blow shut at any air velocity including sonic velocity. A surge check shall be installed on the inlet to reduce the flow of extremely high velocity water during closing to minimize slam and shock.

D. Potable Water Systems: All air valves and accessories shall be supplied by a single manufacturer and shall be GA Industries, APCO Valve Corporation, Crispin, Val-Matic or approved equal.

2.11 AIR RELEASE AND VACUUM VALVES (SEWAGE)

A. Air Release Valves: The air release valve shall automatically release air accumulations from the pipeline due to the action of the float and lever mechanism. When the air valve body fills with air, the float falls. Through the leverage mechanism, this causes the resilient seat to open the orifice and allow the air to escape to the atmosphere. When all the air has been exhausted from the valve body, the float will be buoyed up. Through the leverage mechanism, this will cause the resilient seat to close the orifice, preventing water from being exhausted from the valve. The valve body and cover shall be constructed of cast iron conforming to ASTM A 126, Class B. The float shall be constructed of stainless steel and attached to a stainless steel lever mechanism. A resilient, Buna-N seat shall be attached to the lever mechanism for drop-tight closure. The valve shall be equipped with the necessary attachments, including valves, quick disconnect couplings and hose, to permit back flushing after installation without diverting the valve.

B. Air/Vacuum Valve: The air/vacuum valve shall discharge large amounts of air as the pipeline fills and allow air to enter the pipeline as it drains or in the event of vacuum conditions. The valve body and cover shall be constructed of cast iron conforming to ASTM A 126, Class B. The valve shall operate by means of a non-collapsible stainless steel float which seals an orifice. As air enters the valve the float shall drop from the orifice and allow the air to escape. As water rises in the valve, the float will again seal the orifice. The valve will be of such design that the float cannot blow shut at any air velocity. All working parts shall be of stainless steel. The valve shall be equipped with the necessary attachments, including valves, quick disconnect

couplings and hose, to permit back flushing after installation without diverting the valve.

C. Combination Air Valves: Combination air valves shall combine the features of an air release valve and an air/vacuum valve and shall be of one of the following types:

1. Combination air valves 3 inches and larger shall consist of an air/vacuum valve described in B. above, with an air release valve described in A. above tapped into its body. The valve shall be of two-piece body design with an isolation gate valve separating the two valves.
2. Combination air valves less than 3 inches shall be single body, double orifice, allowing large volumes of air to escape out the larger diameter air and vacuum orifice when filling a pipeline and closes watertight when the liquid enters the valve. During large orifice closure, the smaller diameter air release orifice will open to allow small pockets of air to escape automatically and independently of the large orifice. The large air/vacuum orifice shall also allow large volumes of air to enter through the orifice during pipeline drainage to break the vacuum. The valve body and cover shall be constructed of cast iron conforming to ASTM A 126, Class B. The Buna-N seats must be fastened to the valve, without distortion, for drop-tight shut-off. The float and other internal metal components shall be stainless steel. The valve shall be equipped with the necessary attachments, including valves, quick disconnect couplings and hose, to permit back flushing after installation without diverting the valve.

D. All air and/or vacuum valves and accessories shall be supplied by a single manufacturer and shall be GA Industries, APCO Valve Corporation, Crispin, Val-Matic or approved equal.

2.12 REDUCED PRESSURE ZONE, DOUBLE CHECK & DOUBLE CHECK DETECTOR VALVE TYPE, BACKFLOW PREVENTER

A. The device shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. The relief valve shall contain a separate means whereby free air will enter the zone, and contained water will be discharged to the atmosphere when the valve is fully open. The assembly shall include two tightly closing shut-off valves before and after the device, test cocks, and a strainer. The device shall meet the requirements of AWWA C511, latest revision, UL EX3185, and the SBCCI Plumbing Code. The device shall be Watts Regulator Co. Series 909 or approved equal.

B. The size shall be as shown on the plans. Size 3 inch and smaller shall have ball valves for shut-off. Size 4 inch and larger shall have OS & Y4 gate valves for shut-off. A 2-inch diameter bypass line with shut off valve shall be provided for size 4 inches and larger.

C. If intended for below grade service, the backflow preventer shall be installed in a precast or cast-in-place concrete enclosure. The bottom shall have a minimum of 4-

three inch diameter weep holes. The enclosure shall be installed on a minimum of 6 inches of No. 57 stone. An aluminum watertight lid of non-traffic design and a clear opening exceeding the length of the backflow preventer shall be provided.

2.13 WATER PRESSURE REGULATOR/REDUCING VALVES

A. The reducing valve shall maintain a uniform downstream pressure as preadjusted on the control pilot handwheel or adjusting screw. The control pilot shall be capable of field adjustments from near 25 psi to 10 percent above the factory-preset pressure. The valve shall be completely piped and ready for installation.

B. The main valve shall operate on the differential piston principle, such that the area on the underside of the piston is no less than the pipe area, and the area on the upper surface of the piston is of a greater area than the underside of the piston. The valve piston shall be guided on its outside diameter by ports that minimize the effects of throttling. Throttling shall be done by the ports and not by the valve seating surfaces.

C. Valves shall be of a cast iron body per the requirements of ATSM A126 with ANSI flanges. The valve interior shall be bronze.

D. The valve shall be capable of operating in any position and shall incorporate only one flanged cover at the valve top from which all internal valve parts shall be accessible. There shall be no stems, stem guides or spokes within the waterway, or springs to assist in valve operation.

E. Valve seals shall be easily renewable. All controls and piping shall be of non-corrosive construction.

F. Valve and control system shall lower line pressure to a predetermined set point and shall maintain that set point, regardless of variations in flow or inlet pressure. Valve shall be capable of operating with inlet pressure up to 300 psi and an adjustable outlet pressure of 25 to 75 psi. Valve shall be as manufactured by Watts Regulator, Series 25AUBZ3 (1/2" to 2") for standard capacity water or approved equal.

2.14 DUAL CHECK BACKFLOW PREVENTER

The dual check backflow preventer shall meet the domestic requirements of ANSI/ASSE Standard 1024, and bear the seal of approval. It shall be bronzed bodied and include not less than one union, with the union nut drilled to accept a tamper-proofing lock wire. A brass identification tag shall be securely attached to the valve body by corrosion-resistant mechanical fasteners. The dual check valve shall be as manufactured by Watts Regulator Co., Series 7, or approved equal.

2.15 VALVE BOXES AND COVERS

All valves below ground level shall be furnished with a valve box and cover. Each shall be of the roadway extension type, or proper length and base size with suitable detachable cover, bituminous coated inside and out. Boxes shall be 5 1/4 inch inside diameter, "Standard Telescopic Valve Box" as manufactured by American Cast Iron Pipe Co. or approved equal.

2.16 FIRE HYDRANTS

A. All fire hydrants shall conform to the requirements of AWWA C502, latest revision for 250 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 4 1/2 -inches. Hydrants shall meet Georgia Fire Insurance Commission Standards, and Local Fire Department requirements and be furnished in accordance with owner's standards.

