ONWASA

Manual of Standards, Specifications and Details

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

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FOREWORD

About ONWASA (Onslow Water and Sewer Authority)

ONWASA is a public, nonprofit water and sewer authority serving the Onslow County Area. Its members include representatives from the Towns of Holly Ridge, North Topsail Beach, Richlands, North Topsail Beach, Swansboro, City of Jacksonville and the Onslow County Board of Commissioners. ONWASA's Board of Directors is appointed by its member governments and consists of 8-members.

ONWASA was established in July 2005 to provide Onslow County residents with quality water and wastewater services through responsible, sustainable, and innovative stewardship. Since its inception the Towns of Holly Ridge, North Topsail Beach, Richlands and Swansboro and Onslow County have unified operation of their utility assets to join in the effort to promote a safe and reliable drinking water source for Onslow County residents. The City of Jacksonville, the Town of Surf City, and Marine Corps Base Camp Lejeune operate and maintain their own water and sewer utilities. In addition, ONWASA, in recent years has acquired a variety of private water and wastewater systems and continues to construct additions to the system to improve service to its customers.

Manual Introduction

The first "*ONWASA's Manual of Specifications, Standards and Details"* was developed and adopted August 28, 2008. The purpose was to establish guidelines and standards to ensure compliance with Federal, State and Local regulations and with adopted utility standards as set forth by American Water Works Association (AWWA) and other organizations. The adoption of these standards gave ONWASA the means by which to manage the design and construction of its utility assets and infrastructure to provide a water system that is safe and of the highest quality.

The latest approved version of "*ONWASA's Manual of Specifications Standards and Details"*, was approved M, it explains the water and sewer design, extension and construction process and establishes minimum acceptable guidelines and/or standards for the design and construction of water and sewer lines and appurtenances. Although the document still serves as a good reference manual and guide to contractors, there have been changes in materials, methods and procedures that need to be incorporated into a revised document. Since 2005, new and revised standard details had also been developed by ONWASA staff, and need to be incorporated as revised Standard Specifications.

The revisions contained herein are established as minimum requirements for ONWASA and have been determined as reasonable as they apply to ONWASA. The manual incorporates the standards and practices used by ONWASA as set forth by local, state and federal legislation and regulation. The manual additionally integrates the application of utility standards as directed by governing utility, water and sewer organizations

Manual Format

This manual was created and organized to assist design, engineering, contractor and construction professionals. The material contained herein was compiled from adopted policies, standards, details and practices established within the utility and engineering community. This manual contains the required information needed by design engineers, developers, and contractors to design, develop and construct facilities within the ONWASA service area. The manual is available via ONWASA's web site.

Manual Copies

Copies of this manual may be downloaded from the ONWASA web site. If a hard copy is needed it can be supplied at a cost per ONWASA's current "*Rate and Fee Schedule*".

Manual Sections

Section Titles:

Foreword

Water System Design Specifications
- Regulatory, Engineering, and Industry Standards requirements
- The applicable requirements specific to ONWASA

General System Specifications
- Specifications applicable to both ONWASA's water and sewer systems

Water System Specifications
- Specifications applicable to ONWASA's water systems

Sanitary Sewer System Design Specifications
- Regulatory, Engineering, and Industry Standards requirements

Sanitary Sewer System Specifications
- Specifications applicable to ONWASA's sewer systems

Standard Details
- General, water and sewer details for ONWASA's water and sewer systems

Manual Provision

The authors of this manual, to the best of their ability, have insured that the information presented here is correct and that the procedures are reliable. The execution of an engineering design, however, involves the judgment of the design engineer, and only the engineer can ascertain whether a technique or item of information can be applied to a given situation. It is the sole responsibility of the design engineer to certify the design and standards of their design are accurate and correct. ONWASA will assist the

design engineer, developer, and contractor with the interpretation and application of *ONWASA's "Manual of Standards, Specifications and Details, latest revision*" to ensure the proposed design meets the minimum requirements.

Variance or Modification

Any variances, alternate design, construction methods and materials, not specifically prescribed herein, shall be subject to the approval of the Engineering Director or his/her designee.

Jurisdiction

On or after May 19, 2016 this "*Manual of Standards, Specifications and Details, latest revision"* shall be applicable to all new improvements, alterations and additions located within the regulatory jurisdiction of ONWASA.

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Acknowledgments

Project Team:

ONWASA would like to recognize and extend the gratitude of the Authority to the individuals that assisted in creating and assembling "*ONWASA's Manual of Specifications, Standards, and Details, latest revision"*.

Below is the list of those individuals:

Onslow Water and Sewer Authority

ONWASA
ONSLOW WATER AND SEWER AUTHORITY

Engineering Division

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Anthony Harris	GIS Coordinator
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Ken Whitehurst	Inspector
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Jason Gray	Distribution Field Foreman
Seth Brown	Water Production Superintendent
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ONWASA's

Manual of Standards, Specifications and Details

Section I

HOW TO USE THESE SPECIFICATIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

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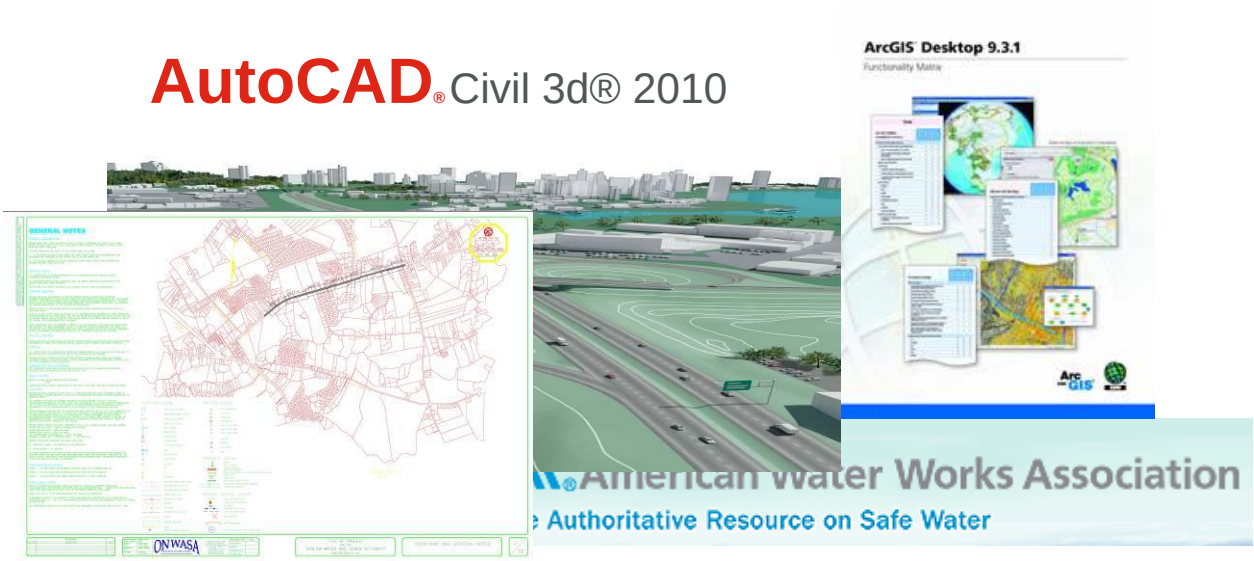
Revision 3, May 19, 2016

- These Standard Specifications and Details are provided as a basis for **"Minimum Design Criteria"**. As such each water or sewer system should be designed to meet the specific requirements of the proposed development site

- These Standard Specifications are applicable only to network of pipes, valves, hydrants and related appurtenances. They are NOT applicable to water pumps, storage tanks, treatment devices, wells or other facilities.

- Should any person, business or other entity wish to appeal the requirements by these specifications, ONWASA staff or the Water and Sewer Advisory Committee, they may appeal to the ONWASA Board of Directors."



ONWASA's

Manual of Standards, Specifications and Details

Section II

WATER SYSTEM DESIGN SPECIFICATIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

"To preserve, protect and enhance North Carolina's water..."

Water Resources
ENVIRONMENTAL QUALITY

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SECTION II
WATER SYSTEM DESIGN SPECIFICATIONS

1. GENERAL

1.1 SPECIFICATION AND DESIGN MANUAL:

A. All projects within the jurisdiction of the Onslow Water and Sewer Authority (ONWASA) shall be designed and constructed in accordance with "*ONWASA's Manual of Specifications and Standards*, latest revision". Projects which are still in progress 5 years after the notice to proceed was issued and each 5 years thereafter shall be brought up to current specs.

B. Public water distribution systems shall conform to the design and construction requirements of the NC Department of Environmental Quality, NCAC Title 15A, Subchapter 18C, *Rules Governing Public Water Systems,* latest revision.

C. All structures and utilities shall comply with the applicable Areas of Environmental Concern (AEC) Standards, as amended, in accordance with the State Guidelines for AEC's (15 NCAC 7H) pursuant to the Coastal Area Management Act of 1974.

1.2 PERMITS:

A. Plan approvals, Water & Sewer: Prior to commencing construction, all plan approvals and permits for water and/or sewer shall be obtained. A preconstruction conference with ONWASA shall be held prior to commencing any construction.

B. Encroachment Permits: An encroachment permit shall be required from any Contractor or Developer wishing to excavate or place utilities on NCDOT or public right-of-ways.

C. Pavement Cuts: Pavement cuts in streets shall be repaired in accordance with the specific requirements of public agency on whose street or roadway the utility is being placed, as well as any other applicable requirements dictated in the approved encroachment permit. Open-cut or bored crossings shall otherwise adhere, as applicable, to specification Section 31 23 17-*Trenching*.

D. Developer shall obtain all other State and Local permits, as applicable (Air Quality, Erosion and Sedimentation Control, Zoning, etc.)

1.3 PLAN REVIEW AND OBSERVATION FEES:

All plan review and observation fees shall be paid prior to acceptance of project. Refer to the current ONWASA fee schedule for applicable fees.

2. WATER SYSTEM DESIGN STANDARDS

The purpose of this module is to establish "**Minimum Design Criteria**" for water system design on systems owned and maintained by, or systems that will be dedicated to, ONWASA.

2.1 DISTRIBUTION SYSTEM

A. General:

Distribution systems shall meet the minimum requirements of the NC Department of Environmental Quality, NCAC Title 15A, Subchapter 18C, *Rules Governing Public Water Systems,* latest revision.

1. Water Supply System: The Developer shall connect the subdivision or development with the water system at his/her expense, and shall construct it in such a manner as to serve adequately for both domestic use and for fire protection.

2. No new permanent structure or pond (storm water, wetland, retention/detention, synthetically lined, etc.) shall be constructed over water mains or located within water or sewer easements.

3. For developments, the Design Engineer shall design the water system to provide for complete coverage of the property frontage along the primary or secondary highway or roadway nearest to the development and all internal streets.

    a. Wherever the existing water system is adequate to support fire protection, projects with multiple phases shall be designed so that fire protection is available to each of the phases of development as they are constructed.

B. Design - System Hydraulic and Demand Design:

As part of the design, the Design Engineer shall perform a steady state analysis model of all proposed extensions using EPAnet, KyPipe, WaterCAD, or other approved compatible, software. The design data shall include a sketch of the system showing assumed minor losses, pipe roughness ("C") constants suitable for design (i.e. Hazen-Williams roughness constant = 130 for PVC), line lengths, fixed grade node elevations, node numbers, demands, pipe numbers, time of day of field test of hydrant (static pressure converted to elevation head) for verification of starting elevation head, the static water elevation in tank at the time a static pressure reading was taken and, ground elevation of hydrant tested. ONWASA will supply flow test data for the fire hydrant closest to the proposed development for each hydraulic analysis. A minimal cost shall be associated with this service.

1. Calibrate the model utilizing actual fire flow test results provided by ONWASA.

2. Average daily flows shall be estimated at 400 gpd per residential household. This estimate shall be modified as necessary based on specific zoning and land use data. Maximum daily flow and peak hourly flow shall be determined as follows:

    Maximum Daily flow = Average daily flow times 2.5
    Peak Hourly flow = Average daily flow times 3.5

3. The water distribution systems and extensions shall be designed to supply for demand of all customers while maintaining the following minimum pressures:
    1. 40 psi for maximum daily flow
    2. 30 psi for peak hourly flow
    3. 20 psi for average daily demand plus fire flow
        1. Utilizing actual fire flow data provided and applied to the hydrant tested, the farthest (innermost) point of the project shall have a minimum of 20 psi residual pressure
        2. The application of the minimum 500 gpm fire flow for design shall be applied at the farthest (innermost) hydrant(s) in the project and the farthest (innermost) point of the project shall have a minimum of 20 psi residual pressure

4. Pipeline Velocity: 3 to 6-fps normal working conditions shall be provided throughout the distribution system, although higher velocities in short lengths of pipe may be tolerated for brief periods. Sustained high discharge velocities can scour the pipe's interior and increase leakage.

5. Main Size: Water mains shall be sized in accordance with ONWASA's long-range water distribution system plans. Standard main sizes in ONWASA's distribution system are 2, 6, 8, 10, 12, 16, 24, and 30-inches. The minimum diameter of public water main is 2-inches. 4-inch diameter mains are not allowed. Fire Hydrants shall not be installed on mains less than 6-inches

in diameter. The inside diameter of the HDPE pipe shall be indicated on the Plans and shall match or exceed the inside diameter of the main upstream and downstream of the ends of the HDPE pipe.

6. Stub outs: Water distribution system shall be designed to allow for future extension of water main to adjacent properties. Water distribution system shall install a valve and kicker-joint (not less than 18-feet in length) at the end of main to allow for future extension.

7. Proposed developments shall connect to ONWASA's public water and/or sewer system if it is within1,000 linear feet or less by public right of way or public utility easement from the closest point of the development to the existing public water and/or sanitary sewer system. If the existing main is inadequate to provide fire protection flow, and another main of character sufficient to provide fire protection flow is within 1,000 linear feet or less by an existing or proposed public right of way or public utility easement, the proposed development shall connect to the main capable of providing the fire protection flow.

8. Waterlines of larger diameter proposed to be connected to existing waterlines of smaller diameter shall only be allowed by approval of the ENGINEERING DIRECTOR.

9. Looping/interconnectivity: Water mains shall be designed to be looped and interconnected as required by ENGINEERING DIRECTOR.

10. Water mains proposed at locations previously occupied by gas stations or other fuel storage areas shall be designed to include DIP and fittings both with nitrile gaskets. Existing water mains along or on properties where gas stations or other fuel storage areas are proposed shall be replaced with DIP and fittings with nitrile gaskets.

11. Valving: Valve shall be fully accessible from ground surface by means of a valve box.

    a) Valve Type/Size: Refer to Section 33 11 00 – *Water Utility Distribution Piping* of ONWASA's Standard Specifications.
    b) Valves shall be installed at all branches from feeder mains and between mains and hydrants according to the following schedule:
        i. One 6-inch valve shall be installed on each Fire Hydrant leg. Unless the fire hydrant assembly is within 50 LF of an intersection, a main-line valve shall be installed adjacent to the hydrant tee.
        ii. 2 valves at tees (excluding Fire Hydrant Tees unless as specified here-in)
        iii. 3 valves at crosses
        iv. An in-line valve shall be installed on the water line and shall not exceed the distances given below:

Line size	Distance
2, 6, or 8-inch mains	500 linear feet
10-inch mains and larger	100 linear feet per inch-diameter

If required, when tapping an existing live main and inserting a main line valve, the main being tapped must be shut off and a valve installed (cut-in) on the existing main within close proximity to the new connection. In-lieu of shutting off the existing main and cutting

in a valve, the ENGINEERING DIRECTOR may allow an "inserting" valve to be placed if the former is undesirable or impractical.

c) Downsizing Mains: When downsizing a main, locate a valve after the reducer on the side with the smaller diameter. However, the designer must evaluate thrust forces and accommodate the forces by placement of a thrust collar (if required) on the larger main.

d) Concrete Blocking under Valves: Provide concrete or solid brick blocking on solid foundation under valves placed on all mains and beneath valves connected to tapping sleeves.

C. Piping Material Applications:

1. General: Use pipe, fittings, and methods of joining in accordance with the following ONWASA Standard Specification Sections as applicable:
   a) Section 33 05 19 – Pressure Piping Joint Restraint
   b) Section 33 05 23 – Trenchless Utility Installation
   c) Section 33 05 24 – Utility Horizontal Directional Drilling
   d) Section 33 11 00 – Water Utility Distribution Piping
   e) *Section 33 12 13 – Water Service Connections*

2. Locator Tape: Brightly colored blue tape continuously printed with "WATER LINE" in large letters, minimum 6-inch wide by 4 mils thick, with magnetic detectable conductor manufactured for direct burial service shall be installed and buried 1.5 to 2 feet from the top of the water line to aid in locating the pipe if an excavation occurs

3. Tracer wire: 10-Gauge insulated wire blue in color shall be installed along the top of the water line to aid in locating the pipe for maintenance purposes. The wire shall be continuous and uninterrupted, and brought to the surface at marker posts as specified in Section 33 11 00.

4. Marker posts of concrete measuring 6” X 6” X 36” with bronze markers stamped “Buried Water Call 811 Before Digging” shall be installed directly above water mains at the locations of every bore entry and exit where water lines cross wetlands, streams, creeks, etc.. Installation shall be as specified in Section 13 11 00.

D. Joint applications:

PIPE	JOINT TYPE	COMMENT
UNDERGROUND APPLICATIONS		
Ductile Iron Pipe	Push-On	6-inch thru 30-inch
Ductile Iron Fittings	Mechanical Joint	6-inch thru 30-inch
PVC C900	Push-On	6-inch thru 12-inch
PVC 905	Push-On	14-inch and 16-inch

PE 3408 water service	Compression w/ solid stainless steel inserts	1-inch thru 2-inch
PVC ASTM D2241	Bell & Spigot w/ gasket	1-inch thru 2-inch
Brass Pipe	NPT threaded	Short sections of 2-inch
ABOVE GROUND APPLICATIONS		
Ductile Iron	Flange Joint	6-inch thru 30-inch
Brass	NPT threaded	1-inch thru 2-inch
Stainless Steel	NPT threaded	1-inch thru 2-inch

1. Galvanized pipe and galvanized fittings shall not be permitted in the ONWASA water system.
2. PVC glued or threaded pipe or fittings shall not be permitted in the ONWASA water system.
3. Provide transition couplings and special fittings with pressure equal to or exceeding the pressure rating of the pipe or fitting to which they will be either connected or fitted.
5. Do not use flanges, unions, or keyed couplings for new underground piping. With the approval of the ENGINEERING DIRECTOR, they may; however, be used in above ground applications such as vaults. 3-part unions may be used for repairs.
6. 90-degree bends shall be minimized to the extent possible.

E. Location:

Water mains shall be located within dedicated street right-of-way or a 20-foot (minimum) publicly dedicated permanent utility easement to ONWASA. Installation of utilities in easements shall be done only by consent of the ENGINEERING DIRECTOR.

F. Fire Hydrants:

1. Fire Hydrants shall not be installed on mains less than 6-inches in diameter.
2. Fire Hydrant Location: Hydrants shall be located in accordance with Appendix C, *Fire Hydrant Locations and Distribution* of the NC Fire Prevention Code, latest edition or per ONWASA's Standard Water Specifications whichever is more restrictive.
3. Fire Hydrant location requirements for uses other than residential single family: Fire Hydrant spacing and location shall be reviewed and approved by the ENGINEERING DIRECTOR and the Fire Marshall.
4. All Fire Hydrants shall be located within dedicated street right-of-way or a 20-foot permanent utility easement publicly dedicated to ONWASA.

5. No fire hydrant shall be buried by landscaping material, dirt or gravel above the maximum bury line painted by the factory on the hydrant barrel. Hydrant extensions are permitted for use to raise hydrants no more than 2'. Hydrants that require extensions in excess of 2' shall be replaced with hydrants of sufficient bury depths.

6. Minimum Fire Flow at Fire Hydrants: All projects involving extension of water mains shall be capable of meeting the minimum requirements of the North Carolina Fire Prevention Code, as updated from time to time, and shall be reviewed and approved by the local Fire Code Official. The minimum design flows shall be measured for a minimum of a five-minute period.

7. Maximum Distances from Structures:

   a) Residential: 250 feet by the pull of the hose method to the building.
   b) Commercial & Multi-family: See Appendix C of the NC Fire Prevention Code

8. Minimum distances from a structure: No new Fire Hydrant shall be located closer than 20-feet from a structure.

9. Fire Hydrant in relation to street: See Standard Details

10. Services on Fire Hydrant Branches: Services on Fire Hydrant branches are not permitted.

11. A Fire Hydrant shall be installed at the entrance of a subdivision if the nearest Fire Hydrant is more than 400 feet away.

12. Fire hydrants located inside the City of Jacksonville's Extra Territorial Jurisdiction (ETJ) area shall meet the requirements of the City of Jacksonville.

G. Pressure/Fire Flow:

1. Minimum System Pressure: The minimum water pressure for future extensions to the water distribution system shall be as follows:

   a) If there is sufficient pressure in the existing water distribution system that is within 1,000 linear feet from the nearest point on the property by way of a new or proposed public right of way or public utility easement, the future water distribution extension shall be designed for a minimum fire flow of **500 gpm at 20 psig residual**. The future extensions shall be design and constructed with fire hydrants as required in this specification.

   b) Where there is not sufficient pressure in the existing water distribution system to provide a minimum fire flow of **500 gpm at 20 psig residual**, the water distribution extension shall be sized to provide a normal minimum working pressure at all points within the distribution system of not less than **30 psi (gauge)** during periods of peak demand (fire flow).

2. The water distribution system and any extensions shall be designed to supply for a minimum fire flow of **500 gpm at 20 psig residual**.

3. Pressure Reducing Valves -The installation of pressure reducing valves shall be as required and installed per the NC State Plumbing Code covers the installation of pressure reducing valves. Pressure reducing valves are neither owned, installed, nor maintained, by ONWASA.

H. Bury:

Water mains shall be designed with a minimum bury of 36-inches cover and a maximum depth of 60 inches from bottom of main. AR

1. Water mains designed to cross under culverts shall be restrained ductile iron pipe with restrained vertical fittings (bends) to minimize the depth of cover on either side of the crossing. Maximum depth of bury shall be approved by the ENGINEERING DIRECTOR.

2. Water mains which have less than 36-inches of ground cover shall be approved by the applicable regulatory agency and the ENGINEERING DIRECTOR.

I. Horizontal and Vertical Blocking:

Concrete thrust blocking, restraint glands, tie rods, restrained joint pipe, and/or other means of restraint shall be provided at all changes in pipe direction. Concrete thrust blocking is not recommended where the blocking may bear on other utilities or where the area behind the block may be excavated in the future.

J. Dead end lines:

Blow-off assemblies shall be installed at the end of all water mains and as required for flushing, as directed by the ENGINEERING DIRECTOR. Temporary blow-off assemblies shall be installed on lines that may be extended. Permanent blow-off assemblies shall be installed on lines that will not be extended. The following blow-off sizes shall apply for the applicable main size:

Main Line Size	Blow-off Size Required	Blow-off Valve Size
Permanent Blow-off Assemblies		
6, and 8-inch mains	2-inch	2-inch
12-inch mains	4-inch	4-inch
16-inch to 20-inch mains and larger	6-inch	6-inch
24-inch mains	8-inch	8-inch
30-inch mains	12-inch	12-inch
Temporary Blow-off Assemblies		
6-inch thru 24-inch	2-inch	Valve to match main size

a) A temporary blow-off shall have a full 18-foot joint of pipe between the valve and the standpipe.

b) The maximum length of a permanent dead end 6 and 8-inch main shall be 700 feet and 1200 feet, respectively, unless approved by the ENGINEERING DIRECTOR. A Fire Hydrant shall be installed at the dead end.

K. Sag Vertical- Sag Blow-offs:

When directed by the ENGINEERING DIRECTOR, provide a sag blow-off when lines have severe sag where sediment can accumulate and retard flow in water line (such as when running beneath large streams, ditches or culverts).

L. Crest Vertical - Air Release/ Valves:

Where water mains are subject to air entrapment, provide an air release valve constructed in accordance with standard Details_WS_ARV as applicable, located at the highest elevation on the main. Where the main undulates along its length and several crests are encountered, a separate air release manhole will be required at each crest. The ENGINEERING DIRECTOR, before placement, shall approve the final actual location of all air release manholes. Typically, when the relative elevation difference in a water main (from the main's sag elevation to the crest elevation) is greater than 15-feet, an air release valve will be needed.

Air release/vacuum valves shall be 2-inch minimum. Refer to air release valve manufacturer's recommendations for air release sizing and quantity.

The valve shall be used to bleed air from the line as it is filled with water for testing.

Manhole Size Determination:

1. The minimum diameter of manholes shall be 4-feet.

2. Manholes with 16-inch diameter or larger pipe shall be a minimum of 6-feet in diameter.

M. Vertical upward thrust:

Vertical upward thrust at fittings or vertically deflected joints shall be resisted with thrust collars of adequate size and weight, pilings, or other acceptable methods approved by ONWASA. See standard Details_WS_TB3.

N. Relation of Water Mains to Sewer:

See specification *Section 33 11 00 – Water Utility Distribution Piping* for separation requirements between water mains and sewer mains, force mains, vacuum sewer and laterals and other related structures and between water mains and other utilities/structures.

O. Stream Crossings:

Where possible, all stream crossings shall be made below water level. Stream crossings may require Environmental Assessment unless directional bored. Stream crossings shall be made as close to perpendicular to the stream as possible. All stream crossings shall be made with ductile iron pipe.

3. **Below streambed crossing**: Unless otherwise approved by the ENGINEER DIRECTOR, stream crossings shall be completed with ductile iron piping and no less than 5-feet of cover in accordance with ONWASA's Standard Details.

4. **Above stream crossing:** Water mains crossing streams above normal water level shall be placed above the 25-year storm elevation when practical and otherwise meet DWQ requirements for stream crossings. Stream crossings above water level shall be constructed with piers or other suitable methods approved by the ENGINEERING DIRECTOR.

3. Hanger Support from Bridges: In the design of the aerial system, provide both details and calculations showing the hanger type, hanger capacity, hanger-to-bridge attachment type (mechanical or chemical), and capacity with a minimum safety factor of Three (3). Assume the pipe is full. Provide lateral bracing of hanger to a girder or to bottom of bridge deck. Two pipe

hangers per pipe joint shall be required. Provide plans showing the plan view and elevation of the water line crossing.

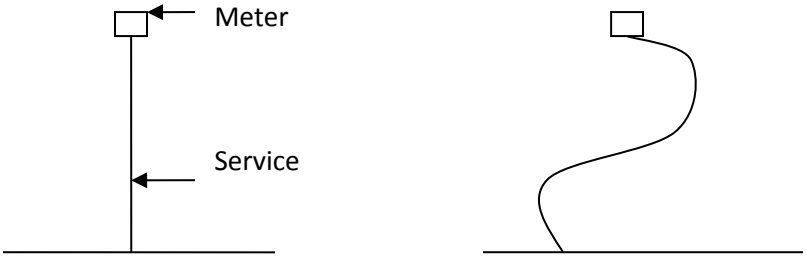
4. **Thermal Protection, allowance for main expansion:** Where aerial crossings are approved by ONWASA, install expansion devices as necessary to allow for expansion and contraction movement in pipe, such as on aerial bridge or creek crossings. Expansion joints are typically to be provided where the line transitions from aerial to underground. Provide calculations showing expected differential movement. To prevent freezing, provide either pipe insulation jackets that totally cover the pipe (so that the pipe and insulation is placed inside the hanger assembly) or an insulation system the covers both the pipe and hanger assembly.

P. Taps:

Taps shall be made in accordance with *Section 33 12 13 – Water Service Connections* of ONWASA's Standard Specifications.

Q. Water Services:

General: A water service shall be provided for each lot. The meter box shall be located 1- foot from the back of the curb, within the public right of way (see standard detail). Services shall be placed perpendicular to the main and shall not meander or snake in such a manner as to offset the meter from its main connection point (see schematic below). The meter box shall be set flush with the finished grade and shall not be installed in a ditch slope. In situations where the meter box is located outside of the public right-of-way, a water easement shall be provided to ONWASA.



For multi-family housing, individual water meters shall be required unless a variance is requested of, and approved by, the ONWASA Board of Directors and master metered.

Meter Location - double frontage lots: If the lot fronts two or more streets, the meter shall be located within 5-feet of the sewer service.

R. Water Meter Sizing:

1. Residential and Commercial Facilities: Water service connections shall be sized in accordance with AWWA Manual M22, "Sizing Water Service Lines and Meters" or the NC Plumbing Code, whichever is more restrictive, and subject to the approval of the ENGINEERING DIRECTOR. The number of gallons per minute required for the facility (flow demand), and the rate-of-flow provided by ONWASA (via flow test) to verify meter size shall determine the size of the proposed water

meter. Documentation of how the flow rate was determined (calculated) by the DESIGN ENGINEER shall be submitted for verification of meter size selection.

2. Irrigation systems shall be metered separately and shall be sized based on flow demand.

3. If the future flow demand is proposed or anticipated to increase (i.e. project phasing/expansion), provisions shall be made to install a meter box or vault, and connections for the future flow demand, but the meter shall be sized for current demands and shall be changed, as future flow demands require.

4. All improvements on the property side (outlet) of the meter shall be in accordance with the current Plumbing Codes. Properly sizing water service lines, backflow prevention devices, and pressure reducing valves to maintain adequate water flow and pressure from the meter to the structure and/or point of demand shall be the responsibilities of the property owner and/or DESIGN Engineer.

5. The DESIGN Engineer shall submit flow demand and pressure requirements to ONWASA for review. The DESIGN Engineer shall be responsible to insure head loss through meter meets project requirements.

6. Commercial Meters: In some cases, a unit may be supplied at the option of ONWASA through a Commercial Meter. Examples of when ONWASA may permit Commercial Meters include, but are not limited to the following:

   a. Units under common ownership such as apartments, multi-storied commercial buildings, recreational vehicle parks, mobile home parks and individual dwelling units containing not more than five hundred (500) square feet of heated living area.

   b. Condominiums under separated ownership which contain five (5) or more units per building.

   c. In no case shall master meters be allowed on multifamily developments in which individual units are sold.

S. Combination Vaults:

Vaults shall be designed and constructed to provide minimum clearances between the pipe, fittings or vault walls per the dimensions prescribed in the applicable vault detail(s). See Standard Details. See the applicable detail for the particular type application proposed.

T. Multiple Source Systems:

Water systems with multiple sources shall be required to install an approved Reduced Pressure Principle Assembly (RP) in accordance with ONWASA's *Water System Cross-Connection Control Ordinance*, latest revision.

U. Cross-connection prevention:

Approved backflow prevention assemblies shall be installed on the service line to all facilities where applicable in accordance with the ONWASA Utility Ordinance.

V. Testing:

Testing of completed water mains shall include the following:

1. Hydrostatic Testing: Perform testing in accordance with ONWASA Specifications, *Section 33 11 00 - Water Utility Distribution Piping* and *Section 33 12 13 – Water Service Connections*, as applicable.

2. Tracer Wire Testing for Continuity: Perform testing in accordance with ONWASA Specifications, *Section 33 11 00 - Water Utility Distribution Piping.*

3. Chlorination and Bacterial Test; HPC Test: Perform testing in accordance with ONWASA Specifications, *Section 33 13 00 - Disinfecting Water Utility Distribution.*

4. **DECHLORINATION**: The disposal of chlorinated water is the responsibility of the CONTRACTOR. Upon completion of retention period required for disinfection, the heavily chlorinated water shall be neutralized by chemical application before discharge from the main. **A de-chlorinating device is required**. Chlorine concentration of the water discharged from the main shall be no higher than 0.1ppm in excess of the residual in the existing system or is acceptable for domestic use.

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ONWASA's

Manual of Standards, Specifications and Details

Section III

GENERAL SYSTEM SPECIFICATIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

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SECTION TABLE OF CONTENTS

ONWASA Standard General Specifications

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SECTION 03 11 13
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formwork for cast-in-place concrete.
2. Openings for other work.
3. Form accessories.
4. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.
5. Cast-in-place concrete.
6. Finishing and curing of horizontal and vertical concrete surfaces.

1.2 QUALITY ASSURANCE

A. Comply with ACI 301-99 unless specifically noted otherwise.

1.3 DEFINITIONS

A. Exposed: Exposed to view by persons responsible for operation or maintenance of the structure.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of form marks.

1. Plywood: U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Earth Forms: Subject to ONWASA's approval.

D. Form Ties: Factory-fabricated removable or snap-off metal type designed to prevent form deflection and to prevent spalling concrete upon removal. Units to leave no metal closer than 1 inch to surface.

E. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete including curing compound, sealer, or water-proofing.

2.2 REINFORCEMENT

A. Reinforcing Steel:

1. ASTM A615, 60 ksi yield grade, deformed billet steel bars, unfinished; or ASTM A616, 60 ksi yield grade, deformed rail steel bars, unfinished, or;

2. Depending on the location and type of Project, ONWASA reserves the right to require epoxy-coated reinforcing steel per ASTM A 775, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

B. Welded Wire Fabric:

1. ASTM A185, plain wire, sheet form. Rolled fabric not permitted, or;

2. If epoxy-coated reinforcing steel is required as specified above, ASTM A 884/A 884M, Class A, Type 1 coated, as-drawn-steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length.

2.3 CONCRETE MATERIALS AND ADMIXTURES

A. Cement: ASTM C150, Type I - Normal Portland type.

1. Fly Ash: ASTM C618 Class F or C; loss on ignition less than 3 percent.

B. Fine and Coarse Aggregates: ASTM C33 (normal weight aggregate); materials containing deleterious substances (spalling causing) are not acceptable.

C. Water: Clean and not detrimental to concrete.

D. Air Entrainment: ASTM C260

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. ASTM C494 Type A - Water-Reducing,

2.4 Type F - Water-Reducing, High Range, containing no chlorides CURING MATERIALS

A. Membrane Curing Compound: ASTM C309, Type I-D, Class B, clear with fugitive dye which disappears approximately 24 hours after exposure to sunlight. Curing compound shall be compatible with coatings which are to be applied to the concrete surface.

B. Absorptive Mats: Burlap-polyethylene, minimum 8 ounces per square yard bonded to prevent separation during handling and placing.

C. Water: Potable, not detrimental to concrete.

2.5 ACCESSORIES

A. Epoxy Repair Coating: If epoxy-coated reinforcement is required, the CONTRACTOR shall have a supply of liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775 onsite. The repair coating shall be applied to any area(s) on the reinforcement where the coating is damaged, and allowed to cure, in strict accordance with the manufacturer’s recommendations

B. Non-Shrink Grout: Pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 28 days; Master Builders Masterflow 713, or as approved.

C. Epoxy Grout (concrete adhesive): Two component, epoxy resin bonding system capable of developing a minimum bond strength of 1,100 psi in 48 hours; ASTM C881 Type IV, Grade 3, Class B and C

D. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

E. Joint Filler Type A: ASTM D994; asphalt-impregnated fiberboard or felt; W.R. Meadows Asphalt Joint, or as approved.

F. Joint Filler Type B: ASTM D1752, pre-molded sponge rubber fully compressible with recovery rate of minimum 95 percent; W.R. Meadows Sponge Rubber, or as approved.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
2. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.6 CONCRETE MIX (UNLESS SPECIFIED OTHERWISE)

A. Concrete Proportions: Comply with ACI 301, 4.2.

B. Class I Concrete: Provide concrete to the following criteria:

1. Compressive Strength (7 Day): 3,200 psi.
2. Compressive Strength (28 Day): 4,000 psi.
3. Water/Cement Ratio (Maximum): 0.50 by weight.
4. Air Entrained: 6 percent, $\pm$1 percent.
5. Fly Ash Content: Maximum 25 percent of cement content.
6. Slump (Maximum): 3 inches (due to water).
7. Mid or High Range Water Reducer: Add at Site to increase slump to 6 inches, $\pm$1-1/2 inches.

C. Class II Concrete: Provide concrete to the following criteria:

1. Compressive Strength (28 Day): 2,500 psi.
2. Fly Ash Content: Maximum 25 percent of cement content.
3. Slump (Maximum): 6 inches.

D. Mud Mat Concrete: Provide concrete to the following criteria:

1. Compressive Strength (28 Day): 1,000 psi.

PART 3 EXECUTION

3.1 SAFETY: Entire Project site shall be kept in strict accordance with OSHA Regulations.

3.2 GENERAL

A. Use Class I concrete for structural concrete, and concrete for pavements, sidewalks and equipment bases; use Class II concrete for fillets and fills, and where indicated.

3.3 PLACING CONCRETE

A. When Class I concrete arrives at the Project with slump below 3 inches, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. Slump adjustment, with water, shall be made only one time. The addition of water shall only be done with the approval, and under the supervision of, the independent testing service representative.

B. Placement of concrete under water is not permitted.

C. Advise the designated testing agency not less than 72 hours before operations to allow for completion of quality tests.

D. TEMPERATURE REQUIREMENTS

1. The concrete temperature at the time of placing in the forms shall be not less than 50°F, or more than 95°F.
2. No concrete shall be placed when the air temperature, measured at the location of the concreting operation in the shade away from artificial heat, is below 35°F, without approval from ONWASA. When such permission is granted, the aggregates and/or water shall be uniformly heated to a temperature not higher than 150°F. The temperature of the heated concrete shall not be less than 55°F and not more than 80°F at the time it is placed in the forms.
3. The aggregates shall be free of ice, frost, and frozen particles, and concrete shall not be placed on frozen foundation material.

4. The Contractor shall assume all risks connected with the placing of concrete under the cold weather conditions referred to herein. Permission given by ONWASA to place concrete when the temperature is below 35°F and the subsequent protection of the concrete as required, shall not relieve the Contractor in any way of the responsibility for obtaining the required results.

E. ELAPSED TIME FOR PLACING CONCRETE

1. Deliver concrete to any monolithic unit of a structure at a rate which will permit proper handling, placing, and finishing of the concrete; and have it so regulated that the maximum interval between the placing of batches at the work site does not exceed 20 minutes.
2. Place concrete before the elapsed time between adding the mixing water to the mix and placing the concrete in the forms exceeds the maximum elapsed times listed in the following table. Retarding admixtures may only be used if approved by ONWASA, if retarding admixtures are approved for use, an additional 45 minutes will be permitted.

Air or Concrete Temperature, Whichever is Higher	Maximum Elapsed Time (min.)
90°F (32°C) or above	30
80°F (27°C) through 89°F (32°C)	45
79°F (32°C) or below	60

3.4 CONCRETE FINISHING

A. Exterior Traffic Surfaces: ACI 301, 5.3.4.2.d, broom finish.

3.5 CURING

A. Horizontal Surfaces: Cure floor surfaces in accordance with ACI 301 using any of the following accepted procedures.

1. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
2. Membrane Curing Compound: Pavement, walks, and curbs only.

3.6 FIELD QUALITY CONTROL

A. Concrete Testing Service: When structures (i.e. manholes, footings, etc.) are being constructed, unless otherwise approved by ONWASA, the CONTRACTOR shall employ an independent testing agency to perform material evaluation tests, design concrete mixtures, observe the entire pour(s), and also conduct slump, air content, and strength testing of the concrete to ensure compliance with applicable ACI Codes and these Specifications. Samples for air content and strength should be taken as near as practical to the point of placement into the formwork or at a location which closely matches the handling conditions when the concrete is placed in the forms. Prior to the addition of a mid or high range water reducer, a slump test may be made from a sample taken from the very first concrete out of the load.

B. Reinforcement Inspection: Unless otherwise approved by ONWASA, the CONTRACTOR shall employ an independent testing agency to inspect, and approve, the reinforcement placement prior to placing concrete.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating topsoil.
2. Excavating subsoil for buildings, pavements, and landscape.
3. Backfilling building perimeter to subgrade elevations.
4. Backfilling site structures to subgrade elevations.
5. Filling under pavements or slabs-on-grade.
6. Undercutting and filling over-excavation.
7. Disposal of excess material.

B. Related Sections:

1. *Section 31 10 00 - Site Clearing*
2. *Section - Erosion Controls* section.31 25 00
3. *Section – Trenching31 23 16.13*
4. *Section - Rock Removal*.31 23 16.26
5. *Section 32 91 19 - Landscape Grading*

1.2 REFERENCES

A. NCDOT Standard Specifications:

1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

B. American Association of State Highway and Transportation Officials:

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

C. ASTM International:

1. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
5. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with Sections 225, 230, 235, 260, and 802 of the NCDOT Standard Specifications.

B. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of North Carolina as necessary.

C. **There shall be no garbage (i.e. food wrappers, drink bottles, etc.) or construction debris (i.e. concrete, tree roots, etc.) placed in the backfill.**

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth. It shall be free of large stones, roots, waste, debris, contamination, or other unsuitable material, which might hinder plant growth.

B. Subsoil: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2-inches in any dimension, debris, waste, frozen material, and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

C. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM, or SP-SC.

D. Structural Fill: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

E. Borrow Material: Conform to subsoil requirements.

2.2 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable, conforming to Section 1056 of the NCDOT Standard Specifications for Type 1 Engineering Fabric.

B. Concrete: Class A Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 3,000 psi at 28 days.
2. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
3. Maximum slump of 3.5-inches for vibrated concrete and 4-inches for non-vibrated concrete.
4. Minimum cement content of 564 lbs per cubic yard for vibrated and 602 lbs per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 GENERAL: The entire site shall be in strict accordance with OSHA Regulations.

3.2 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

C. Verify sub-drainage, damp proofing, or waterproofing installation has been inspected.

D. Verify underground structures are anchored to their own foundations to avoid flotation after backfilling.

E. Verify structural ability of unsupported walls to support loads imposed by fill.

3.3 PREPARATION FOR EXCAVATION

A. Call local utility line locating service(s) as necessary in accordance with North Carolina General Statute Chapter 87, Article 8, the State of North Carolina Underground Damage Prevention Act.. Request underground utilities to be located and marked within and surrounding construction areas. Identify required lines, levels, contours, and datum locations. Locate requests shall not be placed for a greater area than can be worked before the expiration date of the locate ticket.

B. Notify applicable utility companies to remove and relocate utilities as necessary.

C. Protect utilities indicated to remain from damage.

D. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.

E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Establish temporary traffic control and detours in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and all applicable NCDOT requirements when excavation is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.4 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded without mixing with foreign materials for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site and protect from erosion.

D. Remove from site excess topsoil not intended for reuse.

3.5 SUBSOIL EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to accommodate building foundations, structures, slabs-on-grade, paving, landscaping, and construction operations.

C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.

D. Slope banks with machine to angle of repose or less until shored.

E. Do not interfere with 45-degree bearing splay of foundations.

F. Grade top perimeter of excavation to prevent surface water from draining into excavation.

G. Trim excavation. Remove loose matter.

H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. Remove larger material as specified in *Section 31 23 18 – Rock Removal*.

I. Notify ONWASA and testing agency of unexpected subsurface conditions.

J. Correct areas over excavated with granular fill, subsoil or structural fill, as required by project conditions and compact as required for fill areas.

K. Remove excess and unsuitable material from site.

L. Repair or replace items indicated to remain damaged by excavation.

M. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.

N. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

O. When excavating through roots, perform Work by hand and cut roots with sharp axe.

P. Remove from site excess subsoil not intended for reuse.

Q. Benching Slopes: Horizontally bench existing slopes greater than 3:1 to key placed fill material into slope to provide firm bearing.

R. Stability: Replace damaged or displaced subsoil as specified for fill.

3.6 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Design sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18-inches below finished subgrade, or design sheeting and shoring to be removed at completion of excavation work.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.7 SURFACE WATER CONTROL

A. Control and remove unanticipated water seepage into excavation.

B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in *Section 31 25 13- Erosion Controls*.

C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.8 DEWATERING

A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.

B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation. The Contractor is responsible for utilizing dewatering systems in accordance with good standard practice. The dewatering systems must be efficient enough to lower the water level in advance of the excavation and to maintain it continuously to keep the trench bottom and sides firm and dry. Groundwater shall not be allowed to rise around the pipe until after the trench is backfilled. Disposal of groundwater shall be disposed of in a suitable manner so as to not cause damage to adjacent property or facilities, or be a threat to public health.

C. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

D. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.9 PROOF ROLLING

A. In presence of representative from independent geotechnical testing firm, employed by the Contractor, proof roll areas to receive fill, pavement, and building slabs to identify areas of soft yielding soils.

1. Use loaded tandem-axle pneumatic tired dump truck or large smooth drum roller.

2. Load equipment to maximum 50 tons gross weight and make the number of passes as directed by the independent geotechnical testing agency.