B. In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.

C. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.

D. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer.

E. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant.

F. The operating nut and direction of operation shall match the current Owner standard. The operating threads shall be totally enclosed in an operating chamber, separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by a grease or an oil reservoir.

G. Hydrant shall be a non-freezing design and be provided with a simple, positive, and automatic drain which shall be fully closed whenever the main valve is opened.

H. Hose and pumper connections shall be breech-locked, pinned, or threaded and pinned to seal them into the hydrant barrel. Each hydrant shall have two 2-1/2-inch hose connections and one 4-1/2-inch pumper connection, all with National Standard threads and each equipped with cap and non-kinking chain.

I. Hydrants shall be furnished with a mechanical joint connection to the spigot of the 6-inch hydrant lead.

J. The minimum bury depth shall be 42 inches (48 inches in State Highway right-of-way) with 30 to 36 inches above grade. Provide extension section where necessary for proper vertical installation and in accordance with manufacturer's recommendations.

K. All outside surfaces of the barrel above grade shall be painted with enamel equal to Koppers Glamortex 501 in a color to be selected by the Owner.

L. Hydrants shall be traffic model and shall be American-Darling B-84-B, Mueller Super Centurion, M & H Valve 129.

2.17 WATER METERS

A. 1 (one) inch and Smaller Water Meters: Shall conform to AWWA C700, latest revision. The water meter shall be the positive displacement type with frost-protection bottom covers that are enamel coated. The meter shall also be tamper resistant. Residential size shall be Invesus(Sensus) T-10 Full 3/4" and 1" meters with ProRead AutoDetect Register, magnetic drive reading cubic feet. Two-inch meters shall be Invesus(Sensus) compound meter and shall conform to AWWA C702, latest revision with encoder registers and R900 RF Pit MIUs. All meters shall be approved by the City prior to ordering.

B. 12 inch to 3 inch Water Meters: Shall conform to AWWA C701, latest revision, Class II. All meters shall be approved by the City prior to ordering.

C. 14 inch and Larger Water Meters: Shall conform to AWWA C704, latest revision. All meters shall be approved by the City prior to ordering.

2.18 METER BOXES

A. 1 inch and Smaller:

- Ford Long Yokebox For 5/8"X3/4" Meter (Potable Residential Use Only)
  Number LYLV141-243-TR
- Ford Long Yokebox For 5/8"X3/4" Meter (Potable Commercial Use Only) Testable Backflow Preventer Supplied By Water Customer
  Number LYLV141-242-SP-TR
- Ford Long Yokebox For 1" Meter (Potable Residential Use Only)
  Number LYLBB141-444-TR
- Ford Long Yokebox For 1" Meter (Potable Commercial Use Only) Testable Backflow Preventer Supplied By Water Customer
  Number LYLBB141-SP-TR

B. 1-1/2" or 2": Refer to City of Port Wentworth's Technical Detail W-19

2.19 SERVICE PIPE COUPLINGS

A. 3 inch and smaller shall use CTS compression fittings or approved equal by City.

B. 4" or greater shall use M.J. (mechanical joint) D.I. (ductile iron) sleeves or approved equal by the City.

2.20 SERVICE SADDLES

Tapping saddles shall be used for making service connections on PVC and/or Ductile Iron Pipe. A JCM 406 coated service saddle with double stainless steel strap or approved equal.

2.21 CORPORATION STOPS

Corporation Stops shall be of bronze alloy, size 1" inch or as shown on the plans, with compression joint for copper or polyethylene pipe, and with ground key. Shall be Mueller H-15008, Ford F1000 or approved equal.

2.22 CURB STOPS

Curb Stops shall have a body of heavy cast bronze construction, bronze tie head and stem, spherical brass ball valve seated in molded Buna N rubber. The meter valve shall be provided with a female meter connection and a compression joint for connection to both 3/4" plastic or copper tube. Shall be Mueller H-14350, Ford B43-232W or approved equal.

2.23 VALVE MARKERS

A concrete valve marker post shall be furnished and installed as directed, with each gate valve (excluding fire hydrant valves). The concrete marker post shall have a four-inch minimum square section and a minimum length of 42 inches with beveled edges and containing at least one three-eighths inch diameter bar of reinforcing steel. Markers shall be placed as directed by the Engineer and set so as to leave 18 inches exposed above grade. The exposed portion of the valve markers shall be stamped "WATER".

2.24 ELECTRONICALLY DETECTABLE LINE MARKING TAPE

Reef Industries Terra Tape Standard or approved equal.

2.25 VALVE VAULTS

Precast Manufacturing shall be in conformance with ASTM C913.

Furnish and install for each valve vault an aluminum access assembly as shown on plans, complete with hinged and hasp-equipped cover. Frame shall be securely mounted. The door shall have a safety locking handle in the open position. Designed to withstand vehicular traffic in off-street locations. Single or Double leaf covers are constructed of ¼" diamond pattern plate and reinforced for AASHTO H-20 wheel loading.

2.26 YARD HYDRANTS

Shall be the non-freezing, compression type with 1 inch threaded inlet and 1 inch hose thread on the nozzle discharge. It shall be a high capacity 1-inch "Any Flow" frost proof yard hydrant made by Merrill Manufacturing Co. or approved equal. Vacuum breakers shall be provided with each one.

2.27 T-HANDLE OPERATING WRENCH

The contractor shall furnish two wrenches, 30 inches long, standard waterworks type with socket for square operating nuts of gates or other valves. All below grade valves shall be adapted with an extension stem and fittings so that they can be operated with a 30-inch long wrench.

2.28 CUTTING IN SLEEVES AND VALVES

Shall be Clow Class 150 meeting latest AWWA Specifications.

2.29 TAPPING SLEEVES

Tapping sleeves and valves shall be used for making branch connections to an existing water main. Tapping sleeves shall be provided at the locations indicated on the drawings and shall be mechanical joint type, Mueller No. H-615, Clow F-5205 or approved equal. Tapping valves shall be mechanical joint type gate valves, Mueller No. 667, Clow F-5093 or approved equal.

2.30 JOINT RESTRAINTS:

All restraints shall be used in accordance with engineering and manufacturer=s specifications. Thrust block is not allowed. Joint restraints shall be:
Ford 1390 Series, Mega-Lug, EBBA Series 1100 for Ductile Iron 4" and larger, EBBA Series 2000 PV for PVC Pipe 4" and larger, Flexlock, T-lock, Uni-Flange, or approved equal.

2.31 BRASS NIPPLES AND BRASS PIPE FITTINGS (DOMESTIC MADE):

Threads shall be cleanly cut with sharp tools and the jointing procedure shall conform to the best practice. Before jointing, all scale shall be removed from pipe by some suitable means. After cutting, all pipe shall be screwed together with an application for graphite and engine oil, Teflon tape, or other sealing compound applied to all threads and once a joint has been screwed on it shall not be backed off unless the threads are re-cleaned and new compound or Teflon tape applied. Unions shall be installed at every connection to the supply line.