B. Undercut such areas to firm soil, backfill with granular fill, subsoil or structural fill as required by project conditions, and compact to density equal to or greater than requirements for subsequent fill material.

C. Do not proof roll or undercut until soil has been dewatered.

3.10 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess material offsite and legally.

B. Furnish ONWASA with certificate of disposal site or agreement from private property owner.

3.11 BACKFILLING

A. Scarify subgrade surface to depth of 4-inches.

B. Compact subgrade to density requirements for subsequent backfill materials.

C. Backfill areas to contours and elevations with unfrozen materials.

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

E. Place fill material in continuous layers and compact in accordance with Schedule at end of this Section.

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

G. Maintain optimum moisture content of backfill materials to attain required compaction density.

H. Support foundation walls and structures prior to backfilling.

I. Backfill simultaneously on each side of unsupported foundation walls and structures until supports are in place.

J. Slope grade away from building minimum 2 percent slope for minimum distance of 10-feet, unless noted otherwise.

K. Make gradual grade changes. Blend slope into level areas.

L. Remove surplus backfill materials from site.

3.12 TOLERANCES

A. Top Surface of Backfilling within Building and Paved Areas: Plus or minus 1-inch from required elevations.

B. Top Surface of Backfilling within Landscape Areas: Plus or minus 2-inches from required elevations.

3.13 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

D. Repair or replace items indicated to remain damaged by excavation or filling.

3.14 FIELD QUALITY CONTROL

A. It is the responsibility of the Contractor to employ an independent geotechnical testing firm to conduct all required to geotechnical testing to confirm compliance with the requirements of this Section.

B. Request visual inspection of bearing surfaces by ONWASA and independent geotechnical testing firm before installing subsequent work.

C. Laboratory Material Tests: In accordance with ASTM D698.

D. In-Place Compaction Tests: In accordance with the following:

1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
2. Moisture Tests: ASTM D3017.

E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

F. Frequency of Tests:

1. Building and Pavement Areas: Twice per lift for every 5,000 square feet.
2. Landscape Areas: Twice per lift for every 10,000 square feet.

G. Unless otherwise approved by ONWASA, ONWASA shall be on site to witness all geotechnical testing and reserves the right to choose test locations. Notify ONWASA a minimum of 72 hours in advance of geotechnical testing.

3.15 SCHEDULES

A. Under Pavement and Slabs:

1. Maximum 8-inch compacted depth.
2. Compact material to a minimum of 95 percent of maximum density, except the top 12-inches
3. Compact top 12-inches to a minimum of 98 percent of maximum density

B. Under Landscape Areas:

1. Maximum 8-inch compacted depth.
2. Compact to minimum 90 percent of maximum density

C. Footing Foundation Fill:

1. Structural fill to maximum 12-inch compacted depth
2. Compact to 98 percent of maximum density

D. Bridge Lift Fill:

1. Granular fill in 18 to 24-inch lift on top of degraded soil.
2. Place ahead of construction equipment.

END OF SECTION

SECTION 31 23 16.13
TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities and utility structures.
2. Bedding.
3. Backfilling and compacting to subgrade elevations.
4. Sheeting and Shoring.
5. Dewatering.
6. Compacting backfill material.

B. Related Sections:

1. *Section – Rock Removal31 23 16.26*
2. *Section – Erosion Controls31 25 00*
3. *Section – Utility Manholes and Structures33 05 13*
4. *Section 33 11 00 – Water Utility Distribution Piping*
5. *Section 33 12 13 – Water Service Connections*
6. Section 33 31 13 – *Gravity Sewers*
7. Section 33 34 00 – *Force Mains*

1.2 REFERENCES

A. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

B. NCDOT Standard Specifications:

1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Utility Structures: Manholes, catch basins, inlets, valve vaults, hand holes, and other utility access structures as indicated on Drawings.

C. Trench Terminology:

1. Foundation: Area under bottom of trench supporting bedding.
2. Bedding: Fill placed under utility pipe.
3. Haunching: Fill placed from bedding to center line of pipe.
4. Initial Backfill: Fill place from center line to 6 to12-inches above top of pipe.
5. Final Backfill: Fill placed from initial backfill to subgrade.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1505 of NCDOT Standard Specifications. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of North Carolina as necessary.

1.5 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. **There shall be no garbage (i.e. food wrappers, drink bottles, etc.) or construction debris (i.e. remnants of old pipe, tree roots, etc.) placed in the backfill.**

B. Subsoil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2-inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

C. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM or SP-SC.

D. Foundation Stone: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

E. Bedding and Haunching Material:

1. Pressure Pipe (Waterlines and Force Mains)
   a. Rigid Pipe (Ductile Iron Pipe): Granular fill.
   b. Flexible Pipe (C900 PVC, C905 PVC, SDR-21 PVC): Granular fill unless field conditions, as determined by ONWASA, necessitate foundation stone.

2. Non-Pressure Pipe (Gravity Sewer)
   a. Rigid Pipe (Ductile Iron Pipe): Foundation stone
   b. Flexible Pipe (C900 PVC, C905 PVC, SDR-35 PVC, Schedule 40 PVC): Foundation stone

F. Bedding for Structures: Foundation Stone.

G. Initial Backfill to 6-inches Minimum Above Utility:

1. Pressure Pipe (Waterlines and Force Mains)
   a. Rigid Pipe (Ductile Iron Pipe): Granular fill.
   b. Flexible Pipe (C900 PVC, C905 PVC, SDR-21 PVC): Granular fill unless field conditions, as determined by ONWASA, necessitate foundation stone.

2. Non-Pressure Pipe (Gravity Sewer)
   a. Rigid Pipe (Ductile Iron Pipe): Granular fill
   b. Flexible Pipe (C900 PVC, C905 PVC, SDR-35 PVC, Schedule 40 PVC): Foundation stone

H. Final Backfill to Subgrade:

1. Under Pavement: Granular Fill.
2. Under Landscape: Subsoil Fill.

2.2 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Section 1056 of the NCDOT Standard Specifications for Type 1 Engineering Fabric.

B. Concrete: Class A Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 3,000 psi at 28 days.
2. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
3. Maximum slump of 3.5-inches for vibrated concrete and 4-inches for non-vibrated concrete.
4. Minimum cement content of 564 lbs per cubic yard for vibrated and 602 lbs per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 GENERAL: The entire site shall be in strict accordance with OSHA Regulations.

3.2 PREPARATION

A. Call local utility line locating service(s) as necessary in accordance with North Carolina General Statute Chapter 87, Article 8, the State of North Carolina Underground Damage Prevention Act. Request underground utilities to be located and marked within and surrounding construction areas. Identify required lines, levels, contours, and datum locations. Locate requests shall not be placed for a greater area than can be worked before the expiration date of the locate ticket.

B. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.

C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities indicated to remain.

E. Establish temporary traffic control and detours in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and all applicable NCDOT requirements when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 LINES AND GRADES

A. Excavate to lines and grades indicated on Drawings. ONWASA reserves the right to make changes in lines, grades, and depths of utilities as Project conditions necessitate.

B. Use laser-beam instrument with qualified operator to establish lines and grades as required.

3.4 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove lumped subsoil, boulders, and rock up of 1/3 cubic yard, measured by volume. Remove larger material as specified in *Section 31 23 18 – Rock Removal*.

C. Perform excavation within 48-inches of existing utility service in accordance with utility's requirements.

D. Do not advance open trench more than 200-feet ahead of installed pipe or as far ahead as work can be completed in a day, whichever is more restrictive.

E. No trenches or excavations alongside roads or public right of ways shall be left open and unsecured in accordance with all applicable safety requirements regarding open excavations.

F. Remove water or materials that interfere with Work.

G. Trench Width: Excavate bottom of trenches maximum 24-inches wider than outside diameter of pipe or as indicated on Drawings.

H. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

I. Maintain vertical faces to an elevation equal to 12-inches above top of pipe.

1. When Project conditions permit, side walls may be sloped or benched above this elevation.
2. When side walls cannot be sloped, sheet, shore, and brace excavation(s) as specified in this Section.

J. Support Utilities and Structures:

1. Keep trench width at top of trench to practical minimum to protect adjacent or crossing utility lines
2. Support utilities crossing trench by means acceptable to applicable utility company.
3. Do not interfere with 45-degree bearing splay of foundations.
4. Provide temporary support for structures above and below ground as required.

K. When subsurface materials at bottom of trench are loose or soft, excavate to firm subgrade or to depth directed by ONWASA.

1. Cut out soft areas of subgrade not capable of compaction in place.
2. Backfill with foundation stone and compact to density equal to or greater than requirements for subsequent backfill material.

L. Trim Excavation: Hand trim for bell and spigot pipe joints where required. Remove loose matter.

M. Correct areas over excavated areas with compacted backfill or #57 stone as specified for authorized excavation as directed by ONWASA.

N. Place Geotextile fabric over trench foundation stone prior to placing subsequent bedding materials as indicated on the Plans.

3.5 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Design sheeting and shoring to be removed at completion of excavation work unless otherwise approved by ONWASA.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.6 SURFACE WATER CONTROL

A. Control and remove unanticipated water seepage into excavation.

B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in *Section 31 25 13 – Erosion Controls*.

C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.7 DEWATERING

A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.

B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation. The Contractor is responsible for utilizing dewatering systems in accordance with good standard practice. The dewatering systems must be efficient enough to lower the water level in advance of the excavation and to maintain it continuously to keep the trench bottom and sides firm and dry. Groundwater shall not be allowed to rise around the pipe until after the trench is backfilled. Groundwater shall be disposed of in a suitable manner so as to not cause damage to adjacent property or facilities, or be a threat to public health.

C. Modify dewatering systems when operation causes, or threatens to cause, damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

D. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.8 BEDDING, HAUNCHING, AND INITIAL BACKFILL

A. Place bedding full width of trench to the depth indicated on Drawings and compact to 95 percent maximum density. Excavate for pipe bells.

B. Install utility pipe and conduit in accordance with the respective utility section.

C. Support pipe uniformly along entire length of pipe.

D. Carefully place haunching material to center of pipe, rod and tamp material to fill voids and provide uniform support of pipe haunches. Compact to 90 percent maximum density.

E. Carefully place initial backfill to 6-inches above top of pipe or to depth indicated on Drawings. Compact to 95 percent maximum density.

F. Reference applicable ONWASA Standard Details.

3.9 FINAL BACKFILLING TO SUBGRADE

A. Backfill trenches to contours and elevations with unfrozen fill materials.

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

C. Place fill material in continuous layers not exceeding more than 8-inches and compact in accordance with schedule at end of this Section.

D. Employ placement method that does not disturb or damage utilities in trench or foundation perimeter drainage.

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

F. Protect open trench to prevent danger to the public. Open excavations should not exceed trench box dimensions and in no case shall trenches or excavations alongside roads or public right of ways be left open and unsecured in accordance with all applicable safety requirements regarding open excavations.

3.10 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess material offsite and legally.

B. Furnish ONWASA with certificate of disposal site or agreement from private property owner.

3.11 TOLERANCES

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

3.12 FIELD QUALITY CONTROL

A. It is the responsibility of the Contractor to employ an independent geotechnical testing firm to conduct all required geotechnical testing to confirm compliance with the requirements of this Section.

B. Perform laboratory material tests in accordance with ASTM D698.

C. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
   2. Moisture Tests: ASTM D3017.

D. When tests indicate work does not meet specified requirements, remove work, replace, compact, and retest.

E. Frequency of Tests: Two tests per lift for every 1000-feet of trench and at least once per lift for all road crossings. Unless otherwise approved by ONWASA, ONWASA shall be onsite to witness all geotechnical testing and reserves the right to choose test locations. Notify ONWASA a minimum of 72 hours in advance of geotechnical testing.

3.13 PROTECTION OF FINISHED WORK

A. Reshape and compact fills subjected to vehicular traffic during construction.

3.14 SCHEDULE OF COMPACTION

A. Under Pavement and Slabs:
   1. Granular Fill in maximum 8-inch loose lifts.
   2. Compact to minimum 95 percent maximum density except the top 12-inches.
   3. Compact top 12-inches to minimum 98 percent maximum density.

B. Under Landscape Areas:
   1. Subsoil Fill in maximum 8-inch loose lifts.
   2. Compact to minimum 90 percent maximum density.

C. In Unstable or Unsuitable Trench Foundation Areas:
   1. Foundation Stone in maximum 12-inch loose lifts.
   2. Compact to 98 percent maximum density.

END OF SECTION

SECTION 31 23 16.26
ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing identified and discovered rock during excavation.
2. Expansive tools to assist rock removal.
3. Explosive tools to assist rock removal.

B. Related Sections:

1. *Section - Excavation and Fill31 23 00*
2. *Section – Trenching31 23 16.13*

1.2 REFERENCES

A. National Fire Protection Association:

1. NFPA 495 - Explosive Materials Code.

1.3 DEFINITIONS

A. Rock: Solid mineral material with volume in excess of 1/3 cubic yard or solid material that cannot be removed with 3/4 cubic yard capacity excavator without drilling or blasting.

1.4 SUBMITTALS

A. Shop Drawings: Indicate intended rock removal method. If blasting, indicate proposed method of blasting, delay pattern, explosive types, and type of blasting mat or cover.

B. Survey Report: Submit survey report on conditions of buildings near locations of rock removal.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 495.

B. Seismic Survey Firm: Licensed company specializing in seismic surveys with five years documented experience.

C. Explosives Firm: Company specializing in explosives for disintegration of rock with five years documented experience.

1.6 PROJECT CONDITIONS FOR USE OF EXPLOSIVES

A. Conduct survey and document conditions of buildings near locations of rock removal prior to blasting; photograph existing conditions identifying existing irregularities.

B. Advise owners of adjacent buildings or structures, in writing, prior to executing seismographic survey. Explain planned blasting and seismic operations.

C. Obtain seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.

1.7 SCHEDULING

A. Schedule Work to avoid disruption to occupied buildings nearby.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conform to NFPA 495.

B. Explosives, Delay Devices, and Blast Mat Materials: Type recommended by explosive firm following seismic survey and required by authorities having jurisdiction.

C. Mechanical Disintegration Compound: Grout mix of materials that expand on curing.

PART 3 EXECUTION

3.1 GENERAL: Entire project site shall be kept in strict accordance with OSHA Regulations.

3.2 EXAMINATION

A. Verify site conditions and note subsurface irregularities affecting Work of this Section.

3.3 PREPARATION

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

3.4 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical method.

1. Drill holes and use expansive tools, wedges, and mechanical disintegration compound to fracture rock.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and un-shattered base for footings and foundations.

D. In utility trenches, excavate to 6-inches below invert elevation of pipe and 16-inches wider than pipe diameter.

E. Remove excavated materials from site.

1. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of *Section 31 23 16 – Excavation and Fill* or *Section 31 23 17 – Trenching*, whichever is applicable.

3.5 ROCK REMOVAL BY EXPLOSIVE METHODS

A. When rock is uncovered requiring explosives method for rock disintegration, notify ONWASA prior to executing as follows.

1. Provide seismographic monitoring during progress of blasting operations.
2. Drill blasting holes within 12-feet of finished slope.
3. Disintegrate rock and remove from excavation.
4. Remove rock at excavation bottom to form level bearing.
5. Remove shaled layers to provide sound and un-shattered base for footings and foundations.
6. In utility trenches, excavate to 6-inches below invert elevation of pipe and 16-inches wider than pipe diameter.
7. Blasting mats shall be utilized.
8. Remove excavated material from site.
9. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of *Section 31 23 16 – Excavation and Fill* or *Section 31 23 17 – Trenching*, whichever is applicable.

B. Notify ONWASA and affected parties 72 hours in advance of using explosives including.

1. Home owners.

2. Schools
3. Fire department.
4. Rescue.
5. Emergency management.
6. Local Law Enforcement department.
7. NC Department of Transportation.
8. Railroads.

3.6 FIELD QUALITY CONTROL

A. Request visual inspection of foundation bearing surfaces by ONWASA and independent geotechnical inspection agency, employed by the Contractor, before installing subsequent work.

END OF SECTION

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SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Fence framework, fabric, and accessories.
2. Excavation and concrete foundations for posts and for center drop for gates.
3. Gates and related hardware.

B. Related Documents:

1. *Section 03 11 13 – Cast-in-Place Concrete*.

1.2 SYSTEM DESCRIPTION

A. Fence Height: 8-feet nominal fabric height.

B. Barbed Wire: Three strands on extension arms.

C. Line Post Spacing: At intervals not exceeding 10-feet.

PART 2 PRODUCTS

2.1 CHAIN LINK FENCE AND GATES

A. Manufacturers:

1. The American Fence Company
2. Southwestern Wire, Inc.
3. Master Halco, Inc.

B. Framing: Black or green vinyl-coating (installed by the manufacturer), ASTM F1083, hot-dip galvanized, Schedule 40 steel pipe of the following sizes:

1. Line Posts: 2.375 inch outside diameter.
2. Corner, End, and Pull Posts: 3.000 inch outside diameter.
3. Top and Brace Rail: 1.660 inch outside diameter.
4. Gate Frame: 1.900 inch outside diameter.
5. Gate Posts:
   a. 2.875 inch outside diameter for gates 6’-0” or less.
   b. 4.000 inch outside diameter for gates 6’-0” to 13’-0”.
   c. 6.625 inch outside diameter for gates 13’-0” to 18’-0”.
   d. 8.625 inch outside diameter for gates over 18’-0”.

C. Fabric: Aluminum or zinc-coated 9 gage steel wire core; 2-inch diamond mesh; top selvage twisted tight; bottom selvage knuckle end closed. Fabric shall have class 2b thermally fused and bonded black or green vinyl coating installed by the fencing manufacturer.

1. Aluminum-Coated: ASTM A491; applied by hot-dip process at 0.40 ounces per square foot before weaving fabric.
2. Zinc-Coated: ASTM A392 Class 2; applied by hot-dip process at 2.0 ounces per square foot after weaving fabric.
3. Vinyl Coating: ASTM F1664

D. Barbed Wire: Aluminum or zinc-coated, 12-1/2 gage steel wire, and 14 gage steel barbs; consists of three strands of twisted wire with four-point barbs on 5-inch spacing.

1. Aluminum-Coated: ASTM A585.

2. Zinc-Coated: ASTM A121.

E. Accessories:

1. Tension Wire: Marcelled, 7 gage metallic-coated steel wire; ASTM A824 Type I Aluminum-coated, or Type II Zinc-coated Class 2.
2. Tension and Brace Bands: 12 gage pressed steel, hot-dip galvanized, ¾-inch wide.
3. Tension Bars: Steel strip, minimum 3/16-inch thick by ¾-inch wide, hot-dip galvanized.
4. Tie Wires: 9 gage round wire of aluminum alloy 1350-H19.
5. Post Caps: Pressed steel or cast iron, hot-dip galvanized; designed to fit snugly over post and exclude moisture from inside.
6. Barb Wire Support Arms: Pressed steel or cast iron and hot-dip galvanized with provisions for attaching three rows of barbed wire at a 45 degree angle. Capable of withstanding 250 pounds downward pull at outermost end of arm without failure. Arms designed to fit securely over line posts with provisions for passage of top rail. Provide hardware for attaching arms to end and corner posts.
7. Fasteners: Galvanized carriage bolts with nuts.

F. Gate Hardware:

1. Swing Gates:

a. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Permit gate to swing 180 degrees inward or outward.
b. Single Gate Latch: Forked type, capable of retaining gate in closed position and have provision for padlock. Capable of operation from either side of gate.
c. Double Gate Latch: Provide drop rod to hold inactive gate leaf. Provide locking device and padlock eyes as an integral part of latch.
d. Keeper: Provide a keeper for each gate leaf over 5’-0”, consisting of mechanical device for securing free end of gate when in full open position.

2.2 CONCRETE FOUNDATIONS

A. Fence Posts and Center Drop: Class II concrete.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with manufacturer's instructions.

B. Set intermediate, terminal, gate, and line posts plumb, in concrete footings with top of footing 1-inch above finish grade. Slope top of concrete for water run-off.

C. Line Post Footing Depth Below Finish Grade: 3-feet.

D. Corner, Gate and Terminal Post Footing Depth below Finish Grade: 3-feet.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.

F. Provide top rail through line post tops and splice with 6-inch long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Stretch fabric between terminal posts or at intervals of 100-feet maximum, whichever is less.

I. Position bottom of fabric 1-inch above finished grade.

J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15-inches on centers.

K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

L. Install bottom tension wire stretched taut between terminal posts.

M. Install support arms sloped outward and attach barbed wire; tension and secure.

N. Do not swing gate from building wall; provide gate posts.

O. Install gate with fabric and barbed wire overhang to match fence. Install gate hardware.

P. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

Q. Install automatic gate operator components; comply with manufacturer's instructions.

R. All items with nicked or otherwise damaged coating shall be replaced or repaired per manufacturer's specifications. The decision to repair or replace shall be determined by the inspector and based upon the extent and type of damage incurred.

3.2 ERECTION TOLERANCES

A. Maximum Variation from Plumb: ¼-inch.

B. Maximum Offset from True Position: 1-inch.

C. Components shall not infringe adjacent property lines.

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SECTION 33 05 13
UTILITY MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast reinforced concrete manholes and structures with tongue-and-groove joints with masonry transition to frames, lids, grates, anchorage, and accessories.
2. Cast-in-place concrete manholes and structures with masonry transition to frames, lids, grates, covers, anchorage, and accessories.
3. Structure connections to existing public utility lines.
4. Bedding and backfill materials.

B. Related Sections:

1. *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment*
2. *Section – Trenching31 23 16.13*
3. *Section 33 01 30 – Operation and Maintenance of Sewer Utilities*
4. *Section 33 11 00 - Water Utility Distribution Piping*
5. *Section 33 12 13 – Water Service Connections*
6. *Section 33 31 13 – Gravity Sewers*
7. *Section 33 34 00 – Force Mains*
8. *Section – Submersible Pumps43 25 00*
9. *Section – Self-Priming Centrifugal Pumps43 23 00*

1.2 DEFINITIONS

A. Owner: Onslow Water and Sewer Authority - ONWASA

1.3 SUBMITTALS

A. Product Data: Submit data on manholes and structures, manhole frames and lids, access hatches, accessories, component construction, features, configuration, dimensions, and joint data.

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

C. Project Record Documents: Record actual locations of manholes and structures with rim and invert elevations.

D. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities. Manufacturer’s Installation Instructions: Submit special procedures for precast concrete valve vaults and meter boxes installation.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations and inverts of buried pipe, components and connections.

1.5 QUALITY ASSURANCE

A. Obtain precast concrete utility structures from single source.

B. Perform Work in accordance with Sections 825, 840, and 1525 of NCDOT Standard Specifications.

1.6 QUALIFICATIONS

A. Manufacturer: Certified by NPCA Plant Certification Program prior to and during Work of this section.

B. Installer: Company specializing in performing work of this Section with minimum five years' experience.

C. Design of cast-in place and custom utility structures shall be certified by a Professional Engineer experienced in design of this Work and licensed in the State of North Carolina.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing and moving precast manholes and drainage structures.

B. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer and identifying symbols, and numbers shown on Drawings to indicate its intended use.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Masonry Work: Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Cold Weather Requirements: ACI 530/530.1.

1.9 WARRANTY – WATER-PROOFING

A. Provide a written 5-year material warranty issued by the membrane manufacturer upon completion of the work.

PART 2 PRODUCTS

2.1 PRECAST REINFORCED MANHOLES AND STRUCTURES

A. Concrete Base: Precast or cast-in-place as shown on the Drawings.

B. Precast Concrete Manhole and Vaults:

1. Reinforced precast concrete in accordance with ASTM C478
2. Joints shall be watertight and designed for cold-applied sealing compound conforming to ASTM C478 specifications
3. Use flexible connectors with dual stainless steel pipe clamps meeting ASTM C923 for all pipe diameters.
4. Wall Thickness: Minimum wall thickness for manholes shall be 5 inches. Minimum wall thickness for vaults or similar structures shall be 6 inches
5. All precast manholes shall be certified as sufficient for the service condition.
6. All exterior joints shall be sealed with a polyolefin-backed exterior joint wrap in conformance with ASTM E-1745, ASTM C-877, and ASTM C-990
7. Butyl rubber gasket sealing compound shall be CPS-210 as manufactured by Concrete Products Supply Company or CS 102 as manufactured by Concrete Sealants.
8. Manholes shall be set on crushed aggregate of at least 8-inches in depth.

9. All pinholes, interior joints, and crevices shall be filled with hydraulic cement to provide a smooth interior surface.
10. All manholes and structures shall be designed to prevent flotation when empty
11. All manholes and structures shall have extended base of at least 6 inches.
12. Manholes and structures should not include steps.
13. All manholes and structures shall be designed for H-20 loading.

2.2 CAST-IN-PLACE CONCRETE

A. Concrete: Class A Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3 ½-inches for vibrated concrete and 4-inch for non-vibrated concrete.
5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

2.3 ACCESSORIES

A. Manhole Rings and Covers: Grey cast iron, ASTM A48, Class 30B or 35B; size and shape as indicated on the drawings.

1. Minimum Total Weight: 300 lbs.
2. Minimum Weight of Cover: 120 lbs.
3. Type: Standard or Gasketed, as indicated on the schedule.
4. Cover shall have “SANITARY SEWER” or “WATER”, as applicable, cast onto the face.
5. Domestically cast
6. Designed for H-20 loading

B. Sewer Guard manhole inserts shall be used on all manholes. Sewer guards shall be made of high density copolymer that meets the requirements of ASTM 1248, Class A, Category 5. The insert gasket shall be made of closed cell neoprene and shall have a pressure sensitive adhesive on one side. Ventilation shall be provided by insert gas relief valve that will vent at 1 psi. The relief valve shall have a water leak rate no greater than 5 gallons per 24 hours. The insert must have a handle attached to the bowl with stainless steel hardware.

C. Aluminum Access Hatches:

1. Aluminum access covers of the size shown shall be installed at locations indicated on the Drawings. Covers shall be type Series W1S by Halliday Products or TPS as manufactured by U. S. Foundry and Manufacturing Corporation. If the structure is located in a NCDOT maintained area, the access hatch shall be as approved by NCDOT.
2. Door leafs shall be ¼” thick aluminum floor plate reinforced to 300 psf live load. The frame shall be an extruded aluminum channel section with a continuous integral anchor flange and odor reduction gasket. An aluminum frame skirt shall be welded to all four sides of the frame to eliminate wood formwork. The frame shall drain water out through a 1 ½” pipe coupling. The access door shall be equipped with a stainless steel watertight slamlock and removable handle. The door shall open to 90 degrees, lock automatically in that position, and have a vinyl grip release handle. Hinges shall be all stainless steel with tamper proof stainless steel bolts and nuts, and be removable for maintenance after the access door is cast in place. Wing of the hinges shall not cut through the bearing edge of channel seat. The door shall be equipped for a staple for padlock. The access door shall be furnished with a mill finish and a black bituminous coating which shall be applied by the manufacturer to the exterior frame that is in contact with concrete. Provide stainless steel safety chains and 1” removable schedule 40 aluminum pipe for use while doors are open.

3. Access hatches shall be equipped with aluminum fall-through protection grating panels as manufactured by Halliday Products, Inc. or US Foundry and Manufacturing. Safety nets are prohibited.

D. Grout: Non-shrink, non-metallic in accordance with Section 1054 of NCDOT Standard Specifications with a compressive strength of at least 5,000 psi at 3 days.

E. Strap Anchors: Stainless steel capable of supporting pipe or accessories indicated on Drawings, minimum 2-inch wide and 10-gauge

F. Geotextile Filter Fabric: Install geotextile filter fabric as indicated on the Drawings that conforms to Type 1 Engineering fabric in accordance with Section 1056 of NCDOT Standard Specifications; non-woven, needle punched, non-biodegradable, and rot-proof.

G. Protective Interior Lining System (install as indicated on the Plans):

1. The interior walls shall be coated as specified in *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment*.

2. All coatings shall be applied after installation of the manholes or structures is completed.

2.4 PIPING

A. All piping shall be as specified in the applicable piping specification.

B. Gooseneck Vent:

1. Fabricate from carbon steel or ductile iron pipe and fittings.
   a. Carbon Steel Pipe and Fittings:
      1) Pipe: ASTM A53, Grade B, Schedule 40.
      2) Joints: Beveled ends for electric resistance weld.
      3) Fittings: Welded; ASTM A234, Grade WPB.
      4) Flanges: Carbon steel, 150 pound, flat face, ASTM A105.
   b. Ductile Iron Pipe and Fittings:
      1) Pipe: AWWA C115, flanged joint.
      2) Fittings: AWWA C110 or AWWA C153.
      3) Joints: Appendix A of AWWA C115, and ANSI B16.1, Class 125.
      4) Flanges: Ductile iron with zinc-plated bolts and nuts.
2. Provide outlet with stainless steel insect screen held in place between two flanges.

2.5 DROP CONNECTIONS

A. All manholes that require a drop connection shall be a minimum 5-foot inside diameter.

B. An inside drop assembly, in accordance with ONWASA's Standard Detail, shall be provided for a sewer entering a manhole at an elevation greater than 2.5 feet (30 inches) above the manhole invert, or as indicated in the Plans. Where the difference in elevation between the incoming sewer and the manhole invert is less than 2.5 feet (30 inches), the invert shall be filleted to prevent solids deposition.

C. Inside drop connections shall be secured to the interior wall of the manhole as indicated in the Detail and access shall be provided for cleaning.

D. Outside drop assemblies are not permitted.

2.6 CONFIGURATION

A. Provide size and shape as indicated on Drawings.

B. Foundation Slab: Cast-in-place or precast reinforced concrete integral with bottom section, level top surface.

2.7 BEDDING AND BACKFILL MATERIALS

A. Bedding: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

B. Backfill around Structures: As specified in *Section 31 23 17 -Trenching*.

PART 3 EXECUTION

3.1 GENERAL: Entire project site shall be in strict accordance with OSHA Regulations.

3.2 PREPARATION

A. Prior to Start of Construction:

1. Materials will be checked at the site of construction to verify conformance with approved materials. Any materials not in accordance with ONWASA Standards or approved by the Technical Operations Supervisor, or his/her designee, at the job site will not be assumed for use. CONTRACTOR will be directed to remove these materials from the area before work can proceed. CONTRACTOR may be directed to expose any work suspected of containing Inferior materials. Failure, by the Inspector, to notice faulty materials or work does not relieve the CONTRACTOR of his responsibility to provide a completed final product that meets the requirements of the plans and specifications. Any inferior materials discovered will be replaced without charge for rework to the OWNER.
2. ONWASA requires a minimum of forty eight (48) hours' notice before construction is to begin so that ONWASA can schedule construction inspection for the work. Should work for any reason be temporarily discontinued, the CONTRACTOR shall notify ONWASA at least twenty-four (24) hours in advance of resuming operations.

B. Surveys, Lines and Grades:

1. The CONTRACTOR shall establish a Project survey control network, with both horizontal (NAD 83 datum or latest correction) and vertical (NAVD 88 datum or latest correction) controls, and develop and make any detailed surveys he deems necessary to construct the project in accordance with the contract requirements. The CONTRACTOR shall carefully preserve all reference points or existing survey markers and in the case of willful or careless destruction thereof, the CONTRACTOR shall be charged with the resulting expense, and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

C. Traffic Flow and Safety:

1. The CONTRACTOR shall maintain traffic flow and control at all times. CONTRACTOR shall comply with all requirements, suggestions and/or directions of the local Police Department, North Carolina Department of Transportation, and maintain OSHA Compliance concerning traffic control and safety. All necessary precautions shall be taken to affect the full safety of the public as well as the workmen on the job. In any section of the work for which ONWASA must obtain an encroachment from the N.C. Department of Transportation for cutting a paved street, or working in the DOT right-of-way, the CONTRACTOR shall follow the requirements as set out in the approved DOT Encroachment Agreement. The approved traffic control plan shall set forth the method and manner by which the CONTRACTOR shall provide for the convenience and safety of the traveling public. However, if during construction, it is determined by ONWASA, Police Department, DOT or the CONTRACTOR that additional measure is needed; the CONTRACTOR shall implement whatever measures are required for the safety of the public.

2. All encroachment bonds required by the Department of Transportation will be secured by the CONTRACTOR at his own expense.
3. No extra payment will be allowed for securing the required bond or for the implementation of a traffic control plan. The costs of the bond and implementation of traffic control measures shall be included in the bid price for each item in the proposal.

D. Service Cut-Off:

1. When there are CITY OF JACKSONVILLE and ONWASA utility lines within the limits of a project. The following procedure applies to both the CITY OF JACKSONVILLE and ONWASA.
2. The CITY OF JACKSONVILLE/ONWASA requires adherence to the following procedures prior to shutting off service on any existing CITY OF JACKSONVILLE/ONWASA utility lines:
   a. The CONTRACTOR must receive approval for shut-off from the CITY OF JACKSONVILLE Public Utilities Director/ ONWASA Distribution/Collections Superintendent. Generally, shut-offs must occur from 9 a.m. to 11 a.m. and 2 p.m. to 4 p.m. on weekdays.
   b. After receiving approval, CONTRACTOR shall notify affected residents twenty-four (24) hours in advance of beginning operation.
   c. All valves to be closed or opened are to be operated by the CITY OF JACKSONVILLE Public Utilities Department/ONWASA
3. If any utilities are damaged and service interrupted, the utility OWNER (CITY OF JACKSONVILLE or ONWASA) shall immediately be contacted and CONTRACTOR shall conduct repairs in accordance with the utility OWNER'S specifications and requirements, in order to restore service to the customers.
4. NO ONWASA valves are to be operated without prior approval of the ONWASA Distribution/Collections Superintendent (910-937-7560). Except in emergency situations, the contractor shall request approval in writing (e-mail is preferable) no less than 48-hours prior to event, stating reason, length of outage, and number and location of customers affected.
5. Verify existing connection size, location, and inverts are as indicated on Drawings.

3.3 EXAMINATION

A. Verify items provided by other Sections of Work are properly sized and located.

B. Verify built-in items are in proper location and ready for roughing into Work.

C. Verify correct size of manhole and structure excavation.

3.4 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.

B. Do not install manholes and structures where site conditions induce loads exceeding structural capacity of manholes or structures.

C. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify manholes and structures are internally clean and free from damage. Remove and replace damaged units.

3.5 INSTALLATION – GENERAL

A. Excavation and Backfill:

1. Excavate and backfill for manholes and structures in accordance with *Section 31 23 17-Trenching* in location and to depth shown. Provide clearance around sidewalls of manhole or structure for construction operations, backfill, and placement of geotextile filter fabric if required.

2. When groundwater is encountered, prevent accumulation of water in excavations. Contractor is responsible for utilizing dewatering systems in accordance with good standard practice. The dewatering systems must be efficient enough to lower the water level in advance of the excavation and to maintain it continuously to keep the trench bottom and sides firm and dry. Groundwater shall not be allowed to rise around the structure until after the trench is backfilled. Disposal of groundwater shall be disposed of in a suitable manner so as to not cause damage to adjacent property or facilities, or be a threat to public health. Manholes shall not be installed in a wet or frozen excavation.
3. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation.

B. As Work progresses, install fabricated metal items.

C. Install manholes and structures at proper grade and alignment as shown on Drawings.

D. Pipes shall be flush to the edge of the performed invert.

3.6 CONNECTIONS TO STRUCTURES

A. Cut pipe to connect to structure as indicated on Drawings. Connect piping to structures through stubs, wall castings, wall sleeves, etc., provided for same, or make an opening at the proper elevation in the wall of the structure. Unless otherwise approved by ONWASA, all openings into existing structures shall be core-drilled. Using pneumatic hammers, chipping guns, sledge hammers, etc., will not be permitted.

B. In opening of structure, unless otherwise approved by ONWASA, install flexible connector with dual stainless steel clamps meeting ASTM C923 for all pipe diameters in opening, and neatly seal opening with non-shrink concrete grout. Make connections water-tight.

C. Where necessary, reshape the bottoms of existing structures, removing all excess grout and manufacturing imperfections to give a smooth flow in all directions.

3.7 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

A. Install underground precast utility structures in accordance with ASTM C891.

B. Lift precast manholes and structures at lifting points designated by manufacturer.

C. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and manhole or structure remains clean.

D. Set precast manholes and structures bearing firmly and fully on stone bedding as required by this Section or on other support system shown on Drawings.

E. Lower, set level, and firmly position base section before placing additional sections.

F. Assemble multi-section manholes and structures by lowering each section into excavation. Install butyl rubber gasket joint sealant between precast sections in accordance with manufacturer's recommendations and as required by the Specifications. The exterior of each section joints shall be sealed with an exterior joint wrap, and interior joints shall be sealed with grout. Verify that each section is plumb and level before installing additional sections.

G. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections.

H. Verify manholes and structures installed satisfy required alignment and grade.

I. Set cover frames and covers level, unless otherwise indicated, and to correct elevations. Bolt down manhole frame and cover to top of structure unless otherwise directed by the ONWASA, seal frame to structure with butyl sealing rope, and completely grout the ring to the top of the manhole section

J. Precast adjustment (grade) rings shall be used as required. No more than 8 vertical inches of grade ring will be allowed per manhole. In the event the surrounding elevation changes due to plan revisions or error and an adjustment of greater than 12" is required, the manhole cone section shall be replaced with one of appropriate height, the manhole retested and coating replaced/repaired.

K. Place concrete collar around manhole frame as indicated on the Detail.

3.8 CAST-IN-PLACE CONCRETE MANHOLE AND STRUCTURE BASE INSTALLATION

A. Prepare crushed stone bedding or other support system shown on Drawings to receive foundation slab as specified for precast manholes and structures.

B. Erect and brace forms against movement in accordance with Section 825 of NCDOT Standard Specifications.

C. Place foundation slab, trowel top surface level.

D. Place precast manhole sections plumb and level, trim to correct elevations, anchor to foundation slab.

E. Install reinforcing steel as indicated on Drawings and in accordance with Section 425 of NCDOT Standard Specifications.

F. Place and cure concrete in accordance with Section 825 of NCDOT Standard Specifications.

3.9 VERTICAL ADJUSTMENT OF EXISTING STRUCTURES:

A. Where required, adjust top elevation of existing vaults and structures to finished grades shown on Drawings.

B. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

C. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated on Drawings.

D. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete.

3.10 FIELD QUALITY CONTROL

A. Perform soil compaction tests in accordance with *Section 31 23 17-Trenching*.

3.11 TESTING

A. Test cast-in-place concrete in accordance with ASTM C39.

B. All final testing and inspections shall be performed in the presence of ONWASA Representative.

C. Manhole and Pump Station Wet Well Testing as specified in *Section 33 01 30 – Sanitary Sewer Leakage Testing*.

END OF SECTION

SECTION 33 05 19
PRESSURE PIPING JOINT RESTRAINT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joint restraints

B. Related Sections:

1. *Section – Trenching31 23 16.13*
2. *Section – Water Utility Distribution Piping33 11 00*
3. *Section 33 34 00 – Force mains*

1.2 DESIGN REQUIREMENTS

A. The ENGINEERING DIRECTOR reserves the right to determine which method to utilize dependent on site conditions and application.

B. Each fitting shall be secured by two forms of restraint. Restraining glands and concrete thrust blocking are preferred. **Wedge-action restraint glands (i.e. MEGALUGS) are approved only for use on ductile iron pipe**. **Full-circumferential pipe restraint glands (i.e. Grip Rings) may be used on PVC or ductile iron pipe. ALL RESTRAINT GLANDS SHALL BE SPECIFICALLY DESIGNED FOR USE ON THE TYPE OF PIPE FOR WHICH THEY ARE BEING INSTALLED.** Other forms of restraint such as threaded rod, bell restraint harnesses, etc. may be approved by ONWASA on a case-by-case basis.

C. All joints on Fire Hydrant Assemblies shall be restrained.

D. All backside or reverse taps shall require the installation of a restraint joint system

E. Unless otherwise approved by ONWASA, all fittings shall require the installation of a restrained joint system.

1.3 SUBMITTALS

A. Design Data: Submit design calculations showing determination of restrained lengths and submit joint restraint details. Use joint restraint devices specifically designed for applications described in manufacturer's data.

PART 2 PRODUCTS

A. WEDGE-ACTION RESTRAINT GLANDS (i.e. MEGALUGS)

1. Manufacturers:
   a. Ebaa Iron Sales, Inc.
   b. Star Pipe Products, Inc.
   c. Sigma Corp.
   d. Smith-Blair

B. Shall Meet the Following Requirements:

1. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
2. Proper actuation of gripping wedges shall be ensured with torque-limiting twist off nuts.
3. Exterior shall be protected by manufacturer-applied epoxy, or polyester-based powder, coating system.
4. Working pressure of 350 psi for 3-inch through 16-inch and 250 psi for 18-inch through 48-inch, and shall include a minimum safety factor of 2 to 1 in all sizes.

5. Wedge-action restraints are not permitted for use on PVC pipe.

2.2 FULL-CIRCUMFERENTIAL PIPE RESTRAINT GLANDS (i.e. Grip Rings)

A. Shall Meet the Following Requirements:

1. Gland, ring, and follower gland shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
2. Shall be rated for the full working pressure of the pipe for which it is being installed, including an allowance for pressure surges.

2.3 BELL JOINT RESTRAINTS

A. Manufacturers:

1. Ebaa Iron Sales, Inc.
2. Star Pipe Products, Inc.
3. Sigma Corp.

B. Shall Meet the Following Requirements:

1. Restraint glands shall be manufactured of ductile iron conforming to ASTM A536.
2. Exterior shall be protected by manufacturer-applied epoxy, or polyester-based powder, coating system.
3. Shall be rated for the full working pressure of the pipe for which it is being installed, and must include a minimum safety factor of 2 to 1 in all sizes.

2.4 TIED JOINT RESTRAINT SYSTEMS

A. Materials:

1. Steel Types:

a. High Strength Low-Alloy Steel, ASTM A588, heat-treated.
b. High Strength Low-Alloy Steel, ASTM A588.
c. Carbon Steel ASTM A36.

B. Components:

1. Tie Bolts:

a. 5/8-inch for 2-inch and 3-inch mechanical joints, ¾-inch for 4-inch to 12-inch mechanical joints and flanged joints, ASTM A588, Grade B; ASTM A325, Type 3, except increase tensile strength of full-body threaded section to 40,000 pounds minimum for 5/8-inch and 60,000 pounds minimum for ¾-inch by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.
b. ¾-inch for 14-inch to 24-inch mechanical joints, ASTM A588, Grade B; ASTM A325, Type 3.
c. 1-inch for 30-inches and larger mechanical joints and flanged joints, ASTM A588/, Grade B; ASTM A325, Type 3; except increase tensile strength of full-body thread section to 100,000 pounds minimum by heat-treating (quenching and tempering) to manufacturer’s reheat and hardness specifications.

2. Tie Nut: Hex nut for each tie bolt and tie rods; ASTM A563, Grade C3; plain, zinc plated, or galvanized.

3. Tiepin: ¾-inch round bar stock for use on bends and hydrants, 6-inch hairpin shape, ASTM A588; ANSI B1.1; plain, zinc plated, or galvanized.
4. Tie Coupling: Used to extend continuous threaded rods and provided with center stop to aid installation; ASTM A588; plain, zinc plated, or galvanized.

5. Tie Clamp: Retainer clamp for ductile iron, asbestos cement and polyvinyl chlorite, push-on pipe in front of bell; ASTM A36; ASTM A307; ASTM A563, Grade A; plain, zinc plated, or galvanized.
6. Tie Rod: Continuous threaded rod for cutting to desired lengths; ASTM A588, Grade B; ASTM A325, Type 3; ANSI B1.1; plain zinc plated, or galvanized.
7. Tie Bar: Steel bar used to restrain push-in plugs; ASTM A36; plain, zinc plated, or galvanized.
8. Tie Washer: Round flat washers; ASTM A588, ASTM F436, Type 3; plain, zinc plated, or galvanized.

C. FACTORY APPLIED FINISHES – STEEL

1. Items to be zinc plated or galvanized to meet the following requirements:

   a. ASTM B633 for electrodeposited coating of zinc on steel.
   b. ASTM A153 for galvanizing iron and steel hardware.
   c. Galvanizing for rolled, pressed, and forged steel shapes: ASTM A123; minimum 2.0 ounces per square foot coating thickness; galvanize after fabrication.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify pipe and fittings are ready to receive work.