PART 3 EXECUTION

3.01 All items specified under this section shall be installed in conjunction with piping that is specified under the appropriate section. Locations are to be as shown on the plans or as otherwise specified.

3.02 Valves, brackets, and fittings where not constructed of brass, aluminum, bronze, or finished steel, shall be factory finished in accordance with approved manufacturer's standards. Machined surfaces shall be given a suitable coating of grease or other protective material. After installation, exposed items shall be field painted as specified elsewhere.

3.03 All valves shall be tested at point of manufacture. After the valves are installed, the contractor shall test them under the working pressure, and any valves found to leak shall be satisfactorily repaired or replaced.

END OF SECTION

SECTION 02531
SANITARY SEWER FORCE MAIN

PART 1 GENERAL

1.01 SCOPE

A. Furnish all labor, equipment, materials for the construction of all sanitary sewer force main(s) shown on the drawings, including pipe, bends, connections, air release/and or vacuum valves, and all other appurtenances specified and/or required.

B. Site piping covered under this Section shall begin at the outside face of structures and buildings, except where there is no joint at the outside face, then site piping shall begin not more than two feet beyond the face of the structure or building. Piping covered under this section shall also include piping within miscellaneous vaults such as valve vaults.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02317 - Trench Excavation and Backfill

B. Section 02445 – Jack and Bore Crossings

C. Section 02532 – Sanitary Sewers

D. Section 03305 – Cast-In-Place Concrete

1.03 SUBMITTALS

Complete product data and engineering data, including shop drawings, shall be submitted to the Engineer in accordance with the requirements of Section 01330 of the Contract Documents.

1.04 TRANSPORTATION AND HANDLING

A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification. Pipe handled on skids shall not be rolled or skidded against the pipe on the ground.

B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front end loader. Do not use material damaged in handling. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior coatings or internal lining of the pipe. Do not use chains in handling pipe, fittings and appurtenances.

1.05 STORAGE AND PROTECTION

A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.

B. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves shall be drained and stored in a manner that will protect them from damage by freezing.

C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.

D. Stored mechanical and push-on joint gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

E. Mechanical-joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

PART 2 PRODUCTS

2.01 FORCE MAIN PIPE

A. PVC PIPE:
PVC Force main pipe shall be factory dyed industry standard GREEN in color.

1. MATERIAL

PVC Pipe for sewer force mains 4" inches through 12" inches shall conform to AWWA C900, DR 18 (100psi), latest revision.
PVC Pipe less than 4" inches in diameter shall be Class 200, DR21 conforming to ASTM D2241, latest revision with pipe made from PVC 1120 material.

B. DUCTILE IRON PIPE:

Ductile Iron Pipe – DIP shall be pressure class 350 for 4" thru 12", and class 250 for 14" thru 20". The pipe shall be coated on the interior with 40 mils nominal dry film thickness of PROTECTO 401 Ceramic Epoxy within 8 hours of surface preparation as manufactured by U.S. Pipe or "SewperCoat" with Calcium Aluminate as manufactured by Lafarge or approved equal. Ductile Iron Pipe designed and manufactured in accordance with ANSI A21.51 centrifugally cast in metal or sand lined molds. Exterior surface shall be seal coated with 1 mil thick approved asphaltic coating in accordance with ANSI/AWWA C151/A21.51.

C. HIGH DENSITY POLYETHYLENE PIPE (C906): **Sanitary Sewer Force Mains**:

High density polyethylene **Sanitary Sewer Force Main** pipe in sizes 4" and above shall be joined by means of zero leak-rate heat-fusion, and approved mechanical joints, meeting the specifications and requirements of American Water Works Association Standard C906 and ASTM F714.

The polyethylene pipe and fittings shall be made from virgin resins exhibiting a cell classification of PE 345464C for black and a cell classification of PE 345464E for stripes per ASTM D3350; and shall be Listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4, *Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds*, with a standard grade HDB rating of 1600 psi at 73°F.

The wall thickness shall follow the Dimension Ration (DR) system prescribed in AWWA C906. Laying lengths are 40 ft standard. The pipe is to be joined by heat fusion, flanges or other mechanical joint systems proven for HDPE pipes. HDPE shall be the DR as shown on plans or Bid Form. The DIPS longitudinal color stripe pattern shall have three equally spaced pairs of **GREEN** color stripes extruded into the pipe OD for **Sanitary Sewer Force mains**. The pipe shall be DRISCOPLEX 4300 or approved equal.

D. HIGH DENSITY POLYETHYLENE PIPE: **Raw, Treated or Reclaimed Water:**

High density polyethylene **Raw, Treated or Reclaimed Water** pipe in sizes 4" and above shall be joined by means of zero leak-rate heat-fusion, and approved mechanical joints, meeting the specifications and requirements of American Water Works Association Standard C906 and ASTM F714.

The polyethylene pipe and fittings shall be made from virgin resins exhibiting a cell classification of PE 345464C for black and a cell classification of PE 345464E for stripes per ASTM D3350; and shall be Listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4, *Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds*, with a standard grade HDB rating of 1600 psi at 73°F.

The wall thickness shall follow the Dimension Ration (DR) system prescribed in AWWA C906. Laying lengths are 40 ft standard. The pipe is to be joined by heat fusion, flanges or other mechanical joint systems proven for HDPE pipes. HDPE shall be the DR as shown on plans or Bid Form. The DIPS longitudinal color stripe pattern shall have three equally spaced pairs of **GREEN** color stripes extruded into the pipe OD for **Raw, Treated or Reclaimed Water** mains. The pipe shall be DRISCOPLEX 4500 or approved equal.

2.02 JOINTS AND GASKETS

A. PUSH-ON JOINTS:

1. DIP Push-on joints shall conform to AWWA C111/ANSI A21.11 (latest revision) - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings. Details of the joint design shall be in accordance with the manufacturer's standard practice such as "Fastite", "Bell-Tite," "Tyton," or equal joints. Gasket material shall be standard styrene butadiene copolymer (SBR).

   Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

2. PVC Push-on joints shall be an elastomeric gasketed joint. Insertion and lubrication of the elastomeric gasket in the annular groove must be as recommended by the manufacturer.

B. RESTRAINED JOINTS:

Restrained joints for DIP shall be obtained by the installation of "Field Lok", "TR Flex", "Fast-Grip", "Flex-Ring", MEGALUG by EBAA Iron, Inc.or approved equal. These restraint glands shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

Tyton Joint Pipe with "Field Lok Gaskets", Fastite Pipe with "Fast-Grip Gaskets" or DIP or PVC Pipe with EBAA Iron, Inc. pipe restraints or approved equal.

All underground creek crossings and jack and bores with steel casing shall use "Field Lok" or "Fast-Grip" restrained joints.

C. FLEXIBLE JOINTS:

Flexible joints shall be American Pipe "Flex Lok", Clow "Ball and Socket", U. S. Pipe "Usiflex", EBAA Iron Inc. FLEX-900 or approved equal. Piping shall have a minimum working pressure rating of 250 PSI and a minimum allowable joint deflection of 15^{o}.

D. MECHANICAL JOINTS:

Mechanical joints for DIP and PVC shall consist of a bolt joint of the stuffing box type as detailed in AWWA C110/ANSI A21.10 (latest revision) and described in AWWA C111/ANSI A21.11 (latest revision) - Rubber Gasket Joints shall be SBR rubber and conform to AWWA C111/ANSI A21.11 (latest revision).

E. FLANGED JOINTS:

Flanged joints shall conform to AWWA C110/ANSI A21.10 (latest revision). Gaskets shall be SBR rubber per ANSI/AWWA C111/A21.11. This rubber compound is NSF 61 certified for contact with potable water or other approved quality shall be used in all flanged joints. The bolts and nuts shall conform in dimensions to the American Standard heavy series.

"KWIK" or Uni-Flange adaptors for plain and pipe shall be used only when authorized by the Engineer. Set screws shall be self-torquing or be properly torqued during installation with a torque wrench.

F. FUSION JOINTS:

1. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic representation of the fusion cycle shall be part of the Quality Control records.
2. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
3. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.
4. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

G. Transition Couplings – Couplings shall be ductile iron conforming to ASTM A-536. Coupling shall be as manufactured by Ford, Dresser, and JCM or approved equal.

2.03 PIPE FITTINGS, SPECIALS AND MISC.

A. POLYVINYL CHLORIDE PIPE:

Fittings used on 4" thru 10" PVC Pipe transitions shall be mechanical or restrained joints as manufactured by American Pipe, U.S. Pipe, Clow or EBAA Iron Inc.

B. DIP FITTINGS AND SPECIALS:

Shall be manufactured in the USA. Mechanical joint fittings shall conform to either AWWA C110 or AWWA C153 (Compact Fittings). Minimum pressure rating for fittings shall be 350 psi. All other fittings shall conform to AWWA C110. The pipe shall be coated on the interior with 40 mils nominal dry film thickness of PROTECTO 401 Ceramic Epoxy within 8 hours of surface preparation as manufactured by U.S. Pipe or "SewperCoat" with Calcium Aluminate as manufactured by Lafarge or approved equal. Unless otherwise noted on the plans, fittings for underground installation shall be mechanical joint conforming to AWWA C111, and fittings for above ground installation shall be flanged conforming to ANSI B16.1 Class 125. Minimum pressure rating for fittings shall be 250 psi. Fittings and specials shall be completed with rings, bolts, gaskets, etc., for joints.

C. POLYETHYLENE PIPE (HDPE):

1. Butt Fusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
2. Electrofusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
3. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D3261. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

PART 3 EXECUTION

3.01 EXISTING UNDERGROUND UTILITIES AND OBSTRUCTIONS

A. The plans indicate utilities and obstructions that are known to exist according to the best information available to the Owner.

B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.

1. Expose the facility, for a distance of at least 100 feet in advance of pipeline construction, to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
2. Avoid utility damage and interruption by protection with means or methods recommended by the utility owner.

C. Conflict with Existing Utilities

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed piping does not permit safe installation of the piping by the use of sheeting, shoring, tying-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the piping to avoid horizontal conflicts if the new alignment complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. Where such relocation of the piping is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed piping does not permit the crossing without immediate or potential future damage to the utility, main, service, or the piping. The Contractor may change the proposed grade of the piping to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer.

D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

E. Sewer and Water Separation

1. Sewer force mains should maintain a minimum 10 foot edge-to-edge separation from potable water lines. If the main cannot be installed providing the 10 foot separation, the separation may be reduced, provided the bottom of the water main is a minimum of 18-inches above the top of the sewer. Should neither of these two separation criteria be possible, the potable water main shall be installed below the sewer with a minimum vertical separation of 18-inches and

the water main shall be encased in concrete with a minimum depth of 6-inches.

2. Where water mains cross the sewer, the pipe joint adjacent to the pipe crossing the sewer shall be cut to provide maximum separation of the pipe joints from the sewer.

3.02 INSTALLATION IN TRENCH

A. Proper and suitable tools and appliances for safe and convenient handling and installing of pipe and fittings shall be used. Great care shall be taken to prevent pipe coatings from being damaged, particularly calcium aluminate cement linings on the inside of D.I.P. pipes and fittings. Any damage shall be remedied as directed. All pipe and fittings shall be carefully examined by the Contractor for defects just before installing and no pipe or fitting shall be installed which is defective.

B. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense. All pipes and fittings shall be cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.

C. Force mains shall be installed on a 4" Class II or III select natural material bedding as specified in Section 02317 Trench Excavation and Backfill with O.D./2 haunching. The compaction for bedding and haunching shall be 90% of Standard Proctor Density as determined by (ASTM D698). Pipe shall not be installed within 6 inches of rock. In trench rock conditions, a minimum of 6 inches of sand or approved suitable soil shall be placed on rock prior to pipe installation. Trenches shall be kept free of water.

D. Where bends and tees occur in pressure mains, the Contractor will pour a block of concrete at the bend or tee as detailed on the Plans. The block shall consist of 3000 psi concrete, and shall be of size and shape as shown on the plans or as directed by the Engineer. The Contractor may use forms or either walls to mold the "thrust block;" however, if earth walls are used they shall be cut true to shape with all excess earth removed and the work shall be done in such a manner that no loose earth will become mixed with the fresh concrete. The Engineer shall inspect all thrust blocks prior to them being covered.

E. All ductile iron pipe laid underground shall be mechanical joint pipe and fittings or "push-on" type joint unless otherwise shown on the plans or directed by the Engineer.

F. All force mains laid underground shall have a minimum of 42 inches of cover above the top of the pipe in non GA DOT R/W and a minimum of 48 inches of cover above the top of the pipe in GA DOT R/W unless otherwise shown on the plans, or unless otherwise directed by the Engineer.

G. All force mains laid under existing water mains, sewers, storm drains, culverts, structures, etc., shall have a minimum clearance of 18 inches between the outside

wall of the force main pipe and the outside surface of the existing pipe or structure.

3.03 PIPE JOINTING

A. MECHANICAL AND RESTRAINED JOINTS:

Clean spigot and bell of foreign material and apply soapy water containing chlorine solution before slipping gasket and gland over spigot end of pipe. Small side of gasket and lip of gland must face the socket. Paint gasket with soapy solution and place spigot end of pipe securely home in socket. Push gasket evenly into position in socket, slide gland into position and tighten bolts with fingers.

Tighten bolts to uniform tightness with ratchet wrench by tightening bottom bolt and then top bolt. Thereafter, all bolts shall be tightened in sequence of 180 degrees apart until all bolts are within the range of torque recommended by the manufacturer.

B. PUSH-ON JOINTS:

Jointing shall be made with rubber gaskets and lubricant furnished by the manufacturer in strict accordance with the manufacturer's recommendations. Prepare field cut pipe by filing 1/8 inch 30 degree bevel on pipe end to avoid injuring gasket.