B. Field measure and verify conditions.

C. Clean surfaces of pipe and fittings to receive joint restraint.

3.2 INSTALLATION

A. Excavate and Backfill in accordance with *Section 31 23 17-Trenching*.

B. Install pipe and fittings in accordance with applicable utility Specification Section.

C. Install joint restraint system so joints are mechanically locked together to prevent joint separation.

3.3 ERECTION TOLERANCES

A. Torque all restraint system fasteners in accordance with manufacturers' instructions.

END OF SECTION

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SECTION 33 05 23
TRENCHLESS UTILITY INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation and backfill for approach trenches and pits.
2. Excavation for casing pipe.
3. Bore-and-jacking.
4. Carrier pipe.
5. Disposal of excess materials.

B. Related Sections:

1. *Section – Trenching.31 23 16.13*
2. *Section – Water Utility Distribution Piping.33 11 00*
3. *Section 33 31 13 – Gravity Sewers*
4. *Section 33 34 00 – Force Mains*

1.2 REFERENCES

A. NCDOT Standard Specifications:

1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 DESIGN REQUIREMENTS

A. Design casing pipe liner joints of leak-proof construction. Design for earth and/or other pressures present.

1. Highway Crossings: Design tunnel for earth and/or other pressure loads present, plus AASHTO H20 live loading.
2. Railroad Crossings: Design tunnel for earth and/or other pressure loads present, plus railroad E80 live loading with 50 percent added for impact.
3. Design bracing, backstops, and use jacks of sufficient rating for continuous jacking without stoppage, except for adding pipe sections and as conditions permit, to minimize tendency of ground material to "freeze" around casing pipe.

1.4 DEFINITIONS

A. Owner: Onslow Water and Sewer Authority - ONWASA.

1.5 SUBMITTALS

A. Product Data: Submit data on casing pipe, carrier pipe, pipe supports, and accessories.

B. Project Record Documents: Record actual locations of piping, thrust restraints, and invert elevations.

C. Installation Plan: Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignment.

D. Submit emergency response procedures to handle situations when conduit is compromised and jeopardizes integrity of installation or safety.

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

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

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations.

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

1.7 QUALITY ASSURANCE

A. Perform work in accordance with Sections 1540 and 1550 of NCDOT Standard Specifications, NUCA Trenchless Excavation Construction Equipment and Methods Manual, NUCA Pipe Jacking & Micro-tunneling Design Guide, and AREMA when jacking under railroads.

B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1. Work Experience: Include projects of similar magnitude and conditions.
2. Furnish list of references upon request.

1.9 PRE-INSTALLATION MEETINGS

A. Convene with ONWASA minimum one week prior to commencing work of this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping and jacking systems from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

C. Accept system components on site in manufacturer’s original containers or configuration. Inspect for damage.

D. Use wooden shipping braces between layers of stacked pipe. Stack piping lengths no more than three layers high.

E. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.

F. Support casing and carrier pipes with nylon slings during handling.

1.11 ENVIRONMENTAL REQUIREMENTS

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

1.12 FIELD MEASUREMENTS

A. Verify invert elevations of existing work prior to excavation and installation of casing or tunnel.

PART 2 PRODUCTS

2.1 CASING AND JACKING PIPE MATERIALS

A. Steel Casing Pipe: ASTM A53 or ASTM A139, 35,000 psi minimum yield strength, minimum wall thickness as indicated in this Section, in the Plans, or as required by the applicable authority (e.g. NCDOT, applicable Railroad Authority, etc.), whichever is more restrictive, full circumference welded joints in accordance with AWS D1.1 to withstand excavation forces.

2.2 CARRIER PIPE MATERIALS

A. Carrier pipe shall be restrained joint ductile iron pipe as specified in *Section 33 11 00 - Water Utility Distribution Piping, Section 33 31 13 - Gravity Sewers*, or *Section 33 34 00 - Force Mains,* whichever is applicable.

2.3 GROUT AND COVER MATERIALS

A. Soil Backfill for Trench Approaches and Pits to Finish Grade: As specified in *Section 31 23 17 - Trenching*.

B. Fill and Seal Grout at Pipe Ends: Mortar conforming to Section 1040 of NCDOT Standard Specifications proportioned as described below. Do not add more water than is necessary to make a workable mixture.

1. Mix No. 1: 1 part Portland cement, 1/4 part hydrated lime, 3-3/4 parts mortar sand (maximum).
2. Mix No. 2: 1 part Portland cement, 1 part masonry cement, 6 parts mortar sand (maximum).

C. Pressure Grout Mix: One part Portland cement and six parts mortar sand mixed with water to consistency applicable for pressure grouting.

2.4 ACCESSORIES

A. Supports and Insulators:

1. Steel and Plastic: 14 gauge stainless steel band, stainless steel flange bolts, heavy duty PVC liner, polyethylene or phenolic skids.

B. Steel Strapping: ASTM A36.

C. Concrete: Class A Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 3,000 psi at 28 days.
2. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
3. Maximum slump of 3 ½-inches for vibrated concrete and 4-inch for non-vibrated concrete.
4. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 GENERAL: Entire project site shall be kept in strict accordance with OSHA Regulations.

3.2 EXAMINATION

A. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

3.3 PREPARATION

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

B. Locate, identify, and protect utilities indicated to remain from damage.

C. Notify utility company to remove and relocate utilities.

D. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.

E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Establish minimum separation from other utility piping in accordance with all applicable local and state requirements.

3.4 EXCAVATION AND BACKFILL

A. Excavate and backfill in accordance with *Section 31 23 17 – Trenching*.

3.5 DEWATERING

A. Intercept and divert surface drainage precipitation and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps, or other means.

B. Develop substantially dry subgrade for prosecution of subsequent operations.

C. Comply with all Federal, State and local requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.6 EXISTING WORK

A. Maintain access to existing facilities and other remaining active installations requiring access. Modify installation as necessary to maintain access.

3.7 PITS OR APPROACH TRENCHES

A. Excavate approach trenches or pits in accordance with the Plans and as site conditions require.

B. Ensure casing entrance face as near perpendicular to alignment as conditions permit.

C. Establish vertical entrance face at least 1-foot above top of casing.

D. Install dewatering measures and excavation supports as specified in *Section 31 23 17 - Trenching*.

3.8 CASING PIPE INSTALLATION

A. Boring:

1. Push pipe into ground with boring auger rotating within pipe to remove spoil. Do not advance cutting head ahead of casing pipe except for distance necessary to permit cutting teeth to cut clearance for pipe. Arrange machine bore and cutting head to be removable from within pipe. Arrange face of cutting head to provide barrier to free flow of soft material.
2. When unstable soil is encountered during boring retract cutting head into casing to permit balance between pushing pressure and ratio of pipe advancement to quantity of soil.
3. When voids develop greater than outside diameter of pipe by approximately one inch, pressure grout to fill voids.
4. When boring is obstructed, abandon boring, relocate jack or tunnel as directed by ONWASA.
5. Boring rig shall have laser-guided apparatus or other device to accurately align the encasement to the grade on the Drawings. Report in writing any deviation in the alignment and grade from that shown on Drawings.

6. Obstructions encountered during the boring operation or deflections in the bore resulting in less than 36-inches of soil cover above the casing unless otherwise approved by ONWASA, or less vertical separation between the surface and the top of the casing pipe as required by the applicable authority (e.g. NCDOT, applicable Railroad Authority) shall require the bore to be abandoned.
7. The abandonment procedure shall consist of cutting off the excess pipe, capped then filled with Portland cement grout (1:3 parts cement to sand) at sufficient pressure to fill all voids.

Encasement Pipe Table

Carrier Pipe Nominal Diameter	Encasement Pipe Diameter	Minimum Thickness
4”	8” (I.D.)	0.188”
6”	12” (I.D.)	0.188”
8”	16” (I.D.)	0.250”
10”	18” (I.D.)	0.250”
12”	20” (I.D.)	0.250”
16”	26”	0.312”
18”	28”	0.312”
20”	30”	0.312”
24”	36”	0.375”

B. Jacking:

1. Construct adequate thrust wall normal to proposed line of thrust.
2. Impart thrust load to pipe through suitable thrust ring sufficiently rigid to ensure uniform distribution of thrust load on full pipe circumference.

C. Drilling and Jacking:

1. Use oil field type rock roller bit or plate bit made up of individual roller cutter units solidly welded to pipe which is turned and pushed for its entire length by drilling machine to give bit necessary cutting action.
2. Inject high density slurry (oil field drilling mud) to head as cutter lubricant. Inject slurry at rear of cutter units to prevent jetting action ahead of pipe.

D. Mining and Jacking: Utilize manual hand mining excavation from within casing pipe as casing is advanced with jacks, allowing minimum ground standup time ahead of casing pipe.

E. Length of encasement shall be determined as follows:

1. Cut Sections: Ditch line to ditch line
2. Fill Sections: 5-feet beyond toe of slope
3. Curb Sections: 3-feet beyond curb
4. Future highway or railroad right of way: Extend full width of R/W or unless otherwise noted.

3.9 PRESSURE GROUTING

A. Pressure grout annular space between casing pipe and surrounding earth. Pressure levels shall not be such that damage occurs to adjacent areas (i.e. pavement).

3.10 CARRIER PIPE INSTALLATION

A. Clean, inspect, and handle pipe in accordance with applicable Section for carrier pipe.

B. Exercise care to prevent damage to pipe joints when carrier pipe is placed in casing.

C. Support pipeline within casing so no external loads are transmitted to carrier pipe. Attach supports to barrel of carrier pipe; do not rest carrier pipe on bells.

1. Use minimum 2 supports per joint of carrier pipe as shown in ONWASA's Standard Detail.

D. Grout ends of casing to seal.

3.11 TOLERANCES

A. Do not over cut excavation by more than 1-inch greater than outside diameter of casing pipe.

B. Install casing pipe to vertical and horizontal alignment on Drawings within plus or minus 3-inches prior to installation of carrier pipe.

C. Install pipe bells with minimum ½-inch clearance to casing.

3.12 FIELD QUALITY CONTROL

A. Compaction Testing: As specified in *Section 31 23 17 - Trenching*.

END OF SECTION

SECTION 33 05 23.13
UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

A. Scope:

1. The work specified in this section consists of furnishing and installing underground utilities by horizontal directional drilling (HDD) method of installation.
2. This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, restoration of underground utilities and environmental protection and restoration.

B. Related Sections:

1. *Section - Excavation and Fill*.31 23 00
2. *Section – Trenching31 23 16.13*
3. *Section 33 11 00 - Water Utility Distribution Piping*.
4. *Section 33 31 13 - Gravity Sewers*
5. *Section 33 34 00 - Force Mains*

1.2 REFERENCES

A. National Utility Contractors Association

1. NUCA - HDD Installation Guidelines

1.3 SUBMITTALS

A. Work Plan

1. Prior to beginning work, submit a work plan detailing the procedure and schedule to be used to execute the work.
2. Shall include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable), list of SUB-CONTRACTOR, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (If applicable), an environmental protection plan, and contingency plans for possible problems including a Frac-Out and Surface Spill Contingency Plan.

B. Shop Drawing Submittals:

1. Include information pertaining to pits, dewatering, method of spoils removal, equipment size and capacity, equipment capabilities including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade and detection of surface movement, name plate data for drilling equipment, and mobile spoils removal unit.

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

D. Record Drawing:

1. Submit as-built records within five days after completing the pull back.
2. The as-built records shall include a plan and profile (data every 25 LF of main, at a minimum), and all information recorded during the progress of the work, including subsurface anomalies identified by Ground Penetrating Radar or vacuum excavation.
3. Shall certify the accuracy of all as-built record drawings.

1.4 CLOSEOUT SUBMITTALS

A. Show depth and location of abandoned bores.

B. Record depth and location of drill bits and drill stems not removed from bore.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with the following:

1. NUCA HDD Installation Guidelines.
2. ASTM F1962.

1.6 QUALIFICATIONS

A. Directional Boring:

1. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety.
2. Each person must have been fully trained for over 1,000 hours on all facets of directional drilling, including, but not limited to, machine operations, mud mixing, locating, and material fusion.
3. A responsible representative who is thoroughly familiar with the equipment and type of work to be performed must be in direct charge and control of the operation at all times.
4. In all cases the supervisor must be continually present at the job site during the actual Directional Bore operation.
5. The CONTRACTOR shall have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner.

B. Heat Fusion Joining:

1. Joints between plain end pipes and pipe fittings shall be made by butt fusion when possible unless otherwise approved by ONWASA.
2. Electro fusion welding may also be used to complete when the location is not accessible to butt fusion welding equipment.
3. The on-site welder making the joints (butt fusion or electro fusion) shall have received specific training from the manufacturer of the fittings and/or pipe being welded and shall have written proof of proper training/certification from the associated manufacturers.
4. Only certified welders who have written training certifications from the fitting and/or pipe manufacturer will be allowed to perform this work.
5. The fusion work shall be accomplished (welding and cool-down/closing times) in accordance with the fitting and pipe manufacturers' recommendations, at a minimum.

C. Minimum of 5 Years Documented Experience:

1. Submit work experience (similar slope and conditions) upon request.
2. Furnish list of references upon request.

1.7 SITE PREPARATION

A. Coordinate the marking of all utilities, including any service laterals, i.e. water, sewer, cable, gas, electric, phone, etc.

B. Work site shall be graded and filled to provide a level working area. No alterations beyond what is required for operations are to be made. CONTRACTOR shall confine all activities to designated work areas.

C. Following drilling operations, CONTRACTOR will de-mobilize equipment and restore the work-site to original condition. All excavations will be backfilled and compacted in accordance with *Section 31 23 17 – Trenching*.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings until pipe is installed.

B. Protect pipe from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

C. Accept products on site in manufacturer's original containers or configuration. Inspect for damage.

D. Use shipping braces between layers of stacked pipe. Stack piping lengths no more than three layers high.

E. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.

F. Support pipes with nylon slings during handling.

G. Inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, cracked linings, or other defects shall be rejected and removed from the job site without delay.

H. Unload and store opposite or near the place where the work will proceed with minimum handling. Store material under cover out of direct sun light. Keep all materials free of dirt and debris.

I. CONTRACTOR is responsible for obtaining, transporting and sorting any fluids, including water, to the work site.

J. Disposal of fluids is the responsibility of the CONTRACTOR. Disposal of fluids shall be done in a manner that is in compliance with all permits and applicable federal, state, or local environmental regulations. The bentonite drilling slurry may be recycled for reuse in the hole opening operation, or shall be hauled by the CONTRACTOR to an approved location or landfill for proper disposal. CONTRACTOR shall thoroughly clean entire area of any fluid residue upon completion or installation, and replace any and all plants and sod damaged, discolored or stained by drilling fluids.

1.9 ENVIRONMENTAL PROTECTION

A. CONTRACTOR shall place silt fence between all drilling operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations.

B. CONTRACTOR shall place hay bales, or approved protection, to limit intrusion upon project area.

C. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place including berms, liners, turbidity curtains and other measures.

D. Fuel may not be stored in bulk containers (greater than 25 gallons) within 200-feet of any water-body or wetland, or any minimum distance as required by applicable federal, state, or local government regulations, whichever is more restrictive.

1.10 SAFETY

CONTRACTOR shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner.

PART 2 PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE, PE) PIPE AND FITTINGS

A. Materials:

1. Materials used for the manufacturer of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345464E per ASTM D3350; and shall be listed in the name of the pipe and fitting Manufacturer in PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade rating of 1600 psi at 73°F per ASTM D-2837.
2. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.

B. Polyethylene Pipe AWWA C901 (1/2-inch through 3-inch), AWWA C906 (4-inch through 63-inch).

1. HDPE Pipe shall be, DR-9 Ductile Iron Pipe size (DIPS) and NSF 61 Standard.
2. Polyethylene pipe shall be manufactured in accordance with ASTM F714, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter and shall be so marked.
3. Each production lot of pipe shall be tested for (from material or pipe) melt index, density, % carbon, dimensions and either quick burst or ring tensile strength (equipment permitting).

C. Nominal pipe sizes shall be indicated on the drawings and bid form. Service Identification:

1. Permanent identification of piping service shall be provided by co-extruding multiple equally spaced color stripes into the pipe outside surface or by solid colored pipe shell. The striping material shall be the same material as the pipe material except for color. The color blue shall be used to identify potable water piping, green shall be used for sewer piping, and purple shall be used for reclaimed water piping.

2. Small diameter polyethylene piping used for residential grinder pump services shall be solid green.

D. Polyethylene Fittings and Custom Fabrication:

1. HDPE fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer or trained personnel.
2. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe.
3. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.
4. Fabricated fittings must have the same working pressure as the mating pipe.

E. Molded Fittings:

1. Molded fittings shall be manufactured in accordance with ASTM D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing, and shall be so marked.
2. Each production lot of molded fittings shall be subjected to the test required under ASTM D3261.

F. Fabricated Fittings:

1. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings.
2. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe.
3. Directional fittings 16-inch and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets.

G. Electro fusion Branch Saddles:

1. Shall meet AWWA C-906, outlet shall comply with ASTM-D3261, and shall be specifically manufactured for HDPE pipe.
2. May be utilized for wet-tap applications.

3. Shall be designed and manufactured in accordance with ASTM Specifications F-1055 for use with HDPE (DIPS) pipe.

H. Polyethylene Flange Adapters:

1. Flange adapter shall be made with sufficient through bore length to be clamped in a butt fusion joining machine without the use of a stub end holder.
2. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooved to provide gasketless sealing, or to restrain the gasket against blow-out.
3. Below ground flange adapter may be utilized for 30-inch and larger, DIP and valves.
4. Adapters for 24-inch and smaller utilize an MJ adapter (see below).

I. Back-up Rings and Flange Bolts:

1. Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe.
2. Convoluted style backup rings preferred over the flat stock rings.
3. The lap joint flange bore shall be chamfered to provide clearance to the flange adapter radius.
4. Flange bolts and nuts shall be Grade 2 or higher.

J. Manufacturer's Quality Control:

1. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials.
2. Incoming polyethylene materials shall be inspected for density, melt flow rated, and contamination.
3. The cell classification properties of the material shall be certified by the supplier, and verified by Manufacturer's Quality Control.

K. Polyethylene Mechanical Joint (MJ) Adapters:

1. Mechanical connections of HDPE pipe (4-inch through 24-inch diameter) to Ductile Iron or PVC piping, mechanical joint fittings, or valves shall be through a self-restraining, fusible mechanical joint adapter with or without an integral, internal stainless steel insert.
2. Mechanical joint adapter shall be of the same SDR rating as the pipe.
3. A separate, loose stainless steel type insert will only be allowed for pipe sizes 4-inch through 8-inch.
4. Provide the mechanical joint adapter, including but not limited to longer tee bolts or all thread rods with nuts at the mechanical joint bell.

L. Cast Transition Couplings:

1. HDPE to MJ cast transition coupling may only be utilized for 8-inch and smaller pipe size.
2. A stainless steel stiffener is required sized at proper ID of HDPE pipe.
3. The transition coupling must be epoxy lined (93 mils minimum for water use and 12 mils minimum for sewer use).

M. Electro fusion Couplings:

1. Polyethylene pipe and fittings may be joined using approved electro fusion couplings.
2. Fittings shall be PE3408 HDPE, Cell Class 345464C or E as determined by ASTM D3350-99.
3. Electro fusion fittings shall have a manufacturing standard of ASTM F1055.
4. Fittings shall have a pressure rating equal to the pipe.
5. All electro fusion fittings shall be suitable for use as pressure conduit per AWWA C906, and have nominal burst value of 3.5 times the working pressure of the fitting.
6. To minimize "toe-in" problems when installing an electro fusion coupling larger than 12-inch size, the CONTRACTOR shall remove 12-inch (minimum) from all associated "factory ends" and use a re-rounding clamp on the associated pipe.
7. The CONTRACTOR shall mark pipe insertion depth prior to assembly and construct in accordance with manufacturer's instructions.

N. Tracer Wire:

1. Contractor shall pull a heavy gauge tracer wire with the HDPE pipe. Wire shall be fastened to pipe every 5 feet with heavy plastic zip ties. Contractor shall be responsible for ensuring that tracer wire is pulled successfully with the pipe and shall test the continuity of the wire after the pipe is pulled through.

O. Drilling Fluids shall be bentonite slurry

PART 3

3.1 EQUIPMENT REQUIREMENTS

A. General:

1. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the drill, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be re-used, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system.
2. All equipment shall be in good, safety operation condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

B. Drilling Rig:

1. The directional drilling machine shall consist of a power system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head.
2. The power system shall be self-contained with sufficient pressure and volume to power drilling operations.
3. Hydraulic system shall be free of leaks.
4. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.
5. The rig shall be grounded during drilling and pull-back operations.
6. There shall be a system to detect electrical current from the drilling string and an audible alarm which automatically sounds when an electrical current is detected.

C. Drill Head:

1. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

D. Mud Motors (if required):

1. Mud motors shall be of adequate power to turn the required drilling tools.

E. Drill Pipe:

1. Shall be constructed of high quality 4130 seamless tubing, grade D or better.

F. Guidance System:

1. A Magnetic Guidance System (MGS) or proven gyroscopic system shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation.
2. The guidance shall be capable of tracking at all depths up to eighty feet and in any soil condition, including hard rock.
3. It shall enable drill head guidance by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction).

4. The guidance system shall be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet.
5. The Guidance System shall be of a proven type and shall be operated by personnel trained and experienced with this system.
6. The Operator shall be aware of any magnetic anomalies on the surface of the drill path and shall consider such influences in the operation of the guidance system if using a magnetic system.

G. Bore Tracking and Monitoring:

1. At all times during the pilot bore the CONTRACTOR shall provide and maintain a bore tracking system that is capable of accurately locating the position of the drill head in the x, y, and z axes.
2. The CONTRACTOR shall record this data at least once per drill pipe length or every twenty-five (25) feet, whichever is more frequent.

H. Downhole and Surface Grid Tracking System:

1. CONTRACTOR shall monitor and record x, y, and z coordinate relative to an established surface survey bench mark.
2. The data shall be continuously monitored and recorded at least once per drill pipe-length or at twenty-five (25) feet, whichever is more frequent.
3. Deviations between the recorded and design bore path shall be calculated and reported on the daily log.
4. If the deviations exceed plus or minus 5-feet (horizontal or vertical deviation) from the design path, such occurrences shall be reported immediately.
5. The CONTRACTOR shall undertake all necessary measures to correct deviations and return to design line and grade.

I. Drilling Fluid Pressures and Flow Rates:

1. Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the CONTRACTOR.
2. The pressures shall be monitored at the pump.
3. These measurements shall be made during pilot bore drilling, reaming, and pullback operations.

J. Mixing System:

1. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid.
2. Mixing system shall continually agitate the drilling fluid during operations.

K. Drilling Fluids:

1. Drilling fluid shall be composed of clean water, appropriate additives and clay.
2. Water shall be from an authorized source with a minimum pH of 6.0. The Contractor shall utilize an ONWASA-provided meter and backflow assembly if water is procured from an ONWASA fire hydrant.
3. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate.
4. The water and additives shall be mixed thoroughly and be absent of any clumps or clods.
5. No potentially hazardous material may be used in drilling fluid.

L. Delivery System:

1. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe.
2. Connections between the pump and drill pipe shall be relatively leak-free.
3. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system.

4. A berm, minimum of 12-inch high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid cycling system to prevent spills into the surrounding environment.
5. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities if necessary.

M. Drilling Fluid Recycling System:

1. The drilling fluid recycling system shall separate sand, dirt and other solids from the drilling fluid to render the drilling fluid re-usable.
2. Spoils separated from the drilling fluid will be stockpiled for later use or disposal.

N. Control of Drilling Fluids:

1. The CONTRACTOR shall follow all requirements of the Frac-Out and Surface Spill Contingency Plan as submitted and approved and shall control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydro-fracture fluid losses to formations, and control drilling fluid spillage.
2. This includes any spillages or returns at entry and exit locations or at any intermediate point.
3. All inadvertent returns or spills shall be promptly contained and cleaned up.
4. The CONTRACTOR shall maintain on-site mobile spoil removal equipment during all drilling, pre-reaming, reaming and pullback operations and shall be capable of quickly removing spoils.
5. The CONTRACTOR shall immediately notify ONWASA of any inadvertent returns or spills and immediately contain and clean up the return or spill.

O. Pipe Rollers:

1. Pipe rollers, if utilized, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations.
2. Sufficient number of rollers shall be used to prevent excess sagging of pipe.

P. Pipe Rammers:

1. Hydraulic or pneumatic pipe rammers may only be used if necessary, and as approved by ONWASA.

PART 4 EXECUTION

4.1 GENERAL: Entire Project site shall be kept in strict accordance with OSHA Regulations.

4.2 EXAMINATION

A. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

4.3 PREPARATION

A. Call local utility line locating service(s) as necessary in accordance with North Carolina General Statute Chapter 87, Article 8. Request underground utilities to be located and marked within and surrounding construction areas. Identify required lines, levels, contours, and datum locations. Locate requests shall not be placed for a greater area than can be worked before the expiration date of the locate ticket.

B. Notify utility company to remove and relocate utilities as necessary.

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

D. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.

E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Establish minimum separation between utilities in accordance with applicable code.

4.4 EXISTING WORK

A. Maintain access to existing facilities and services indicated to remain. Modify pipe installation to maintain access to existing facilities.

4.5 EXCAVATION

A. Excavate subsoil as specified in *Section 31 23 17 – Trenching*.

B. Dewater excavation in accordance with requirements of *Section 31 23 17 – Trenching*.

C. Excavate approach trenches and pits in accordance with Plans and as site conditions require. Minimize number of access pits.

D. Provide sump areas to contain drilling fluids.

E. Install excavation supports as specified in *Section 31 23 17– Trenching*.

F. Restore areas after completion of drilling and piping installation.

4.6 DRILLING PROCEDURES

A. Drill Path:

1. Prior to beginning drilling operations, CONTRACTOR shall flag proposed alignment at intervals no greater than 25-feet and walk the alignment with ONWASA. Any deviation from the proposed alignment must be approved by ONWASA prior to starting the drilling operations.
2. Prior to drilling CONTACTOR shall utilize all verified locate information to determine drill pathway.
3. Marked up drawings shall be on site at all times, and referred to during the drill operation.

B. Guidance System:

1. CONTRACTOR shall provide and maintain instrumentation necessary to accurately locate the pilot hole (both horizontal and vertical displacements), measure pilot string torsional and axial and measure drilling fluid discharge rate and pressure.

C. Pilot Hole:

1. The pilot hole shall be drilled along the path shown on the plans and profile drawings.
2. Unless approved otherwise by ONWASA, the pilot hole tolerances shall be as follows:
   a. Elevation: As shown on the plans, and in no case shall depth of bury be less than the minimum specified.
   b. Alignment: ± 2-feet horizontal, and in no case outside the easement or right-of-way. In the event that the pilot bore deviates from the bore path more than the minimum allowed, CONTRACTOR shall notify ONWASA and ONWASA may require CONTRACTOR to pull-back and re-drill from the location along the bore path before the deviation.
   c. Curve Radius: The pilot hole radius shall be no less than 80% of the maximum bending radius as recommended by the pipe manufacturer of the pipe being installed. In no case shall the bending radius be less than 30 pipe diameters.
   d. Entry and Exit Point Locations: As shown on the Plans.
   e. Limitations on Depth: Where utilities cross under DOT roads, the depth of cover shall comply with applicable DOT permit.

D. Drill pilot bore with vertical and horizontal alignment as indicated on the Plans.

E. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.

1. Monitor depth, pitch, and position.
2. Adjust drill head orientation to maintain correct alignment.
3. The CONTRACTOR shall mark location and depth of bore with spray paint on paved surfaces, and wooden stakes on non-paved surfaces at 25-foot intervals. This shall be done as the pilot hole is bored.

F. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.

G. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.

1. Provide relief holes when required to relieve excess pressure.
2. Minimize heaving during pullback.

H. Calibrate and verify electronic monitor accuracy during first 50-feet of bore in presence of ONWASA before proceeding with other drilling. Excavate minimum of two test pits spaced along first 50-feet bore to verify required accuracy. Test pit locations shall be chosen by ONWASA. When required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.

I. After completing pilot bore, remove drill bit.

4.7 DRILLING OBSTRUCTIONS

A. When obstructions are encountered during drilling, notify ONWASA immediately. Do not proceed around obstruction without ONWASA'S approval. If the obstruction prevents completion of the installation in accordance with the design location and specification, as determined by ONWASA, the pipe may be taken out of service or left in place at the discretion of ONWASA. All voids will be immediately filled with flowable fill. CONTRACTOR shall then submit a revised boring plan to ONWASA for review and approval prior to resuming the work.

B. Maintain adjusted bore alignment within easement or right-of-way.

4.8 PULLBACK

A. After success reaming bore hole to the required diameter, CONTRACTOR will pull the pipe through the bore hole.

B. In front of the pipe will be a swivel and reamer to compact bore hole walls.

C. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole.

D. During pull-back operations CONTRACTOR will not apply more than the maximum safe pipe pull pressure at any time. If the pipe is damaged or deformed in any way during the pull-back, the CONTRACTOR shall stop work immediately and procure written certification from the pipe manufacturer that the pipe is suitable for use. There shall be no charge to ONWASA associated with this request.

E. Maximum allowable tensile force imposed on the pull section shall be equal to 80% of the pipe manufacturer's safety pull (or tensile) strength.

1. Torsional stress shall be minimized by using a swivel to connect a pull section to the reaming assembly.
2. The pullback section of the pipeline shall be supported during pullback operations so that it moves freely and the pipe is not damaged.
3. External pressure shall be minimized during installation of the pullback section in the reamed hole. Damage pipe resulting from external pressure shall be replaced at no cost to the OWNER.

4. Buoyancy modification shall be at the discretion of the CONTRACTOR and shall be approved by ONWASA. The CONTRACTOR shall be responsible for any damage to the pull section resulting from such modifications.
5. In the event that pipe becomes stuck, CONTRACTOR will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, CONTRACTOR will notify ONWASA.

4.9 PIPE ASSEMBLY

A. Pipe shall be welded/fused together in one length, if space permits. Unless otherwise approved by ONWASA, pipe shall be placed on pipe rollers before pulling into bore hole to minimize damage to the pipe.

B. For pipes 16-inch and larger, a re-rounding clamp tool may be utilized during the electro-fusion process to ensure pipe roundness.

C. For pipe sizes larger than 12-inch, mechanical scrapers (per the fitting manufacturer's recommendation) shall be utilized during the electro-fusion work.

D. It is critical that all original oxidized pipe surfaces be removed in order for fusion to take place. The scraping process requires that approximately.10-inch of the outer "skin" be removed in order to penetrate the oxidation and contamination barrier.

E. Cuts or gouges that reduce the wall thickness by more than 10% is not acceptable and must be cut out and discarded. If cuts, gouges, or other damage to the pipe is observed, and the CONTRACTOR does not agree that the damaged area will affect the integrity of the pipe, ONWASA reserves the right to request written certification from the pipe manufacturer that the pipe is suitable for use prior to installation. There shall be no charge to ONWASA associated with this request.

F. Butt Fusion Testing:

1. When requested by ONWASA or OWNER, butt fusion testing will be performed.
2. The test fusion shall be allowed to cool completely, and then fusion test straps shall be cut.
3. The test strap shall be 12-inch (min) or 30 times the wall thickness in length with the fusion in the center and 1-inch (min) or 1.5 times the wall thickness in width.
4. Bend the test strap until the ends of the strap touch.
5. If the fusion fails at the joint, a new test fusion shall be made, cooled completely and tested.

G. Mechanical Joining:

1. Polyethylene pipe and fittings may be joined together or to the materials by means of flanged connections (flange adapters, electro-fused couplings, and back-up rings) or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material.
2. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins.
3. External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

H. Mechanical Joint and Flange Installation:

1. Mechanical joints and flange connections shall be installed in accordance with the Manufacturer's recommended procedure.
2. Flange faces shall be centered and aligned to each other before assembling and tightening bolts.
3. In no case shall the flange bolts be used to draw the flanges into alignment.
4. Bolt threads shall be lubricated, and flat washers shall be used under the flange nuts.

5. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer.
6. At least 1 hour after initial assembly, flange connections shall be retightened following the tightening patter and torque step recommendations of the Manufacturer. The final tightening torque shall be 100 ft-lbs. or less as recommended by the Manufacturer.

I. Install trace wire, as specified in the applicable Utility Specification Section, continuous with each bore. Splice trace wire only at intermediate bore pits.

1. Terminate trace wire for each pipe run at structures along pipe system.
2. Test trace wire for continuity for each bore before acceptance.

J. Provide sufficient length of pipe to extend past termination point to allow connection to other pipe sections.

K. Allow minimum of 24 hours for stabilization after installing pipe before making connections to pipe.

4.10 SLURRY REMOVAL AND DISPOSAL

A. Contain excess drilling fluids at entry and exit points until recycled or removed from site. Provide recovery system to remove drilling spoils from access pits.

B. Remove, transport and legally dispose of drilling spoils off site.

1. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.
2. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.

C. When drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.

D. Complete cleanup of drilling fluid at end of each work day.

4.11 BACKFILL

A. Install backfill and compact as specified in *Section 31 23 17 - Trenching*.

B. Backfill approach trenches and pits with subsoil fill to contours and elevations of surrounding existing grade or as indicated on Drawings.

4.12 FIELD QUALITY CONTROL

A. Leakage Testing: Upon completion of pipe installation, test pipe in accordance with the applicable Utility Specification Section. Unless otherwise approved by ONWASA, no pipe shall be tested prior to installation.

B. Disinfection of Water piping: As specified in *Section 33 11 00 – Water Utility Distribution Piping.*

C. Compaction Testing: As specified in *Section 31 23 17 - Trenching*.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Install above-ground concrete utility markers as specified in the applicable Utility Specification Sections at ends of directional bores and bank edges of all channels crossed by directional bores.

4.13 CLEANING

A. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits. Clean up excess slurry from ground.

B. Restore approach trenches and pits to original condition.

END OF SECTION

ONWASA's

Manual of Standards, Specifications and Details

Section IV

WATER SYSTEM SPECIFICATIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

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SECTION TABLE OF CONTENTS

ONWASA Standard Water Specifications

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SECTION 33 11 00
WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for potable water line and fire water line.
2. Valves and Valve Boxes
3. Fire Hydrant Assembly.
4. Tapping Sleeves and Valves.
5. Air Release valves.
6. Pipe Markers.
7. Thrust Blocking.
8. Pressure Testing

B. Related Sections:

1. *Section 03 11 13 - Cast-in-place Concrete*
2. *Section – Trenching31 23 16.13*
3. *Section - Utility Manholes and Structures33 05 13*
4. *Section 33 05 19 - Pressure Piping Restraint.*
5. *Section 33 05 23 - Trenchless Utility Installation*
6. *Section - Utility Horizontal Directional Drilling33 05 23.13*
7. *Section 33 12 13 - Water Service Connections*
8. *Section 33 13 00 - Disinfecting of Water Utility Distribution*

1.2 DEFINITIONS

A. Owner: Onslow Water and Sewer Authority - ONWASA.

1.3 QUALITY ASSURANCE

A. All pipes, fittings, valves, and appurtenances shall be appropriately marked for identification purposes. The materials, methods of manufacture and completed pipes, fittings, valves, and appurtenances shall be subject to inspection and rejection at all times. ONWASA and ENGINEER have the right to make inspections.

B. Perform Work in accordance with ONWASA Standards and Sections 1500, 1510, and 1515 of NCDOT Standard Specifications except as modified here-in

C. Brass and bronze materials in contact with potable water shall contain No Lead Alloy (UNS/CDA No. C89833*).*

D. PVC pipe that has faded color due to extended exposure to sun and weather shall not be acceptable for use

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, services, valves, fire hydrant assemblies, thrust restraints, and invert elevations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with manufacturer's name and pressure rating labeling in place.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property without written consent of the property owner or in areas obstructing pedestrian or vehicle traffic.

D. Store PVC pipe out of sunlight or under black polyethylene plastic or other suitable opaque material. Store rubber gasket rinds in shipping cartons out of sunlight and away from oil and grease until ready for use.

E. At no time shall other pipes or material be placed in the pipes.

PART 2 PRODUCTS

2.1 WATER PIPING

A. Ductile Iron Pipe (DIP): AWWA C151. Bituminous outside coating: AWWA C151. Cement Mortar Lining: AWWA C104. All water mains 18-inches in diameter and greater shall be ductile iron.

1. Pressure Class: 350 for pipe 12" in diameter and less
2. Pressure Class: 250 for pipe 14" in diameter and up
3. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153.
   a. Coating: Bituminous Coating, AWWA C110.
   b. Lining: Cement Mortar Lining, AWWA C104.
4. Joints:
   a. Mechanical Joints: AWWA C111.
   b. Push-On Joints: AWWA C111.
   c. Flanged Joints: AWWA C115. (Above ground installation only)
   d. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications. Required for carrier pipe installed through steel casing.
   e. Restrained Joints: Per *Section 33 05 19 – Pressure Piping Joint Restraint*.

B. Polyvinyl Chloride (PVC): AWWA C900 (6-inch to 12-inch), AWWA C905 (14-inch through 16-inch), and SDR-21 (2-inch in diameter). All PVC water mains shall be marked with NSF 61 designation for potable water use.

1. Pipe Class: PVC C900 and C905
   a. Pressure Rating: 235 psi minimum
   b. Color: Blue
   c. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153
   d. Joints:
      1. ASTM D3139 PVC with ASTM F477 flexible elastomeric seals. Solvent-cement couplings are not permitted.
      2. Ductile Iron, Mechanical Joint, AWWA C110
2. Pipe Class: SDR-21, Iron Pipe Size (IPS), ASTM D2241, ASTM D1784
   a. Pressure Rating: 200 psi minimum
   b. Fittings:
      1. Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153
   c. Joints:
      1. ASTM D3139 PVC with ASTM F477 flexible elastomeric seals. Solvent-cement fittings are not permitted.
      2. Ductile Iron, Mechanical Joint, AWWA C110

C. Polyethylene Pipe: See *Section 33 05 24 – Utility Horizontal Directional Drilling*

2.2 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves

1. Manufacturers:
   a. M&H Company.
   b. Mueller Company.
   c. Romac
   d. Ford Meter Box Company

2. Requirements:

   a. Stainless Steel, ductile iron or cast-iron dual compression type.
   b. Outlet Flange Dimensions and Drilling: MSS SP-60.

B. Tapping Valves:

1. Manufacturers:
   a. M&H Company
   b. American Flow Control
   c. Mueller
   d. Clow

2. Requirements:

   a. AWWA C500, non-rising stem. Inlet flanges shall conform to ANSI B16.1, Class 125 and MSS SP-60.
   b. Mechanical joint outlets shall conform to AWWA C111.
   c. Operating Nut: 2-inch square
   d. Coating: AWWA C550, interior and exterior
   e. Maximum Working Pressure: 250 psi

2.3 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. M&H Company.
2. Mueller Company.
3. American Flow Control
4. Clow

B. Resilient Wedge Gate Valves: AWWA C509 or C515; iron body, bronze or ductile iron.

1. Elastomeric Polydisulfide (EPDM) encapsulated valve gate
2. Stem: Non-rising bronze stem.
3. Operating Nut: 2-inch Square; open counterclockwise unless otherwise indicated.
4. Ends: Mechanical joint end connections for valves greater than 2-inch. IBBM end connections for 2-inch gate valves. Flanged joints are approved for above-ground or in-vault installations only.
5. Coating: AWWA C550; interior/exterior.
6. Maximum Working Pressure: 250 psi

2.4 BUTTERFLY VALVES

A. Manufacturers:

1. Clow.
2. M&H Company.
3. Mueller Company.

B. Size 4-Inch to 24-Inch for above ground applications: AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, ten infinite position lever handle (unless otherwise shown on the Drawings).

C. Size 16-Inch and larger for buried applications: AWWA C504, iron body per ASTM A126 Class B, cast iron disc per ASTM A48A capable of an uninterrupted 360 degree seating edge, solid 316

stainless steel disc seating edge, 316 stainless steel torque screw to secure disc to valve shaft, elastomeric polydisulfide (EPDM) seat molded in and vulcanized to valve body, traveling nut manual actuators.

2.5 VALVE BOXES

A. Valve boxes shall be of roadway extension type, of proper length and base size with suitable detachable cover, coated inside and out with a good asphaltum paint, domestically casted. Boxes shall be Tyler Union 6850 Series, Bingham & Taylor I5B20W, or East Jordan Iron Works 8550 Series two-piece valve box, screw type. The cast iron lid shall be marked "WATER"

2.6 FIRE HYDRANT ASSEMBLY

A. Manufacturers:

1. Mueller Company, Centurion.
2. American Flow Control Mark, 73
3. Clow, Medallion

B. Furnish materials in accordance with ONWASA requirements.

C. Dry-barrel Break-away Type: AWWA C502; cast-iron body, compression type valve.

1. Bury Depth: As indicated on the Drawings.
2. Inlet Connection: 6-inch mechanical joint shoe connection.
3. Valve Opening: 4 ½-inch diameter.
4. Ends: Mechanical Joint.
5. Bolts and Nuts: Corrosion resistant.
6. Coating: AWWA C550; interior.
7. Direction of Opening: Counterclockwise.
8. Operating Nut: National Standard Pentagon (1 ½-inchpoint to flat).
9. Self-draining, non-freezing, 2-inch mechanical joint shoe inlet connection, one 2 ½-inch NST outlet connection with a 2 1/8-inch bronze main seat valve opening

D. One pumper, two hose nozzles.

1. (2) 2 ½-inch and (1) 4 ½-inch outlets – National Standard threads.
2. Attach nozzle caps by separate chains.
3. Storz Adapters shall be installed on the 4 1/2" outlets

E. Finish: Primer and two coats of enamel, painted fire hydrant red above ground line.

F. Fire Hydrant Extensions: maximum 24" per hydrant

2.7 AIR RELEASE/VACUUM VALVES

A. Manufacturers:

1. Crispin Valve Co. (AL SERIES)
2. Valmatic Valve and Manufacturing Corp. (Series 100)

B. Air release valves shall be located at all high points along water mains where the distance between the high point and the low point in the pressure main exceeds fifteen feet (15') in elevation. ONWASA may require additional air release valves to be provided at other locations where it is determined that the possibility exists for the accumulation of excess air in the main.

2.8 UNDERGROUND PIPE MARKERS

A. Locator Tape: Brightly colored blue tape continuously printed with "WATER LINE" in large letters, minimum 6-inch wide by 4 mils thick shall be installed and buried 1.5 to 2 feet from the top of the water line

B. Tracer wire: 10-Gauge insulated wire blue in color shall be installed along the top of the water line to aid in locating the pipe for maintenance purposes. The wire shall be continuous and uninterrupted, and brought to the surface as specified in this Section.

2.9 ABOVE-GROUND PIPE MARKERS

A. The standard above-ground utility markers shall be Rhino Tri-View Markers, Model No TVF66UB. Above-ground utility markers designed to provide access to tracer wire shall be Rhino Tri-View markers, Model No.TVTI66UW2. Decals as shown in ONWASA's Standard Detail shall be placed on all three sides. Above-ground pipe markers are not required inside residential developments.

B. Concrete monument markers 6" X 6" X 36" reinforced with rebar with bronze utility markers stamped "WARNING BURRIED WATER MAIN, CALL 811 BEFORE YOU DIG" drilled and epoxied into the top of the monument per Standard Detail .Concrete monument markers shall be installed to a depth of 18" immediately above the water main at the entry and exit site of all directional drill locations where water mains cross any body of water or wetland area. When installation takes place after the work has been completed, the monuments shall be installed only after confirming the location of the water main below.

2.10 METER AND METER ENCLOSURES- See *Section 33 12 13 – Water Service Connections*

2.11 CONCRETE FOR THRUST RESTRAINT, ENCASEMENT AND CRADLES

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 2,500 psi at 28 days.
2. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
3. Maximum slump of 2 ½-inches for vibrated concrete and 4-inch for non-vibrated concrete.
4. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

2.12 BEDDING AND COVER MATERIALS

A. Backfill around Pipe and Above Pipe: As specified in *Section 31 23 17 -Trenching*.

B. Reference WS_ED "Water Main Embedment Details" in Details.

2.13 ACCESSORIES

A. Steel rods, bolt, lugs and brackets: ASTM A36 or ASTM A307 carbon steel.

B. Polyethylene Jackets: AWWA C105 polyethylene jacket. Single layer, lapped over pipe joint, and secured with 10-mil polyethylene tape.

PART 3 EXECUTION

3.1 GENERAL: Entire Project site shall be in strict accordance with OSHA Regulations.

3.2 PREPARATION

A. Prior to Start of Construction

1. Materials will be checked at the site of construction to verify conformance with approved materials. Any materials not in accordance with ONWASA Standards or approved by the Technical Operations Supervisor, or his designee, at the job site will not be assumed for use.

CONTRACTOR will be directed to remove these materials from the area before work can proceed. CONTRACTOR may be directed to expose any work suspected of containing Inferior materials. Failure, by the Inspector, to notice faulty materials or work does not relieve the CONTRACTOR of his responsibility to provide a completed final product that meets the requirements of the plans and specifications. Any inferior materials discovered will be replaced without charge for rework to ONWASA.

2. ONWASA requires a minimum of forty eight (48) hours' notice before construction is to begin so that ONWASA can schedule construction inspection for the work. Should the prosecution of the work for any reason be temporarily discontinued, the CONTRACTOR shall notify ONWASA at least twenty-four (24) hours in advance of resuming operations.

B. Surveys, Lines and Grades

1. The CONTRACTOR shall establish a Project survey control network, with both horizontal (NAD 83 datum or latest correction) and vertical (NAVD 88 datum or latest correction) controls, and develop and make any detailed surveys he deems necessary to construct the project in accordance with the contract requirements. The CONTRACTOR shall carefully preserve all reference points or existing survey markers and in the case of willful or careless destruction thereof, the CONTRACTOR shall be charged with the resulting expense, and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

C. Traffic Flow and Safety

1. The CONTRACTOR shall maintain traffic flow and control at all times. CONTRACTOR shall comply with all requirements, suggestions and/or directions of the local Police Department, North Carolina Department of Transportation, and maintain OSHA Compliance concerning traffic control and safety. All necessary precautions shall be taken to affect the full safety of the public as well as the workmen on the job. In any section of the work for which ONWASA must obtain an encroachment from the N.C. Department of Transportation for cutting a paved street, or working in the DOT right-of-way, the CONTRACTOR shall follow the requirements as set out in the approved DOT Encroachment Agreement. The DOT approved traffic control plan shall set forth the method and manner by which the CONTRACTOR shall provide for the convenience and safety of the traveling public. However, if during construction, it is determined by ONWASA, Police Department, DOT or the CONTRACTOR that additional measure is needed; the CONTRACTOR shall discontinue work and implement whatever measures are required for the safety of the public. Work shall not resume until the required safety measures are in place.
2. All encroachment bonds required by the Department of Transportation will be secured by the CONTRACTOR at his own expense.
3. No extra payment will be allowed for securing the required bond or for the implementation of a traffic control plan. The costs of the bond and implementation of traffic control measures shall be included in the bid price for each item in the proposal.

D. Water Service Cut-Off

1. When there are CITY OF JACKSONVILLE and ONWASA waterlines within the limits of a project. The following procedure applies to both the CITY OF JACKSONVILLE and ONWASA.

2. The CITY OF JACKSONVILLE/ONWASA requires adherence to the following procedures prior to shutting off water service on any existing CITY OF JACKSONVILLE/ONWASA lines:

   a. The CONTRACTOR must receive approval for shut-off from the CITY OF JACKSONVILLE Public Utilities Director/ ONWASA Distribution/Collections Superintendent. Generally, shut-offs must occur from 9 a.m. to 11 a.m. and 2 p.m. to 4 p.m. on weekdays.
   b. After receiving approval, CONTRACTOR shall notify affected residents twenty-four (24) hours in advance of beginning operation.

c. All valves to be closed or opened are to be operated by the CITY OF JACKSONVILLE Public Utilities Department/ONWASA.

3. If any water mains are damaged and service interrupted, the utility OWNER (CITY OF JACKSONVILLE or ONWASA) shall immediately be contacted and CONTRACTOR shall conduct repairs in accordance with the utility OWNER'S specifications and requirements, in order to restore water to the customers.

4. NO ONWASA valves are to be operated without prior approval of the ONWASA Distribution/Collections Superintendent (910.937.7560). Except in emergency situations, the Contractor shall request approval in writing (e-mail is preferable) no less than 48-hours prior to event, stating reason, length of outage, and number and location of customers affected.

5. Verify existing conditions before starting work. Verify existing water main size, location, and inverts are as indicated on Drawings.

3.3 EXCAVATION

A. Excavate pipe trench in accordance with *Section 31 23 17 - Trenching* for Work of this Section.

B. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation. . The Contractor is responsible for utilizing dewatering systems in accordance with good standard practice. The dewatering systems must be efficient enough to lower the water level in advance of the excavation and to maintain it continuously to keep the trench bottom and sides firm and dry. Groundwater shall not be allowed to rise around the pipe until after the trench is backfilled. Disposal of groundwater shall be in a suitable manner so as to not cause damage to adjacent property or facilities, or be a threat to public health. Pipe shall not be installed in a wet or frozen trench.

D. Provide sheeting and shoring as required.

E. Place bedding material at trench bottom and shape for accurate placement and proper support of pipe.

F. Carefully place and tamp bedding material so as not to damage or displace joints or pipe. Do not drop material directly on pipe.

G. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION – PIPE AND FITTINGS

A. Installation of waterlines shall be located within dedicated street right of ways or a 20-foot (minimum) water main easement publicly dedicated to ONWASA.

B. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufacturer’s instructions unless stricter requirements are noted in this Section.

C. Install PVC pipe in accordance with AWWA C605 and manufacturer’s instructions unless stricter requirements are noted in this Section.

D. PVC pipe shall be deflected onto a radius no smaller than 1.2 times the minimum radius set out in the PVC Pipe Handbook. Ductile iron joint deflections shall be no greater than 80 percent of the maximum set out in the Ductile Iron Handbook.

E. Each fitting and section of pipe shall be inspected for defects prior to installation.

F. Each fitting shall be secured by two forms of restraint. Restraining glands and concrete thrust blocking are preferred. Wedge-action restraint glands (i.e. MEGALUGS) are approved only for use on ductile iron pipe. Full-circumferential pipe restraint glands (i.e. Grip Rings) may be used on PVC or ductile iron pipe. All restraint glands shall be designed for use on the type of pipe for

which they are being installed. Other forms of restraint such as threaded rod, bell restraint harnesses, etc. may be approved by ONWASA on a case-by-case basis.

G. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings.

H. Required Separation Between Pipe Systems:

1. Lateral Separation of Sewer and Water Mains. Water mains shall be laid at least 10- feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation -- in which case
   a. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer; or
   b. The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation *of* the bottom of the water main at least 18-inches above the top of the sewer.
2. Crossing a Water Main over a Sewer. Whenever It is necessary for a water main to cross over a sewer or storm sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18-inches above the top of the sewer or storm sewer, unless local conditions or barriers prevent an 18-inch vertical separation -- in which case both the water main and the sewer or Storm Sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10-feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.
3. Crossing a Water Main under a Sewer or storm sewer. Whenever it is necessary for a water main to cross under a sewer or storm sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10-feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing. If water line is incased and the steel casing is run 10 feet past the sewer pipe, will it be allowed not to change the force main or gravity sewer to a ferrous material?
4. In accordance with NCAC Title 15A Ch.18C Section 0.0906 and NCAC Title 15 Ch.2 M 0.0200, ONWASA interpretation of this ruling shall be as follows for a new development; Whenever a Sewer Main crosses above or below a water main and the minimum clearance will not be met, both pipes shall be constructed of ferrous material for a distance of 10-feet on center in each direction, however, any areas pre-existing shall be handled on a case by case basis.
5. Crossing a Water Main or Sewer Main under a Storm Sewer Main.
   a. When water mains cross under a storm sewer main with less than 24-inches separation at depths of 6' or less, the main may be deflected to provide 24-inches of separation and shall be constructed of ductile iron pipe or as shown on the plans. One joint of pipe shall be centered under the storm drain
   b. When water mains cross under a storm sewer main with less than 24-inches separation at depths greater than 6', the main must be lowered as shown in the Culvert Crossing Detail utilizing restrained joint ductile iron pipe for the entire length of the crossing structure.
   c. When sewer mains cross under a storm sewer with less than 24-inches separation, the main shall be constructed of ductile iron pipe or as shown on the plans. One joint of pipe shall be centered under the storm drain. Install pipe in locations and at grades as specified, except as otherwise permitted by ONWASA. Pipe shall be installed to designed elevation to within tolerance of ½-inch.

I. The pipe and fittings shall be kept thoroughly clean of any water, earth, stones, or other debris until work is completed and accepted by ONWASA. Open ends of the pipe shall be capped or plugged with a water-tight fitting during periods of work stoppage.

J. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

K. Remove scale and dirt on inside and outside before assembly.

L. Pigging is required for pipe 8-inches in diameter and greater.

M. Flanged Joints: Not to be used in underground installations except within structures.

N. Install in open cut, except where otherwise required or permitted by ONWASA.

1. Where installed by free boring, extend hole 5 feet each side of pavement, thread pipe into hole from boring pit with leading end of first pipe covered to prevent damage and the entry of earth, and fill space around pipe with grout.
2. All piping that is dry-bored shall be ductile iron.
3. Where installed within steel encasement pipe, refer to *Section 33 05 23 - Trenchless Utility Installation*.
4. Install concrete monument markers directly above the pipe at the entrance and exit points of the bore

O. Install pipe with no high points unless shown on the plans. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by the ENGINEER.

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

Q. Install access fittings to permit required testing.

R. When necessary to cut pipe at fittings, valves, or elsewhere, the remaining portions may be used to minimize the number of scrap pieces when the work is complete; however, scrap pieces less than 5-feet in length shall not be used.

S. Install underground marking tape continuously above pipe line 12 to 18 inches below the ground surface.

T. Install and secure trace wire to the pipe with duct tape near every bell and at the center of each pipe joint. The wire shall be fastened securely to all fittings as directed by ONWASA**.** Splices in the tracer wire shall be connected by means of a waterproof and corrosion-proof connectors designed for direct bury applications. Standard wire nuts are not acceptable. The connection shall then be completely wrapped in electrical tape. There shall be no exposed bare wire. The tracer wire shall be made accessible through above-ground utility markers as specified in this Section. In residential developments, trace wire shall be made accessible in valve boxes, vaults, etc.

U. Install above-ground utility markers at horizontal bends, main-line valve boxes (not within 10 feet of a fire hydrant assembly branch), each side of a roadway crossing, and along the piping alignment. The maximum spacing for the above-ground utility markers shall be 500 linear feet. In locations where there are multiple horizontal bends in close proximity, one marker will be sufficient to demonstrate the change in direction. Utility markers designed to provide access to tracer wire shall be installed at every third marker, or every 1000 feet of pipe, whichever is less. Concrete monument markers shall be installed at the ends of directional bores and bank edge of all channels crossed by directional bores, Tracer wire accessible above-ground utility markers shall also be installed at ends of directional bores.

V. Establish elevations of buried piping with not less than 3-feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.

W. Backfill trench in accordance with *Section 33 23 17 – Trenching*.

X. Make connections at such times and using fittings as approved by ONWASA. Connections to existing pipes shall be made by ductile iron mechanical joint sleeves with transition gaskets as necessary, or stab fit, wide range gasketed sleeves (i.e. Hymax Coupling) suitable for water service as determined by the sleeve manufacturer. Flexible couplings (i.e. Fernco) shall not be permitted on water mains.

3.5 INSTALLATION – FIRE HYDRANT ASSEMBLY

A. Install Fire Hydrant; use hydrant tees, provide support blocking and drainage gravel; do not block drain hole. Fire Hydrant Assemblies will require installation of a restraint joint system.

B. Set hydrants plumb with pumper nozzle facing roadway; set hydrants with centerline of pumper nozzle 18-inches above finished grade and ensure the finish grade includes any foreseen landscaping material such as rock, mulch or sod, etc. Under no circumstances shall the hydrant maximum bury line fall below the finish grade.

C. When hydrant extensions are necessary, they shall be installed prior to testing. No more than one hydrant extension shall be installed on any hydrant and hydrants shall not be extended more than 2'. If a hydrant requires an extension greater than 2', it shall be replaced with a hydrant of adequate height for the location.

D. Paint hydrants fire hydrant red to ground line.

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

F. When construction conditions require, Fire Hydrant Assemblies shall be protected with the installation of bollards.

G. Fire hydrants located inside the City of Jacksonville's Extra Territorial Jurisdiction (ETJ) area shall meet the requirements of the City of Jacksonville.

3.6 INSTALLATION – VALVES

A. Install valves in conjunction with pipe installation; set valves plumb.

B. Provide buried valves with valve boxes installed flush with finished grade and centered over the valve so that the operating nut is easily and fully accessible.

C. Adjust valve boxes to final grade at the time designated by ONWASA.

D. Install concrete support underneath valves as indicated in the Detail.

E. All valve boxes outside pavement shall have a standard concrete valve collar or a 2' x 2' x 4" pad of concrete poured around the valve boxes. Where there are multiple valve boxes in close proximity and the valve boxes are too close to install whole valve pads on each one, a single concrete pad shall be poured of sufficient size to provide a minimum of 8" of concrete around the outer edge of the valve boxes. No valve pads are to be cut.

3.7 INSTALLATION – AIR RELEASE / VACUUM VALVES

A. Air release/vacuum valves shall be installed in minimum 5-foot inside diameter vented manholes with solid concrete bottoms in accordance with *Section 33 05 14 – Utility Manholes and Structures* and ONWASA's Standard Details.

3.8 INSTALLATION - TAPPING SLEEVES AND VALVES

A. Install tapping sleeves and valves in accordance with ONWASA requirements, as indicated on Drawings, and in accordance with manufacturer's instructions. ONWASA is to be notified a minimum of 48 hours prior to any tap being made. ONWASA's requirements include pressure testing the tapping sleeve in the presence of an ONWASA representative.

B. Once installed, tapping sleeves shall be pressure tested at 100 psi (water pressure) for 10 minutes to ensure no leakage.

C. Whenever a reverse tap (backside tap) is required, all fittings **MUST** be restrained from the wet tap valve all the way to the casing using stainless steel threaded rod as well as restraint glands (mega-lugs or grip rings).

D. Only licensed UTILITY CONTRACTORS will be allowed to make taps on ONWASA water lines.

3.9 INSTALLATION - CONCRETE THRUST RESTRAINT

A. Provide concrete thrust restraint for valves, tees, bends, caps, plugs, and dead ends with concrete thrust blocks as indicated on the Drawings. Thrust should be located to resist resultant force and so pipe and fittings will be accessible for repair

B. Fittings shall be wrapped in polyethylene prior to pouring the concrete thrust blocking to protect the fittings, glands, bolts, etc. from direct contact with the concrete.

C. The concrete for the thrust blocks shall be mixed outside the excavation in a clean container with potable water. Mixing of concrete in the excavation using ground or surface water, or placement of dry, unmixed bags of concrete behind fittings shall not be allowed.

D. Pour concrete thrust blocks against undisturbed earth. Do not encase fittings, glands, bolts, etc.

3.10 INSTALLATION - POLYETHYLENE ENCASEMENT

A. Encase Ductile Iron Piping in polyethylene where indicated on Drawings to prevent contact with surrounding backfill material.

B. Install in accordance with AWWA C105.

C. Terminate encasement 3 to 6-inches above ground where pipe is exposed.

3.11 INSTALLATION - JOINT RESTRAINT

A. Install joint restraint in accordance with *Section 33 05 19 – Pressure Piping Joint Restraint*.

3.12 INSTALLATION - SERVICE CONNECTIONS

A. Install service connections in accordance with *Section 33 12 13 – Water Service Connections*.

3.13 BACKFILLING

A. Backfill and compact around sides and to top of pipe in accordance with *Section 31 23 17 - Trenching*.

B. Maintain optimum moisture content of material to attain required compaction density.

3.14 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with *Section 33 13 00 - Disinfecting Water Utility Distribution.*

3.15 FIELD QUALITY CONTROL

A. The Contractor shall conduct preliminary pressure, leakage, and tracer wire testing prior to the witnessed tests to verify the tests will pass on the first attempt. If the Contractor schedules a required test in advance and the test is not ready to begin at the scheduled time, the Contractor will be required to reimburse ONWASA for all costs to ONWASA associated with the delay.

B. Check valve boxes after installation to ensure the valves are installed plumb and centered over the valve operating nut. Remove stones, dirt, debris, and backfill material.

C. Compaction Testing: Perform soil compaction tests in accordance with *Section 31 23 17 - Trenching*.

D. Trace Wire Testing: Contractor shall perform a continuity test on all trace wire in the presence of an ONWASA representative. If the trace wire is found to be not continuous after testing, the Contractor shall repair or replace the failed segment of the wire. Continuity test shall be repeated as necessary.

E. Notification: Notify ONWASA and, if necessary, the testing agency 72 hours in advance of all required testing and have test witnessed.

F. Test Pressure: Not less than 150 psi. The test will result in automatic failure if the test pressure drops below 150 psi and fails a leakage test.

G. Prior to conducting pressure testing, the Contractor shall demonstrate to the ONWASA Representative that all valves in the system are fully opened.

H. Pressure and Leakage Test Procedure:

1. Pressure and leakage testing is the responsibility of the Contractor, who shall provide all materials, labor, and equipment, and pay for the total volume of water used. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct pressure and leakage tests in accordance with AWWA C600 unless otherwise required by this Section.
2. Conduct tests for at least two-hour duration.
3. Pipeline installations that lose more than 5 psi at completion of the Hydrostatic Pressure Test will be required to pass an Allowable Leakage Test.
4. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks and plug resulting piping openings.
5. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
6. Examine exposed piping, fittings, valves, hydrants, and joints carefully during pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
7. No pipeline installation will be approved when leakage test, if required, is greater than that determined by the following formula:

$$AL = \left(\frac{L}{5280}\right) \cdot \left(\frac{D \cdot 10}{12}\right)$$

AL = allowable leakage over 2-hour test period at 150 psi, in gallons
L = length of pipe tested, in feet
D = nominal diameter of pipe, in inches

8. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.
9. Test must be witnessed by ONWASA and the Certifying Engineer. Both parties must complete and sign ONWASA's Leakage/Hydrostatic/Chlorination and Flushing Form before the water line will be approved.

3.16 COMPLETION OF TESTS

A. After successful completion of testing, mains shall be flushed and cleaned and all connections made prior to acceptance.

3.17 CONNECTION TO EXISTING WATER SUPPLY SYSTEM

A. No connection shall be made to the existing water system unless and until the CONTRACTOR has obtained all necessary approvals from ONWASA.

B. Connections shall be made by approved methods and in accordance with the requirements of these specifications and ONWASA.

C. No pipe shall be opened until the new system is complete, tested and approved in accordance with these specifications, ONWASA's requirements under them, Final Approval has been received from the North Carolina Division of Environmental Quality, Division of Public Water Supply and (for projects with sanitary sewer systems) the North Carolina Division of Environmental Quality, Division of Water Quality has acknowledged receipt of the Engineer's Certification. Projects with off-site septic systems or private sewer systems must provide ONWASA with a copy of the approval letter of the permitting authority prior to water being turned on.

D. **IF MORE THAN 30 DAYS PASS BETWEEN INITIAL CHLORINATION AND THE PLACEMENT OF THE WATER LINES INTO SERVICE, THE NEW SYSTEM MUST BE RECHLORINATED AND PASS AN NEW BACTERIOLOGICAL TEST.**

END OF SECTION

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SECTION 33 12 13
WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for domestic water service connections to buildings.
2. Corporation stop assembly.
3. Curb stop assembly.
4. Water meters and meter setting equipment.
5. Backflow preventers.
6. Bedding and cover materials.

B. Related Section:

1. Section – Trenching31 23 16.13
2. Section – Utility Manholes and Structures33 05 13
3. Section 33 11 00 - Water Utility Distribution Piping
4. Section 33 13 00 - Disinfecting of Water Utility Distribution

1.2 DEFINITIONS

A. Owner: Onslow Water and Sewer Authority - ONWASA

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with ONWASA Standards and Sections 1500, 1510, and 1515 of NCDOT Standard Specifications.

B. All pipes, fittings, valves, and appurtenances shall be appropriately marked for identification purposes. The materials and methods of manufacture, and completed pipes, fittings, valves, and appurtenances shall be subject to inspection and rejection at all times. ONWASA and ENGINEER have the right to make inspections.

C. Brass and bronze materials in contact with potable water shall contain No Lead Alloy (UNS/CDA No. C89833).

1.4 DELIVERY, STORAGE, AND HANDLING

A. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.

B. Store products and materials off ground and under protective coverings and custody, away from walls and in manner to keep these clean and in good condition until used.

C. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Polyethylene Pipe: AWWA C901 CTS Equivalent O.D.

1. Standard Dimension Ratio: SDR-9
2. Pressure Rating: 200 psig
3. Fittings: AWWA C901 molded or fabricated.
4. Joints: Compression

B. Polyvinyl Chloride(PVC): SDR-21, Iron Pipe Size (IPS), ASTM D2241, ASTM D1784. All PVC water service lines shall be marked with NSF 61 designation for potable water use.

1. Pressure Rating: 200 psi minimum
2. Fittings:
   a. PVC fittings conforming to pipe requirements pressure rated to exceed pipe class.
   b. Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153
3. Joints:
   a. ASTM D3139 PVC with ASTM F477 flexible elastomeric seals for the pipe.
   b. Ductile Iron, Mechanical Joint, AWWA C110

2.2 CORPORATION STOP ASSEMBLY (for ¾ -inch and 1-inch taps)

A. Manufacturers:

1.	Ford Meter Box Company.	Model FB 1000-3-G-NL
2.	Mueller Company.	Model B-25008-N
3.	A.Y. McDonald Mfg. Co.	Model 74701 BT (Ball Valve Only).
4.	Cambridge Brass, Inc.	Model 301-NL-A3GJ3

Model numbers listed in this Section may be specific to a certain size, and may change due to size variations in the equipment. Features of each respective make and model listed in this Section shall remain the same.

Corporation stop assemblies will not be permitted on 1 1/2-inch and larger service taps. IBBM gate valves meeting the requirements of *Section 33 11 00 – Water Utility Distribution Piping* shall be installed for 1 ½-inch and larger service taps.

2.3 SERVICE SADDLES (¾-inch–2-inch Service Taps)

A. Manufacturers:

1. Romac Industries, Inc
2. Smith-Blair, Inc.
3. A. Y. McDonald Mfg. Co.
4. Mueller Company
5. Ford Meter Box Company

B. Brass and Bronze, single strap service saddles, manufactured specifically for the type of pipe being tapped, shall be installed on water mains 6-inches in diameter or less.

Double or triple-stud stainless steel service saddles, manufactured specifically for the type of pipe being tapped, shall be installed for all 2-inch and greater service taps, all SDR-26 PVC and AC water mains, and all water mains 8-inches in diameter and greater. Single-stud stainless steel service saddles are not acceptable. Service saddles for all SDR- 26 PVC and AC water mains shall be long and Romac style306 or Smith and Blair model 373.

C. 1 1/2-inch services will require a 2-inch service tap and 2-inch IBBM gate valve. The service may be reduced down from 2-inch diameter to 1 1/2-inch diameter downstream of the gate valve.

D. Insert for poly-tube shall be solid one piece Stainless Steel at compression fitting.

2.4 METER SETTING EQUIPMENT

A. Manufacturers:

1.	Ford Meter Box Company.	Model VB 72-7W-4133FPG-NL
2.	Mueller Company.	Model B2404-42-N
3.	A. Y. McDonald Mfg. Co.	Model 724-207-JXTD33-NL (Ball Valve Type Only)
4.	Cambridge Brass	Model 6020NL – 207H3D3-UO

Model numbers listed in this Section may be specific to a certain size, and may change due to size variations in the equipment. Features of each respective make and model listed in this Section shall remain the same.
NO METER SETTERS WILL BE AUTHORIZED ON 1½-INCH OR LARGER TAPS.

B. Outside Meter Setting:

1. Meter Yokes: Copper or iron, riser type assembly with bronze inlet inverted key angle valve expansion type outlet connection and Ell fitting; flared copper tubing connections both ends.
2. Meter Yokes: Copper or iron, inlet and outlet horizontal or vertical setting with matching couplings, fittings, and stops.

2.5 WATER METERS

A. ONWASA shall furnish and install 1-inch and smaller water meters.

B. ONWASA shall furnish 1 1/2-inch and larger meters at the current cost to ONWASA. Contact ONWASA for current pricing information and the amount of time necessary to order and receive the prepaid meters. The Contractor shall install the meters provided.

2.6 METER BOXES

A. Meter boxes for 2-inch meters and smaller shall be Oldcastle Precast Carson Model, DFW or NDS with solid HDPE plastic base. Meter boxes for 1 1/2-inch meters shall be jumbo-type. Brick supports shall be installed underneath meter boxes to prevent settling.
B. Meters greater than 2-inches shall be installed inside of a precast concrete vault.
C. Meter box lids for standard size meter boxes shall be constructed of solid cast iron, shaped to fit the meter box base. Plastic lids are acceptable for jumbo-type meter boxes.

The size of the meter box shall be sized to accommodate the equipment to be installed.

2.7 BACKFLOW PREVENTERS

A. Furnish materials in accordance with *ONWASA Backflow and Cross Connection Standards*. See ONWASA's website for requirements.

2.8 PRECAST CONCRETE VAULT

A. Conform to *Section* 33 05 14 - *Utility Manholes and Structures*.

B. Shape and Size: As indicated on Drawings.

2.9 CONCRETE

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 2,500 psi at 28 days.
2. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
3. Maximum slump of 2 ½-inches for vibrated concrete and 4-inch for non-vibrated concrete.
4. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

2.10 BEDDING AND COVER MATERIALS

A. Backfill around pipe and above pipe: As specified in *Section 31 23 17 -Trenching*.

PART 3 EXECUTION

3.1 GENERAL: Entire Project site shall be kept in strict accordance with OSHA Regulations.

3.2 PREPARATION

A. Prior to Start of Construction

1. Materials will be checked at the site of construction to verify conformance with approved materials. Any materials not in accordance with ONWASA Standards or approved by the Technical Operations Supervisor, or his designee, at the job site will not be assumed for use. CONTRACTOR will be directed to remove these materials from the area before work can proceed. CONTRACTOR may be directed to expose any work suspected of containing Inferior materials. Failure, by the Inspector, to notice faulty materials or work does not relieve the CONTRACTOR of his responsibility to provide a completed final product that meets the requirements of the plans and specifications. Any inferior materials discovered will be replaced without charge for rework to ONWASA.
2. ONWASA requires a minimum of forty-eight (48) hours' notice before construction is to begin so that ONWASA can schedule construction inspection for the work. Should the prosecution of the work for any reason be temporarily discontinued, the CONTRACTOR shall notify ONWASA at least twenty-four (24) hours in advance of resuming operations.

B. Surveys, Lines and Grades

1. The CONTRACTOR shall establish a project survey control network, with both horizontal (NAD 83 datum or latest correction) and vertical (NAVD 88 datum or latest correction) controls, and develop and make any detailed surveys he deems necessary to construct the project in accordance with the contract requirements. The CONTRACTOR shall carefully preserve all reference points or existing survey markers and in the case of willful or careless destruction thereof, the CONTRACTOR shall be charged with the resulting expense, and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

C. Traffic Flow and Safety

1. The CONTRACTOR shall maintain traffic flow and control at all times. CONTRACTOR shall comply with all MUTCD requirements as well as any requirements, suggestions and/or directions of the local Police Department, North Carolina Department of Transportation, and maintain OSHA Compliance concerning traffic control and safety. All necessary precautions shall be taken to affect the full safety of the public as well as the workmen on the job. In any section of the work for which ONWASA must obtain an encroachment from the N.C. Department of Transportation for cutting a paved street, or working in the DOT right-of-way, the CONTRACTOR shall follow the requirements as set out in the approved DOT Encroachment Agreement. The DOT approved traffic control plan shall set forth the method and manner by which the CONTRACTOR shall provide for the convenience and safety of the traveling public. However, if during construction, it is determined by ONWASA, Police Department, DOT or the CONTRACTOR that additional measure is needed; the CONTRACTOR shall immediately cease operations and implement whatever measures are required for the safety of the public. Work shall not resume until all necessary measures are in place
2. All encroachment bonds required by the Department of Transportation will be secured by the CONTRACTOR at his own expense.
3. No extra payment will be allowed for securing the required bond or for the implementation of a traffic control plan. The costs of the bond and implementation of traffic control measures shall be included in the bid price for each item in the proposal.

D. Water Service Cut-Off

1. When there are CITY OF JACKSONVILLE and ONWASA waterlines within the limits of a project. The following procedure applies to both the CITY OF JACKSONVILLE and ONWASA.
2. The CITY OF JACKSONVILLE/ONWASA requires adherence to the following procedures prior to shutting off water service on any existing CITY OF JACKSONVILLE/ONWASA lines:

a. The CONTRACTOR must receive approval for shut-off from the CITY OF JACKSONVILLE Public Utilities Director/ ONWASA Distribution/Collections Superintendent. Generally, shut-offs must occur from 9 a.m. to 11 a.m. and 2 p.m. to 4 p.m. on weekdays.
b. After receiving approval, CONTRACTOR shall notify affected residents twenty-four (24) hours in advance of beginning operation.
c. All valves to be closed or opened are to be operated by the CITY OF JACKSONVILLE Public Utilities Department/ONWASA.

3. If any water mains are damaged and service interrupted, the utility OWNER (CITY OF JACKSONVILLE or ONWASA) shall immediately be contacted and CONTRACTOR shall conduct repairs in accordance with the utility OWNER'S specifications and requirements, in order to restore water to the customers.
4. NO ONWASA valves are to be operated without prior approval of ONWASA Distribution/Collections Superintendent (910.937.7560). Except in emergency situations, the Contractor shall request approval in writing (e-mail is preferable) no less than 48-hours prior to event, stating reason, length of outage, and number and location of customers affected.
5. Verify existing conditions before starting work. Verify existing water main size, location, and inverts are as indicated on Drawings.

E. Verify building service connection and water main size, location, and invert are as indicated on Drawings.

3.3 INSTALLATION - CORPORATION STOP ASSEMBLY

A. Make connection for each different kind of water main using suitable materials, equipment and methods approved by the ONWASA.

B. Provide service clamps for mains other than of cast iron or ductile iron mains.

C. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock position on main's circumference; locate corporation stops at least 12-inches apart longitudinally and staggered.

D. For plastic pipe water mains, provide full support for service clamp for full circumference of pipe, with minimum 2-inch width of bearing area; exercise care against crushing or causing other damage to water mains at time of tapping or installing service clamp or corporation stop.

E. Use proper seals or other devices so no leaks are left in water mains at points of tapping; do not backfill and cover service connection until approved by ONWASA.

3.4 EXCAVATION, BEDDING AND BACKFILL

A. Excavate pipe trench in accordance with *Section 31 23 17 - Trenching* for Work of this Section.

B. Place bedding material at trench bottom in accordance with *Section 31 23 17 - Trenching.*

C. Backfill around sides and to top of pipe with cover fill, tamp in place in accordance with *Section 31 23 17 - Trenching*.

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

3.5 INSTALLATION - PIPE AND FITTINGS

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

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with proper flanges or unions.

D. Group piping with other site piping work whenever practical.

E. Install pipe to indicated elevation to within tolerance of 5/8-inch.

F. Route pipe in straight line.

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

H. Install access fittings to permit disinfection of water system performed under *Section 33 13 00 – Disinfecting Water Utility Distribution*.

I. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.

J. Establish elevations of buried piping with not less than 3-feet of cover.

K. Backfill trench in accordance with *Section 31 23 17 - Trenching.*

3.6 INSTALLATION - CURB STOP ASSEMBLY

A. Set curb stops on solid bearing of compacted soil.

B. Center and plumb curb box over curb stops. Set box cover flush with finished grade.

3.7 INSTALLATION - BACKFLOW PREVENTERS AND WATER METERS

A. Install positive displacement meters in accordance with AWWA M6, as indicated on Drawings, and in accordance with manufacturer's instructions.

B. Install backflow preventers where indicated on Drawings and in accordance with *ONWASA Cross Connection Standards.*

C. Comply with ONWASA requirements and applicable plumbing codes regarding testing and installation requirements.

3.8 SERVICE CONNECTIONS

A. Install water service in accordance with ONWASA requirements with backflow preventer and water meter.

3.9 PRECAST CONCRETE VAULT

A. Shape and Size: As indicated on the Drawings.

B. Install in accordance with *Section 33 05 14 – Utility Manholes and Structures*.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with *Section 33 13 00 – Disinfecting Water Utility Distribution.*

3.11 FIELD QUALITY CONTROL

A. The Contractor shall conduct preliminary pressure and leakage testing prior to the witnessed tests to verify the tests will pass on the first attempt. If the Contractor schedules a required test in advance and the test is not ready to begin at the scheduled time, the Contractor will be required to reimburse ONWASA for all costs to ONWASA associated with the delay.

B. Compaction Testing: Perform soil compaction tests in accordance with *Section 31 23 17 - Trenching*.

C. Notification: Notify ONWASA and, if necessary, the testing agency 72 hours in advance of all required testing and have witness test.

D. Test Pressure: Not less than 150 psi, the test will result in automatic failure if the test pressure drops below 150 psi.

E. Pressure and Leakage Test Procedure:
Pressure and leakage testing shall be in accordance with the Pressure and Leakage Test Procedure set out in section 33 11 00 -11,

1. Water Utility Distribution Piping, of this Manual.

3.12 CONNECTION TO EXISTING WATER SUPPLY SYSTEM

A. Connections to existing water supply systems shall be in accordance with the requirements set out in section 33 11 00-12, Water Utility Distribution Piping, of this manual.

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SECTION 33 13 00
DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes disinfection of potable water distribution and transmission system; and testing and reporting results.

B. Related Sections:

1. *Section 33 11 00 - Water Utility Distribution Piping*
2. *Section 33 12 13 - Water Service Connections*.

1.2 REFERENCES

A. American Water Works Association:

1. AWWA B300 - Hypochlorite.
2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
3. AWWA C651 - Disinfecting Water Mains.

1.3 REPORTS

A. Disinfection Report: Must comply with ANSI\AWWA C-651, *Disinfecting Water Mains, latest revision*.

1. Type, form and application method of disinfectant used.
2. Date, time and quantity of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

B. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certify water conforms, or fails to conform, to bacterial standards of ONWASA.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651; maintain one copy of document on site.

B. Water Quality Certificate: Provide documentation to certify water conforms to quality standards of authority having jurisdiction, suitable for human consumption.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Aqueous Solution of Hypochlorite (lime, calcium, sodium)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping system has been cleaned, inspected, and pressure tested.

B. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

A. Disinfection is the responsibility of the Contractor, who shall provide all materials, labor, and equipment necessary, and pay for the total volume of water used.

B. Provide and attach required equipment to perform the Work of this Section.

C. Perform disinfection of water distribution system after each line between valves has been tested and all necessary repairs made.

D. Water containing not less than 50 parts per million and not more than 100 parts per million of chlorine shall be placed in the line at a slow rate and in such proportion that the required chlorine content is evenly distributed in the main.

E. Maintain disinfectant in system for 24 hours minimum, with not less than 10 parts per million residual after 24 hours.

F. Unless otherwise approved by ONWASA, sampling points shall be spaced no greater than 1000 LF of completed pipeline apart and there shall be a minimum of 2 samples collected for any project regardless of pipe length.

G. Flush, circulate, and clean until required cleanliness (purity) is achieved; use municipal domestic water. The minimum flushing rate for pipes shall be as follows:

2”	30 gpm
4”	100 gpm
6”	200 gpm
8”	400 gpm
10”	600 gpm
12”	900 gpm
16”	1,600 gpm

H. 18” 2,000 gpm Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL

A. ONWASA will transport the bacteriological testing samples from the site to a third-party testing agency for analysis. The results will be sent to ONWASA for review, and then forwarded to the Design Engineer. The Contractor shall be responsible for all testing fees.

B. Disinfection, De-chlorination, Flushing, and Sampling:

1. Notify ENGINEER and ONWASA 72 hours in advance of test and have witness test.
2. Disinfect pipeline installation in accordance with AWWA C651. Use of liquid chlorine is not permitted.
3. **DECHLORINATION**: The disposal of chlorinated water is the responsibility of the CONTRACTOR. Upon completion of retention period required for disinfection, the heavily chlorinated water shall be neutralized by chemical application before discharge from the main. **A de-chlorinating device is required**. Chlorine concentration of the water discharged from the main shall be no higher than 0.1ppm in excess of the residual in the existing system or is acceptable for domestic use.
4. After final flushing and before pipeline is connected to existing system or placed in service, employ an approved independent testing laboratory to sample, test, and certify water quality suitable for human consumption.

5. **IF MORE THAN 30 DAYS PASS BETWEEN INITIAL CHLORINATION AND THE PLACEMENT OF THE WATER LINES INTO SERVICE, THE NEW SYSTEM MUST BE RECHLORINATED AND PASS AN NEW BACTERIOLOGICAL TEST.**

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ONWASA's

Manual of Standards, Specifications and Details

Section V

SANITARY SEWER SYSTEM DESIGN SPECIFICATIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

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Section V
Sanitary Sewer Design Specifications

1 GENERAL

1.1 Specification and Design Manual:

A. All projects within the jurisdiction of the Onslow Water and Sewer Authority (ONWASA) shall be designed and constructed in accordance with ONWASA's Manual of Specifications and Standards, latest revision.

B. All engineering plans for public and private sewer systems must meet State and ONWASA design standards on the most recently amended Waste not Discharged to Surface Waters by the North Carolina Department of Environmental Quality a NCAC Title 15A 2H .0200 and/or ONWASA's Manual of Specifications and Standards, whichever is more stringent.

C. All structures and utilities shall comply with the applicable Areas of Environmental Concern (AEC) Standards, as amended, in accordance with the State Guidelines of AEC's (15 NCAC 7H) pursuant to the Coastal Area Management Act of 1974.

1.2 Permits

A. Plan approvals, Water and Sewer: Prior to commencing construction, all plan approvals and permits for water and/or sewer shall be obtained. A preconstruction conference with ONWASA must also be held prior to commencing any construction.

B. Encroachment Permits: An encroachment permit will be required from any Contractor or Developer wishing to excavate or place utilities on NCDOT or public right-of-ways.

C. Pavement Cuts: Pavement cuts in streets shall be repaired in accordance with the specific requirements of the public agency on whose street or roadway the utility is being placed, as well as any other applicable requirements dictated in the approved encroachment permit. Open cut or bored crossings shall otherwise adhere, as applicable, to specification *Section 31 23 17 - Trenching.*

D. Developer must obtain all other State and Local Permits, as applicable (Air Quality, Erosion and Sedimentation Control, Zoning, etc.).

1.3 Plan Review and Observation Fees:

All plan review and observation fees must be paid prior to acceptance of project. Refer to the current ONWASA fee schedule for applicable fees.

2 SANITARY SEWER SYSTEM DESIGN STANDARDS

The purpose of this module is to establish standard design procedures and criteria for sanitary sewer system design on systems owned and maintained by ONWASA.

Proposed developments should connect to ONWASA's public sanitary sewer system if it is within 1,000 linear feet by public right of way or public utility easement from the closest point of the development to the existing public water and/or sanitary sewer system.

The sewer system for any proposed development shall be designed so that the gravity system will extend to the upper drainage limit of the site and be sized for the entire natural drainage basin of the proposed project.

2.1 Pipeline Location

A. Sewer mains located in street right-of-way will be in the center of the pavement or right-of-way, except where prohibited by NCDOT.

B. Sanitary sewer lines may not be placed in private easements.

C. Where future flow is expected from an adjacent property, public easements shall be provided for future sewer main extensions.

D. All easements must be at least 20 feet wide. See the table below for further detail.

Pipe Size (Dia.)	Pipe Depth	Easement Width*
8-15 inches	<10 feet	20 feet
Over 8”	10-20 feet	30 feet

*Easement widths for all pipes larger than 24 inches or deeper than 20 feet will be approved by ONWASA on a case by case basis.

E. All utilities must be centered on the easement.

F. All easements shall be recorded as “Water and Sewer Utility Easement,” and it shall be dedicated to ONWASA.

G. All off-site easements shall be acquired by the developer.

H. No structures of any kind, including fences, shall be allowed in a utility easement.

I. No plants, trees or shrubs of any kind shall be allowed in a utility easement.

J. All easements must be fully accessible by rubber-tired vehicles. Stream fords may be required in accordance with DWQ and USACE requirements.

K. The maximum grade on an easement for vehicular access can be 4:1.

2.2 Gravity Sewer Size, Slope and Design Criteria

A. Pressure systems may not be installed where gravity sewer is technically feasible. Pressure systems must have prior approval from ONWASA.

B. No public gravity sewer shall be smaller than 8 inches in diameter.

C. Slopes and velocities are to be determined by most recent State standards.

D. Potential conflicts with parallel pipe systems must be taken into consideration during vertical design to allow for appropriate lateral connections.

E. Pipe greater than 12-feet and up to 15-feet deep shall be C900 PVC or PC 350 ductile Iron.

F. Pipe greater than 15-feet deep shall be ductile iron.

G. Services of ductile iron gravity sewer must be ductile iron for one entire length of service line, or to a depth of 10 feet or less.

H. Pipe diameter and direction may only change at manholes.

I. A minimum cover of 36 inches must be provided for all sewers.

J. Fill dirt cannot be placed around gravity sewer pipes above existing grade level.

K. Buoyancy of pipes shall be taken into consideration. For design purposes, assume water to the top of the pipe, and the pipe is empty.

2.3 Manholes

A. Manholes shall be made of pre-cast concrete unless otherwise approved by the ENGINEERING DIRECTOR.

B. All manholes are to be extended base.

C. The maximum distance between two manholes shall be no greater than 425 feet.

D. All manholes will be eccentric.

E. Manholes shall not contain steps.

F. Outside drop assemblies are not permitted.

G. The diameter of each manhole shall be determined by the following table:

Diameter	Main Size	Depth of Installation
4'-0"	8" to 12"	0' to 15'
5'-0"	15" to 30"	15' to 30'
6'-0"	36" and greater	30' and greater

H. Drop manholes shall be minimum 5-feet in diameter.

I. An inside drop assembly, in accordance with ONWASA's Standard Detail, shall be provided for a sewer entering a manhole at an elevation greater than 2.5 feet (30 inches) above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 2.5 feet (30 inches), the invert shall be filleted to prevent solids deposition. Outside drop assemblies are not permitted.

J. A maximum drop of 12 inches will be allowed where a force main discharges into a manhole. If the drop is greater than 12 inches, an inside drop assembly in accordance with ONWASA's Standard Detail shall be installed.

K. A force main entering a manhole must enter in the same direction as the downstream flow. A protective lining as specified in *Section 09-96-59 – Protective Lining for Concrete Exposed to Severe Wastewater Environmen*t shall be installed in each manhole with a force main entering into it.

L. The maximum deflection angles at a manhole are as follows:

Pipe Diameter (largest pipe controls)	Max Deflection Angle per Manhole
8-10 inch	90 degrees
12-20 inch	75 degrees
>20 inches	60 degrees

M. Manholes cannot be buried for any reason. Manholes located in pavement or inside the public right-of-way shall be at grade. Manholes located in "cross country" utility easements shall be raised two feet above grade with flat tops and cast-in-place lock-down frames and covers.

N. Manholes located in the 100-year flood plain must be flat top and must have bolt-down watertight frames and covers or be raised 2 feet above the 100-year base flood elevation. Barrel sections plus top slab shall be strapped together on the quarter points using 3" x 8" x ½" Stainless Steel ¾" SS bolts and expansion anchors.

O. Sealed gravity sewer systems must be vented every 1,000 feet or every third manhole, whichever is smaller. Vents are to be elevated 24 inches above the 100-year base flood elevation, and they are to have insect screens.

P. Buoyancy of manholes shall be taken into consideration. For design purposes, assume water to existing grade. Buoyancy calculations may be required on a case by case basis by ONWASA.

Q. All manhole frames and covers shall be domestically cast**.**

2.4 Force Mains

A. Piping shall be in accordance with *Section 33 34 00 – Force Mains*.

B. PVC sewer force mains are permitted under pavement on a case by case basis as determined by the ENGINEERING DIRECTOR.

C. A minimum cover of 36 inches is required for all sewer force mains.

D. Air release valves are to be provided at all high points in the pipeline.

2.5 Service Connections

A. A cleanout shall be installed for each sewer service.

B. Cleanouts may not be located in pavement, driveways, or sidewalks.

C. Cleanouts are to be located in the right-of-way or on an ONWASA easement.

D. Service connections to manholes are permitted at dead-end lines only. When possible, such connections must enter the bottom of the manhole. Service connections to gravity sewer mains are allowed where available.