C. THREADED FLANGE JOINT:

Insert recommended manufacturer's gasket and tighten bolts to uniform tightness with ratchet wrench by tightening bottom bolt and then top bolt. Thereafter, all bolts shall be tightened in sequence of 180 degrees apart until all bolts are within the range of torque recommended by the manufacturer.

D. POLYVINYL CHLORIDE PIPE:

Do not thread PVC pipe. When threads are necessary, adaptors will be used. Use strap wrenches to couple threaded PVC pipe fittings and use lubricant recommended by pipe manufacturer.

Avoid excessive torque and do not score pipe. Use couplings furnished with pipe for fittings and install in strict accordance with the manufacturer's recommendations.

E. POLYETHYLENE PIPE (HDPE):

Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic

representation of the fusion cycle shall be part of the Quality Control records.

3.04 PIPELINE DETECTION MARKING

A. All metallic force mains shall be protected by a 6" wide plastic marking tape placed a minimum of 12 inches above the top of pipe for its full length. The tape shall be equal to Reef Industries Terra Tape Extra Stretch™. It will have sufficient thickness; tensile strength; elongation and resistance to alkalis, acids and other destructive agents to remain a permanent marker of the line buried below. A message shall be printed on the tape at least every 30 inches **"CAUTION SEWER LINE BURIED BELOW", "CAUTION RAW WATER LINE BURIED BELOW"** or **"CAUTION TREATED/RECLAIM WATER LINE BURIED BELOW".**

B. All non-metallic force mains shall be protected by a 6" wide metalized foil tape buried a minimum of 12 inches above the top of the pipe for its full length. The foil shall be protected by plastic film laminated on each side. The lamination shall be strong enough to prevent the separation of foil and plastic film. The tape should be equal to Reef Industries Terra Tape Sentry Line® Reinforced Detectable. It shall be inductively locatable and conductively traceable using a standard pipe and cable-locating device. A message shall be printed on the tape every 30 inches **"CAUTION SEWER LINE BURIED BELOW", "CAUTION RAW WATER LINE BURIED BELOW"** or **"CAUTION TREATED/RECLAIM WATER LINE BURIED BELOW".**

C. Tracing Wire shall be single strand #12 AWG, Vinylon – A THWN or THHN or gasoline and oil resistant II VW 600V or AWM.

3.05 PRESSURE TESTING

A. Hydrostatic testing shall be performed on lines after pipe has been laid and backfilled between joints, all newly laid pipe, or any valved section thereof. The pipe shall be subjected to a hydrostatic gauge pressure of at least (150%) of the rated working pressure of the pipe for two hours and not less than (125%) at the high point per AWWA C600 (DIP) and AWWA C605 (PVC). Working pressure is defined as maximum anticipated sustained operating pressure. In no case shall the test pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.

1. The Contractor shall have the responsibility to ensure that all outlets are closed by valves or plugged and braced to prevent blowouts. Pressurizing equipment shall be constantly monitored or include a regulator or relief valve to avoid over pressurizing and damaging an otherwise acceptable line. No one shall be allowed in manholes, wet wells, valve pits, etc. during testing.
2. To prepare the line for testing, the contractor shall backfill all pipe and provide all reaction blocking before hydrostatic testing. The Engineer may direct the Contractor to leave certain joints and connections uncovered until testing has been completed. All pipe outlets shall be secured to resist the test pressure. Clean out all debris in the pipe.
   The section of pipe under test shall be slowly filled with water and all air shall be expelled from the pipe. If blow-offs are not available at high places,

taps at points of highest elevation shall be made before the test and plugged during and after test.

3. Procedure; the specified test pressure, based on the elevation of the lowest point of the line or lowest point of the section under test and corrected to the elevation of the test gauge, shall be applied by means of a gasoline driven test pump connected to the pipe in a manner satisfactory to the Engineer. The Contractor shall meter the amount of water used during the test. The duration of the test shall be at least two consecutive hours.
   The Contractor shall locate and repair any and all leaks that may develop. All exposed pipe, fittings, valves, hydrants, and joints will be carefully examined during the test. Any cracked or defective pipe, fittings or valves discovered as a result of this test shall be removed and replaced with sound material, and the test shall be repeated until satisfactory to the Engineer.

B. Allowable leakage. The contractor shall furnish the gauges and measuring device for the leakage test, pump, pipe, connections, and all other necessary apparatus, unless otherwise specified, and shall furnish the necessary assistance to conduct the test. The duration of each leakage test shall be 2 hours, unless otherwise specified. During the test, the pipeline shall be subjected to the pressure stated above. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi of the specified leakage-test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if the leakage is greater than that determined by the formula per AWWA C600 (DIP) and AWWA C605:

1) For DIP use:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:
L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

2) For PVC use:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where:
L = allowable leakage, in gallons per hour
N = number of joints in the length of pipeline tested
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 10.50 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

3) Hydrostatic Leak Testing for HDPE:

This hydrostatic leak test procedure consists of filling, an initial expansion phase, a test phase, and depressurizing in accordance with **Chevron Phillips Chemical Co. Publication – Technical Note 802 – Leak Testing.**

a) Filling: Fill the restrained test section completely with a test liquid acceptable to the Owner.

WARNING – Ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release and result in death or serious bodily injury. Use equipment vents at high points to remove air.

b) Initial Expansion Phase:
Gradually pressurize the test section to test pressure, and maintain test pressure for three (3) hours. During the initial expansion phase, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

c) Test Phase:
This alternative is applicable when the test pressure is 150% of the system design pressure.
Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain test
pressure for one (1), or two (2), or three (3) hours. If the amount of make-up water needed to maintain test pressure does not exceed the amount in Table 2, no leakage is indicated.

Table 2 Test Phase – Make-Up Water Allowance:

Make-Up Water Allowance for Test Phase – (U.S. Gal/100 ft of pipe)			
Nominal Pipe size (in.)	1-Hour Test	2-Hour Test	3-Hour Test
4	0.13	0.25	0.40
6	0.3	0.6	0.9
8	0.5	1.0	1.5
10	0.8	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.0	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3

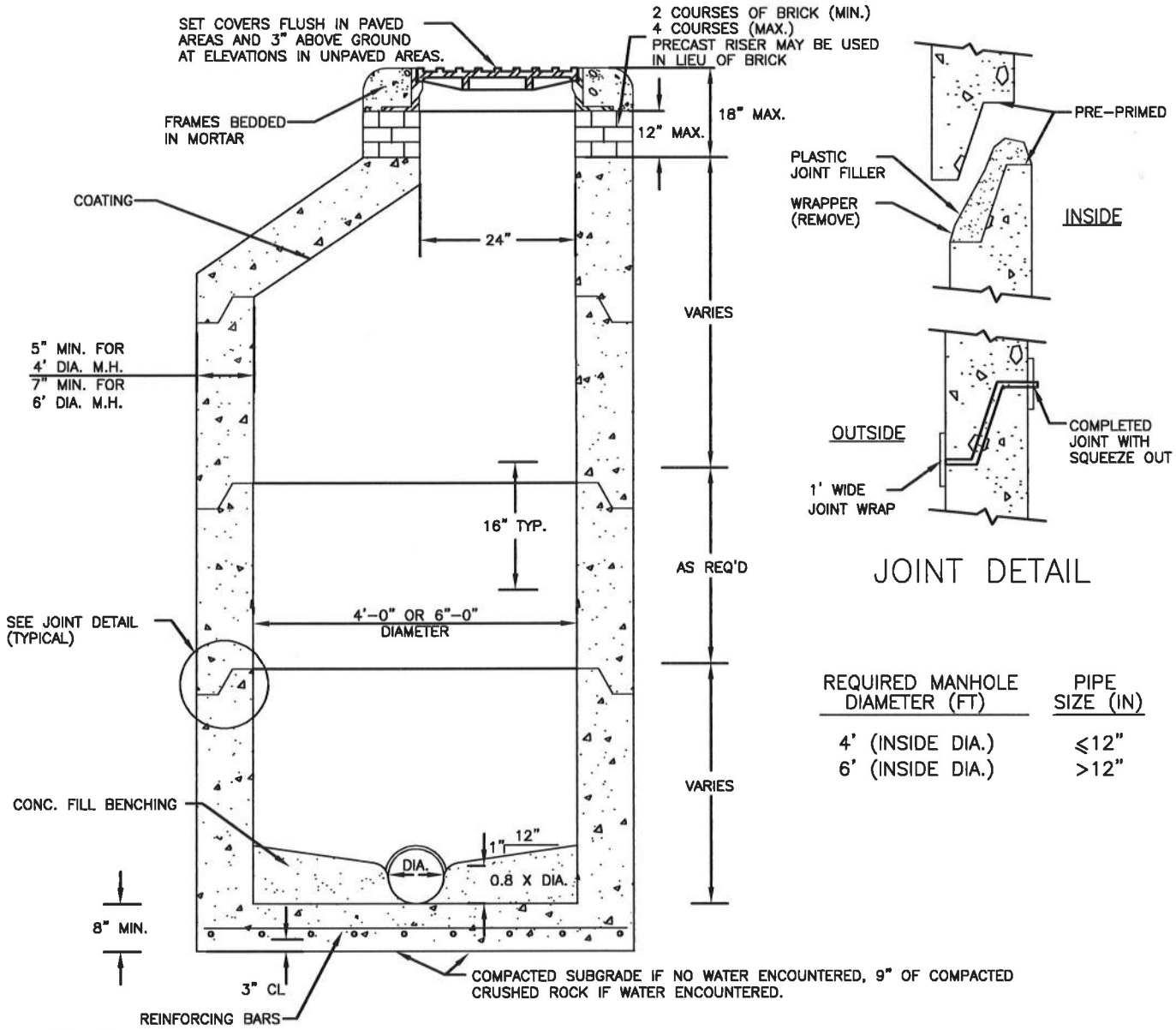
d) Depressurizing:

At the conclusion of the test, carefully depressurize the test section by the controlled release of test liquid. The test liquid may need to be drained and its disposal may be subject to regulations.

3.06 CLEANUP

Remove all surplus materials, tools, excess dirt, rubbish, and debris from the site as installation progresses. Clean as directed by the Engineer. Obtain letter of approval from the State Highway Department covering work installed in areas of State Highway jurisdiction. Contractor to maintain surface of ditches, unpaved streets, road shoulders, sod, grass, and other disturbed surfaces for a period of thirty (30) days thereafter.

END OF SECTION



JOINT DETAIL

REQUIRED MANHOLE DIAMETER (FT)	PIPE SIZE (IN)
4' (INSIDE DIA.)	≤12"
6' (INSIDE DIA.)	>12"

NOTES:

1. PRECAST REINFORCED CONCRETE TOPS, RISERS, BASES AND REBARS SHALL CONFORM TO LATEST ASTM C-478 STD. SPECIFICATIONS.
2. INTERIOR OF MANHOLE SHALL BE COATED IN ACCORDANCE WITH CITY OF PORT WENTWORTH STD. SPECIFICATIONS. THE EXTERIOR OF MANHOLE SHALL BE COATED WITH CONSEAL CS-55 DAMP-PROOF COATING OR EQUAL
3. MANUFACTURER CERTIFICATION THAT MANHOLE MEETS ASTM SPECIFICATION SHALL BE SUBMITTED TO CITY OF PORT WENTWORTH.
4. SEE DETAIL SHEET FOR MANHOLE COVER & FRAME.
6. BUOYANCY MAY NEED TO BE CHECKED IF NECESSARY
7. ALL PIPE PENETRATIONS SHALL HAVE A BOOT CONNECTION. SEE DETAIL S-6.

PRECAST CONCRETE MANHOLE

City of Port Wentworth

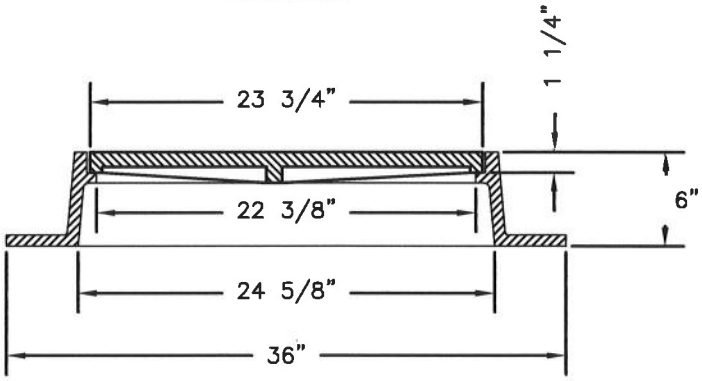
TECHNICAL DETAILS

S-1

PREPARED BY SAUSSY ENGINEERING, LLC.

SCALE: N.T.S.
DATED: FEBRUARY 2007

PLAN



SECTION

NOTE:

MANHOLE RING & COVER SHALL BE HEAVY DUTY RATED EQUAL TO U. S. FOUNDRY CO. USF 195–ORS. TOTAL WEIGHT 325# TYPE "C" LID TO HAVE MACHINED BEARING SURFACES. LID TO BE LETTERED 2 1/2" –3" LETTER HEIGHT "SANITARY" (NON VENTED). MANHOLE RING SHALL INCLUDE A WATERTIGHT GASKET. STACKING CLEATS ON THE BOTTOM OF THE COVER SHALL NOT BE ALLOWED.