E. Cleanouts must be located below grade and inside a cast iron box (see Detail SS_ARVM).

F. Commercial grinder pump station systems discharging to an ONWASA force main shall be owned and operated by the Owner.

G. Residential grinder pump station system discharging to an ONWASA force main shall be manufactured by Flygt and maintained by ONWASA.

1. Connection to the ONWASA system shall not be made until a signed Maintenance Agreement has been submitted, plans for the proposed grinder pump station are approved by ONWASA and an Authorization to Construct has been received from the NCDEQ PERCS Unit.

2. Residential grinder pump stations shall be located in the front or on the side of the residence where easily accessible or at the R-O-W. See the Detail for Residential Grinder Pump Stations.

3. A 20’ Public Utility Easement dedicated to ONWASA shall be provided over the grinder pump station site and service (in situations where the pump station is not located at the right-of-way).

4. The property owner is responsible for hiring a NC Professional Licensed Surveyor to prepare and provide the appropriate easement documents to include a Meets and Bounds Survey.

5. The property owner is responsible for hiring a NC Professional Engineer to design the grinder pump station to include a hydraulic model of the existing force main. The Engineer shall also prepare and file all necessary Local and State permits.

2.6 Streams and Other Bodies of Water

A. All stream crossings shall be made using ductile iron pipe with restrained joints in accordance with ONWASA’s Standard Details. Stream crossings may also be made with HDPE using directional drill methods.

B. Material used to backfill trench shall be stone, coarse aggregate, or other material, in accordance with *Section 31 23 17 – Trenching*, that will resist erosion around the pipe without damaging or corroding it.

C. Where a sewer parallels a stream, the pipe will be located below the stream bed elevation, such that lateral connections will also be below the stream bed elevation. Sewers that parallel a stream shall be designed and installed in accordance with all watershed and stream/river buffer rules.

D. All stream crossings are to be as close to perpendicular to the stream as possible and shall intersect the surface water at an angle between 75 degrees and 105 degrees and at a minimum depth of 5’.

E. Any structures located in an area subject to flooding shall be designed to resist hydrodynamic forces associated with flooding and debris.

F. Aerial crossings shall only be permitted with prior approval from the ENGINEERING DIRECTOR.

1. The bottom of the pipe shall be located no lower than the 25-year base flood elevation.
2. PC 350 ductile iron pipe shall be required for all aerial crossings. Long-span, rigid restrained joint ductile iron pipe may be installed as approved by ONWASA.
3. Proper flanged joint technology shall be used in all aerial crossings to prevent excessive deflection.
4. Proper expansion jointing shall be furnished for transition between aerial and underground sewer.
5. Precautions against freezing shall be provided as necessary.
6. Support piers shall be provided at a maximum of 20 feet apart for standard piping. If long-span, rigid restraint joint piping is approved for use, support piers shall be provided at a maximum of 40-feet apart.
7. Support piers shall not be located at pipe joints.
8. Structural calculations shall be provided for all aerial mains and their supporting structures.

3 PUMP STATIONS

A. Pump station and force mains will only be allowed with permission by the ENGINEERING DIRECTOR.

B. Design of all pump stations must meet the most recently amended Waste not Discharged to Surface Waters by the North Carolina Department of Environmental Quality a NCAC Title 15A 2H .0200.

C. All pump stations shall meet ONWASA Design Specifications. Pumps will be self-priming or submersible pumps with electro-mechanical controls. Pump stations capable of pumping more than 50 gallons per minute (gpm) are required to have non-clog pumps. Grinder pumps may be used for pump stations that are capable of pumping 50 gpm or less.

D. Self-priming pumps are preferred over submersible pumps and are required for all pump stations capable of pumping more than 200 gpm. Separate grinders are also required for all pump stations capable of pumping more than 200 gpm

E. Pump Station sites shall be on lots dedicated to ONWASA with a 16’ wide paved driveway access constructed to support a truck with a gross vehicle weight of 60,000 lbs.

3.1 Self-Priming Pumps

A. Self-priming pumps require bubbler type control system with hand-off-automatic (H-O-A) switch and automatic alternator.

B. Pumps shall be capable of handling a minimum 3-inch solid and any other items than can pass through a 4-inch hose.

C. All pumps shall have a non-clog impeller with blades that are generally configured to avoid catching solids and other items passing through the system.

D. All pumps and associated controls shall be located in a climate controlled brick building with interior dimensions of 12’ X 12’. The building shall have the following:

a. forced air ventilation.

b. a 4” floor drain to the wet well located between the pumps near the wall with the floor sloped toward the drain.

c. A water spigot and hose reel mounted to an interior wall near the pumps

3.2 Submersible Pumps

A. Submersible pumps shall have transducer or mercury float control switches with electro-mechanical controls.

B. Pumps shall be capable of handling a minimum 3-inch solid and any other items than can pass through a 4-inch hose.

C. All pumps shall have a non-clog impeller.

D. Grinder pumps are not permitted for pump stations capable of pump greater than 50 gpm.

E. Impellers shall have blades that are generally configured to avoid catching solids and other items passing through the system.

3.3 Pump Station Minimum Design Requirements

A. The ENGINEERING DIRECTOR, prior to final design of any sewer pump station, shall determine if flow measurement facilities, or provisions for future flow measurements facilities, will be required. Measurement facilities design and equipment must be approved by the Engineering Director prior to construction. Primary measurement device shall not contain any moving parts or require devices that may impede wastewater flow.

B. All pump stations shall have a 100% reserve peak pumping capacity (dual pumps) and shall be capable of pumping at a rate 2.5 times the average daily flow rate with any one pump out of service. At the average flow rate, 2 to 8 pumping cycles should be used to set the on/off elevations.

C. Pump stations with a rated capacity of 1,000,000 gpd, or greater, shall be triplex. In triplex pump stations, two of the pumps shall be linked to one control panel, and the third pump shall be linked to a separate control panel.

D. Pump stations with pumps controlled by Variable Frequency Drives (VFD) shall have climate controlled cabinetry or be installed in a room separate from the wetwell area that is climate controlled.

E. The available capacity of the downstream sewer shall be evaluated to verify that it can handle the additional flow from the pump station.

F. ONWASA reserves the right to require separate grinders for certain pump stations, based on what the pump station may be serving.

G. ONWASA reserves the right to require odor control facilities at pump stations

H. The power source, phasing, and voltage must be verified prior to construction.

I. NEMA 4X stainless steel weatherproofed control panels are required.

J. All conduits must be rigid.

K. Service head, meter base, service connection, disconnect, and area light.

L. Underground power inside the pump station fence.

M. Audible high water alarm and alarm silence. Visual alarm shall be visible over the pump station fence.

N. Mission Model No.802 in NEMA 4 enclosure to include wet well level sensor, R2 wet well module, and pulse board adapter. Mission units shall be installed and wired by the Contractor and programmed by ONWASA.

O. Automatic air release valves, as applicable.

P. 3-phase power to pump station site, with 3-phase voltage monitor that indicates 3-phase power failure.

Q. Power supply to all control panels shall meet the requirements of *Section 44 42 56 – Submersible Pumps*. Each pump control panel shall include a 120V, 1 phase, 60 Hz duplex receptacle.

R. Discharge and/or suction gauges.

S. Protection against high pump temperatures.

T. Surge suppressor.

U. Motor overload reset.

V. Pump run lights.

W. Duplex service receptacles on GFCI.

X. Surge relief valve and associated return piping to the wetwell.

Y. Heaters and fluorescent lighting for self-priming pump stations.

Z. All pump stations are required to have a debris basket manhole separate from the wetwell, and appurtenances, regardless of whether a grinder is included or not. A protective lining as specified in *Section 09-96-59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment* shall be installed in all debris basket manholes after installation.

AA. Back-up alarm system with a 12-volt battery connection. A trickle charger is to be included with battery system to ensure battery integrity.

BB. Start-up assistance and certification, included certified pump curves, and operational/drawdown tests.

CC. On-site auxiliary diesel fired stand-by power generator source that is automatically activated. Generator shall be automatically activated and have an automatic reset. The generator shall have sufficient capacity to sequentially start and run all pumps in the pump station. The generator unit shall consist of radiator-cooled, four-cycle, engine direct connected to an alternating current generator, and a unit-mounted control panel. All items shall be mounted to a common sub-base. The generator unit shall, at a minimum, include the following:

1. Engine controls and instruments, panel lights, and safety controls.
2. Capability of powering all pump station equipment that may be necessary for the safe and effective operation of the pump station. This equipment includes, but may not be limited to the electrical systems, instrumentation/controls, alarm system, and pump motors.
3. Appropriate power rating to start and continuously operate all pumps.
4. Special sequencing controls to delay lead and lag pump starts when generator is not equipped to start all pumps simultaneously when auxiliary equipment is also operational.
5. Minimum four cylinder, four cycle, radiator cooled engine, at 1800 RPM.
6. Batteries shall start the unit, at 32 degrees Fahrenheit.
7. Three phase power.
8. Generator rating shall be continuous standby service at 0.8 power factor, at 1800 RPM.
9. Frequency regulation from no-load to full load shall be less than 3 cycles.
10. Capability of activating audible and visual alarms if dangerous operating condition develops.
11. Protection from damage when power restoration occurs.
12. Automatic transfer switch to transfer loads if power conditions suddenly change, as well as a manual disconnect on utility service main side.
13. Control panel must contain the following: remote start-stop terminals, run-stop-remote switch, cranking limit, oil pressure gauge, temperature gauge, battery charge rate ammeter, high engine temperature shutdown, low oil pressure shutdown, over speed shutdown, AC voltmeter, voltage adjustment, running time meter, frequency meter, circuit breakers.
14. Manufacturer's recommended anti-freeze, trickle battery charger, and engine heaters shall be provided.
15. All accessories shall be located in a weatherproof sound attenuated housing.
16. The generator unit shall be completely assembled and tested by the manufacturer prior to shipping.
17. Manufacturer shall provide one complete spare set of fuel, air and oil filters.
18. All accessories necessary for proper system installation shall be provided.
19. Three bound sets of operation and maintenance manuals with parts list shall be provided to ONWASA.

20. The generator shall be enclosed in a factory-installed weather-protective, sound attenuating housing (68 db @ 23 ft). Housing shall provide easy access to instrument panel and engine.
21. The muffler should be designed such that cooling air does not move exhaust across the set.
22. A sub-base double-walled fuel tank shall be provided with all diesel generators. The tank should be fitted with a leak sensor device, and shall be UL approved closed-top dike type. The tank must have enough capacity to run the generator at full load for a minimum of 72 hours.
23. All fuel tanks shall be bought, not leased.
24. A drain plug shall be provided at one end of the rupture basin. Vibration isolators shall be provided between tank assembly and the generator set. A remote mounted low fuel alarm shall be provided.
25. A minimum of four continuous hours of operation and maintenance training shall be provided for the Owner's personnel.
26. Annunciator panels with audible and visual alarms shall be provided to monitor and warn of emergency operating conditions.
27. A stainless steel super critical grade type exhaust silencer mounted inside the generator enclosure shall be provided for corrosion protection.

3.4 Wetwells

A. The interior walls of all wetwells shall be coated as specified in *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment* after installation.

B. Buoyancy calculations shall be provided for all wetwells. Assume water to the top of the structure and the structure is empty except for the liquid below the pump-off elevation.

C. Surface water shall be directed away from the wetwell in all directions.

D. All pump station access roads shall be located at least 3 feet above the 100 year flood elevation. Exceptions must be approved by the ENGINEERING DIRECTOR.

E. A screened exterior vent shall be provided to prevent gas buildup inside the wetwell.

F. All wetwell components shall be located such that normal operation and maintenance items may be completed without entering the wetwell.

G. Electrical conduit between the wetwell and control panel shall be sealed to prevent gas entry into the pump house enclosure or panel.

H. All guide rails, mounting brackets, screws, etc. must be stainless steel and sized to withstand the static and dynamic loads that may posed to by the equipment. Cable pump lift chains shall be used. Pump lift cables shall not be permitted.

I. All wetwell and debris manhole hatches shall be equipped with aluminum safety grating fall-through protection as manufactured by Halliday Products, Inc. or . Safety nets are not permitted.

3.5 Pump Station Site Design

A. Pump station site plans shall be approved by ONWASA on a case-by-case basis.

B. A service head, service connection, meter base, disconnect, area light with photocell, and light with switch on the hood near control rack shall be provided.

C. A 16-foot wide all-weather access road with 8-inches of ABC stone and 2 inches of asphalt or concrete pavement shall be provided to the station. The station site shall also contain a turn-around sufficient in size for ONWASA maintenance vehicles to utilize. A 30-foot access shall be provided with the lot where a pump station does not directly abut a public right-of-way.

D. A steel-reinforced concrete generator pad with a thickness of at least 8-inches shall be provided.

E. All pump stations are to be fenced with an 8-foot high chain-link fence, with green or black vinyl coating, and three strands of barbed wire meeting the requirements of *Section 32 31 13 – Chain Link*

Fences and Gates. A minimum of a 16-foot or wider gate shall be provided. An area light, on a separate circuit from the pumps, shall be provided on the pump station site. The light shall have a minimum height of 15-feet above the ground, and shall be a minimum of 100-watt sodium high-pressure.

F. A stainless steel or aluminum hood with light shall be provided over the control panel. The light shall have a switch on the control panel.

G. An emergency pump connection with quick connect gate valve and flange shall be provided at each pump station.

H. A metered potable water source with non-freeze yard hydrant shall be required at each station. Woodford Y-1 (1”), Woodford W-34 (3/4”), Clayton Mark model 5451 Lever type, frost proof yard hydrant shall be provided.

I. A backflow prevention device shall be provided at each pump station and include electrical service and heat tape for freeze protection, in accordance with ONWASA Standard Details. The Contractor is responsible for having the backflow device tested by an ONWASA-approved contractor. The backflow device should be installed inside the fence and the potable water meter should be installed outside the fence.

J. A non-freeze shower with eyewash and concrete pad shall be provided at all pump stations with an on-site chemical feed system and at the discretion of the ENGINEERING DIRECTOR. The eyewash station shall include measures to warm the water before it is discharged.

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ONWASA's

Manual of Standards, Specifications and Details

Section VI

SANITARY SEWER SYSTEM SPECIFICATIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

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SECTION TABLE OF CONTENTS

ONWASA Standard Sanitary Sewer Specifications

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SECTION 09 96 59

PROTECTIVE LINING FOR CONCRETE EXPOSED
TO SEVERE WASTEWATER ENVIRONMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as specified, shown, and required to furnish, install, and place into satisfactory service the protective liner for concrete Work.
2. Where not otherwise shown, extent of the protective lining shall be located 1) interior walls of the structures and manholes to be protected and, 2) interior surface of lids and top slabs (soffits) of structures to be protected.
3. Types of protective lining for concrete Work required include, but are not necessarily limited to, the following:
    a. Trowelable, rapid-setting, cementitious repair mortar
    b. Trowelable, fast-setting, epoxy- modified resurfacer (thin overlay)
    c. Corrosion-resistant, spray-applied, fiber-reinforced high-build epoxy lining (basecoat)
    d. Corrosion-resistant, high-build epoxy glaze coat (topcoat)
    e. Miscellaneous materials.
4. Cleaning, drying, surface preparation, lining application, and thicknesses shall be as specified herein and shall meet or exceed the lining manufacturer's requirements and recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the Manufacturer's minimum recommendations.
5. Application shall not commence until installation of the structure is complete.

B. Coordination:

1. Coordinate surface preparation of substrates to avoid later difficulty or delay in performing the Work of this Section.
2. Review installation procedures under other Sections and coordinate the installation of items that must be installed prior to application of the protective lining.
3. All substrate surface preparation and lining application, including concrete resurfacing, to be completed by manufacturer's approved Applicator.
4. The Contractor shall coordinate with Engineer regarding the availability of work areas, completion times, safety, access and other factors which can impact plant operations.

C. Related Sections:

1. Section 33 05 14 – *Utility Manholes and Structures*
2. Section 33 31 13 – *Gravity Sewers*
3. Section 44 42 56 – *Submersible Pumps*
4. Section 44 42 57 – *Self-Priming Centrifugal Pumps*

1.2 REFERENCES

A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

1. American Concrete Institute, (ACI)

    a. ACI 224.1R – Causes, Evaluation and Repair of Cracks in Concrete Structures
    b. ACI 301 – Specifications for Structural Concrete
    c. ACI 308R – Guide to Curing Concrete
    d. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
    e. ACI 515 – A Guide to the use of Waterproofing, Damp-proofing, Protective, and Decorative Barrier Systems for Concrete
    f. ACI 546.R – Concrete Repair Guide
    g. ACI 546.3R – Guide for the Selection of Materials for the Repair of Concrete

2. ASTM International, (ASTM)

    a. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
    b. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
    c. ASTM D 2794 – Standard Test Method for Resistance of Organic Linings to the Effects of Rapid Deformation (Impact)
    d. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser
    e. ASTM D 4285 – Standard Test Method for Indicating Water or Oil in Compressed Air
    f. ASTM D 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
    g. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
    h. ASTM D 6944 Standard Test Method for Measuring Humidity with a Physchrometer
    i. ASTM D 7682 – Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
    j. ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
    k. ASTM F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
    l. ASTM F 2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

3. International Concrete Repair Institute, (ICRI)

    a. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
    b. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays

4. NACE International, (NACE)

    a. NACE Publication 6D-173 – A Manual for Painter Safety
    b. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
    c. NACE SP0892 – Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
    d. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete

5. Occupational Safety and health Administration, (OSHA)

    a. Safety and health Standards (29 CFR 1910/1926)

6. SSPC: The Society for Protective Linings, (SSPC)

    a. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
    b. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects

7. Standard Practice for the Rapid Evaluation of Coatings and Linings by Severe Wastewater Analysis Test, (S.W.A.T.)

    a. Corrosion Testing Laboratories, Inc., Newark, DE, USA. (www.corrosionlab.com). Contact: Brad Krantz 302-454-8200.
    b. RAE Engineering and Inspection, LTD., Edmonton, Alberta, CANADA. (www.raeengineering.ca) Contact: Linda Gray 780.440.9391.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents, the last version of the document before it was discontinued.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Contractor shall be a qualified Applicator by the corrosion protection lining manufacturer. Submit proof of acceptability of Applicator by manufacturer to ONWASA.
2. Installation equipment shall be acceptable to the protective lining manufacturer.
3. Applicator to establish quality control procedures and practices to monitor phases of surface preparation, storage, mixing, application, and inspection throughout the duration of the project. Contractor to provide a fulltime, on-site person whose dedicated responsibilities will include quality control of the corrosion protection linings.
4. Applicator's quality control procedures and practices must include the following items:
    a. Training of personnel in the proper surface preparation requirements.
    b. Training of personnel in the proper storing, mixing, and application and quality control testing of the linings.

B. Performance Criteria: The surfaces to receive the protective lining shall be capable of withstanding under constant exposure to raw wastewater, permeation from hydrogen sulfide and other sewer gases, and attack from organic acids generated by microbial sources. Products must have sufficient field history and accelerated laboratory testing to substantiate product viability for these exposures.

C. Source Quality Control: Provide each component of protective lining produced by a single manufacturer; including recommended repair mortar, repair overlay (resurfacer), base coat and topcoat materials.

D. Reference Standards: Comply with applicable provisions and recommendations of all standards listed in Section 1.2 except as otherwise shown or specified.

E. Protective Linings system specified are as manufactured by Tnemec Company, Inc., Kansas City, MO 816.483.3400. Specified system is the minimum standard of quality for this project. Request for material substitutions shall be in accordance with requirements of the project specifications.

F. A protective lining pre-installation meeting, with ONWASA, a lining system manufacturer's representative, the lining applicator, and the General Contractor in attendance, shall be held prior to commencing any Work described in the Section.

1.4 SUBMITTALS

A. The Contractor shall submit all required information as specified herein.

B. Shop Drawings: Submit for approval prior to commencing any Work:

1. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.

2. Material Safety Data Sheets: Copies of current MSDS for any materials brought on-site including all clean-up solvents, repair or resurfacing mortars and lining materials.
3. Qualification Data: Approved Installer Training Certificates from manufacturer.
4. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
5. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.
6. Construction Details: Copies of manufacturer's computer generated standard lining details for specified materials, including: leading edge termination, metal embedment in concrete, joint detail, wall-to-slab detail, pipe termination detail, and any other detail at the request of the Engineer.
7. Maintenance Manual: Upon completion of the Work, submit five copies of corrosion protection lining manufacturer's written instructions for recommended maintenance practices. Include the following information:
    a. Product name and number.
    b. Name, address, e-mail address and telephone number of manufacturer and local representative.
    c. Detailed procedures for routine maintenance and cleaning.
    d. Detailed procedures for repairs.
8. Product Substitution: The specified corrosion protection lining is the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of ONWASA. Requests for material substitutions shall be in accordance with requirements of the project specification.
    a. Manufacturers of "or equal" products shall provide direct property comparison with the materials specified in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic materials and system components as the corrosion protection lining specified. "Or equal" products shall provide equivalent performance as the specified corrosion protection lining.
    b. Developers/Contractors desiring to use corrosion protection lining other than those specified shall submit proposed system with their proposal at the time of Plan Review, together with the information required here-in.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver material in manufacturer's original, unopened and undamaged packages.
2. Clearly identify manufacturer's, brand name, contents, color, batch number, and any personal safety hazards associated with the use of or exposure to the materials on each package.
3. Packages showing indications of damage that may affect condition of contents are not acceptable.

B. Storage of Materials:

1. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life as defined by the manufacturer shall be removed promptly from the site. Store all materials only in area or areas designated by the Engineer solely for this purpose.
2. Store in original packaging under protective cover and protect from damage.
3. Stack containers in accordance with manufacturer's recommendations.

C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

1.6 JOB CONDITIONS

A. Environmental Requirements:

1. Proceed with corrosion protection lining Work only when temperature and moisture conditions of substrates, air temperature, relative humidity, dew point and other conditions comply with the corrosion protection lining manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the material will be vulnerable to such environmental damage. Record all such conditions and include in final Site Quality Control Report.
2. Maintain substrate temperature and ambient temperature before, during and after installation above 50°F (10°C) and rising in accordance with protective lining material manufacturer's instructions.
3. Provide adequate ventilation during installation and full curing periods of the protective lining.
4. Protective Lining shall not be applied when ambient air temperature is within 5°F (3°C) of the dew point and falling.
5. Protective Lining shall not be applied when relative humidity is outside of material manufacturer's recommendations. Do not prepare surfaces or apply materials in rain, snow, fog, mist, or otherwise inclement weather as per material manufacturer's instructions.

B. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminates during protective lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

1.7 WARRANTY

A. Protective Lining Manufacturer shall warranty its products as free from material defects for a minimum period of three (3) years. Provide associated Warranty Certificate.

B. Contractor shall warranty the installed protective lining system as free from workmanship defects for a minimum period of three (3) years.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Protective Lining shall be comprised of: 1) concrete repair mortar or epoxy resurfacer, 2) trowel-applied, aggregate reinforced epoxy liner (basecoat), and 3) epoxy glaze (topcoat).

1. Cementitious Repair Mortar: Trowelable grade, rapid-setting, cementitious repair mortar when concrete is deteriorated greater than a depth of 1/4-inch (6.35 mm) and when recommended by the Manufacturer to rehabilitate and restore concrete and provide level substrate for application of the protective lining; or
2. Epoxy Resurfacer: Epoxy-polymer modified cementitious resurfacer (thin overlay) applied to new or existing concrete to a depth up to 1/4-inch (6.35 mm). Repair new or existing concrete to fill all bug holes, surface imperfections and provide a uniform, level substrate for application of the protective lining; and
3. Trowel-applied, aggregate-reinforced high-build epoxy liner (basecoat) to provide a chemical, permeation, and abrasion resistant protective lining against physical and chemical attack phenomena typically associated with municipal wastewater headspace conditions; and
4. Epoxy glaze coat (topcoat) to provide enhanced chemical, permeation, and abrasion resistance.

B. Contractor shall provide all accessory components such as polysulfide sealants, and curing compounds, as recommended by the manufacturer for maximum protective lining adhesion to substrate, and long-term service performance.

C. Cementitious Repair Mortar (i.e. Tnemec Series 217 MortarCrete):

1. Properties:
   a. Minimum Thickness:1/4 inches
   b. Maximum Thickness: 2.0 inches
   c. Application Time
      Initial set at 75°F: 60 min
      Final set at 75°F: 90 min
   d. Bond Strength (ASTM C 1583)
      Applied at ¼" to Concrete: Concrete Failure
      Applied at 2.0" to Concrete: Concrete Failure
   e. Compressive Strength (ASTM C 579)
      16 hours: 8,670
      28 days: 10,650 psi
   f. Curing Requirements (ACI 308R) Method: Wet- or Membrane-cure
      Duration: 1 hour
   g. Hydration (TDR Testing): 6 hours
   h. Drying Shrinkage (ASTM C 596): 0.0%
   i. Linear Shrinkage (ASTM C 531): 0.022%
   j. Thermal Expansion (ASTM C 531): 7.46 x 10^{-6} in/in/°F

2. Cementitious repair mortar shall be a rapid-setting, non-shrinking resurfacing material capable of spray-transfer. Material shall have similar CLTE properties as concrete.

D. Epoxy Cementitious Resurfacer (i.e. Tnemec Series 218 MortarClad) :

1. Properties:
   a. Minimum thickness: 1/16 inch
   b. Maximum thickness: 1/2 inch
   c. Application Working Time at 75°F: 60 min
   d. Maximum Recoat Window: Unlimited
   e. Minimum Substrate Temperature: 40°F
   f. Bond Strength (ASTM D 7234)
      Applied at 1/16" to Concrete: Concrete Failure
   g. Compressive Strength (ASTM C 579): 7,100 psi
   h. Curing Requirements (ACI 308)
      Method: Ambient Cure
      Duration: 15 hours
   i. Flexural Strength (ASTM C580): 1,290 psi
   j. Slant Shear (ASTM C882): 1,040 psi
   k. Splitting Tensile (ASTM C496): 640 psi

2. Epoxy cementitious resurfacer shall be an epoxy-modified, aggregate reinforced material for surfacing, patching and filling voids and bug holes in concrete. The material shall be suitable for the application down to 1/16 inch (1.6 mm) thickness and be capable of spray-transfer.

E. Epoxy Lining, Aggregate-Reinforced Epoxy Lining (basecoat – i.e. Tnemec Series 434 Perma-Shield):

1. Properties:
   a. Application Time at 75°F: 30 min
   b. Color: Beige
   c. Maximum Dry Film Thickness (DFT): 125 mils
   d. Severe Wastewater Analysis Test (S.W.A.T.)
      Initial EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2): 10.7
      Final EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2): 9.1
      S.W.A.T. Results with Epoxy Glaze Topcoat
      Initial EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2): 11.3
      Final EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2): 10.8

e. Bond Strength (ASTM D 7234)
Bare Concrete/Series 434: Concrete Failure
Bare Concrete/Series 218/Series 434: Concrete Failure
f. Chemical Resistance (ASTM C 686)
25% H_2SO_4, 100 days, 100°F: No effect
g. Compressive Strength (ASTM D 695): 12,331 psi
h. Flexural (ASTM C 580)
Strength: 3,200 psi
Modulus of Elasticity: 1.1×10^6 psi
i. Impact (ASTM D 2794) 160 in.-lbs.
j. Shrinkage (ASTM C 531): -0.013%
k. Tensile Strength (ASTM D 307): 2,030 psi
l. Thermal Expansion
Linear Coefficient (ASTM C 531): 6.3×10^{-5} in/in/°F
m. Water Absorption (ASTM C 413): 0.15%
n. Water Vapor Transmission
(ASTM E 96, Procedure D): 0.27 perms

2. Epoxy Lining shall be a 100% solids, aggregate-reinforced, trowel-applied epoxy polymer protective barrier material specifically designed to protect concrete and steel surfaces in severe wastewater environments, including associated abrasive physical attack and chemical attack from sewer gases and organic acids generated by microbial sources.
3. Epoxy Lining shall be capable of achieving the specified thickness in a single coat application.

F. Epoxy Lining, Glaze Protective Lining (topcoat – i.e. Tnemec Series 435 Perma-Glaze):

1. Properties:
a. Application Time at 75°F: 30 min
b. Color: Gray
c. Minimum Dry Film Thickness (DFT): 15 mils
d. Maximum Dry Film Thickness (DFT): 20 mils
e. Severe Wastewater Analysis Test (S.W.A.T.)
Initial EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2): 11.3
Final EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2): 11.1
Optical Microscopy: No more than 9%
Δ Tensile Strength: No more than 19%
Δ Flexural Strength: No more than 6%
f. Bond Strength (ASTM D7234)
Bare Concrete/Series 435: Concrete Failure
Bare Concrete/Series 218/Series 435: Concrete Failure
Bare Concrete/Series 434/Series 435: Concrete Failure
g. Chemical Resistance (ASTM C686)
25% H_2SO_4, 100 days, 100°F: No effect
h. Compressive Strength (ASTM D695): 9,427 psi
i. Elongation (ASTM D638): 14.1%
j. Flexural (ASTM D790)
Strength: 3,289 psi
Modulus of Elasticity: 3.0×10^5 psi
k. Tensile Strength (ASTM D2370): 2,053 psi
l. Water Absorption (ASTM C413):0.07%
m. Water Vapor Transmission
(ASTM D1653, Method B, Condition C): 0.243 perms

G. Product and Manufacturer:

1. Materials specified are those that have been evaluated for the specific service. Products of Tnemec Company, Inc. (816.483.3400) are listed to establish a standard of performance and quality.
2. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, laboratory testing showing results to equal the performance criteria of the products specified herein. In addition, a list of ten projects shall be submitted in which each product has been used and rendered satisfactory service.

PART 3 EXECUTION

3.1 GENERAL: Entire Project site shall be kept in strict accordance with OSHA Requirements.

3.2 PREPARATION

A. Contractor shall provide, erect, and maintain all required hoists, scaffolding, staging and planking, and perform all access related hoisting work required to complete the Work of this Section as specified.

B. Contractor shall cover or otherwise protect finish work or other surfaces not being coated within the scope of this Section. Contractor shall erect and maintain protective tarps, enclosures and/or masking to contain debris, including dust or other airborne particles from surface preparation or application activities. This may include the use of dust or debris collection apparatus as required at no additional cost to ONWASA.

C. Concrete surfaces to receive protective coating shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.

D. Allow cast-in-place concrete to cure for a minimum of 28 days at 75°F (24°C) and with adequate air movement before installing the corrosion protection lining system.

E. All surface washing, abrasive blasting, water-jetting, grinding, patching, filling and preparation shall be completed by the Applicator in accordance with the Protective Coating Manufacturer's recommendations.

F. Substrate: Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that my inhibit bonding. Prior to start of protective coating systems application, pre-clean as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6, Severe Service. Surface preparation procedures shall be in accordance with NACE SP0892, SSPC-SP13/NACE No. 6 and ICRI Guideline No. 310.2. Surface preparation shall expose aggregate and obtain a uniform surface texture resembling the minimum recommended concrete surface ICRI-CSP profile.

G. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of all sharp edges, ridges, form fins, and other concrete protrusions.

H. New Concrete Application: All voids, bug holes, and other surface depressions shall be filled with the specified epoxy-modified resurfacer, re-establishing plan finished grades and concrete planes. The thin overlay shall be applied as a continuous parge coat at a minimum 1/16 inch (1.6 mm) thickness to the entire concrete surface.

I. Existing Concrete Application: Existing concrete structures to receive protective coating system must be capable of withstanding imposed loads. All oil, grease, waste and chemical contaminants must be removed from the surface of the concrete prior to preparation in accordance with NACE SP0892 and SSPC-SP13/NACE No. 6. Concrete surfaces must be sound and capable of supporting the Protective Lining system as determined by the engineer. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP. The appropriate cementitious repair mortar or epoxy cementitious

resurfacer material shall be applied to the entire, prepared surface to level surface suitable for coating.

J. Metal Application: Remove all visible contaminants per SSPC-SP1. Prepare the surfaces in accordance with SSPC/NACE surface preparation standards per the Manufacturer's instructions.

3.3 INSPECTION

A. Contractor shall examine the areas and conditions under which the protective coating Work is to be performed in accordance with NACE SP0892, Table 1 and SSPC-SP13/NACE No. 6, and notify ONWASA in writing of conditions detrimental to the proper and timely completion of the Work.

B. Contractor shall confirm the presence of a positive side waterproofing on the exterior of the concrete structure.

C. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor and his Applicator, and will produce a finished product meeting the requirements of the Specifications. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.

D. Stopping Active Leaks: After surface cleaning, any visible leaks or other water ingress shall be reported to ONWASA. Any water infiltration through minor leaks must be stopped using a polyurethane grout manufactured by Avanti International, Webster, TX (281.486.5600), or approved equal, or other approved method in accordance with ACI 221.1R. Surface and grouting material may require additional surface preparation prior to application of protective coating.

3.4 APPLICATION

A. Protective coating systems shall be installed when ambient air and surface temperature is above 50°F. The substrate temperature shall be at least 5°F (3°C) above the dew point. Condition the material between 70-80°F (21-27°C) for 24 hours prior to use. Application when temperatures outside of this range will require written instruction from the Manufacturer and approval of ONWASA.

B. Application in direct sunlight and/or with rising surface temperatures is not allowed, as this may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling. Concrete surfaces that have been in direct sunlight should be shaded for at least 24 hours prior to application. Consult the Manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce outgassing.

C. Cementitious Repair Mortar: Cementitious repair mortar shall be used for structural repairs or surface repairs exceeding a depth 1/4 inch (7 mm) in accordance with Manufacturer's written instructions as outlined in the product data sheet and application guide.

1. Thickness – Minimum 1/4 inch as required to re-establish original plane.

D. Epoxy Cementitious Resurfacer: Epoxy cementitious resurfacer shall be used for filling voids, bug holes, static cracks and joints, and for general concrete patching, and to provide a uniform, void free surface for Epoxy Lining application.

1. Thickness – Epoxy lining shall be applied to a minimum thickness of 1/16 inch (1.6 mm) to the entire surface.

E. Epoxy Lining (basecoat): Epoxy lining protective coating shall be trowel applied and cured in accordance with Manufacturer's written instructions as outlined in the product data sheet and application guide.

1. Thickness – Epoxy lining shall be applied to a thickness of 100-125 mils (2540-3175 microns) dry film thickness to the entire surface.

F. Epoxy Glaze Coat (topcoat): Epoxy glaze topcoat shall be applied over the epoxy lining in accordance with Manufacturer's written instructions as outlined in the product data sheet and application guide.

1. Thickness – Epoxy glaze coat shall be applied to a thickness of 15-20 mils (381-508 microns) dry film thickness over the entire epoxy lining basecoat surface.

3.5 FIELD QUALITY CONTROL, INSPECTION AND TESTING

A. Contractor to perform the quality control procedures listed below in conjunction with the requirements of this Section.

B. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.

C. Surface pH Testing: The pH of the concrete substrate will be measured using pH indicating papers. The pH testing is to be performed once every 50 square feet (5 square meters). Acceptable pH values shall be a minimum 9.0 as measured using color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 1-12, or equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH. Spot check any questionable areas with a 1% phenolphthalein solution. The phenolphthalein solution shall turn bright pink on concrete.

D. Surface Profile: Inspect and record substrate profile (anchor pattern). Surfaces shall be profiled, at a minimum, equal to the CSP roughness as recommended by the coating manufacturer in accordance with ICRI Guideline 310.2 and SSPC-SP13/NACE No. 6.

1. Perform replication of the concrete surface profile every 500 square feet (46 square meters) using replica putty in accordance with ASTM D7682. Submit replications to the Engineer as part of the Jobsite Reports.

E. Measure and record ambient air temperature once every two hours of each work shift using a thermometer and measure and record substrate temperature once every two hours using an infrared or other surface thermometer.

F. Measure and record relative humidity and dew point temperature every two hours of each work shift using a sling psychrometer in accordance with ASTM E 337.

G. Provide verification of correct mixing of coating materials in accordance with the Manufacturer's instructions.

H. Inspect and record that the "pot life" of coating materials is not exceeded during installation.

I. Verify curing of the coating materials in accordance with the Manufacturer's instructions.

J. Dry-Film Thickness:

1. Wet-Film Thickness shall be taken every 100 square feet (9 square meters) in accordance with ASTM D 4414 and recorded.
2. The Dry-Film Thickness can be determined using a surface area calculation for material consumption.

K. High-Voltage Holiday (Spark) Testing: Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE SP0188 and the Manufacturer's printed application guide to verify a pinhole-free surface. Areas which do not pass the spark detection test shall be corrected at no cost to ONWASA.

L. Contractor is responsible for keeping ONWASA informed of all progress so that ONWASA may provide additional quality control at his discretion.

M. Inspection by ONWASA or others does not absolve the Contractor from his responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions whichever is more restrictive.

3.6 ACCEPTANCE CRITERIA

A. All surfaces shall be prepared, applied, and tested in accordance with the specification and referenced standards herein.

3.7 ADJUSTMENTS AND CLEANING

A. At the completion of the Work, Contractor shall remove all materials and debris associated with the Work of this Section.

B. Clean all surfaces not designated to receive protective coating. Restore all other work in a manner acceptable to ONWASA.

C. All finished protective coating shall be protected from damage until Final Acceptance of the Work. Protective coating damaged in any manner shall be repaired or replaced at the discretion of Engineer, at no additional cost to ONWASA.

END OF SECTION

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SECTION 26 32 13
PACKAGED ENGINE-GENERATOR SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Packaged engine-generator system.
2. Engine.
3. Generator.
4. Coolant system.
5. Exhaust system.
6. Fuel supply system.
7. Batteries and charging system.
8. Line circuit breaker.
9. Engine-generator control panel.
10. Weather-protective enclosure.
11. Automatic Transfer Switch (ATS)

B. Related Documents

1. *Section 03 11 13 – Cast-in-Place Concrete*
2. *Section – Submersible Pumps43 25 00*
3. *Section – Self-Priming Centrifugal Pumps43 23 00*

1.2 SHOP DRAWINGS

A. Provide engine-generator set dimensions, weights, design weight of vibration isolators being supplied, ventilation and combustion air requirements, and fuel consumption rate curves at various loads.

B. Provide layout drawing of the engine-generator, showing location of the circuit breaker, control panel, battery/charger, and conduit entrance locations. Include dimensions of concrete pad.

C. Provide layout drawing of fuel supply system, including sub-based or skid-mounted fuel tank dimensions, fuel inlet cap location, fuel supply piping location, fuel return piping location, location of fuel level sensor and low fuel level float, and location of leak detection unit. Show location of wiring terminal strip associated with remote monitoring of the fuel system. Show coordination between tank location within the skids and conduit entrances into the engine-generator set.

D. Provide electrical characteristics and connection requirements of generator, including subtransient reactance of the generator unit.

E. Generator sizing documentation based on the starting load schedule, showing expected maximum voltage drop when starting listed step loads.

F. Provide electrical diagrams, including schematics and interconnection diagrams for the control panel and all electrical components provided with the engine-generator set. Identify terminals utilized for auxiliary monitoring of generator status and alarm contacts.

G. Provide ATS catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details; indicate application conditions and limitations of use stipulated by testing agency specified under Regulatory Requirements.

H. Prototype test certification and specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimensional drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set, the transfer switch, and the remote monitoring/control devices if included elsewhere in these Contract Documents.

I. Contact information for the 24-hour parts and service organization. Generator shop-drawings without this information will be rejected.

1.3 CERTIFICATES

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements based upon testing performed at the factory.

1.4 OPERATION AND MAINTENANCE DATA

A. Operation Data: Include instructions for normal operation of equipment and for operating equipment under emergency conditions.

B. Maintenance Data: Include instructions for routine maintenance, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.5 QUALITY ASSURANCE

A. Any and all exceptions to the published Specifications shall be subject to the approval of the ENGINEERING DIRECTOR.

B. Perform Work in accordance with NFPA 110.

C. Perform an aerostatics leakage test at the factory of the skid-mounted fuel tank by applying pressure maintained at 5 psi for 24 hours with all fittings soaped. Correct any leaks detected.

1.6 QUALIFICATIONS

A. Manufacturer: Domestic manufacturer currently engaged in the production of such equipment with service facilities within 100 miles of the Project.

B. Supplier: Factory-authorized supplier of specified manufacturer with complete parts and service department. It is the intent of these Specifications that the entire packaged engine-generator system be supplied by the same supplier; dealer-assembled units are not acceptable.

1.7 GENERAL REQUIREMENTS

A. It is the intent of this Specification to secure an electrical power system that has been tested during design verification, production and at the final job site. All finished equipment shall be of the lasted commercial design and will be complete with all of the necessary accessories for complete installation as shown on the Drawings and specifications herein. The equipment supplied and installed shall meet the requirements of the National Electrical Code, along with all applicable local codes and regulations. All equipment shall be new and of current production of a national firm that manufactures generator sets and controls, automatic transfer switches, switchgear, and assembles them as a complete and coordinated system. There will be one source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 30, NFPA 70, NFPA 110, and NFPA 101.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

C. Conform to requirements of NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept unit at Site and inspect for damage.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.10 MANUFACTURER WARRANTY

A. Provide a minimum 5-year manufacturer's warranty against defects in material and factory workmanship; effective immediately after manufacturer start-up services are completed. Warranty shall provide full coverage on all costs associated with the repair or replacement of defective parts, including material and labor costs.

1.11 MAINTENANCE MATERIALS

A. Furnish one set of any unique tools required for preventive maintenance of the engine-generator system.

1.12 SPARE PARTS

A. Provide two spare fuel, oil and air filters.

B. Four keys for weatherproof enclosure doors and removable panels.

C. One can of touch-up paint for engine-generator.

PART 2 PRODUCTS

2.1 GENERATOR MANUFACTURERS

A. Kohler.

B. Caterpillar.

C. Cummins/Onan.

D. MTU Onsite Energy (Detroit Diesel)

2.2 PACKAGED ENGINE-GENERATOR SYSTEM

A. Description: NFPA 110, engine-generator system to provide source of power for Level 2 applications.

B. System Capacity: As indicated on schedule for operation at elevation of 1000 feet above sea level, standby rating using engine-mounted radiator.

C. Factory-assembled.

D. Finish: Factory paint with one prime coat and two finish coats.

E. Include lifting eyes on unit.

F. Include factory-installed battery charger and receptacle.

2.3 ENGINE

A. Type: Stationary, water-cooled, in-line, or V-type, four-stroke cycle, diesel ignition, internal combustion engine.

B. Rating: Sufficient to operate under 10 percent overload for 1 hour in an ambient of 104 degrees F.

C. Fuel System:

1. Type: No. 2 fuel oil (diesel) with sulfur content (by weight) of no more than 0.5 percent.
2. Fuel Injection Pumps: Constant stroke pumps actuated by a cam driven by gears from the engine crankshaft.
3. Fuel Filter: Replaceable without breaking any fuel line connections. Locate ahead of injection pumps.

D. Air Cleaner: Panel-type, dry, single-stage air cleaner.

E. Engine Speed: 1800 rpm.

F. Governor: Isochronous type to maintain engine speed within 0.5 percent, steady state.

G. Engine Starting: DC starting system with positive engagement. Limit number and time duration of starts for overcrank protection. Include remote starting control circuit, with AUTO-MANUAL-OFF/RESET-REMOTE selector switch on engine-generator control panel.

The kW rating of jacket water heaters depends on the coldest ambient temperature expected. For outdoor units in the northern states, you can expect around 4 or 5 watts per generator kW rating. It may be necessary to use 240 VAC or higher to support jacket water heaters on generators larger than 400 kW.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 70 degrees F, and suitable for operation on 120 volts AC.

I. Radiator: Radiator using 50 percent solution of ethylene glycol coolant with propeller type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F.

Select single or dual fuel filters; use dual fuel filters for units 200 kW and larger.

J. Engine Accessories: Fuel filter, Dual fuel filters, lube oil filter, intake air filter, lube oil cooler, crankcase breather, fuel transfer pump, fuel priming pump, oil filler in valve cover, dip stick, thermostat and housing, proportional vibration dampener, and gear-driven water pump. Include fuel pressure gage, water temperature gage, and lube oil pressure gage on engine-generator control panel.

2.4 GENERATOR

A. Type: NEMA MG1, three-phase, four-wire, four-pole, twelve-lead, reconnectable, brushless, synchronous generator with permanent magnetic excitation. Include field excitation circuit breaker for inherent overload/short circuit protection.