MANHOLE RING & COVER

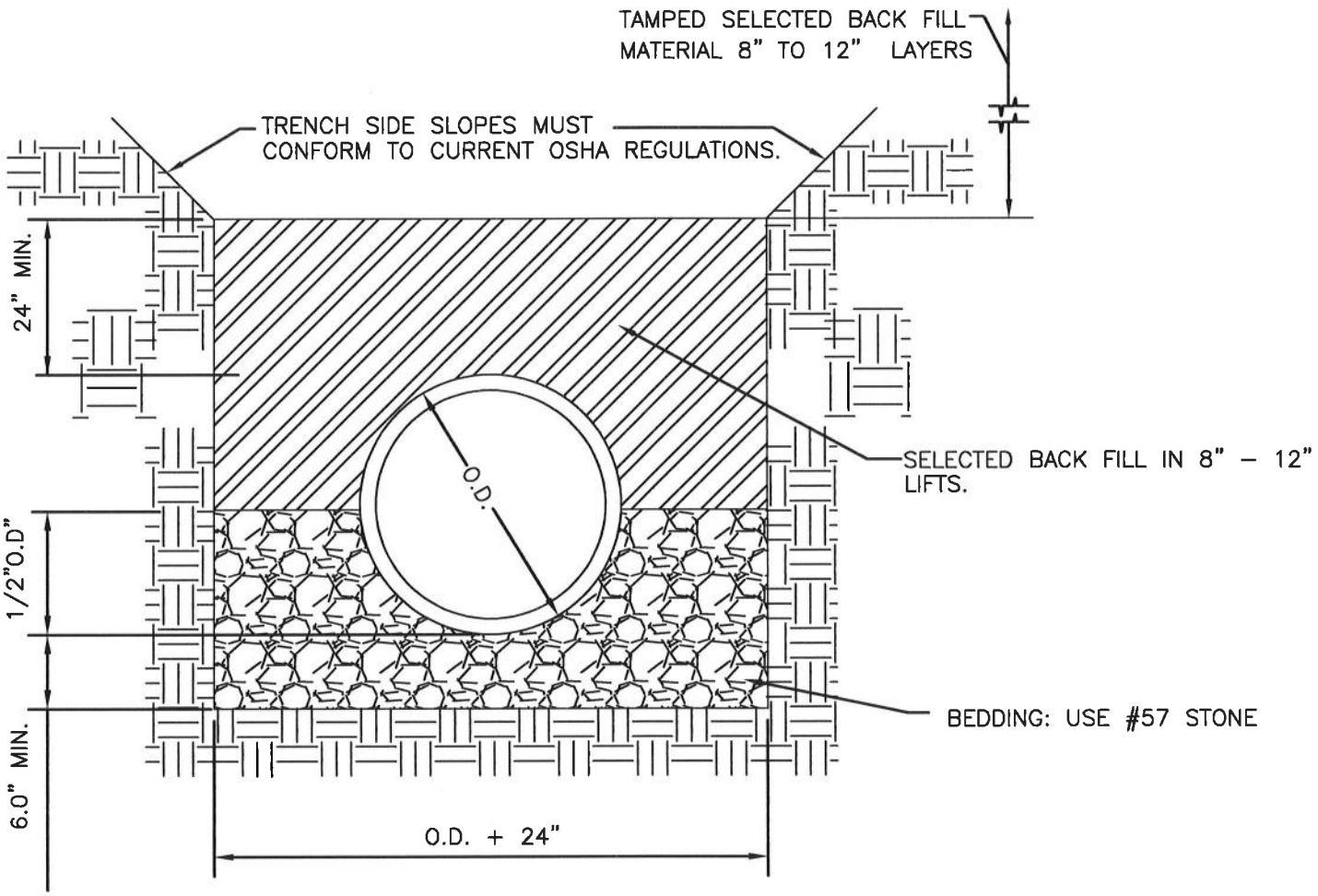
City of Port Wentworth

TECHNICAL DETAILS

S–2

PREPARED BY SAUSSY ENGINEERING, LLC.

SCALE: N.T.S.
DATED: FEBRUARY 2007



PIPE BEDDING

City of Port Wentworth

TECHNICAL DETAILS

S-8

PREPARED BY SAUSSY ENGINEERING, LLC.

SCALE: N.T.S.
DATED: FEBRUARY 2007

COMBINATION AIR VALVE & MANHOLE

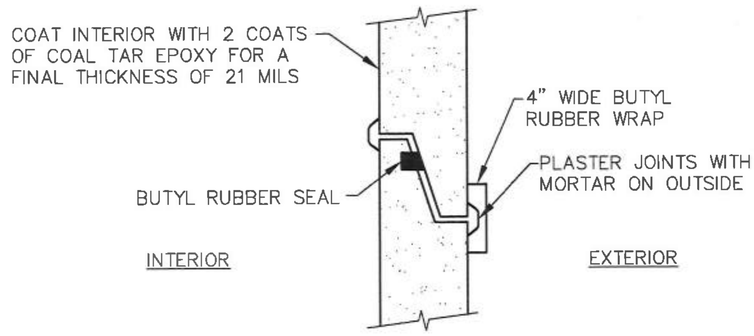
City of Port Wentworth

TECHNICAL DETAILS

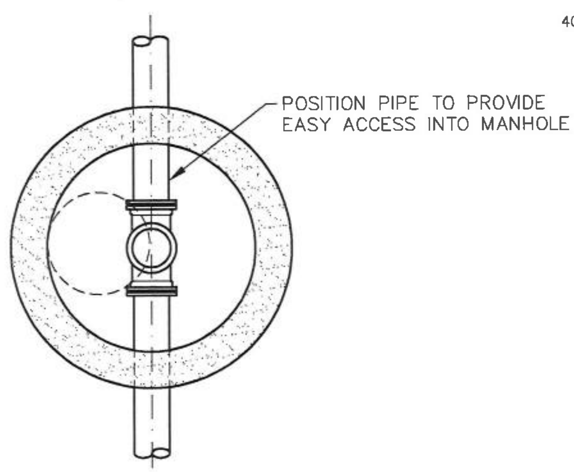
PREPARED BY SAUSSY ENGINEERING, LLC.