B. Rating: Minimum ratings as indicated in the schedule, at 0.8 power factor, volts, 60 Hz at 1800 rpm. Capable of starting the motor loads listed in the starting load schedule without exceeding 20 percent calculated voltage dip on starting of any load step. Increase generator kVA rating above the scheduled kVA rating if the voltage dip requirement cannot be met.

C. Insulation Class: Class F or H.

D. Temperature Rise: 130 degrees C.

E. Enclosure: NEMA MG1, open drip-proof.

F. Voltage Regulation: Include generator-mounted volts per Hz exciter-regulator to match engine and generator characteristics, with voltage regulation $\pm$1 percent from no load to full load. Include manual controls to adjust voltage drop, voltage level ($\pm$5 percent) and voltage gain.

2.5 COOLANT SYSTEM

A. Unit-mounted radiator with expansion tank of type and capacity as instructed by engine manufacturer.

B. Circulate jacket water through the cooling system via an engine driven self-priming pump. Include solenoid shutoff valve for installation on the cooling water inlet, and connected to open when engine runs.

C. Coolant: 50 percent solution of ethylene glycol.

D. For after-cooled engines, cool after-cooler with jacket water or provide a separate factory-mounted cooling circuit for the after-cooler and a split core radiator. After-cooler systems not suitable for 110 degree F air cooling are not acceptable.

2.6 EXHAUST SYSTEM

A. Silencer: Stainless steel residential type critical silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.

B. Piping: Schedule 40 welded stainless steel pipe suitable for temperatures up to 1200 degrees F. Size in accordance with generator manufacturer's instructions. Provide rain shield on exhaust pipe opening.

C. Condensation Trap: Provide condensation trap with manual drain valve at low point of exhaust piping.

2.7 FUEL SUPPLY SYSTEM

A. Skid or Base-Mounted Fuel Tank: Size for capacity to achieve 72 hours of continuous operation at 100-percent of rated load. Steel, double-wall fuel tank constructed per UL 142, with fuel supply, fuel return, fuel inlet cap, leak detection, level detection, and containment fittings.

1. Provide containment of inner shell leak.
2. Provide free flow of liquid between surfaces of both steel walls to ensure leak detection.
3. Provide threaded plugs for all openings.
4. Provide all required fuel piping for fill, supply, return, vent, and liquid level controls.
5. Provide 3 inch high lettering on tank exterior, labeled "Combustible – Keep Fire Away".
6. Coat bottom of tank with a corrosion-resistant mastic coating.
7. Vibration Isolator Pads

B. Piping: Schedule 40 steel or Type K copper.

C. Liquid Level Indicator: Float type, to include tank fittings and accessories. Provide electric fuel panel gage mounted on the engine control panel.

D. Leak Detection: Provide sensors between the two tank walls for detection of an inner shell leak.

1. Activate "Fuel Leak" alarm lamp on generator control panel upon detection of leak.
2. Provide normally open auxiliary dry contact for remote monitoring of fuel leak. Wire contact to terminal strip for field connection.

E. Low Fuel Level Alarm: Provide a sensing system to activate an alarm upon detection of a low fuel level.

1. Activate "Low Fuel Level" alarm lamp on generator control panel upon detection of a low fuel level.
2. Provide normally open auxiliary dry contact for remote monitoring of low fuel level. Wire contact to terminal strip for field connection.

2.8 BATTERIES AND CHARGING SYSTEM

A. Batteries: Heavy duty, diesel-starting type lead-acid storage batteries, sized to start engine-generator set after completing four successive overcrank alarm conditions. Match battery voltage to starting system. Include necessary cables and clamps.

B. Battery Tray: Treated for electrolyte resistance; constructed to contain spillage.

C. Battery Charger: (Factory-mount inside weather-proof enclosure):

1. Type: Float type charger; current-limiting design.
2. Power Requirements: 120 VAC.
3. Output Power: 12 or 24 VDC, dependent upon starting voltage required by engine-generator set.
4. Indicators: DC ammeter, DC voltmeter.
5. Alarm Contacts: Undervoltage dry contact.
6. Automatic load regulation and DC voltage regulation.
7. Protection: Automatic overload protection; fusing for AC input and DC output.

2.9 LINE CIRCUIT BREAKER

A. NEMA AB 1, molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized for 125 percent of the generator's full load current rating.

2.10 ENGINE-GENERATOR CONTROL PANEL

A. NEMA 250, Type 1 generator-mounted control panel enclosure with engine and generator controls and indicators. Include provisions for padlock and the following equipment and features:

1. Frequency Meter: 45-65 Hz range.
2. AC Output Voltmeter: 2 percent accuracy with phase selector switch.
3. AC Output Ammeter: 2 percent accuracy with phase selector switch.
4. Output voltage adjustment.
5. Indicator Lamps for the Following:
   a. Low oil pressure.
   b. High water temperature.
   c. Overspeed.
   d. Overcrank.
   e. Low coolant level.
   f. Low fuel level.
   g. Fuel leak detected.
   h. "Not In Auto".
6. Engine "Auto-Manual-Off/Reset-Stop" selector switch.
7. Engine running time meter.
8. Oil pressure gage.
9. Water temperature gage.
10. Additional visual indicators and alarms as required by NFPA 110.
11. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
12. Engine to start upon "loss of utility power" signal from the automatic transfer switch.
13. Remote Status and Alarm Contacts: Pre-wire SPDT dry contacts to terminal strip for each of the following status and alarm functions:
    a. Generator Running (Provide three SPDT dry contacts).
    b. Generator Trouble.
    c. Fuel Leak.
    d. Low Fuel.
    e. Low Battery (from battery charger).

2.11 WEATHER-PROTECTIVE ENCLOSURE

A. Reinforced steel housing mounted on a channel iron skid base, allowing access to control panel and service points with lockable doors and panels.

1. Ventilation: Fixed louvers to allow adequate ventilation with all doors and panels closed.
2. Key all doors alike.
3. Provide means for external draining of oil and water.
4. Finish: One coat primer and two finish coats.

2.12 AUTOMATIC TRANSFER SWITCH

A. Manufacturers:

1. Kohler
2. Cummins/Onan.
3. ASCO
4. Russ Electric.

Edit the following descriptive Specifications to identify Project requirements and to eliminate any conflict with manufacturers' products specified above.

B. Description: NEMA ICS 10-1993, automatic transfer switch. Automatic transfer switches not intended for continuous duty or repetitive load switching are not acceptable.

C. Configuration: Electrically operated, mechanically held in both positions.

D. Service Conditions:

1. Service Conditions: NEMA ICS 1.
2. Altitude: 500 feet.

E. Ratings:

1. Voltage: _____ volts, three-phase, three four-wire, 60 Hz.
2. Switched Poles: Three Four.
3. Load In-Rush Rating: Combination Tungsten lamp Electric discharge lamp Resistive load.
4. Continuous Rating: _____ amperes.
5. Interrupting Capacity: _____ percent of continuous rating.
6. Withstand Current Rating: _____ amperes RMS symmetrical, when used with Class [J] [K1] [L] current-limiting fuse, molded case circuit breaker.

2.13 ATS PRODUCT OPTIONS AND FEATURES

A. Indicating Lights: Mount in cover of enclosure to indicate:

1. NORMAL SOURCE AVAILABLE.
2. ALTERNATE SOURCE AVAILABLE.
3. SWITCH POSITION.

B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.

C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

D. Transfer Switch Auxiliary Contacts: One normally open and one normally closed.

E. Normal Source Monitor: Monitor normal source voltage and frequency; initiate transfer when voltage drops below 90 percent or frequency varies more than 3 percent Hz from rated nominal value.

F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 90 percent or frequency varies more than 3 percent Hz from rated nominal value.

G. Switched Neutral: Non-overlapping contact.

H. Actuated by a single or double electrical operator momentarily energized and connected to the transfer mechanism by a simple over-center type linkage.

I. Capable of transferring successfully in either direction with 70 percent of rated voltage applied to the switch terminals.

J. Normal and emergency contacts positively interlocked mechanically and electrically to prevent simultaneous closing. Mechanical interlock separate from operating mechanism so as to provide positive interlock in the event of operator failure.

K. Main Contacts: Silver tungsten alloy protected by arcing contacts with magnetic blowouts on each pole. Mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnets, or springs.

L. Equip with a manual operator.

M. All relays, timers, and accessories front-mounted and accessible for ease of maintenance.

N. Control Wiring: Flame-retarding, 600-volt type SIS throughout with numbered sleeve type identification on each end, front-mounted and accessible.

O. Three close differential relays, factory-set at 90 percent pickup, 80 percent dropout, and field-adjustable.

P. Voltage balance/under-voltage relay, Basler BE4-47N27, or as approved.

Q. Breaker-Type ATS is not acceptable.

2.14 ATS ENCLOSURE

A. Enclosure: NEMA 4X, Stainless Steel.

2.15 AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine-Generator: Upon initiation by normal source monitor.

B. Time Delay to Start Alternate Source Engine-Generator: 0 to 600 seconds, adjustable.

C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

D. Time Delay Before Transfer to Alternate Power Source: 0 to 30 seconds, adjustable.

E. Initiate Time Delay for Center Off: Upon reaching center off position.

F. Time Delay for Center Off: 0 to 5 seconds, adjustable.

G. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

H. Time Delay Before Transfer to Normal Power: 0 to 600 seconds, adjustable; bypass time delay in event of alternate source failure.

I. Time Delay Before Engine Shutdown: 0 to 30 minutes, adjustable, of unloaded operation.

J. Engine Exerciser: Must be able to program day and time for exerciser; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising periods.

K. Alternate System Exerciser: Transfer load to alternate source during engine exercising periods.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that locations are suitable for installation.

B. Verify measurements in the field.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations, the Project Drawings, and all applicable codes.

B. Mounting: Provide unit with structural steel base and mount on suitable spring-type vibration isolators.

C. Concrete Pad:

1. Provide steel-reinforced concrete pad for engine-generator set.
2. Size pad based upon manufacturer's footprint of engine-generator set. Coordinate slab openings for conduit with actual equipment requirements.

D. Engine:

1. Provide initial fill of CD/SE classification lubrication oil as instructed by manufacturer.
2. Install all filters.

E. Fuel System: Provide initial fill of fuel tank with fuel grade as previously specified.

F. Cooling System:

1. Provide initial fill of coolant.
2. Install all interconnecting piping and supports necessary for completion the system installation.

G. Exhaust System:

1. Install condensation trap at low point of exhaust piping.
2. Install vibration isolators at all locations where the exhaust system is supported by a building wall or ceiling.

H. Provide engraved plastic nameplates;

I. Repaint any portions of the finish damaged during installation.

3.3 ADJUSTING

A. Adjust generator output voltage and engine speed.

3.4 CLEANING

A. Clean engine and generator surfaces.

3.5 MANUFACTURER'S START-UP SERVICES

A. Prepare and start standby generator unit and ATS for testing and demonstration.

B. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

C. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional checkout of the Switchgear. Upon completion of the manufacturer's start-up and checkout, the manufacturer shall demonstrate to the customer all the automated sequences of operation as specified herein. Provide report indicating field test and inspection procedures and test results.

D. Coordinate with transfer switch operations for automatic starting and stopping of standby power system.

E. Program time delays and settings and make final adjustments for proper operation.

3.6 DEMONSTRATION

A. ONWASA shall be onsite to witness the demonstration. ONWASA shall be notified at least 2 weeks prior of the time and date of the site test.

B. Prepare and start systems in accordance with manufacturer's instructions.

C. Provide systems demonstration for a minimum of 2 hours.

D. Describe loads connected to standby system and restrictions for future load additions.

E. An installation check, start-up, and load bank test shall be performed by the manufacturer's local representative. The tests shall include:

1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, alternator strip heaters, remote annunciator, etc.

3. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.
4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Simulate power failure (two times) including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal. Prior to testing, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
5. The generator shall be load tested by connecting it to a load bank to load the generator set to the nameplate kW rating. The generator shall be tested at full nameplate load for a minimum of two hours not counting start-up and cool-down time.
6. Contractor shall provide all fuel, lubricants, and engine fluids required and consumed for testing at no additional cost to ONWASA.
7. Test alarm and shutdown circuits by simulating conditions.

F. After testing is complete, and prior to final acceptance of the engine-generator system, the Contractor shall replenish fuel to maximum filled level at no cost to ONWASA.

Note: For the load schedule, variable torque loads consist of all centrifugal pump loads. Constant torque loads include mixers, clarifier drives, progressing cavity pumps, and positive displacement blowers.

3.7 LOAD SCHEDULE

STEP	DESCRIPTION	LOAD	MOTOR STARTING CODE	STARTER TYPE (NOTE 1)	LOAD TORQUE (NOTE 2)

Note 1 Line: Across-the-line starter.
RV-Auto: Reduced Voltage Auto-transformer with 60 percent starting voltage.
NL: Ramped load with variable frequency controller or soft-starter (non-linear load).

Note 2 VAR: Variable torque load.
CON: Constant torque load.

END OF SECTION

SECTION 33 01 30
OPERATION AND MAINTENANCE OF SEWER UTILTITIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Leakage testing of pump station wet wells and gravity sanitary sewers for the entire length of the Work, including service connections and manholes.

B. Related Sections:

1. *Section – Utility Manholes and Structures33 05 13*
2. *Section 33 31 13 – Gravity Sewers.*
3. *Section – Submersible Pumps.43 25 00*
4. *Section – Self-Priming Centrifugal Pumps*.43 23 00

1.2 PERFORMANCE REQUIREMENTS

A. Perform leakage testing after deflection testing, unless otherwise approved by ONWASA. If leakage testing is performed before deflection testing, a test section failing deflection testing shall be retested for leakage after acceptable deflection testing.

B. Sanitary sewer leakage testing is the responsibility of the Contractor, who shall provide all materials, labor, and equipment necessary.

C. Perform with representative of ONWASA present.

D. Judgment of ONWASA's representative as to the acceptance of tests is final.

1.3 QUALITY ASSURANCE

A. The Contractor shall conduct preliminary leakage testing prior to the witnessed tests to verify the tests will pass on the first attempt. If the Contractor schedules a required test in advance and the test is not ready to begin at the scheduled time, the Contractor will be required to reimburse ONWASA for all costs associated with the delay.

B. Notify ONWASA 72 hours in advance of tests and have tests witnessed.

C. Perform leakage testing in accordance with the following applicable ASTM Standards and the requirements of this Section.

1. ASTM F1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using low-pressure air
2. ASTM C828 - Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
3. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
4. Manhole Testing: ASTM C1244.

PART 2 PRODUCTS - Not used.

PART 3 EXECUTION

3.1 GENERAL: Entire project site shall be in strict accordance with OSHA Regulations.

3.2 LOW-PRESSURE AIR TEST

A. Conduct low-pressure air tests after backfilling. CONTRACTOR may conduct air tests before backfilling the trench as a check for defects and workmanship, but such tests are at CONTRACTOR’s option and are not a substitute for tests required after backfilling has been completed.

B. Low-pressure air tests shall be conducted on sewers 36 inches in diameter and smaller.

1. Conduct an air test between each two consecutive manholes by plugging each end of the section to be tested and all pipe outlets in the section with suitable test plugs; one plug used at a manhole shall have an inlet tap or other provision for connecting an air hose from the air supply equipment.
2. Pneumatic plugs shall be able to resist internal pressures without external blocking.
3. The equipment shall include valves to control the rate at which air flows into the test section and pressure gages with minimum graduations of 0.1 psi and an accuracy of +0.04 psi to monitor the air pressure within the test section.
4. Apply air pressure slowly to the test section until the pressure reaches 5 psi.
5. The section of pipe being tested shall maintain the starting pressure of 5 psi for at least 5 minutes with no leakage.

3.3 MANHOLE TESTS

A. Test each manhole after assembly and after all lift holes have been plugged with non-shrink grout and, at CONTRACTOR's option, before or after completing backfilling.

B. Test by drawing a vacuum on the manhole using equipment specifically designed for such testing.

C. Plug and brace pipes entering the manhole to prevent being drawn into the manhole.

D. Place a test head with necessary gages and connections at the inside of the top of the cone section and seal in accordance with the manufacturer's instructions.

E. Draw a vacuum of 10 inches of mercury and then shut the vacuum pump off.

F. With valves closed, measure the time for the vacuum to drop to 9 inches. The test shall be successful if the time measured meets or exceeds the values indicated in the following table:

MINIMUM TEST TIMES IN SECONDS						
MANHOLE DEPTH	**MANHOLE DIAMETER ***					
	48”	**60”**	**72”**	**84”**	**96”**	**108”**
8’ or less	20	26	33	40	48	56
10’	25	33	41	50	58	67
12’	30	39	49	59	69	79
14’	35	46	57	68	80	92
16’	40	52	65	77	91	104
18’	45	59	73	87	102	116
20’	50	65	81	97	113	129
22’	55	72	89	106	123	140
24’	59	78	97	116	135	152
26’	64	85	105	125	148	168
28’	69	91	113	135	157	179
30’	74	98	121	144	168	192
32’	79	104	128	154	179	204
34’	83	110	136	162	190	217
36’	88	116	144	172	201	229
38’	93	122	152	182	213	242
40’	97	128	159	191	223	254

* When there is a transition involved, add the times for each size based on the depth associated with each size.

3.4 WET WELL LEAKAGE TEST (EXFILTRATION TEST)

An Exfiltration test must be performed after the wet well has been backfilled and compacted. Exfiltration shall not exceed 0.0142 gal/hr per foot diameter per foot depth. The test must be done by plugging the invert-in and filling up the wet well with water to either 1-foot below the wet well top slab. This level must be clearly marked in the wet well internal wall. Once the wet well is filled, it must be left for stabilization for 48 hours minimum prior to beginning the Exfiltration test. After the stabilization period, the wet well must be refilled up to the mark to begin the test. The test will be done for four hours, and no water must be added to the wet well during the test period. The Exfiltration test must be determined by measuring the amount of water required to raise the wet well level back to the mark at the end of the test period. The maximum allowable water loss to pass the test is determined by the following equation:

$$Maximum\ Allowable\ \ Water\ Loss\left(gallons\right)=0.0142\cdot t\cdot D\cdot h$$

Where:
t = test time duration (4 hours)
D = wet well diameter (feet)
h = water level depth within wet well (feet)

If the Exfiltration test fails, the Contractor shall determine and complete the necessary corrective actions to reduce the exfiltration. Once the repairs are completed the test will be repeated. The wet well will not pass the test until the exfiltration is equal or less then the allowable water loss as determined by the equation above. ONWASA will witness the complete Exfiltration test. The Contactor or Developer will provide a certified letter showing the results of the exfiltration test to ONWASA. The certification letter will include a description of all steps taken to complete the exfiltration test, including water loss, wet well level mark, and any corrective actions taken if a prior test failed.

3.5 REPAIR/REPLACEMENT

A. For any sewer test section failing to meet the limits of the Specifications, locate and remedy the defects causing the failure, retest the section, and continue repairs or replacement until the limits of the Specifications are satisfied.

B. For sewers not accessible, should a test fail due to other than a leaking plug, conduct a closed circuit television inspection of the test section to determine the cause of the failure.

C. When failure is the result of a leaking sewer joint, the joint may be chemically grouted.

D. Television inspection and chemical grouting of sewer joints shall comply with all applicable "Recommended Specifications for Sewer Collection System Rehabilitation" of the National Association of Sewer Service Companies as approved by ONWASA. Furnish OWNER DVDs of all television inspections.

E. If a manhole test is unsuccessful, make repairs and retest until a satisfactory test is obtained.

F. Repair all visible leakage in sewers and manholes, even though tests may have been satisfactory.

END OF SECTION

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SECTION 33 01 30.16
TELEVISION INSPECTION OF SEWER PIPELINES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Television inspection of all sanitary sewer mains and service laterals installed.
2. Cleaning of all sanitary sewer lines and service laterals prior to video-inspection.
3. Review of pipeline videos with the ONWASA and preparation of defect log for each section of pipeline inspected.

B. Related Sections:

1. *Section 33 31 13 – Gravity Sewers*

1.2 REFERENCES

A. Codes, Specifications, and Standards

1. North Carolina Division of Water Quality: All applicable rules and regulations.
2. North Carolina State Plumbing Code: All applicable requirements.
3. Applicable sections of the National Association of Sewer Service Companies (NASSCO) publication *Specification Guidelines, SG-11, for Wastewater Collection Systems, Maintenance and Rehabilitation,* Revised May 2005, and NASSCO publication *Inspector Handbook for Sewer Collection System Maintenance and Rehabilitation*.

1.3 TERMINOLOGY

A. Defects shall include damaged pipe, leaking joints, presence of debris, misaligned or sagging pipe, bowed pipe sections, deflected pipe, pipe joints not fully seated, improperly installed gaskets, or other abnormalities not in conformance with the contract requirements.

B. *AVI*: Audio Video Interleave (.avi) Files: Non-proprietary multimedia data format by Microsoft, containing standard audio and video for simultaneous playback. MP4 or MPG format also acceptable.

1. Resolution: 320 x 240 pixels.
2. Frame Rate: 15 frames per second, minimum.

C. *CD-ROM*: Compact Disk-Read Only Memory: CD-R written or “burned” in accordance with ISO-9660 Level 2; minimum 700mb information storage. *Digital Video/Versatile Disk (DVD-ROM)*: Optical disk storage media format used for storing data; containing a filing system called UDF for indexing and storage; minimum 4.7 gb information storage.

PART 2 EQUIPMENT

2.1 TELEVISION INSPECTION SYSTEM

A. The CONTRACTOR shall furnish the television inspection studio, television camera, audio-visual digital encoding equipment/software, and other necessary equipment, materials, electricity, labor, technicians, as may be needed to perform the television inspection.

B. The television studio shall be large enough to accommodate a minimum of three people for the purpose of viewing the television monitor while the inspection is in progress. The television studio shall be insulated against noise and extremes in temperature, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the requirements of these Specifications. ONWASA shall have access to view the television screen at all times.

C. The television camera used for the sewer line inspection shall be one specifically designed and constructed for sewer pipeline inspection and be capable of clearly televising the interior of 4-inch diameter gravity sewer and all larger pipe sizes, and capable of inspecting a minimum of1,000 linear feet of pipe line with one setup. The camera shall be waterproof and shall be operative in any conditions that may be encountered in the inspection environment. The CONTRACTOR shall provide a color pan and tilt, or radial, camera to facilitate the inspection of service laterals and sewer line and manhole defects. The illumination must be such as to allow a clear periphery of the pipe interior. The view seen by the television camera shall be transmitted to a monitor of not less than 11 inches in size. Picture quality shall be to the satisfaction of ONWASA. The travel speed of the television inspection equipment through the sewer shall be uniform and shall not exceed the maximum speed directed by ONWASA; or 6-inches per second under normal conditions.

2.2 CLEANING EQUIPMENT

A. High-Velocity Jet (Hydrocleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.

PART 3 EXECUTION

3.1 PREPARATION

A. Notification: Notify ONWASA 72 hours in advance of all required testing and have test witnessed.

B. Unless otherwise approved by ONWASA, video-inspection of the gravity sewer lines and service laterals shall take place not less than 30 days after final backfill has been placed.

C. Pipe lines, including service laterals, shall be thoroughly flushed and cleaned with equipment as required by this Section to remove dirt, sand, stone, and other materials from the lines to ensure a clear view of interior conditions. Flushing operations shall take place a maximum of 24 hours prior to video-inspection.

D. Each service lateral shall be water-dropped with at least 5 gallons of water prior to video- inspection.

3.2 GENERAL

A. Television Inspection:

1. The entire lengths of all sewer mains installed, and sewer service laterals from the cleanout stand-pipe to the connection at the main, shall be video-inspected.
2. Inspect sewer pipelines with pan and tilt conventional television imagery as specified so as to record all relevant features and defects of the pipeline under inspection. Thoroughly video-inspect all lateral connections at the main to the extent possible.
3. Position the camera head so as to reduce the risk of picture distortion. In circular sewers, the camera lens shall be positioned centrally (i.e. in prime position) within the sewer. In non-circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera lens shall be directed along the longitudinal axis of the sewer when in prime position. A positioning tolerance of ±10% of the vertical sewer dimension shall be allowed when the camera is in prime position.
4. Television inspect sewers during low flow conditions. ONWASA reserves right to refuse any television inspection that, because of high flow conditions or for any other reason, does not produce an effective survey of the sewer pipe.

B. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter

shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to ONWASA.

3.3 DIGITAL AUDIO VISUAL RECORDING

A. Video Recording: Continuous digital video recordings of the inspection view as it appears on the television monitor shall be taken. The recording shall also be used as a permanent record of defects. The recording shall be delivered in AVI format. The digital video encoding shall include both sound and video information that can be reproduced with a video image equivalent to the quality of the original picture on the television monitor during the onsite video-inspection. The following data shall be displayed on the monitor and included in the video-recording :

1. Project name.
2. Camera's position, in feet, in the sewer line. The starting point shall be set at zero feet.
3. Sewer pipe diameter and material type (8" PVC, etc.).
4. Upstream manhole and downstream manhole reference numbers. If video-inspecting a service lateral, the address or lot number should be displayed.
5. Direction of inspection (upstream or downstream).
6. Date of inspection.

B. The size and position of the data display shall not interfere with the main subject of the picture yet shall be easily readable when the recording is replayed.

C. The audio portion of the inspection report shall include the location or identification of the section, the manhole-to-manhole direction of travel, and the distance traveled on the specific run encountered. The inspection camera equipment shall be continuously connected to the television inspection or monitoring equipment.

D. **Separate AVI files shall be created for each sewer line segment. In case of a reverse setup, such inspection shall be stored in a separate AVI file.** AVI files shall be written to CD-ROM or DVD-ROM media for delivery to ONWASA. Multiple AVIs may exist on each CD-ROM or DVD-ROM. Each CD-ROM or DVD-ROM shall be labeled, at a minimum, with the following information: Project Name, Date of CD/DVD creation, CD/DVD ID, Sewer Line Sections, and Contractor Firm.

E. AVI files shall be named according to the following file specification:

[STARTMANHOLENUMBER]_[ENDMANHOLENUMBERER]_[MONTH][DAY][YEAR].avi

F. ONWASA reserves the right to refuse any recording on the basis of poor image quality, excessive bit rates, inconsistent frame rates or any other characteristics that may affect usability.

G. Video Recording Review: The Contractor shall submit all inspection recording to ONWASA within 5 business days of the onsite video-inspection for further review,

H. At ONWASA's request, during the video-inspection, the Contractor shall demonstrate the play-back capabilities of the recording.

3.4 TELEVISION INSPECTION REPORTS

A. Television Inspection Report: The CONTRACTOR shall complete an inspection report covering the television inspection work and the information acquired noting the condition of the line, deficiencies, etc. The CONTRACTOR shall submit a bound hardcopy to ONWASA for further review and approval within 5 business days of the onsite video-inspection for further review.

B. Television Inspection Record: Record the following minimum information:

1. Project name.
2. Camera's position, in feet, in the sewer line from adjusted zero.
3. Size and length of pipe.
4. Pipe material.
5. Upstream manhole and downstream manhole reference numbers (OWNER to provide unique GIS SMH numbers).

6. Date of inspection.
7. Address, road name and/or location.
8. Direction of inspection (upstream or downstream).
9. Starting time of the inspection.

3.5 CLEANING

A. Cleaning Precautions: During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When water from fire hydrants is necessary, the water shall be conserved and not used unnecessarily. **Water from fire hydrants shall be procured through an ONWASA provided metering and back-flow assembly.** No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

B. Sewer Cleaning: Gravity sewers, sewer service laterals, and sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. Selection of the equipment used shall be based on the conditions of lines at the time the work commences. The equipment and methods selected shall be satisfactory to ONWASA. The equipment shall be capable of removing dirt, rocks, sand, and other materials and obstructions from the sewer lines and manholes. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed that a major blockage exists and the cleaning effort shall be repeated with other types of equipment.

C. Material Removal: All dirt, sand, rocks, and other collected materials resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section shall not be permitted.

D. Disposal of Materials: All waste materials resulting from the cleaning operations shall be removed from the site and disposed of properly, no less often than at the end of each workday. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time. Contractor shall be responsible for all disposal costs.

E. Final Acceptance of Sewer Line Cleaning: Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner. If CCTV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect the sewer line until the cleaning is shown to be satisfactory.

3.6 SEWER FLOW CONTROL

A. When the sewer line depth of flow at the upstream manhole of the pipe section being inspected is above the maximum allowable for television inspection as determined by ONWASA, the inspection shall be delayed until a lower flow time of day, or the flow shall be reduced to the level shown below by operation of pump stations, plugging or blocking of the flow, or by pumping and bypassing of the flow. Wastewater flow control plans must be approved by ONWASA prior to starting the work.

END OF SECTION

SECTION 33 01 30.51
MAINTENANCE OF SEWER UTILITIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Point repairs to defective sanitary sewer mains and laterals by traditional dig and replace methods.
2. Replacement of pipe sewers by traditional dig and replace methods.

B. Related Sections:

1. *Section – Trenching. 31 23 16.13*
2. *Section 33 01 30 – Operation and Maintenance of Sewer Utilities*
3. *Section – Television Inspection of Sewer Pipelines.33 01 30.16*
4. *Section 33 05 13 – Utility Manholes and Structures.*
5. *Section 33 31 13 – Gravity Sewers.*
6. *Section 33 34 00 – Force Mains*.

PART 2 PRODUCTS

2.1 MATERIAL REPLACEMENT

A. Vitrified Clay Pipe, Cast Iron Pipe: replace with Ductile Iron Pipe or SDR 35 PVC as specified in *Section 33 31 13 – Gravity Sewers* or *Section 33 34 00 – Force Main,* whichever is applicable.

B. PVC Pipe: replace with SDR 35 PVC for gravity sewer, or AWWA C900 or C905 PVC pipe for pressure force main, as specified in *Section 33 31 13 – Gravity Sewers* or *Section 33 34 00 – Force Mains,* whichever is applicable.

C. ABS/PVC Truss Pipe: replace with Ductile Iron Pipe as specified in *Section 33 31 13 – Gravity Sewers* or *Section 33 34 00 – Force Mains*, whichever is applicable.

D. Asbestos Concrete Pipe: use a full circle repair clamp for the damaged section, or replace with Ductile Iron Pipe as specified in *Section 33 31 13 – Gravity Sewers* or *Section 33 34 00 – Force Mains*, whichever is applicable.

E. Manholes: Refer to *Section 33 05 13 – Utility Manholes and Structures*.

F. Sanitary Sewer and Manhole Appurtenances: Refer to *Section 33 05 13 - Utility Manholes and Structures, Section 33 31 13 – Gravity Sewers*, or *Section 33 34 00 – Force Mains,* whichever is applicable.

2.2 PIPE CONNECTIONS:

A. Gravity Sewers:

1. Connections to existing gravity pipes shall be made by ductile iron mechanical joint sleeves if possible. For types of pipe where ductile iron mechanical joint sleeves cannot be used (i.e. Vitrified Clay Pipe), flexible couplings (e.g. Fernco) shall be considered. Flexible couplings shall not be permitted on gravity sewer mains unless approved by ONWASA. Flexible connectors shall be manufactured by Fernco, Inc., Joints, Inc., or Indiana Seal.

2. For transitions from Ductile Iron Pipe or C900 PVC to SDR-35 PVC Pipe, transition couplings shall be ductile iron, deep bell, push on joint, and air test rated. Ductile iron material shall comply with ASTM A536, Grade 65-45-12 or 80-55-06. Bell depths shall meet the minimum socket depth requirements of ASTM F1336. Gasket grooves shall be machined. Gaskets shall be of SBR rubber and comply with ASTM F477. No transition gaskets are permitted. All couplings shall have pipe stops and a flow way tapered to allow a smooth transition between the pipes.

B. Force Mains:

1. Connections to existing pipes shall be made by ductile iron mechanical joint sleeves with transition gaskets as necessary, or stab fit, wide range gasketed sleeves (i.e. Hymax Coupling) suitable for pressure sewer service as determined by the sleeve manufacturer. Flexible couplings (e.g. Fernco) shall not be permitted on force mains.

PART 3 EXECUTION

3.1 GENERAL: Entire Project site shall be kept in strict accordance with OSHA Regulations.

3.2 WASTEWATER FLOW CONTROL: A wastewater flow control plan shall be submitted to ONWASA and approved prior to beginning work.

3.3 SEWER MAIN POINT REPAIRS

A. All new pipe sewers, laterals and cleanouts, manholes and appurtenances shall be in accordance with ONWASA Standard Specifications.

B. For Cured-in-Place Pipe (CIPP): In places where cured-in-place pipe has been excavated and exposed (e.g., in access shafts, service connections, etc.), prepare for the placement of a crushed stone backfill by removing all debris and creating a void below and around the pipe. The width of this void shall not exceed ¾" of the liner's outside diameter plus 15 inches. Provide a minimum of six inches of ½" to ¾" diameter crushed stone as bedding for the liner and service line. Place crushed stone to a height of 6 inches above the liner and service line.

C. CONTRACTOR shall excavate down to the sewer pipe, completely exposing the section of pipe to be replaced plus the area needed to make reconnections. A minimum of three joints of clay pipe shall be exposed and one joint of PVC and ductile iron pipe. CONTRACTOR shall provide service tees or taps encountered within the point repair using materials specified. Any defective service laterals encountered within the point repair area shall be replaced.

D. The CONTRACTOR shall, after consulting with the ONWASA, remove the section of defective pipe or fitting by cutting on each side along lines perpendicular to the longitudinal axis of the pipe so as to leave "spigot ends" to be connected to replacement pipe. Install stone bedding. Replacement of Ductile Iron or PVC pipe shall be cut to the length needed to make the repair and connected to the existing pipe with couplings. A minimum of 4 feet of piping shall be replaced.

E. Excavation, trenching, backfill, compaction, sheeting, shoring, conflicts with existing utilities.

F. Replace existing pavement removed during point repair.

G. After point repairs are completed, return site of point repair to original condition.

3.4 TESTING

A. All point repairs shall be leak-tested in accordance with *Section 33 01 30 – Sanitary Sewer Leakage Testing* or *Section 33 34 00 – Force Mains*, whichever is applicable, prior to returning wastewater flow to the pipe.

B. All gravity sewer point repairs shall be subject to video-inspection in accordance with *Section 33 01 32 – Television Inspection of Sewer Pipelines*.

C. All sections failing the leak test or video-inspection, as determined by ONWASA, shall be removed and repaired at the CONTRACTOR's expense by a method approved by the ONWASA.

D. Vacuum Test Manholes in accordance with *Section 33 01 30 – Sanitary Sewer Leakage Testing*.

END OF SECTION

SECTION 33 31 13
GRAVITY SEWERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Pipe and fittings.
2. Pipe Markers.
3. Service Connections.

B. Related Sections

1. *Section 03 11 13 – Cast-in-Place Concrete*.
2. *Section – Trenching*.31 23 16.13
3. *Section 33 01 30 –* Operation and Maintenance of Sewer Utilities
4. *Section – Television Inspection.33 01 30.16*
5. *Section – Utility Manhole and Structures.33 05 13*
6. *Section 33 05 23 – Trenchless Utility Installation.*
7. *Section – Utility Horizontal Directional Drilling.33 05 23.13*

1.2 DEFINITIONS

A. Owner: Onslow Water and Sewer Authority – ONWASA

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, manholes, and invert elevations.

1.4 QUALITY ASSURANCE

A. All pipes, fittings, and appurtenances shall be appropriately marked for identification purposes. The materials and methods of manufacture, and completed pipes, fittings, and appurtenances shall be subject to inspection and rejection at all times. ONWASA has the right to make inspections.

B. Perform Work in accordance with ONWASA Standards and Sections 1500, 1510, and 1515 of NCDOT Standard Specifications except as modified here-in.

C. PVC pipe that has faded color due to extended exposure to sun and weather shall not be acceptable for use.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Ductile Iron Pipe (DIP): AWWA C151. Bituminous outside coating: AWWA C151.

1. Pressure Class: 350
2. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153.
   a. Coating: Bituminous Coating, AWWA C110.
3. Joints:
   a. Mechanical Joints: AWWA C111.
   b. Push-On Joints: AWWA C111.
   c. Flanged Joints: AWWA C115. (Above ground installation only)
   d. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications. Required for carrier pipe installed through steel casing.

e. Tied Restrained Joints: Per *Section 33 05 19 – Pressure Piping Joint Restraint*.

4. Ductile Iron Pipe and Fitting Lining (a. or b. as specified below):

a. Amine-cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment (i.e. Protecto 401). Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

1. Permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.

2. The following test must be run on coupons from factory-lined ductile iron pipe:

- ASTM B-117 Salt Spray (scribed panel) - Results to equal 0.0 undercutting after two years.
- ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5 mm undercutting after 30 days.
- Immersion testing rated using ASTM D-714-87.
  - 20% Sulfuric acid—No effect after two years.
  - 140°F 25% Sodium Hydroxide—No effect after two years.
  - 160°F Distilled Water—No effect after two years.
  - 120°F Tap Water (scribed panel)—0.0 undercutting after two years with no effect.
- ASTM G-22 90 Standard practice for determining resistance of Synthetic Polymeric materials to bacteria. The test should determine the resistance to growth of Acidithiobacillus Bacteria and should be conducted at 30 degrees centigrade for a period of 7 days on a minimum of 4 panels. The growth must be limited only to trace amounts of bacteria.
- An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance

3. Applicator: The lining shall be applied by a certified firm with a successful history of applying epoxy linings to the interior of ductile iron pipe and fittings.

b. Modified polyamine ceramic epoxy (i.e. Tnemec Series 431 Perma-Shield PL). Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the product meeting the performance criteria.

1. Properties:
   - Solids by Volume: 100 percent
   - Hazardous Air Pollutants: Zero
   - Ceramic Hollow Microspheres: 20 percent by volume (no silica fume, fly ash, or alumina dust)
   - Pigment Volume Concentration: Less than 22 percent
   - Coal-Tar Content: Zero
   - Dry Film Thickness:
     - 40 mils minimum
     - 60 mils maximum
2. Performance Criteria:
   - Abrasion: (ASTM D4060-07, CS-17 wheel, 1,000 grams) – 76 mg loss. (BS EN 598:2007+A1:2009, 50,000 cycles) – 0.6 mils loss
   - Adhesion: (ASTM D 4541) – Not less than 1,860 psi.
     - Severe Wastewater Analysis Test: (150°F, 500 ppm H2S, 4000 ppm NaCl, 10% H2S04, EIS Permeation Analysis) – Initial impedance of 11.2 (log-z). No

blistering, cracking, checking or loss of adhesion. Reduction in electrical impedance of 0.5 after 28 days exposure.

- Cathodic Disbondment: ASTM G 8 (1.5 V) Classification Group A. No more than 0.000 inch (0.00 mm) disbonded equivalent circle diameter.
- Chemical Resistance: (ASTM C 868-02, 25 percent sulfuric acid, 100 degrees F, 100 days – (NACE TM0174-2002, 6 months continuous immersion, 50 percent sulfuric acid, 13 percent sodium hypochlorite, 5 percent sodium hydroxide, 75 degrees F – No effect.
- Dielectric Strength: (ASTM D 149-09) – greater than 600 volts per mil
- Hardness: (ASTM D 2240): Shore D hardness of 79. (ASTM D 3363).
- Immersion: 140°F (60°C) De-ionized Water Immersion. No blistering, cracking or delamination of film after 5,000 hours continuous immersion.
- Impact: (ASTM D 2794-04) – No visible cracking or delamination after 160 inch-pounds (18.0 J) direct impact.
- Salt Spray (ASTM B 117-09): No blistering, cracking, rusting or delamination of film after 10,000 hrs.
- Water Absorption (ASTM C413-01(2006) – 0.0 percent water absorption
- Water Vapor Transmission (ASTM D 1653-03(2008) Method B, Wet Cup, Condition C) – 1.25 g/m2 per 24 h water vapor transmission and 0.09 perms water vapor permeance

3. Applicator: The lining shall be applied by a certified firm with a successful history of applying ceramic epoxy linings to the interior of ductile iron pipe and fittings.

B. Polyvinyl Chloride (PVC). PVC Class shall be as indicated in the plans:

1. Pipe Class: AWWA C-900 (4-inch through 12-inch) or AWWA C-905 (14-inch through 36-inch) PVC sewer mains shall be green in color.
   a. Pressure Rating: 235 psi minimum.
   b. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153.
2. Pipe Class: SDR-35, ASTM D1784, and ASTM D3034 (4-inch through 15-inch) or ASTM F679 (18-inch through 24-inch)
   a. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153. Transition gasket to be used.
   b. Joints: ASTM D3212 PVC with ASTM F477 flexible elastomeric seals. Solvent-cement couplings are not permitted.
3. Pipe Class: Schedule 40, ASTM D1784, ASTM D1785 (4-Inch to 6-Inch Sewer Service Laterals Only)
   a. Fittings: Schedule 40 PVC, ASTM D2466
   b. Joints: Solvent-weld, ASTM D2564 (Primer manufactured for thermoplastic piping systems is required for all solvent-welds.)

C. Polyethylene Pipe: See *Section 33 05 24 – Horizontal Directional Drilling*

D. Reinforced Concrete Pipe (RCP): ASTM C-76 (15-inch diameter gravity sewer pipe and larger as indicated on the Plans)

1. Joints: Pipe joints and joint material shall conform to the requirements defined in ASTM C-443
2. Interior Lining: If specified on the Plans, the interior walls shall be coated as specified in *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment*.

2.2 GROUT

A. Per *Section 33 05 14 – Utility Manholes and Structures*

2.3 UNDERGROUND PIPE MARKERS

A. Locator Tape: Brightly colored green tape continuously printed with "SANITARY SEWER" in large letters, minimum 6-inch wide by 4 mils thick, manufactured for direct burial service shall be installed and buried 1.5 to 2 feet from the top of the sewer line.

2.4 ABOVE-GROUND PIPE MARKERS

A. The standard above-ground utility markers shall be Rhino Tri-View Markers, Model No TVF66GB. Decals as shown in ONWASA's Standard Detail shall be placed on all three sides. Above-ground pipe markers are not required inside residential developments.

PART 3 EXECUTION

3.1 GENERAL: Entire Project site shall be in strict accordance with OSHA Regulations.

3.2 PREPARATION

A. Prior to Start of Construction:

1. Materials will be checked at the site of construction to verify conformance with approved materials. Any materials not in accordance with ONWASA Standards or approved by the Technical Operations Supervisor, or his designee, at the job site will not be assumed for use. CONTRACTOR will be directed to remove these materials from the area before work can proceed. CONTRACTOR may be directed to expose any work suspected of containing Inferior materials. Failure, by the Inspector, to notice faulty materials or work does not relieve the CONTRACTOR of his responsibility to provide a completed final product that meets the requirements of the plans and specifications. Any inferior materials discovered will be replaced without charge for rework to the OWNER.
2. ONWASA requires a minimum of forty eight (48) hours' notice before construction is to begin so that ONWASA can schedule construction inspection for the work. Should the prosecution of the work for any reason be temporarily discontinued, the CONTRACTOR shall notify ONWASA at least twenty-four (24) hours in advance of resuming operations.

B. Surveys, Lines and Grades:

1. The CONTRACTOR shall establish a Project survey control network, with both horizontal (NAD 83 datum or latest correction) and vertical (NAVD 88 datum or latest correction) controls, and develop and make any detailed surveys he deems necessary to construct the project in accordance with the contract requirements. The CONTRACTOR shall carefully preserve all reference points or existing survey markers and in the case of willful or careless destruction thereof, the CONTRACTOR shall be charged with the resulting expense, and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

C. Traffic Flow and Safety:

1. The CONTRACTOR shall maintain traffic flow and control at all times. CONTRACTOR shall comply with all MUTCD requirements and all requirements, suggestions and/or directions of the local Police Department, North Carolina Department of Transportation, and maintain OSHA Compliance concerning traffic control and safety. All necessary precautions shall be taken to affect the full safety of the public as well as the workmen on the job. In any section of the work for which ONWASA must obtain an encroachment from the N.C. Department of Transportation for cutting a paved street, or working in the DOT right-of-way, the CONTRACTOR shall follow the requirements as set out in the approved DOT Encroachment Agreement. The approved traffic control plan shall set forth the method and manner by which the CONTRACTOR shall provide for the convenience and safety of the traveling public. However, if during construction, it is determined by ONWASA, the Police Department, DOT or the CONTRACTOR that additional measures are needed; the CONTRACTOR shall cease operation and implement whatever measures are required for the safety of the public. Work shall not resume until the measures are fully implemented.