S-9

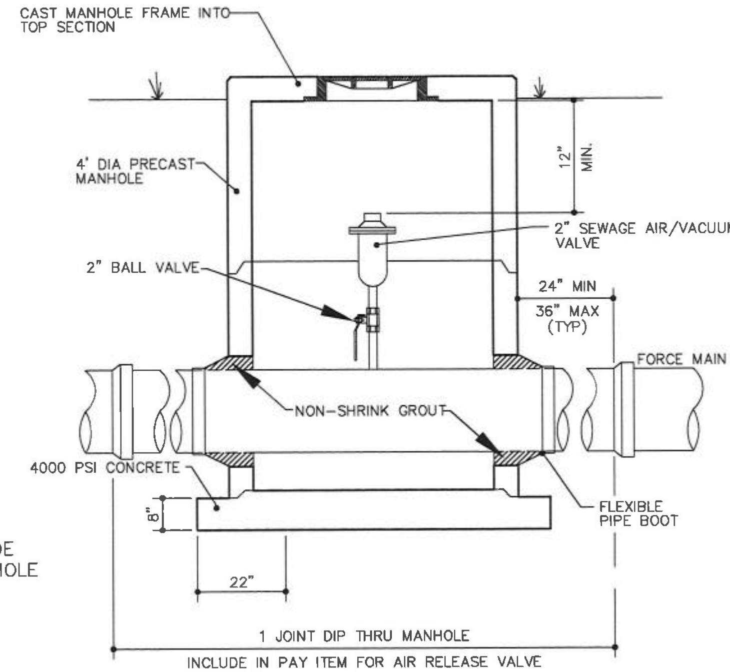
SCALE: N.T.S.
DATED: FEBRUARY 2007



JOINT DETAIL



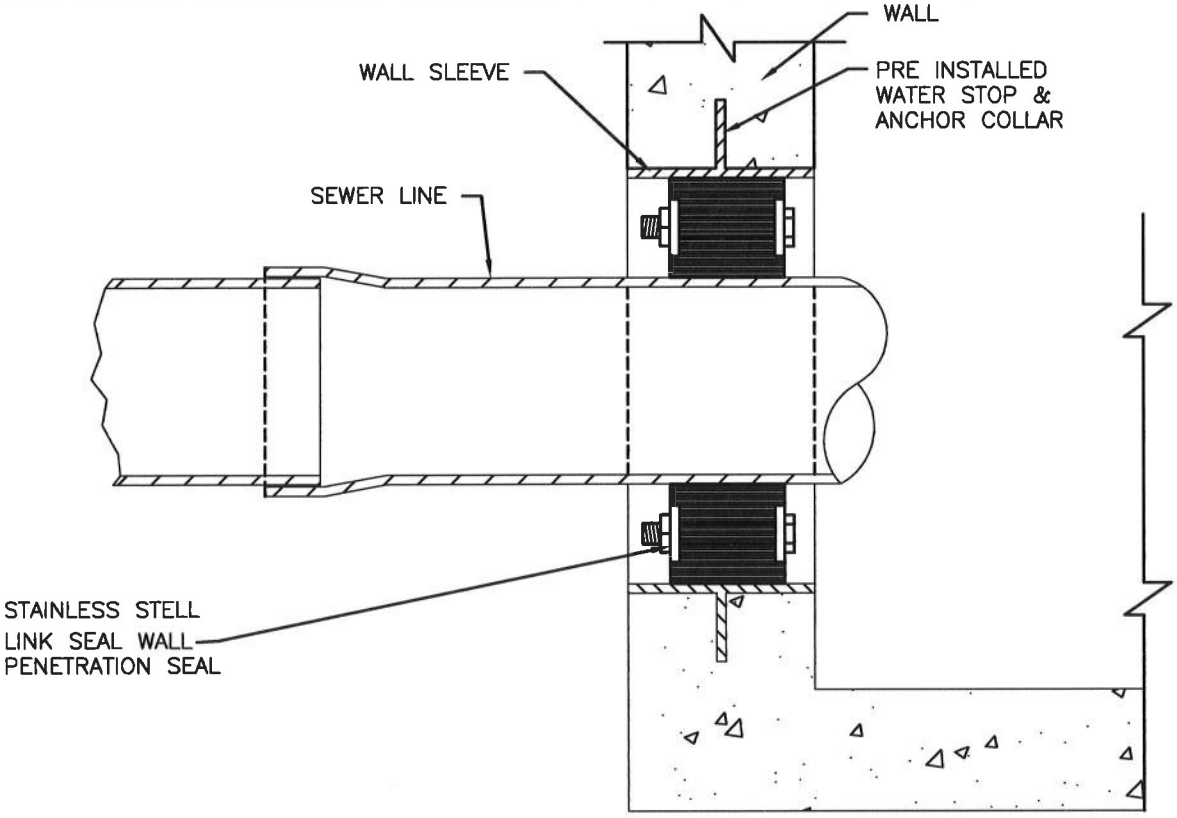
PLAN



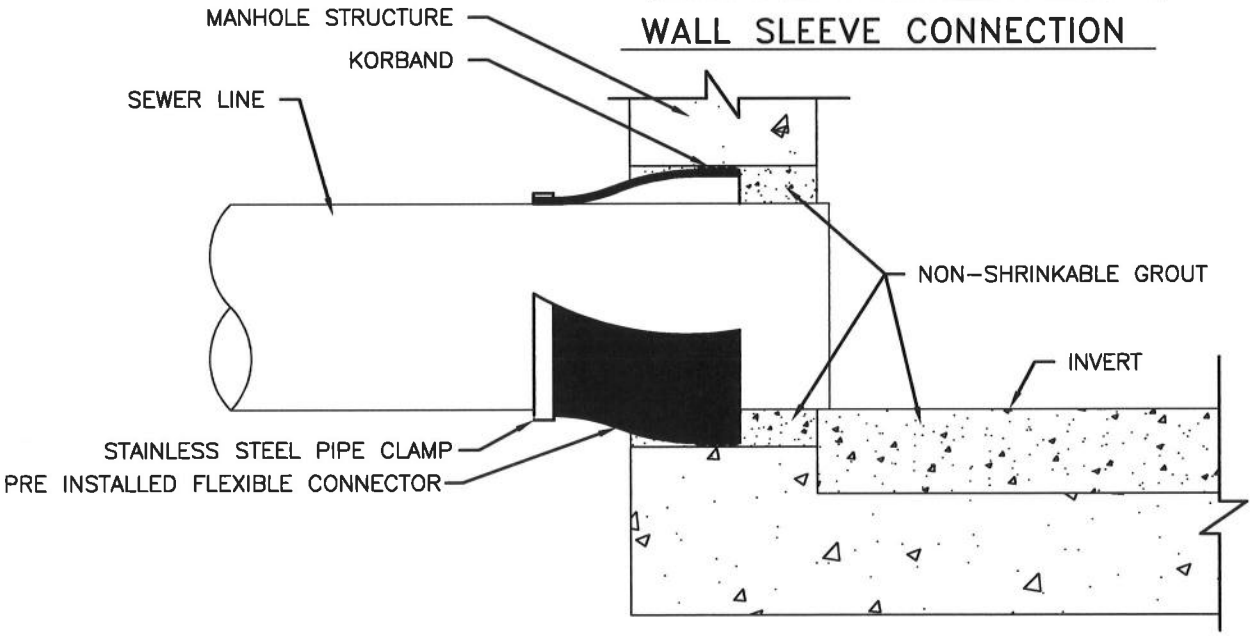
NOTES:

1. SET MANHOLE COVER 2" ABOVE NATURAL GRADE OR FLUSH WITH PAVING.
2. MANHOLE FRAME AND COVER SHALL BE NEENAH R-1595A OR EQUAL. CLEAR OPENING SHALL BE 24" AND HEIGHT SHALL BE 6".

NOTE:
WALL SLEEVE CONNECTIONS ARE REQUIRED FOR VALVE PITS & WETWELLS



WALL SLEEVE CONNECTION



"BOOT" CONNECTION

PRECAST STRUCTURE PIPE CONNECTION

City of Port Wentworth

TECHNICAL DETAILS

S-6

PREPARED BY SAUSSY ENGINEERING, LLC.

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DATED: FEBRUARY 2007