2. All encroachment bonds required by the Department of Transportation will be secured by the CONTRACTOR at his own expense.
3. No extra payment will be allowed for securing the required bond or for delays associated with the implementation of a traffic control plan. The costs of the bond and implementation of appropriate traffic control measures shall be included in the bid price for each item in the proposal.

D. Sewer Service Cut-Off:

1. When there are CITY OF JACKSONVILLE and ONWASA sewer lines within the limits of a project. The following procedure applies to both the CITY OF JACKSONVILLE and ONWASA.
2. The CITY OF JACKSONVILLE/ONWASA requires adherence to the following procedures prior to shutting off sewer service on any existing CITY OF JACKSONVILLE/ONWASA lines:
   a. The CONTRACTOR must receive approval for shut-off from the CITY OF JACKSONVILLE Public Utilities Director/ ONWASA Distribution/Collections Superintendent. Generally, shut-offs must occur from 9 a.m. to 11 a.m. and 2 p.m. to 4 p.m. on weekdays.
   b. After receiving approval, CONTRACTOR shall notify affected residents twenty-four (24) hours in advance of beginning operation.
   c. All valves to be closed or opened are to be operated by the CITY OF JACKSONVILLE Public Utilities Department/ONWASA
3. If any sewer mains are damaged and service interrupted, the utility OWNER (CITY OF JACKSONVILLE or ONWASA) shall immediately be contacted and CONTRACTOR shall conduct repairs in accordance with the utility OWNER'S specifications and requirements, in order to restore water to the customers.
4. NO ONWASA valves are to be operated without prior approval of the ONWASA Distribution/Collections Superintendent (910.937.7560). Except in emergency situations, the contractor shall request approval in writing (e-mail is preferable) no less than 48-hours prior to event, stating reason, length of outage, and number and location of customers affected.
5. Verify existing conditions before starting work.
6. Verify existing sewer connection size, location, and inverts are as indicated on Drawings.

3.3 EXCAVATION

Excavate trench in accordance with *Section 31 23 17 – Trenching*.

3.4 INSTALLATION - BEDDING

A. Backfill around Pipe and Above Pipe: As specified in *Section 31 23 17 - Trenching*.

B. Reference Detail SS_GSED “Sanitary Sewer Embedment Detail” in Details.

C. ONWASA reserves the privilege of altering the type of bedding material and regulating the exact grading of the bedding material depending upon the characteristics of the trench.

D. Provide sheeting and shoring as required.

E. After pipe is laid, shovel place and tamp to fill all voids.

F. Carefully place and tamp so as not to damage or displace joints or pipe. Do not drop material directly on pipe.

G. Maintain optimum moisture content of bedding material to attain required compaction density.

H. Provide concrete encasement in lieu of granular bedding in locations noted on the Drawings.

I. Provide concrete cradles to support new pipes crossing over existing pipes in the locations noted on Drawings.

3.5 INSTALLATION - PIPE SEWERS

A. Each section of pipe shall be inspected for defects prior to installation.

B. Except where otherwise specifically required or permitted by ONWASA, lay sewers in open trench, starting at the lowest point, with spigot ends pointing in the direction of flow.

C. Install PVC plastic pipe and fittings in accordance with ASTM D2321 and the requirements of these Specifications.

D. Install ductile iron pipe, fittings, and accessories in accordance with applicable portions of AWWA C600 and the requirements of these Specifications.

E. Install in open cut, except where otherwise required or permitted by ONWASA.

1. Where installed by free boring, extend hole 5 feet each side of pavement, thread pipe into hole from boring pit with leading end of first pipe covered to prevent damage and the entry of earth, and fill space around pipe with grout.
2. All piping that is dry-bored shall be ductile iron.
3. Where installed within steel encasement pipe, refer to *Section 33 05 23 - Trenchless Utility Installation*.

F. Lubricants, primers, adhesives, etc. shall be used as recommended by the pipe or joint manufacturer's specifications.

G. Utilities shall be installed in a dry trench. The Contractor is responsible for utilizing dewatering systems in accordance with good standard practice. The dewatering systems must be efficient enough to lower the water level in advance of the excavation and to maintain it continuously to keep the trench bottom and sides firm and dry. Groundwater shall not be allowed to rise around the pipe until after the trench is backfilled. Disposal of groundwater shall be disposed of in a suitable manner so as to not cause damage to adjacent property or facilities, or be a threat to public health. Pipe shall not be installed in a wet or frozen trench.

H. The pipe and fittings shall be kept thoroughly clean of any water, earth, stones, or other debris until work is completed and accepted by ONWASA. Open ends of the pipe shall be capped or plugged with a water-tight fitting during periods of work stoppage.

I. Make butt fusion joints in accordance with pipe manufacturer's and fusion machine manufacturer's instructions. The wall thickness of the adjoining pipes shall have the same DR at the point of fusion.

J. Lay pipe on bedding material with their full lengths true to line and grade with the aid of grade laser, batterboards, grade pole and grade string, or other method approved by ONWASA. The pipe shall be bedded in accordance with the Contract Drawings. When batterboards are used, set not less than three at 25 foot intervals and maintain in proper position at all times as a check on the accuracy of the grade line. When laser beam equipment is used, check equipment a minimum of twice daily, once in the A.M. and once in the P.M., in the presence of ONWASA to verify that equipment is maintaining the established line and grade, and when temperature and other atmospheric conditions prevent the laser beam from maintaining grade, provide additional ventilation through the pipeline by the use of blowers as instructed by the equipment manufacturer or as directed by ONWASA.

K. Install underground marking tape continuously above pipe line 12 to 18 inches below the ground surface.

L. Install above-ground utility markers at all manholes.

M. Immediately notify ONWASA of any misalignment of the pipe when laid in accordance with established cuts or elevations.

N. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line and grade.

O. Backfill trench in accordance with *Section 31 23 17 - Trenching*.

3.6 SERVICE CONNECTIONS

A. All applicable requirements noted in paragraph 3.3 of this Section shall be adhered to.

B. Provide for existing and future houses and businesses; 4 inches in diameter unless otherwise shown or it is discovered that an existing home or business is served by a service line larger than 4-inches in diameter. The diameter of the existing service lateral shall be matched. .

C. Locations and depths, where shown, are approximate only. Final locations and depths will be established at time of construction.

D. Connect to the main sewer by providing an appropriate wye. Wyes shall be installed with the branch turned to the proper direction and angle.

E. Where to be installed to the property line, install the pipe true to line and on at least 1 percent grade with a minimum depth of 8 feet at the property line or the maximum depth possible for main sewers less than 8 feet deep, plus deep enough to serve all basements where the main sewer allows.

F. Provide riser sections of pipe and fittings between the main line sewer connection and that portion installed on at least a 1 percent grade where depths to the main sewer invert exceed 12 feet. Fix riser in place for its full height by providing thoroughly tamped pipe embedment material as shown.

G. Close service connections not immediately connected to an existing sewer with a stopper. Stoppers shall be specifically designed for use with the pipe, shall be for use as a permanent or temporary plug, shall be water-tight, and shall be removable without damaging the pipe.

H. Do not backfill the ends of service connections until the location is referenced and recorded in accordance with the detail on Drawings. Provide a 2 inch square oak pole accurately placed over the terminus of each service connection and extending vertically to flush with the surface of the ground so that it can be located.

I. Clean-out should be installed inside cast iron box.

J. Care should be taken during installation to minimize the number of bends required. Unless otherwise specified, sewer service laterals shall pass air test and video inspection as specified for gravity sewers. Services must be installed for a period of at least 30 days prior to video-inspection, and each lateral is to be water dropped with at least 5 gallons of water prior to video work.

K. Contractor shall keep and provide ONWASA an accurate record of each service location. Such information should be maintained during construction on a field set of project construction drawings and should also include locations of wyes, bends, cleanouts, etc.

3.7 CONNECTIONS TO STRUCTURES

A. Connect new sewers to structures through stubs, wall castings, wall sleeves, etc., provided for same, or make an opening at the proper elevation in the wall of the structure. Unless otherwise approved by ONWASA, all openings into existing structures shall be core-drilled. Using pneumatic hammers, chipping guns, sledge hammers, etc., will not be permitted.

1. For polyethylene pipe, provide a water-tight seal around the pipe using grout or other material as instructed by the pipe manufacturer and approved by ONWASA, and a coupling slipped over the pipe end against the manhole wall and fused in place for axial restraint.

B. In opening of structure, unless otherwise approved by ONWASA, install flexible connector with dual stainless steel clamps meeting ASTM C923 for all pipe diameters in opening, and seal opening with non-shrink concrete grout. Make connections water-tight.

C. An inside drop assembly, in accordance with ONWASA's Standard Detail, shall be provided for a sewer entering a manhole at an elevation greater than 2.5 feet (30 inches) above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 2.5 feet (30 inches), the invert shall be filleted to prevent solids deposition. Outside drop assemblies are not permitted.

D. Where necessary, reshape the bottoms of existing structures with grout to give a smooth flow in all directions.

3.8 CONNECTION OF DIFFERENT TYPES OF PIPE

A. Ductile Iron Pipe / C900 PVC to SDR-35 PVC Pipe: Transition Couplings shall be ductile iron, deep bell, push on joint, and air test rated. Ductile iron material shall comply with ASTM A536, Grade 65-45-12 or 80-55-06. Bell depths shall meet the minimum socket depth requirements of ASTM F1336. Gasket grooves shall be machined. Gaskets shall be of SBR rubber and comply with ASTM F477. No transition gaskets are permitted. All couplings shall have pipe stops and a flow way tapered to allow a smooth transition between the pipes.

B. C900 PVC / SDR-35 PVC Wye to Schedule 40 PVC Pipe (Service Lateral Connection): PVC adapters designed to accommodate a C900 PVC or SDR-35 to Schedule 40 PVC transition shall be used.

C. Ductile Iron Wye to Schedule 40 PVC Pipe (Service Lateral Connection): Ductile iron adapters designed to accommodate a ductile iron pipe to Schedule 40 PVC transition, or a transition gasket in the branch outlet of the wye, shall be used.

D. Transition couplings between other types of pipe shall be indicated on the Plans, or as approved by ONWASA. Flexible couplings (e.g. Fernco) shall not be permitted on gravity sewer mains unless approved by ONWASA. Flexible connectors shall be manufactured by Fernco, Inc., Joints, Inc., or Indiana Seal.

3.9 FIELD QUALITY CONTROL

A. The Contractor shall conduct preliminary leakage and mandrel testing prior to the witnessed tests to verify the tests will pass on the first attempt. If the Contractor schedules a required test in advance and the test is not ready to begin at the scheduled time, the Contractor will be required to reimburse ONWASA for all costs associated with the delay.

B. Compaction Testing: Perform soil compaction tests in accordance with *Section 31 23 17 – Trenching*.

C. Notification: Notify ONWASA and, if necessary, the testing agency 72 hours in advance of any required testing and have witness test

D. Test sanitary sewers for leakage in accordance with *Section 33 01 30 – Sanitary Sewer Leakage Testing.*

E. Video-inspect all gravity sewer mains and service laterals in accordance with *Section 33 01 32 – Television Inspection of Sewer Pipelines.*

F. For storm sewers, repair all visible leakage.

G. Deflection Test: (Mandrel Method)

1. Test 8 inch diameter and larger PVC plastic pipe for a maximum deflection of 5 percent not less than 30 days after final full backfill has been placed, as determined by ONWASA. Pipe with a pipe stiffness of 200 psi or greater at 5 percent deflection, as determined in accordance with ASTM D2412, need not be tested for deflection if all pipe between two manholes is less than 12 feet below final grade.
2. Conduct deflection tests with a representative of ONWASA present.
3. Repair or replace pipes exceeding a deflection of 5 percent and then retest until satisfactory test results are obtained. For sanitary sewers requiring retesting for deflection and previously tested for leakage, upon obtaining satisfactory deflection test results, retest the affected sewer section for leakage.
4. Conduct tests by pulling an approved deflection probe, having a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, including the appendix, to which the pipe is manufactured, through the sewer line without mechanical pulling devices. Have a proving ring with an inside diameter equal to the outside diameter of the probe available at the time the probe is used to verify that the probe has the proper diameter by inserting the probe into the ring. The pipe shall be measured in accordance with ASTM D2122.

5. Deflection Probe: Designed specifically for testing the deflection of the type and size of pipe subject to test, and complying with the following:

   a. Odd number (no less than 9) of 1/2 inch by 3/16 inch bar stock runners equally spaced on edge around and welded to the circumference of two minimum 1/4 inch thick circular steel plates.
   b. Distance between plates, out-to-out, of not less than 2 inches smaller than the nominal diameter of the pipe to be tested, with runners extending approximately 1-1/2 inches beyond each plate being bent inward for this distance at approximately 30 degrees.
   c. Continuous 3/4 inch threaded rod through the center of the plates, having a hex nut drawn tight against the inside face of each plate, and extending each side as required for providing a 3/4 inch ferrule loop insert or similar piece for attaching the pulling medium.

END OF SECTION

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SECTION 33 32 16.13
GRINDER PUMP STATION INSTALLATION

PART 4 GENERAL

4.1 SUMMARY

A. Section Includes:

1. Installation of Residential and Commercial grinder pump systems connecting to sewer force mains. All the equipment specified herein is intended to be engineered equipment for macerating and pumping all material in normal domestic wastewater.

2. Grinder pump connections to Authority gravity collection systems shall be reviewed by staff for approval on a case by case basis.

B. Related Sections:

1. *Section 31 23 16-4 Excavation and Fill*

2. *Section 31 23 17-5 Trenching*

3. *Section 33 05 13 – Utility Manholes and Structures*

4. *Section 33 05 23 – Trenchless Utility Installation*

5. *Section 33 05 24 – Utility Horizontal Directional Drilling*

6. *Section 33 01 30 – Sanitary Sewer Leakage Testing*

7. *Section 33 11 00-2 Water Utility Distribution Piping*

8. *Section 33 34 00 – Force Mains*

4.2 REFERENCES

A. North Carolina Administrative Code – 15A NCAC 2T

4.3 SUBMITTALS

A. After receipt of notice to proceed, the supplier shall furnish the Engineer a minimum of four (4) sets of shop drawings of all materials required to establish compliance with the specifications. Submittals shall include the following:

1. Drawing illustrating details of the package grinder pump station including the fiberglass, HDPE or precast concrete pump station with discharge elevation, basin diameter and depth with side and top view.

2. Package grinder pump station components, shut-off and ball check valves, anti-siphon valve, stainless steel lifting chain, float switch level controls, float bracket, 4” sch. 40 inlet flange, and 36” x 72” or larger fiberglass, HDPE or precast concrete basin. See Package Grinder Pump Station Details

3. Flygt MF3068.175 1.7 HP 8.1 amps, 230 volt single phase progressive cavity grinder pump spec sheet with motor and performance curve. Simplex (or duplex) NEMA 4X stainless steel control panel drawing, wire schematic and spare parts list. Individual electrical control panel components cut sheets.

4. Certified agreement to the conditions of warranty.

5. Flygt engineering report illustrating the hydraulic design analysis utilizing the MF3068.175 progressive early cavity grinder pump hydraulic pump curve.

6. Details of the progressive cavity grinder pump serving each residence.

7. Flygt Hydraulic Analysis Report, to include engineered scaled drawing detailing the package grinder pump system piping configuration, pipe type, pipe size and C-factor. Design flow identification, line velocity with flow calculations in GPM @ TDH will be provided. The hydraulic analysis will be based upon the rational method design requirements, manufacturer's recommendations, industry standards, and pertinent regulations and guidelines.

4.4 QUALITY ASSURANCE

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from time of shipment.

C. Factory assembled parts and components shall not be dismantled for shipment.

D. Finished surfaces of all exposed pump openings shall be protected.

E. After hydrostatic or other test have been completed, all trapped water shall be removed prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

F. Each grinder pump shall be submerged and operated for 5 minutes (minimum). Actual appurtenances and controls which will be installed in the field, shall be 100% factory tested. The pump performance test shall cover three (3) points of operation on its curve, with the maximum pressure not less than that required by the system design.

G. All equipment furnished under this Specification shall be new and unused.

H. All parts shall be properly stamped for identification and location as shown in the Operating and Maintenance Manuals furnished. Clear identification giving the name of the manufacturer and all other pertinent data shall be attached to each pump station.

I. The manufacturer shall provide a warranty on materials and workmanship for a period of twenty-four (24) months from date of installation, but no greater than twenty-seven (27) months after receipt of shipment. The Owner will return any equipment found defective to the manufacturer for inspection and validation of the defect. Defective equipment will be repaired or replaced at manufacturer's discretion and shipped back to Owner at no charge. (This probably needs to be modified.)

PART 5 PRODUCTS

5.1 SUBMERSIBLE GRINDER PUMP STATION

A. The simplex grinder pump stations shall include one (1) Flygt model MF3068.175 progressive cavity pump, accessories and a 36" X 72" or larger basin or pre-approved equal.

B. The duplex grinder pump stations shall include two (2) Flygt model MF3068.175 progressive cavity pumps, accessories, and a 48" X 84" or larger basin or pre-approved equal.

C. The grinder pumps shall be Flygt model 3068.175 or pre-approved equal.

5.2 PERFORMANCE REQUIREMENTS

A. Each pump shall be capable of delivering a 9 GPM against a rated total dynamic head of 138 feet (60 PSIG). At 10 feet of head, the output shall be 15.31 GPM minimum. HQ conditions 261-3.72 & 100-10.92 shall be utilized for hydraulic analysis. The pumps shall be suitable for any operation along its performance curve in the LPSS application.

5.3 STATION CONFIGURATION

A. Basins shall be supplied in a wet well configuration. The wet well must have storage volumes according to the following table:

Volumetric Range	Capacity in Gallons		
	36x72 Basin (S)	42x78 Basin (S)	48x84 Basin (D)
OFF level from bottom	57	78	101
OFF level to LEAD level	26	36	46
OFF level to LAG level	N/A	N/A	93
LEAD ON level to ALARM level	52	72	93
Total Storage Capacity of Basin	317	468	658

5.4 WIRING

A. Pump power and float switch level control wiring shall be field installed by a certified electrician. All electrical cables penetrating or passing through the conduit flange of the pump station must be water-tight and sealed by the electrician immediately upon installation.

5.5 CHECK VALVE

A. Pump discharge pipe shall be equipped with a gravity-operated flapper-type integral check valve built into the stainless steel discharge piping. The valve will provide a fully ported passageway when open and shall introduce a friction loss of less than six inches of water at maximum rated flow. The valve body shall be injection molded part made of glass filled PVC. Ball type check valves shall be unacceptable due to their limited capacity in slurry application.

5.6 LOW PRESSURE LATERAL

A. Each basin package will require a ball valve and redundant check valve assembly for installation by contractor in the service lateral between the grinder pump station and the low pressure sewer main. Valves shall be 1.25 inch NPT and only require ½ pound of backpressure for complete closure.

B. Lateral assembly must be factory assembled, hydro-tested, and shipped complete.

C. Low Pressure lateral assembly will be identified on a separate line item on bid sheet and provided by the supplier of the grinder pump stations.

5.7 LIQUID LEVEL DETECTION

A. Float level switches shall be used to operate the pump(s) and signal a high level alarm connect to a pump controller.

B. The float level switches shall be manufactured by Consolidated Electric Company, Model LS or Anchor Scientific, Inc., Model Roto-Float Type P and Type S or approved equal.

5.8 ANTI-SIPHON VALVE

A. The pump shall be constructed for a positively primed, flooded suction. As added assurance that the pump cannot lose prime, even under negative head conditions in the discharge piping, a PVC anti-siphon valve will be installed after the check valve.

5.9 FIBERGLASS BASIN 36x72 Basin and 48x84 Basin (Filament Wound Process)

A. Basin – The fiberglass basin shall be made of a green polyester resin saturated glass filament wound process to obtain maximum axial and hoop modulus strength. The placement of E-type continuous glass fiber shall be computer controlled under constant tension during the manufacturing process. The finished resin saturated filament tank wall shall have 65% glass content and be inert and acceptable to the environment. Simplex basin shall have solid FRP lid. Duplex basin shall have 70/30 split aluminum lid.

B. Inner Surface – The inner surface shall be smooth and resin rich, free of cracks, exposed fibers, porosity and crazing.

C. Exterior Surface – The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. Green pigment is added, color should be relatively equal throughout. Foreign inclusions, dry spots, pinholes or pits, de-laminations, large dimples not meeting thickness requirements, and air bubbles are not acceptable.

D. Inner Layer – The inner layer shall be resin saturated continuous E-type glass fiber.

E. Tank Wall – The tank wall consisting of the inner surface, inner layer, and exterior surface should not have a minimum wall thickness of less than .10 inches (see minimum thickness chart). The tank wall thickness may increase as the depth or diameter changes to meet design and test requirements. The tank must be designed to withstand wall collapse or cracking, based on an assumption of saturated soil, hydrostatic pressure of 120 lbs. per cu. Ft. The tank must be designed to withstand or exceed two (2) times the assumed loading on any depth of basin. Length of tank (depth of bury) to be specified on purchase order with wall thickness approval calculations to be supplied by manufacturer upon request.

F. Tank Bottom – The basin bottom shall be of sufficient thickness (see minimum thickness chart) to withstand applicable hydrostatic uplift pressure with a safety factor of two (2). In saturated conditions, the center deflection of the empty basin bottom shall be less than 3/8" (elastic deflection) and shall not interfere with bottom pump mounting requirements. Any mounting studs, plates, cap screws into tank bottom should be stainless steel and resin covered except for threads. Any inserts should be stainless steel or brass and resin covered except for threads.

G. Tank Collar (Anti-Flotation) – A means to counteract buoyancy forces shall be provided on the tank bottom in the form of a ring, and shall extend a minimum of 3" beyond the O. D. of the basin wall. Thickness shall be uniform, but increased as needed to prevent cracking or failure, assuming two times applied load as tank dimensions increase. Wall and collar should be blended with a radius not to exceed 1 ½" beyond wall O.D. Tank. Tank shall be ballasted based on basin manufacturer's installation instructions and as required by engineer.

H. Tank Manufacturer - to provide calculations verifying acceptable wall stress/thickness upon request.

I. Top Flange – The top flange should be parallel to the tank bottom/collar and perpendicular to the tank wall. Corrosion resistant nuts shall be embedded in the top flange for securing the basin cover. The nuts shall be totally encapsulated to prevent turning (minimum turning torque should not be less than 30 foot/lbs.), pullout and corrosion.

5.10 HDPE BASIN

A. General – The contractor shall provide all materials, equipment and labor necessary to install, test and place into service the Compit high density polyethylene (HDPE) pump station as shown on the plans and described in this specification. The station package, including submersible pump and control, pump station with internal piping, accessories and auxiliary equipment shall be supplied by the pump manufacturer.

B. Requirements – The HDPE pump station package shall be capable of handling unscreened residential sewage. It shall have a bowl shaped bottom, which is self-cleaning by virtue of its design. The flat surface area shall be minimized to an area that is directly influenced by the pump suction and shall be free of obstacles. The round sloping walls of the pump station bottom shall further optimize the self-cleaning features of this station by directing all solids, trash and sludge, normally found in sewage and wastewater, to the suction of the submersible pump to facilitate removal and effectively clean the bottom. The tank shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be high density polyethylene, with a load rating of 150 lbs per square foot.

C. Compit HDPE Pump Station Construction –

1. The station shall be made from UV stabilized high density polyethylene that has high environmental stress crack resistance and low temperature impact resistance. The station shall be furnished complete with discharge pipes, fittings, check valves and shut-

off valves. The complete station shall be capable of withstanding the full hydrostatic pressure exerted by fully saturated soil at the maximum burial depth from the exterior of the station while the station is completely empty. A safety factor of two (2) on the minimum ultimate tensile strength of the station taking into account all normally imposed loads arising from flotation, soil pressures, normal backfill, handling loads, operating loads and static loads imposed by equipment used in hoisting the pumps in and out of the station.

2. All inside surfaces shall be smooth and bright white finish. The station shall be provided with an anti-flotation flange located on the bottom of the station. This anti-floatation flange is an integral part of the station and is sufficient in design to withstand the forces acting upon the station due to the subsoil water pressure. Once the station is inserted into the hole, concrete ballast may be required depending on the station depth. Please refer to the recommendations for concrete ballast as recommended. The combination of the flange and the loading of backfill material over the concrete shall provide adequate ballast against buoyancy under full hydrostatic head conditions.

5.11 PRECAST CONCRETE BASIN – see Utility Manholes and Structures 33 05 14-1

5.12 PUMP PERFORMANCE

A. Each pump shall be equipped with a 1.7HP, submersible electric motor connected for operation on 230 volts, 1 phase, 60 hertz, 8.1 amp 3 wire service, with minimum 15 feet of submersible cable (SUBCAB) suitable for submersible pump applications. Motors listed a 1 HP shall not be approved as equal. The power cable shall be 7-wire cable sized according to NEC and ICEA standards and also meet with P-MSHA Approval.

B. The pump shall be capable of delivering 9 GPM at 138 feet TDH and 15 GPM at 10 feet TDH. Each pump shall be fitted with 10 feet of braided polypropylene lifting rope. The working load of the lifting system shall be 300% greater than the pump unit weight.

5.13 MANUFACTURING

A. Pumps shall be manufactured by Flygt

B. Any pump manufacturer not specified, but wishing to be pre-approved as an acceptable supplier shall submit a complete hydraulic analysis based on the design detailed in the drawings 30 days prior to bid date. All manufacturers must have been in the business of manufacturing grinder pumps for a minimum of ten years. Manufacturer must demonstrate to the satisfaction of the Engineer that the proposed pumping equipment will meet system flows and heads required. In addition, pre-submittal must also demonstrate to the satisfaction of the Engineer that the equipment being proposed meets or exceeds all performance and safety requirements, materials of construction and user benefits of the specified equipment. All bids utilizing manufacturers not pre-approved will be considered non-responsive.

5.14 PUMP DESIGN

A. Pumps shall be a heavy duty and used as a grinder. Each grinder pump shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of “foreign objects”, such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4” diameter 304 SS discharge piping. The stationary cutter and rotary cutter shall consist of hardened stainless steel.

B. The cutter materials shall provide maximum corrosion and abrasion resistance. The remaining portion of the grinder pumps, with the exception of seal materials and wet end, shall be similar to the heavy duty pumps used in larger pump stations for daily operation.

C. The grinder pump shall be firmly connected to the discharge connection. There shall be no need for personnel to enter the wet-well.

D. In order to ensure proper operation under all conditions, pump must provide winding thermal protection directly connected to control panel circuit. Pump must also be capable of operating at zero or negative heads without damage to the pump.

5.15 PUMP CONSTRUCTION

A. Major pump components shall be of grey cast iron, ASTM A-48, Class 30B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel or brass construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate and a polyester resin enamel finish.

B. Motor cooling system is sufficiently cooled by the surrounding environment or pumped media. Water jackets are not required nor are oil filled motors.

C. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. Epoxies, silicones, or other secondary sealing systems make it difficult to replace power cable and shall not be considered acceptable.

D. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type. Oil filled motors will not be accepted The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 155 C (311 F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

E. The motor shall be designed for continuous duty handling pumped media of 40 C (104 F) and capable of no less than 15 evenly spaced starts per hour. Motor will be suited for low pressure sewer system hydraulic conditions. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125° C (260° F) embedded in the stator end coils to monitor the temperature of each phase winding shall be made available upon request.

F. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel terminal strip. The motor and pump shall be designed and manufactured by the same source.

G. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40° C (104° F) ambient and with a temperature rise not to exceed 80° C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

H. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

I. Motor shall be manufactured by the pump manufacturer. No control component shall be housed within the motor housing or in a separate compartment located outside the control panel.

J. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper and lower bearings shall be single row ball bearings. Sleeve bearings do not provide adequate alignment and will not be acceptable.

K. Each grinder pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary carbon seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable.

L. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces or an single mechanical seal system. No system requiring a pressure differential to offset pressure and to affect sealing shall be used. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. Seal lubricant shall be FDA Approved, nontoxic.

M. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be ASTM type 431 stainless steel. If a shaft material of lower quality than stainless steel is used, a shaft sleeve of stainless steel is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

N. The progressive cavity pump spiral rotor / impeller shall consist of 304 stainless steel with a 520-720 tensile strength, min 40% elongation and max 200 HB hardness. The rotor shall be capable of handling fine slurry from the special cutters. The progressive cavity pump stator shall be made of Nitrile rubber.

O. Protection for all motor stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125 C (260 F) the thermal switches shall open, stop the motor.

5.16 CONTROL PANELS

A. The simplex pump controls shall be housed in a NEMA 4X stainless steel enclosure with a red alarm light, H-O-A switch, audible alarm with push to silence switch, and pump run light. The enclosure shall be mounted type with exterior mounting tabs and sized to house all the required components listed in this section for complete operating control system and allow adequate space for testing and maintenance as necessary. The enclosure shall have back plate mounting studs, padlocking provisions, door latches and continuous hinge, all of stainless steel. The door gasket shall be seamless foam-in-place type. Pumps that have controls housed inside of pump consisting of contactors, start switch, level pressure switches and capacitors shall not be accepted or deemed equal.

B. Duplex control panels shall adhere to the same specification as simplex panels with controls, breakers, and indicators provided for each pump within a single NEMA 4X stainless steel control enclosure.

C. The panel shall have a formed aluminum switch mounting plate. All control switches and indicator pilot lights shall be mounted on the switch mounting plate.

D. All conduit entrances shall be made in a NEC approved manner. The conduits to the wet well shall have approved seal-off fittings installed and properly sealed to protect the control panel from adverse damage from the wet well. Electrical contractor will furnish and install.

E. All components shall be securely mounted to the back plate with plated machine screws through machine thread tapped holes in the back plate. The screws shall be of adequate size for the device being secured.

F. The panel power distribution shall include all components as indicated below and be completely wired with stranded conductors having a minimum of 90 degree insulation rating and an ampacity rating a minimum of 125% of the motor ampere rating. All power wiring shall be neatly routed and totally accessible. All conductor terminations shall be as recommended by the device manufacturer and be secure to provide adequate electrical conductivity.

G. The pump breakers shall be thermal magnetic trip devices and provide for individual motor disconnect and overload / short circuit protection as required by the NEC rating for motor branch circuit protection. The voltage rating shall match that of the panel incoming service. The 120 volt common control circuit shall be protected by a circuit breaker. Breakers shall be Square D type "QOU".

H. The motor starters shall be full voltage non-reversing I.E.C. rated three (3) pole devices with three (3) pole overload relay protection. They shall provide the electrical start / stop control and running overload protection for each pump and have 120 volt operating coils. Contactors and overloads shall be ABB model DP30C3P and Furnas model 48DA18AA4.

I. "Hand-Off-Auto" switch shall be provided for each motor and mounted on the formed aluminum switch bracket.

J. Pilot lights for each pump shall be mounted on the aluminum switch bracket and be supplied as follows: Pump Run Light – Green

K. Alarm light shall be constructed of shatter-resistant lexan. The red light shall be rated NEMA 4X and be supplied with a heavy duty one piece porcelain lamp holder and 15 watt rough service bulb. The red light will be mounted on top of the enclosure and shall be as manufactured by Ingram model LRX-40. Under high level conditions, the red light shall glow bright and flash, via a solid-state flasher and the electronic piezo horn shall sound. The red light & horn shall go out automatically after water level drops below the high level elevation. The alarm light will also be connected to a battery backup with charger that will allow the alarm to operate in the event of an electrical power outage.

L. The alarm panel shall include a 25 amp VAC generator receptacle with a spring-loaded, gasketed, cover suitably mounted to provide access for connection of an external generator while maintaining the NEMA 4X rating. A three position selector switch shall be provided to permit operator selection of normal electric power, off, or generator electric power during a power outage, allowing the audible and visual alarms to function normally in generator mode.

M. Package grinder pump stations installed at residences equipped with on-site generators to be connected to the stations are considered special conditions and require staff review and approval on a case by case basis.

N. Terminal strips shall be provided for all wiring termination. The control panel assembly shall be completely factory tested and shall be "UL" 508A listed and labeled. The control panel described in these specifications shall be manufactured specifically for the Flygt MF3068.175 PC grinder pump.

O. The simplex and duplex pump level controls shall be float level switches. See Section 44 42 56 Submersible Pumps, subsection 2.6 Float Level Switches.

5.17 CORROSION PROTECTION

A. All materials exposed to wastewater shall have inherent corrosion protection: i.e., coated cast iron, fiberglass, polyethylene, engineered polypropylene copolymer, stainless steel, PVC or CPVC.

PART 6 EXECUTION

6.1 GENERAL

A. The grinder pump station shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the grinder pump and panel shall be listed CSA and Underwriters Laboratories.

B. The grinder pump station shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications.

6.2 INSTALLATION OF EQUIPMENT

A. Installing the Tank – The tank must be installed buried outside buildings, fixed so as to prevent it from rotating and floating. The tank must be protected from frost. Do not walk on the cover of the tank.

B. Preparing the pit –

1. Fiberglass and HDPE tanks –

a. The pit must be 12” deeper than the planned installation. Allow suitable distance between the sides of the tank and the walls of the pit. When installing in clayey, granulose or muddy ground, place a geotextile fabric around all the surfaces of the pit to prevent the filling material from mixing with the soil. If burial depth is greater than the basin height, consult a factory representative to assure structural integrity is not compromised. - reinforcement may be required.

b. Filling the pit – When filling the pit, always make sure the tank is vertical. The fill shall be dry gravel or stone, free flowing, naturally rounded aggregate with a particle size of not less than 3/8” or larger than ¾” and free of ice. Ensure dewatering of excavation is sufficient to allow filling the pit before the surface of the water table reaches the level of the filling material.

1) Place a 12-inch thick layer of filling material at the bottom of the pit. Compact and level the surface. Install the tank.

2) Concrete may be poured around the basin bottom if ballast is required for buoyancy.

3) Backfill with pea gravel 4” to 6” around the entire periphery of the basin.

4) Place and compact the remaining filling material in 12-inch lifts, stopping to connect piping as required.

2. Precast concrete tanks – installation procedures shall be the same as for manholes. See Section 33 05 13 – Utility Manholes and Structures. Precast concrete tanks are subject to leakage testing. See Section 33 01 30 Sanitary Sewer Leakage Testing.

C. Hydraulic connections –

3. Hydraulic connections may only be performed by qualified staff in compliance with current regulations.

4. Depending on the type of installation and current local regulations, it may be necessary to fit a trap, check valve and/or tap on the pipe connecting the system to the Authority or private sewer or on other pipes. Always refer to current local and/or national

regulations, laws and standards. It is always best to fit a check valve and an on/off valve up line and downline from the station.

5. All pipes must be installed in such a way that they are not subject to stress. The pipes must not stress the tank. Make sure the electric pumps are correctly installed on the descent line and that all the hydraulic connections are tightened and watertight.

6. When necessary, use suitable systems to prevent the transmission of vibrations and to protect the piping from icing up.

D. Connection to the inlet piping – glue the template tot the flat drilling area. Make a hole in fiberglass or HDPE tanks using a cup saw to accommodate the 4-inch sewer service from the residence. Install the gasket. Precast concrete tanks shall be delivered with the inlet hole pre-cored and gasket installed by the factory. Smooth the 4-inch diameter external pipe. Insert the pipe in the gasket with the help of lubricant.

E. Connection to the outlet piping – Connect the outlet piping of the tank to the piping connected to the sewage duct using the threaded/smooth PVC sleeve for gluing. Fit a flexible union between the tank and the piping connected to the sewage duct to prevent breakages caused by ground settlement. Fit non-return valve on the piping connection to the Authority sewer. This will prevent backwash.

F. Connection to the vent piping – For fiberglass or HDPE tank packages, make a hole of the same size as the vent pipe in the upper part of one of the two flat surfaces. Precast concrete tanks shall have the vent holes cored by the factory in the flat-top lid. Connect the vent pipe to the tank with a joint. The vent pipe and electrical connections must use two separate ducts.

G. Hooks for electric pump lifting chains – For fiberglass or HDPE tank packages, the hooks are located on the stainless steel crosspiece. There are 2 small bent feet on the crosspiece that are used to hang the pump chains. For precast concrete tanks, install 1 (simplex stations) or 2 (duplex stations) stainless steel hooks just below the aluminum hatch on the precast flat-top lid directly above the pump(s).

H. Cable paths -

7. Fiberglass or HDPE tank packages –

   a. Install the grommets for the electric pumps in the upper part of the area used to make holes in the inlet piping.

   b. Install the conduit.

   c. Pull the cables through the conduit. Make sure the cables are long enough to allow further work to be performed on the electric pumps.

   d. Separate the ground cable from the electric pump power cables.

   e. Install the cable grommets and conduit for the float switches in the flat area above the hooks for the float switches.

   f. Pass the cables through the conduit. Make sure the cable is long enough. Spliced cables are prohibited. Adjust the length of the cables and fix them to the hooks.

8. Precast concrete tanks –

   a. The holes for the pump cable conduit shall be cored and the gaskets installed by the factory in the upper part of the area above the inlet piping.

   b. Install conduit.

   c. Pull the pump cables through the conduit. Make sure the cables are long enough to allow further work to be performed on the electric pumps.

   d. Separate the ground cable from the electric pump power cables.

e. Install the switch float cable conduit and the stainless steel float switch cable hooks in an area within reach of the hatch.

f. Pass the cables through the conduit. Make sure the cable is long enough. Spliced cables are prohibited. Adjust the length of the cables and fix them to the hooks.

I. Float switches – there are 3 float switches – pump on, pump off and high level alarm. Fix the floats to the relative hooks inside the tank. Adjust the level of the pump on float switch to the height of the electric pump lifting handle and the pump off float switch to the flange between the oil housing and the rotating assembly. Set the alarm float switch 20-inches above the pump off switch.

J. Assembling the electric pumps – consult the installation instructions supplied with the electric pumps.

9. Check the impeller turns in the right direction before installing the electric pump(s).

10. Remove any foreign bodies at the bottom of the tank before setting the pump(s).

11. Connect the electric pumps to the slide kit adaptors

12. Install the pump(s) in the tank.

13. Electrical connections –

a. Electrical connections may only be performed by a qualified installer in compliance with current regulations.

b. Make sure that the type of main power network, voltage and frequency are compatible with the ratings of the station components shown on the respective rating plates.

c. Provide suitable short circuit protection in the supply line.

d. Before making electrical connections, read the operating manual, that of the station, of the electric pumps, of the electrical panel, where applicable, and of the other station components, the instructions and any electrical diagrams.

e. Before proceeding with any operations, make sure that all the connections (even those that are potential-free) are voltage-free.

f. Unless otherwise specified in the NC Electric Code, the supply line must be fitted with:

1) A short circuit protection device.

2) A high sensitivity residual current circuit breaker (30 mA) for additional protection from electrocution in case of inefficient grounding.

3) A general switch with a contact aperture of at least 3 mm.

g. Fix the cables making sure they do not curve too tightly. Make sure the cables cannot be caught up in the electric pumps. Make sure the liquid cannot enter the cables through capillarity. Thread the cables of the electric pumps and float switches through the relative cable conduits and connect them to the electrical panel.

h. Ground the system in compliance with current regulations. Connect the ground cable, if fitted, to the guide bar support and to the crosspiece in the tank.

i. The inside of the tank is damp. Fit suitable electrical safety devices. Use suitably insulated joints.

j. Connect the main power supply.

K. Extension (fiberglass and HDPE tanks) – screw the extension onto the upper part of the tank instead of the cover. Screw the cover onto the top of the extension. Up to 2 extensions may be installed.

L. Cover Gasket (fiberglass and HDPE tanks) – the cover gasket comprises a rectangular piece of mousse rubber. Glue the gasket to the bottom of the cover. When the cover is screwed into place, the tank becomes airtight. Turn the cover at least twice for a perfect seal.

M. Mounting cover – screw the cover into its seat and tighten. Fit a lock to prevent unauthorized opening.

N. Mounting the cover lock –

14. Make a 21 mm diameter hole in the center of the recessed cylindrical area of the cover.
15. Insert the cylindrical upper part of the lock into the above hole (the triangular lock insert must be on the outside of the cover).
16. Screw the nut to the lock thread.
17. Insert the metal lock tongue into the square end of the lock, insert the screw and tighten to keep the tongue in position.
18. Use the supplied wrench to turn the moving part of the lock so that the tongue does not slip out of the cover.
19. Screw the cover onto the tank (or extension) and turn the wrench to lock the cover.
20. Remove the wrench and then insert the supplied protective cover to prevent dirt from entering.

O. Cover (precast concrete) – the station cover shall be a lockable aluminum access hatch (Haliday Products or approved equal) cast into the flat top precast concrete cover.

6.3 TESTING / STARTUP

A. Before start-up, read the operating manual, that of the station, of the electric pumps, of the electrical panel and of the other station components. Keep the manuals in a safe place.

B. Start-up operations may only be performed by expert and qualified staff.

C. The Contractor shall provide the necessary means to successfully start and operate the grinder pumps, including a minimum 150 gallons of water for simplex (250 gallons for duplex), 230v power supply and a minimum of one construction worker to facilitate and coordinate start-up for each grinder pump station. Contractor will coordinate with engineer, system supplier, and manufacturer to establish a date and time for start-up.

D. Before starting the station and the electric pumps, check that there are no residues or other materials in the system and tank that can prevent correct operation.

E. Leave the check valve on the inlet piping closed and fill the lifting station with clean water.

F. Open the check valves on the outlet piping, check the piping is perfectly watertight and make sure the electric pumps work correctly. Also make sure the electric pumps are primed.

G. Open the check valve on the inlet piping and make sure the station works correctly.

H. The flow of liquid from the user must not prevent the float switches in the tank from operating correctly.

I. For three-phase electric pumps, check the correct direction of the rotation of the impellers. Also check the electric pump manual. Make sure the cut-in levels of the float switches are correct. If necessary, adjust them according to effective system requirements.

J. During operation, make sure the electric pumps cannot be unprimed. Make sure the number of hourly start-ups is compatible with the characteristics of the system components.

K. Check that the system operates correctly and put it into service.

L. After starting the station and making sure it works correctly, close the tank cover (and screw it into its seat, if applicable and/or necessary).

M. Secure and lock the cover to prevent unauthorized opening.

END OF SECTION

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SECTION 33 34 00
FORCE MAINS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, fittings, accessories, and bedding for force mains. Force mains shall be of ductile iron pipe and fittings, PVC plastic pipe and ductile iron fittings, or Polyethylene pipe. Force mains installed by directional drilling shall be of polyethylene pipe and ductile iron fittings.
2. Valves and appurtenances.
3. Thrust restraint.
4. Pressure and leakage testing.
5. Pipe Markers.

B. Related Sections:

1. *Section 03 11 13 – Cast-in-place Concrete*
2. *Section – Trenching 31 23 16.13*
3. *Section 33 05 19 – Pressure Piping Joint Restraint*
4. *Section 33 05 23 – Trenchless Utility Installation*
5. *Section – Utility Horizontal Directional Drilling33 05 23.13*
6. *Section – Utility Manholes and Structures33 05 13*
7. *Section – Submersible Pumps43 25 00*

1.2 DEFINITIONS

A. Owner: Onslow Water and Sewer Authority – ONWASA

1.3 SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

1.4 QUALITY ASSURANCE

A. All pipes, fittings, valves, and appurtenances shall be appropriately marked for identification purposes. The materials and methods of manufacture, and completed pipes, fittings, valves, and appurtenances shall be subject to inspection and rejection at all times. ONWASA and ENGINEER have the right to make inspections.

B. Perform Work in accordance with ONWASA Standards and Sections 1500, 1510, and 1515 of NCDOT Standard Specifications except as modified here-in.

C. PVC pipe that has faded color due to extended exposure to sun and weather shall not be acceptable for use.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, valves, thrust restraints, and invert elevations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with manufacturer's name and pressure rating labeling in place.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Store PVC pipe out of sunlight or under black polyethylene plastic or other suitable opaque material. Store rubber gasket rinds in shipping cartons out of sunlight and away from oil and grease until ready for use.

E. At no time shall other pipes or material be placed in the pipes.

F. Repair damage to pipe exterior and interior surfaces; pipe so damaged subject to rejection.

PART 2 PRODUCTS

2.1 FORCE MAIN PIPING

A. Ductile Iron Pipe (DIP): AWWA C151. Bituminous outside coating: AWWA C151. Force mains 18-inches in diameter and greater shall be ductile iron.

1. Pressure Class: 350

2. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153.
   a. Coating: Bituminous Coating, AWWA C110.

3. Joints:
   a. Mechanical Joints: AWWA C111.
   b. Push-On Joints: AWWA C111.
   c. Flanged Joints: AWWA C115. (Above ground installation only)
   d. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications. Required for carrier pipe installed through steel casing.
   e. Restrained Joints: Per *Section 33 05 19 – Pressure Piping Joint Restraint*.

4. Ductile Iron Pipe and Fitting Lining: Type shall be required as follows; The epoxy lining as described below shall be required for all mechanical joint fittings, pump station and vault piping, piping at high points in the force main (5 full sections centered at each air release/vacuum valve if force main is ductile iron upstream and downstream of the valve, 1 full section if force main is PVC upstream and downstream of the valve) and piping within 50 LF of a tie-in to a structure (i.e. manhole, pump station wet well, etc.). Cement mortar lining as described below shall be acceptable for all other locations unless otherwise directed by the ONWASA.

   a. Cement Mortar Lining per AWWA C104, or
   b. Epoxy Lining (1. or 2. as specified below):
      1. Amine-cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment (i.e. Protecto 401). Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.
         1) Permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
         2) The following test must be run on coupons from factory-lined ductile iron pipe:
            i. ASTM B-117 Salt Spray (scribed panel) - Results to equal 0.0 undercutting after two years.
            ii. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5 mm undercutting after 30 days.
            iii. Immersion testing rated using ASTM D-714-87.
               a. 20% Sulfuric acid—No effect after two years.
               b. 140°F 25% Sodium Hydroxide—No effect after two years.

c. 160°F Distilled Water—No effect after two years.
d. 120°F Tap Water (scribed panel)—0.0 undercutting after two years with no effect.

iv. ASTM G-22 90 Standard practice for determining resistance of Synthetic Polymeric materials to bacteria. The test should determine the resistance to growth of Acidithiobacillus Bacteria and should be conducted at 30 degrees centigrade for a period of 7 days on a minimum of 4 panels. The growth must be limited only to trace amounts of bacteria.

v. An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance

3) Applicator: The lining shall be applied by a certified firm with a successful history of applying epoxy linings to the interior of ductile iron pipe and fittings.

2. Modified polyamine ceramic epoxy (i.e. Tnemec Series 431 Perma-Shield PL). Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the product meeting the performance criteria.

1) Properties:
i. Solids by Volume: 100 percent
ii. Hazardous Air Pollutants: Zero
iii. Ceramic Hollow Microspheres: 20 percent by volume (no silica fume, fly ash, or alumina dust)
iv. Pigment Volume Concentration: Less than 22 percent
v. Coal-Tar Content: Zero
vi. Dry Film Thickness:
a. 40 mils minimum
b. 60 mils maximum

2) Performance Criteria:
i. Abrasion: (ASTM D4060-07, CS-17 wheel, 1,000 grams) – 76 mg loss. (BS EN 598:2007+A1:2009, 50,000 cycles) – 0.6 mils loss
ii. Adhesion: (ASTM D 4541) – Not less than 1,860 psi.
iii. Severe Wastewater Analysis Test: (150°F, 500 ppm H2S, 4000 ppm NaCl, 10% H2S04, EIS Permeation Analysis) – Initial impedance of 11.2 (log-z). No blistering, cracking, checking or loss of adhesion. Reduction in electrical impedance of 0.5 after 28 days exposure.
iv. Cathodic Disbondment: ASTM G 8 (1.5 V) Classification Group A. No more than 0.000 inch (0.00 mm) disbonded equivalent circle diameter.
v. Chemical Resistance: (ASTM C 868-02, 25 percent sulfuric acid, 100 degrees F, 100 days – (NACE TM0174-2002, 6 months continuous immersion, 50 percent sulfuric acid, 13 percent sodium hypochlorite, 5 percent sodium hydroxide, 75 degrees F – No effect.
vi. Dielectric Strength: (ASTM D 149-09) – greater than 600 volts per mil
vii. Hardness: (ASTM D 2240): Shore D hardness of 79. (ASTM D 3363).
viii. Immersion: 140°F (60°C) De-ionized Water Immersion. No blistering, cracking or delamination of film after 5,000 hours continuous immersion.
ix. Impact: (ASTM D 2794-04) – No visible cracking or delamination after 160 inch-pounds (18.0 J) direct impact.
x. Salt Spray (ASTM B 117-09): No blistering, cracking, rusting or delamination of film after 10,000 hrs.
xi. Water Absorption (ASTM C413-01(2006) – 0.0 percent water absorption
xii. Water Vapor Transmission (ASTM D 1653-03(2008) Method B, Wet Cup, Condition C) – 1.25 g/m2 per 24 h water vapor transmission and 0.09 perms water vapor permeance

3. Applicator: The lining shall be applied by a certified firm with a successful history of applying ceramic epoxy linings to the interior of ductile iron pipe and fittings.

B. Polyvinyl Chloride Pipe (PVC): AWWA C900 (4-inch through 12-inch), AWWA C905 (14-inch through 16-inch), and SDR-21 (less than 4-inch)

1. Pipe Class: PVC C900 and C905

a. Dimension Ratio: DR18
b. Pressure Rating: 235 psi minimum
c. Color: Green
d. Fittings: Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153
e. Joints:

1. ASTM D3139 PVC with ASTM F477 flexible elastomeric seals. Solvent-cement couplings are not permitted.
2. Ductile Iron, Mechanical Joint, AWWA C110

2. Pipe Class: SDR-21, Iron Pipe Size (IPS), ASTM D2241, ASTM D1784

a. Pressure Rating: 200 psi minimum
b. Fittings:
1. Ductile Iron, AWWA C110. Compact Fittings, Ductile Iron, AWWA C153
2. PVC fittings conforming to pipe requirements pressure rated to exceed pipe class. PVC fittings may only be installed as indicated on the Drawings.
c. Joints:
1. ASTM D3139 PVC with ASTM F477 flexible elastomeric seals. Solvent-cement couplings are not permitted.
2. Ductile Iron, Mechanical Joint, AWWA C110

C. Polyethylene Pipe: See *Section 33 05 24 – Utility Horizontal Directional Drilling*

Coordinate following with detail. May require more than one option for connection to main depending upon types of pipe. Modify as required for type of operation and size required. Be aware of height of unit so it fits within any structure provided.

2.2 AIR RELEASE / VACUUM VALVES

A. Manufacturer: Crispin - Multiplex Manufacturing Co. (S Series), Val-Matic (Series 300)

B. Valve: 2 inch inlet and outlet;150 psi operating pressure; cast iron body and top; stainless steel internal linkage and float.

C. Appurtenances: Brass backflush attachments.

D. Connection: Screw type; tapping saddle and strap assembly.

2.3 PLUG VALVES

A. Shall be eccentric of the non-lubricated type with resilient faced plugs. Valve bodies shall be ASTM A126 Class B cast iron according to AWWA C504. Valves shall include the following features:

1. Plugs shall be resilient faced cast iron, ASTM A126 Class B. The resilient covering shall be neoprene or hycar and suitable for use with sewage.
2. Sleeve metal bearings which are sintered, oil impregnated, and permanently lubricated stainless steel conforming to Type 316, ASTM A743, Grade CF-8M or AISI Type 317 L shall be used. Non-metallic bearings are not acceptable.
3. Valve shaft seals shall conform to AWWA C504 and AWWA C507 and shall utilize a multiple v-ring that is externally adjustable and re-packable under pressure.
4. Valve actuators shall be of the nut-operated type.
5. Valve shall be suitable for use in a buried condition.
6. Valve shall provide a minimum of 100% of pipe area when fully open.

B. Equip valves 6 inches and larger with gear actuators with gearing enclosed in semi-steel housing, seals on all shafts, and actuator shaft supported on permanently lubricated bronze bearings.

2.4 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. M&H Company.
2. Mueller Company.
3. American Flow Control
4. Clow

B. Resilient Wedge Gate Valves: AWWA C509 or C515; iron body, bronze or ductile iron.

1. Elastomeric Polydisulfide (EPDM) encapsulated wedge
2. Stem: Non-rising bronze stem.
3. Operating Nut: 2-inch Square; open counterclockwise unless otherwise indicated.
4. Ends: Mechanical joint end connections.
5. Coating: AWWA C550; interior/exterior.
6. Maximum Working Pressure: 250 psig

2.5 VALVE BOXES

A. Valve boxes shall be of roadway extension type, of proper length and base size with suitable detachable cover, coated inside and out with a good asphaltum paint, domestically casted. Boxes shall be Tyler Union 6850 Series, Bingham & Taylor I5B20W, or East Jordan Iron Works 8550 series two-piece valve box, screw type. The cast iron lid shall be marked “SEWER”.

2.6 UNDERGROUND PIPE MARKERS

A. Locator Tape: Brightly colored blue tape continuously printed with "SEWER FORCE MAIN" in large letters, minimum 6-inch wide by 4 mils thick manufactured for direct burial service shall be installed and buried 1.5 to 2 feet from the top of the sewer line.

B. Tracer wire: 10-Gauge insulated wire, green in color, shall be installed along the top of the water line to aid in locating the pipe for maintenance purposes. The wire shall be continuous and uninterrupted, and brought to the surface at as specified in this Section.

2.7 ABOVE-GROUND PIPE MARKERS

A. The standard above-ground utility markers shall be Rhino Tri-View Markers, Model No.TVF66GB. Above-ground utility markers designed to provide access to tracer wire shall be Rhino Tri-View markers, Model No.TVTI66GW2. Decals as shown in ONWASA’s Standard Detail shall be placed on all three sides. Above-ground pipe markers are not required inside residential developments.

PART 3 Concrete monument markers 6” X 6” X 36” reinforced with rebar with bronze utility markers stamped “WARNING BURRIED SEWER FORCE MAIN, CALL 811 BEFORE YOU DIG” drilled and epoxied into the top of the monument per Standard Detail .Concrete monument markers shall be installed to a depth of 18” immediately above the sewer force main at the entry and exit site of all directional drill locations where sewer force mains cross any body of water or wetland area. When installation takes place after the work has been completed, the monuments shall be installed only after confirming the location of the sewer force main below.

A.

3.2 GROUT

A. Per *Section 33 05 14 – Utility Manholes and Structures*

3.3 CONCRETE FOR THRUST RESTRAINT, ENCASEMENT AND CRADLES

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

1. Compressive strength of 2,500 psi at 28 days.
2. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
3. Maximum slump of 2.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
4. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

3.4 BEDDING AND COVER MATERIALS

A. Backfill around Pipe and Above Pipe: As specified in *Section 31 23 17 -Trenching*.

B. Reference SS_SED “Sewer Force Main Embedment Details” in Details.

3.5 ACCESSORIES

A. Steel rods, bolt, lugs and brackets: ASTM A36 or ASTM A307 carbon steel.

B. Polyethylene Jackets: AWWA C105 polyethylene jacket. Single layer, lapped over pipe joint, and secured with 10-mil polyethylene tape.

PART 4 EXECUTION

4.1 GENERAL: Entire Project site shall be in strict conformance to OSHA Regulations.

4.2 PREPARATION

A. Prior to Start of Construction:

1. Materials will be checked at the site of construction to verify conformance with approved materials. Any materials not in accordance with ONWASA Standards or approved by the Technical Operations Supervisor, or his designee, at the job site will not be assumed for use. CONTRACTOR will be directed to remove these materials from the area before work can proceed. CONTRACTOR may be directed to expose any work suspected of containing Inferior materials. Failure, by the Inspector, to notice faulty materials or work does not relieve the CONTRACTOR of his responsibility to provide a completed final product that meets the requirements of the plans and specifications. Any inferior materials discovered will be replaced without charge for rework to the OWNER.
2. ONWASA requires a minimum of forty eight (48) hours’ notice before construction is to begin so that ONWASA can schedule construction inspection for the work. Should the prosecution of the work for any reason be temporarily discontinued, the CONTRACTOR shall notify ONWASA at least twenty-four (24) hours in advance of resuming operations.

B. Surveys, Lines and Grades:

1. The CONTRACTOR shall establish a Project survey control network, with both horizontal (NAD 83 datum or latest correction) and vertical (NAVD 88 datum or latest correction) controls, and develop and make any detailed surveys he deems necessary to construct the project in accordance with the contract requirements. The CONTRACTOR shall carefully preserve all reference points or existing survey markers and in the case of willful or careless destruction thereof, the CONTRACTOR shall be charged with the resulting expense, and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

C. Traffic Flow and Safety:

1. The CONTRACTOR shall maintain traffic flow and control at all times. CONTRACTOR shall comply with all MUTCD requirements and all requirements, suggestions and/or directions of the local Police Department, North Carolina Department of Transportation, and maintain OSHA Compliance concerning traffic control and safety. All necessary precautions shall be taken to

affect the full safety of the public as well as the workmen on the job. In any section of the work for which ONWASA must obtain an encroachment from the N.C. Department of Transportation for cutting a paved street, or working in the DOT right-of-way, the CONTRACTOR shall follow the requirements as set out in the approved DOT Encroachment Agreement. The approved traffic control plan shall set forth the method and manner by which the CONTRACTOR shall provide for the convenience and safety of the traveling public. However, if during construction, it is determined by ONWASA, Police Department, DOT or the CONTRACTOR that additional measure is needed; the CONTRACTOR shall immediately cease operations and implement whatever measures are required for the safety of the public. Work shall not resume until the measures are fully implemented.

2. All encroachment bonds required by the Department of Transportation will be secured by the CONTRACTOR at his own expense.
3. No extra payment will be allowed for securing the required bond or for delays associated with the implementation of a traffic control plan. The costs of the bond and implementation of traffic control measures shall be included in the bid price for each item in the proposal

D. Sewer Service Cut-Off:

1. When there are CITY OF JACKSONVILLE and ONWASA sewer lines within the limits of a project. The following procedure applies to both the CITY OF JACKSONVILLE and ONWASA.
2. The CITY OF JACKSONVILLE/ONWASA requires adherence to the following procedures prior to shutting off sewer service on any existing CITY OF JACKSONVILLE/ONWASA lines:
   a. The CONTRACTOR must receive approval for shut-off from the CITY OF JACKSONVILLE Public Utilities Director/ ONWASA Distribution/Collections Superintendent. Generally, shut-offs must occur from 9 a.m. to 11 a.m. and 2 p.m. to 4 p.m. on weekdays.
   b. After receiving approval, CONTRACTOR shall notify affected residents twenty-four (24) hours in advance of beginning operation.
   c. All valves to be closed or opened are to be operated by the CITY OF JACKSONVILLE Public Utilities Department/ONWASA
3. If any sewer mains are damaged and service interrupted, the utility OWNER (CITY OF JACKSONVILLE or ONWASA) shall immediately be contacted and CONTRACTOR shall conduct repairs in accordance with the utility OWNER'S specifications and requirements, in order to restore water to the customers.
4. NO ONWASA valves are to be operated without prior approval of the ONWASA Distribution/Collections Superintendent (910.937.7560). Except in emergency situations, the contractor shall request approval in writing (e-mail is preferable) no less than 48-hours prior to event, stating reason, length of outage, and number and location of customers affected.
5. Verify existing conditions before starting work.
6. Verify existing sewer connection size, location, and inverts are as indicated on Drawings.

4.3 EXCAVATION

A. Excavate pipe trench in accordance with *Section 31 23 17 - Trenching* for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.

B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation. The Contractor is responsible for utilizing dewatering systems in accordance with good standard practice. The dewatering systems must be efficient enough to lower the water level in advance of the excavation and to maintain it continuously to keep the trench bottom and sides firm and dry. Groundwater shall not be allowed to rise around the pipe until after the trench is backfilled. Disposal of groundwater shall be disposed of in a suitable manner so as to not cause damage to adjacent property or facilities, or be a threat to public health. Do not lay pipe in wet or frozen trench.

C. Provide sheeting and shoring as required.

D. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8-inches in compacted depth; compact to 95 percent.

E. Place bedding material at trench bottom and shape for accurate placement and proper support of pipe.

F. Carefully place and tamp bedding material so as not to damage or displace joints or pipe. Do not drop material directly on pipe.

G. Maintain optimum moisture content of bedding material to attain required compaction density.

4.4 INSTALLATION - PIPE AND FITTINGS

A. Sewer lines shall be installed within dedicated street right of ways or centered in a 20-foot (minimum) dedicated public “utility” easement to ONWASA.

B. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufacturer’s instructions unless stricter requirements are noted in this Section.

C. Install PVC pipe in accordance with AWWA C605 and manufacturer’s instructions unless stricter requirements are noted in this Section.

D. PVC pipe shall be deflected onto a radius no smaller than 1.2 times the minimum bending radius set out in the PVC Pipe Handbook. Ductile iron joint deflections shall be no greater than 80 percent of the maximum set out in the Ductile Iron Handbook.

E. Each fitting and section of pipe shall be inspected for defects prior to installation.

F. Each fitting shall be secured by two forms of restraint. Restraining glands and concrete thrust blocking are preferred. Wedge-action restraint glands (i.e. MEGALUGS) are approved only for use on ductile iron pipe. Full-circumferential pipe restraint glands (i.e. Grip Rings) may be used on PVC or ductile iron pipe. All restraint glands shall be designed for use on the type of pipe for which they are being installed. Other forms of restraint such as threaded rod, bell restraint harnesses, etc. may be approved by ONWASA on a case-by-case basis.

G. Required Separation Between Pipe Systems:

1. Lateral Separation of Sewer and Water Mains. Water mains shall be laid at least 10- feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation -- in which case
   a. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer; or
   b. The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation *of* the bottom of the water main at least 18-inches above the top of the sewer.
2. Crossing a Water Main over a Sewer. Whenever It is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18-inches above the top of the sewer, unless local conditions or barriers prevent an 18-inch vertical separation -- in which case both the water main and the sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10-feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.
3. Crossing a Water Main under a Sewer. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10-feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.
4. In accordance with NCAC Title 15A Ch.18C Section 0.0906 and NCAC Title 15 Ch.2 M 0.0200, ONWASA interpretation of this ruling shall be as follows for a new development; Whenever a Sewer Main crosses above or below a water main and the minimum clearance will not be met, both pipes shall be constructed of ferrous material for a distance of 10-feet on center in each direction, however, any areas pre-existing shall be handled on a case by case basis.

5. Crossing a Water Main or Sewer Main under a Storm Sewer Main. When mains cross under a storm sewer main with less than 24-inches separation, the main shall be constructed of ferrous material or as shown on the plans. One joint of pipe shall be centered under the storm drainage.

H. Install pipe in locations and at grades as specified, except as otherwise permitted by ONWASA. Pipe shall be installed to indicated elevation to within tolerance of ½-inch.

I. The pipe and fittings shall be kept thoroughly clean of any water, earth, stones, or other debris until work is completed and accepted by ONWASA. Open ends of the pipe shall be capped or plugged with a water-tight fitting during periods of work stoppage.

J. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

K. Remove scale and dirt on inside and outside before assembly.

L. Flanged Joints: Not to be used in underground installations except within structures.

M. Install in open cut, except where otherwise required or permitted by ONWASA.

1. Where installed by free boring, extend hole 5 feet each side of pavement, thread pipe into hole from boring pit with leading end of first pipe covered to prevent damage and the entry of earth, and fill space around pipe with grout.
2. All piping that is dry-bored shall be ductile iron.
3. Where installed within steel encasement pipe, refer to *Section 33 05 23 - Trenchless Utility Installation*.

N. Install pipe with no high points unless shown on the Plans. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by ONWASA.

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

P. Install access fittings to permit required testing.

Q. When necessary to cut pipe at fittings, valves or elsewhere, the remaining portions may be used to minimize the number of scrap pieces when the Work is complete; however, scrap pieces less than 5-feet in length shall not be used.

R. Install underground marking tape continuously above pipe line 12 to 18 inches below the ground surface and secure trace wire to the pipe with duct tape near every bell and at the center of each pipe joint. The wire shall be fastened securely to all fittings as directed by ONWASA. Splices in the tracer wire shall be connected by means of a waterproof and corrosion-proof connector designed for direct bury applications. Standard wire nuts are not acceptable. The connection shall then be completely wrapped in electrical tape. There shall be no exposed bare wire. The tracer wire shall be made accessible through above-ground utility markers designed to provide access to tracer wire as specified in this Section. In residential developments, trace wire shall be made accessible in valve boxes, vaults, etc.

S. Install above-ground utility markers at horizontal bends, main-line valve boxes (not within 10 feet of a fire hydrant assembly branch), ends of directional bores (concrete monument markers), bank edge of all channels crossed by directional bores (concrete monument markers), each side of a roadway crossing, and along the piping alignment. The maximum spacing for the above-ground utility markers shall be 500 linear feet. In locations where there are multiple horizontal bends in close proximity, one marker will be sufficient to demonstrate the change in direction. Utility markers designed to provide access to tracer wire shall be installed at every third marker, or every 1000 feet of pipe, whichever distance is less. Tracer wire accessible above-ground utility markers shall also be installed at ends of directional bores. Establish elevations of buried piping with not less than 3-feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.

T. Backfill trench in accordance with *Section 31 23 17 – Trenching*.

4.5 INSTALLATION – VALVES

A. Install valves in conjunction with pipe installation; set valves plumb.

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

C. Adjust valve boxes to final grade at the time designated by ONWASA.

D. Install concrete support underneath valves as indicated in the Detail.

E. All valve boxes outside pavement shall have a concrete valve collar or a 2' x 2' x 4" area of concrete poured around the valve boxes where valve boxes are too close to install whole valve pads. (No valve pads are to be cut).

4.6 INSTALLATION – AIR RELEASE / VACUUM VALVES

A. Air release/vacuum valves shall be installed in minimum 5-foot inside diameter manholes in accordance with *Section 33 05 14 – Utility Manholes and Structures* and ONWASA's Standard Details. Note that all force main air release/vacuum valve manholes shall be vented with a ductile iron vent terminating in two 90° bends with a stainless steel insect screen installed on the end. The vent shall be installed to a height 3' above the flood plain elevation.

4.7 INSTALLATION – CONCRETE THRUST RESTRAINT

A. Provide concrete thrust restraint for valves, tees, bends, caps, plugs, and dead ends with concrete thrust blocks as indicated on drawings. Thrust blocks should be located to resist resultant force and so pipe and fittings will be accessible for repair

B. Fittings shall be wrapped in polyethylene prior to pouring the concrete thrust blocking to protect the fittings, glands, bolts, etc. from direct contact with the concrete.

C. The concrete for the thrust blocks shall be mixed outside the excavation in a clean container with potable water. Mixing of concrete in the excavation using surface or ground water, or placement of dry, unmixed bags of concrete behind fittings shall not be allowed.

D. Pour concrete thrust blocks against undisturbed earth. Do not encase fittings, glands, bolts, etc.

4.8 CONNECTIONS TO EXISTING PIPING AND STRUCTURES

A. Connect new sewers to structures through stubs, wall castings, wall sleeves, etc., provided for same, or make an opening at the proper elevation in the wall of the structure. Unless otherwise approved by ONWASA, all openings into existing structures shall be core-drilled. Using pneumatic hammers, chipping guns, sledge hammers, etc., will not be permitted.

B. In opening of structure, unless otherwise approved by ONWASA, install flexible connector with dual stainless steel clamps meeting ASTM C923 for all pipe diameters in opening, and seal opening with non-shrink concrete grout. Make connections water-tight.

1. For polyethylene pipe, provide a water-tight seal around the pipe using grout or other material as instructed by the pipe manufacturer and approved by ONWASA, and a coupling slipped over the pipe end against the structure wall and fused in place for axial restraint.

C. An inside drop assembly, in accordance with ONWASA's Standard Detail, shall be provided for a force main entering a manhole.

D. Where necessary, reshape the bottoms of existing structures to give a smooth flow in all directions.

E. Provide 48 hours' notice to ONWASA prior to making connections.

F. Plan Work to reduce number of shut-offs and to minimize length of shut-off.

G. Make connections at such times and using fittings as approved by OWNER and ONWASA. Connections to existing pipes shall be made by ductile iron mechanical joint sleeves with transition gaskets as necessary, or stab fit, wide range gasketed sleeves (i.e. Hymax Coupling) suitable for

pressure sewer service as determined by the sleeve manufacturer. Flexible couplings (e.g. Fernco) shall not be permitted on force mains.

4.9 INSTALLATION - POLYETHYLENE ENCASEMENT

A. Encase Ductile Iron piping in polyethylene where indicated on Drawings to prevent contact with surrounding backfill material.

B. Install in accordance with AWWA C105.

C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

4.10 INSTALLATION - JOINT RESTRAINT

A. Install joint restraint in accordance with *Section 33 05 19 – Pressure Piping Joint Restraint*.

4.11 BACKFILLING

A. Backfill and compact around sides and to top of pipe in accordance with *Section 31 23 17 - Trenching*.

B. Maintain optimum moisture content of material to attain required compaction density.

4.12 FIELD QUALITY CONTROL

A. The Contractor shall conduct preliminary pressure, leakage, and tracer wire testing prior to the witnessed tests to verify the tests will pass on the first attempt. If the Contractor schedules a required test in advance and the test is not ready to begin at the scheduled time, the Contractor will be required to reimburse ONWASA for all costs to ONWASA associated with the delay.

B. Check valve boxes after installation to ensure the valves are installed plumb and centered over the operating nut, and remove stones, dirt, debris, and backfill material.

C. Compaction Testing: Perform soil compaction tests in accordance with *Section 31 23 17 - Trenching*.

D. Trace Wire Testing: Contractor shall perform a continuity test on all trace wire in the presence of an ONWASA representative. If the trace wire is found to be not continuous after testing, the Contractor shall repair or replace the failed segment of the wire. Continuity test shall be repeated as necessary

E. Notification: Notify ONWASA and, if necessary, the testing agency 72 hours in advance of all required testing and have witness test.

F. Test Pressure: Not less than 150 psi, the test will result in automatic failure if the test pressure drops below 150 psi and fails an allowable leakage test.

G. Prior to conducting pressure testing, the Contractor shall demonstrate to the ONWASA Representative that all valves in the system are fully opened.

H. Pressure and Leakage Test Procedure:

1. Pressure and leakage testing is the responsibility of the Contractor, who shall provide all materials, labor, and equipment, and pay for the total volume of water used.
2. Prior to conducting pressure testing, the Contractor shall demonstrate to the ONWASA Representative that all valves in the system are fully opened.
3. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct pressure and leakage tests in accordance with AWWA C600 unless otherwise required by this Section.
4. Conduct tests for at least two-hour duration.
5. Pipeline installations that lose more than 5 psi at completion of the Hydrostatic Pressure Test will be required to pass an Allowable Leakage Test.
6. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks and plug resulting piping openings.

7. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
8. Examine exposed piping, fittings, valves, and joints carefully during pressure test. Repair or replace damage or defective pipe, fittings, valves, or joints discovered, following pressure test.
9. No pipeline installation will be approved when leakage test, if required, is greater than that determined by the following formula:

$$AL = \left(\frac{L}{5280}\right) \cdot \left(\frac{D \cdot 10}{12}\right)$$

AL = allowable leakage over 2-hour test period at 150 psi, in gallons
L = length of pipe tested, in feet
D = nominal diameter of pipe, in inches

10. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.
11. Test must be witnessed by ONWASA and the Certifying Engineer. Both parties must complete and sign ONWASA's Leakage/Hydrostatic/Chlorination and Flushing Form before the sewer line will be approved.
12. Sewer systems constructed in side of City of Jacksonville ETJ (Extra Territorial Jurisdiction) will be inspected by the City of Jacksonville inspection personnel. ONWASA personnel will witness the inspection. The City of Jacksonville will provide a copy of the inspection report to ONWASA for their records.

4.13 COMPLETION OF TEST

A. After successful completion of testing, mains shall be flushed and cleaned and all connections made prior to acceptance.

4.14 CONNECTION TO SEWER SYSTEM

A. No connection shall be made to the existing sewer system until the CONTRACTOR has obtained all necessary approvals from ONWASA and the North Carolina Division of Environment Quality, Division of Water Resources has acknowledged receipt of the Engineer's Certification.

B. Connections shall be made by approved methods and in accordance with the requirements of these specifications and ONWASA.

C. No pipe shall be opened until the new system is complete, tested and approved in accordance with these specifications and ONWASA's requirements under them.

END OF SECTION

SECTION 43 25 00
SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Work under this section consists of furnishing and installing two submersible non-clog wastewater pumps complete with a pump removal system and pump control panel as described herein.

B. Related Sections:

1. Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment
2. Section 33 05 13 – Utility Manholes and Structures.
3. Section 33 01 30 – Operation and Maintenance of Sewer Utilities.
4. *Section 33 31 13 – Gravity Sewers.*
5. *Section 33 34 00 – Force Mains*

1.2 REFERENCES

A. North Carolina Administrative Code – 15A NCAC 2T – Waste Not Discharged to Surface Waters.

1.3 SUBMITTALS

A. Provide manufacturer's shop drawings for pumps, drives, and controls to certify compliance with ONWASA requirements.

B. Three (3) Copies of Operation and Maintenance manuals shall be submitted for pumps and controls. O&M to include serial #, hp, voltage, amp ratings, pump curves and manufacturers contact information.

1.4 QUALITY ASSURANCE

A. All equipment components shall be adequately sized to carry all loads and stresses occurring during fabrication and erection and resulting from normal and emergency operation in the installation shown on the Plans and under the conditions specified and/or implied.

PART 2 PRODUCTS

2.1 PUMP PERFORMANCE REQUIREMENTS

A. The following pump performance characteristics shall be determined by the engineer:

1. Rated Capacity: XX gpm
2. Head at Rated Capacity: XX' TDH
3. Minimum Efficiency at Rated Capacity: 40%
4. Pump Speed: X RPM, maximum
5. Motor Power: X hp
6. Discharge Size: X"

2.2 MANUFACTURERS

A. Fairbanks Morse.
B. ABS
C. Flygt
D. Myers
E. Hydromatic

2.3 PUMP DESIGN

A. Pump stations with a rated capacity of 1,000,000 gpd, or greater, shall be triplex. In triplex pump stations, two of the pumps shall be linked to one control panel, and the third pump shall be linked to a separate control panel.

B. The discharge connection elbow for each pump shall be permanently installed in the wet well along with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump.

C. A sliding guide bracket shall be an integral part of the pump unit. During installation or retrieval, the pumping unit shall be guided by guide rails. Guide rails shall be constructed using Schedule 40 stainless steel pipe. The guide rails shall be supported by a stainless steel upper guide rail bracket mounted in the opening of the access cover to support and guide the pump/motor into and out of the wet well. Intermediate guide rail brackets shall be provided for all installations deeper than 20 feet.

D. The pump discharge connection surface shall be pressed tightly against the discharge connection elbow by means of a lever action utilizing the weight of the pump alone. No portion of the pump shall bear directly on the floor of the sump. The pump with its appurtenances and stainless steel lifting chain shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65'.

E. The lower end of the stainless steel chain of the retrieval system, rated for five (5) times the installed pump and coupling weight, shall remain attached to the pump at all times. The upper end of the chain shall be retained above the surface of the liquid by a suitable clip or hook on the side of the wetwell.

F. Unless otherwise approved by the ENGINEERING DIRECTOR, the power cable shall be of such length to reach the disconnect without splicing. If a splice is permitted, an ONWASA-approved junction box shall be used.

2.4 PUMP CONSTRUCTION

A. Major pump components shall be of gray cast iron, Class 35, with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of AISI Type 304 stainless steel or brass construction. All surfaces coming into contact with wastewater, other than stainless steel or brass, shall be protected by an approved wastewater resistant coating. Pump exterior shall be sprayed with PVC epoxy primer with chloric rubber paint finish.

B. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease, or other devices shall be used.

C. The cable entry water seal design shall insure a watertight and submersible seal.

D. Motor:

1. The pump motor shall be a squirrel-cage, induction, dry shell type design housed in an air-filled, watertight chamber. Motor shall have a minimum service factor of 1.10. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155 degrees C (311 degrees F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall be rejected. The motor shall be designed for continuous duty, capable of sustaining a minimum of 20 starts per hour.

2. Motor shall be explosion proof.

3. Each unit shall be capable of being operated continuously in air or submerged without additional cooling.

4. The junction chamber, containing the terminal board, shall be sealed from the motor using a gasket. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding posts permanently affixed to a terminal board and thus perfectly leak proof.

5. Thermal switches shall be used to monitor stator temperatures. The stator shall be equipped with 3 thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with and supplemental to external motor overload protection and wired to the control panel.

E. The pump shaft shall be of ANSI Type 420 stainless steel.

F. Mechanical Seals:

1. Each pump shall be provided with a tandem mechanical shaft seal system. The upper of the tandem set of seals shall operate in an oil chamber located just below the stator housing. This set shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing. The lower of the tandem set of seals functions as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring both of which shall be tungsten carbide or silicon carbide.

2. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable.

3. Each pump shall be provided with an oil chamber for the shaft sealing system. The drain and inspection plug, with positive anti-leak seal, shall be easily accessible from the outside.

G. An electrical probe shall be provided in the oil chamber for detecting the presence of water. A solid-state device mounted in the pump control panel shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber, the device shall stop the motor and energize an alarm.

H. The pump shaft shall rotate on two permanently lubricated bearings. The upper bearing shall be a single row roller bearing and the lower bearing a two row angular contact ball bearing. Bearings shall have a minimum B10 life rating of 40,000 hours under the design conditions.

I. The impeller shall be of gray cast iron, Class 35, dynamically balanced, non-clogging design having a long thrulet without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal wastewater applications. The pump manufacturer shall, upon request, furnish mass moment of inertia data for the proposed impeller. The impeller shall be capable of passing a minimum 3" solid sphere. The fit between the impeller and the shaft shall be a sliding fit with one key.

J. The volute shall be of a single piece, non-concentric design and shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller.

K. A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear rings shall be of a material having a Brinell hardness of greater than 300.

2.5 CONTROL PANELS

A. General: All control panels supplied under this section shall be of the dead front design housed in a NEMA 4X stainless steel enclosure with quick release latches. Each panel shall include the combination starters, level controller, hand switches, pilot lights, transformers, pump alternators, 3-phase relay, condensation protection, lighting protection, and other accessories as described below. Power supply to all control panels will be 120/240V, 200 amp, 3 phase, 60 Hz, or 277/480V, 200 amp, 3-phase, 60 Hz. Each pump control panel shall include a 120 V, 1 phase, 60 Hz duplex receptacle. Enclosure shall be UL rated and bear the 698 UL stamp prior to shipment.

B. The control panel will be used to control the sewage pumps. Pumps off, lead pump start, lag pump start, and high level alarm shall be controlled by float level switches. HOA switch, starter, run light, run time meters, thermal overload trip pilot light, alternators, and pump leakage pilot light shall be provided for each pump and internal to the panel for security.

2.6 FLOAT LEVEL SWITCHES

A. Units shall be direct-acting float type consisting of a 1 or 2-pole mercury switch enclosed in a float, and connected to a 2 or 4-conductor signal cable. The entire assembly shall form a completely watertight and impact-resistant unit. Floats shall be of chemical-resistant polypropylene material or other corrosion-resistant material suitable for use in sewage and sludge applications. Cable shall be rugged and flexible with heavy neoprene or PVC jacket. The actuation/de-actuation differential shall not exceed 1". The mercury switch shall spot and be rated at 5 amps at 120 volt AC. Float Switches shall be mounted to a heavy duty stainless steel float switch 6- hook mount bracket attached in an area of the wetwell easily accessible and within reach of the hatch opening.

B. Manufacturers:

1. Consolidated Electric Company, Model LS mounting clamps weight kit;
2. or Anchor Scientific, Inc., Model Roto-Float Type P and Type S.

2.7 ELECTRICAL

A. All above-ground conduits shall be rigid galvanized steel.

B. All conductors shall be thin-stranded copper.

C. All buried conduit shall be PVC.

D. All work shall be conducted in accordance with National Electric Code, and local, regulations.

E. All enclosures shall be dead-front NEMA 4X stainless steel.

F. All disconnects shall be NEMA 4X stainless steel.

G. All conduits from the wetwell shall vent to a vertical or horizontal ladder trough a minimum of 60" from the wetwell prior to entering electrical cabinetry.

H. All panels shall be certified by UL and bear the UL label.

I. All cabinetry shall be mounted to stainless steel unistruts and not directly to the control center structure.

2.8 DAVIT CRANE

A. One portable davit crane with a hand winch hoist will be provided for all pumps weighing less than 1,000 lbs. The system shall consist of a davit crane, hand winch, pedestal support, and stainless steel lifting cables terminating in a hook assembly. Stainless steel chain shall be permanently attached to each pump and hooked to a stainless steel hook mount located adjacent to the pump guide rails.

B. The davit crane shall be designed to lift the pumps from the wet well. Boom and mast shall rotate 240 degrees on tapered roller bearings. Mast shall be capable of being locked in position.

C. Lifting equipment shall be load tested and certified in accordance with current OSHA regulations.

D. Crane boom, mast, and base shall be fabricated from AISI 304/304L stainless steel minimum with electro-polish finish.

E. Manufacturer: Halliday Products, Inc., or approved equal.

2.9 JIB CRANE

A. One jib crane shall be provided for all pumps weighing more than 1,000 pounds.

B. Capacity shall be determined by the weight of the pumps or grinder unit in pounds.

C. Mounting: Anchor bolts to concrete.

D. Rotation: Provide unit capable of 360 degree rotation with tie rod supported to the mast.

E. Equip with thrust bearings and provide boom complete with end stops.

F. Travel Distance from top of concrete foundation to Bottom of Boom shall be determined by the engineer.

G. Boom Span shall be as necessary and determined by the engineer.

H. Install according to manufacturer's instructions.

I. Lubricate operating parts.

J. Test-operate each unit at full-rate capacity load. Make adjustments required for proper operation.

2.10 SPARE PARTS

A. Provide one spare mechanical seal set for each type of pump supplied. Provide one set of wear rings and one spare impeller.

B. If a control panel is equipped with any component(s) that could cause the entire station to be inoperative, said component(s) must be provided.

2.11 PUMP STATION WET WELL

A. Design calculations shall be submitted confirming that storage capacity complies with North Carolina Administrative Code.

B. Reference *Section 33 05 14 – Utility Manholes and Structures* for wet well, debris basket manhole and check valve vault.

C. The interior walls of all wetwells shall be coated as specified in *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment* after installation.

D. Buoyancy calculations shall be provided for all wet wells. Assume water to the top of the structure and the structure is empty except for the liquid below the pump-off elevation.

E. Hatches shall be in accordance with *Section 33 05 14 – Utility Manholes and Structures.*

F. All bolts, hardware, etc. for fasten items or bolting piping shall be stainless steel.

G. The wet wells shall be equipped with a vent pipe with insect screen.

H. A sloped invert of non-shrink grout (i.e. hopper bottom) shall be constructed at the base of the wet well. The invert shall have sufficient slope to prevent build-up of solids in the wet well bottom.

I. Exfiltration testing of the wet well shall be conducted in accordance with *Section 33 01 30 – Sanitary Sewer Leakage Testing.*

PART 3 EXECUTION

3.1 GENERAL:

A. The contractor shall install all pumps, motors and appurtenances specified herein in accordance with the plans and as recommended by the manufacturer. Pump manufacturer shall provide pumps, motors and all other necessary items to make a complete installation.

3.2 INSTALLATION OF EQUIPMENT

A. Install all equipment as shown on the drawings and in accordance with manufacturer's instructions.

B. Anchors: Attach all brackets and hardware using Type 316 stainless steel connectors and anchor bolts.

C. After all equipment and appurtenances have been installed, the Contractor shall touch-up any abrasions or scratches in the paint or surface protection of any furnished item of work. In so far as possible, the Contractor shall match exactly the paint or protective coating system and color as originally provided. All deviations from this procedure shall be specifically approved by the ENGINEERING DIRECTOR. Any mud, grease or other extraneous material shall be removed from the completed work using suitable solvents or detergent solutions.

D. All openings made in the wet well for anchorages, conduit runs, pipe runs, etc., shall be sealed using a cement grout. The grout shall be neatly applied to the vacancy and shall be troweled in, and excess grout shall be immediately removed from the wet well. Grout shall be high strength, non-shrink type.

E. Uni-flange devices are not permitted.

3.3 PUMP TESTS

A. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

1. Impeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.
2. A motor and cable insulation test for moisture content or insulation defects shall be made.
3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
4. The pump shall be run for 30 minutes submerged, a minimum of 6' under water.
5. After Operational Test No. 4, the insulation test (No. 2) is to be performed again.

B. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment.

3.4 PUMP REMOVAL

A. The Contractor shall remove the pumps completely out of the wet well, using the davit or jib crane, during start-up testing with ONWASA onsite to witness.

3.5 MANUFACTURER'S SERVICE

A. The pump manufacturer shall furnish the services of a competent and experienced person to check the installation and supervise start-up for pumps supplied under this section.

END OF SECTION

SECTION 43 23 00
SELF-PRIMING CENTRIFUGAL PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Work under this section consists of furnishing and installing two self-priming centrifugal wastewater pumps complete with a pump removal system and pump control panel as described herein.

B. Related Sections:

1. *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment*
2. *Section – Utility Manholes and Structures.33 05 13*
3. *Section 33 01 30 – Operation and Maintenance of Sewer Utilities*
4. *Section 33 31 13 – Gravity Sewers.*
5. *Section 33 34 00 – Force Mains*

1.2 REFERENCES

A. North Carolina Administrative Code – 15A NCAC 2T – Waste Not Discharged to Surface Waters.

1.3 SUBMITTALS

A. Provide manufacturer's shop drawings for pumps and controls.

B. Three (3) Copies of Operation and Maintenance manuals shall be submitted for pumps and controls. O&M to include serial #, hp, voltage, amp ratings, pump curves and manufacturers contact information.

1.4 QUALITY ASSURANCE

A. All equipment components shall be adequately sized to carry all loads and stresses occurring during fabrication and erection and resulting from normal and emergency operation in the installation shown on the Plans and under the conditions specified and/or implied.

PART 2 PRODUCTS

2.1 PUMP PERFORMANCE REQUIREMENTS

A. The following pump performance characteristics shall be determined by the engineer :

1. Rated Capacity: XX gpm
2. Head at Rated Capacity: XX' TDH
3. Minimum Efficiency at Rated Capacity: 40%
4. Pump Speed: X RPM, maximum
5. Motor Power: X hp
6. Motor Speed: X RPM
7. Minimum Size Solids: X Inches

2.2 MANUFACTURERS

A. Gorman-Rupp Company,
B. Or as approved by ONWASA.

2.3 PUMP DESIGN

A. Duplex, self-priming, wet well mounted, packaged pump station. The station shall be constructed in one complete, factory-built assembly designed to rest on top of a circular, precast concrete wet well as shown on the drawings. The pumps and control equipment shall be housed in a climate controlled brick building with interior dimensions of 12' X 12'. The building shall have the following:

   a. forced air ventilation.

   b. a 4" floor drain to the wet well located between the pumps near the wall with the floor sloped toward the drain.

   c. A water spigot and hose reel mounted to an interior wall near the pumps

B. The enclosure shall be equipped with forced air ventilation.

2.4 PUMPS

A. Vertical, non-clog, self-priming pumps designed for pumping raw wastewater and capable of passing a 3-inch sphere. Provide pumps with stainless steel shafts, enclosed type, cast iron impellers and mechanical seals.

2.5 MOTOR

A. Vertical, solid shaft, squirrel-cage induction motors, suitable for 240 volts, 3 phase, 60 cycle electrical current. Three (3) horsepower minimum, open drip-proof design and Class F insulation, 1.15 service factor. The motors shall not be overloaded beyond their nameplate rating at the design condition, or any point in the specified operating range.

2.6 CONTROLS

A. Control equipment for the pumps and accessories shall be housed in a NEMA 4X stainless steel panel located inside the brick building. Equipment shall include a circuit breaker, starter and HOA switch for each of the main pumps, an automatic pump alternator, 3-phase relay, an alarm light, and grounding-type convenience outlet for 120 Volt devices.

B. Wet well liquid levels shall be controlled by float switches with a backup high water alarm. These systems within the wet well shall be located to minimize the turbulent influences of flow into the wet well on the control of liquid level.

C. Provide dry contacts for monitoring signals to RTU, as follows: pump run, high water alarm, loss of power.

2.7 ELECTRICAL

A. All above-ground conduits shall be rigid galvanized steel.

B. All conductors shall be thin-stranded copper. All buried conduit shall be PVC.

C. All work shall be conducted in accordance with National Electric Code, and local, regulations.

D. All enclosures shall be dead-front NEMA 4X stainless steel.

E. All disconnects shall be NEMA 4X stainless steel.

F. . All conduits from the wetwell shall vent to a vertical or horizontal ladder trough a minimum of 60" from the wetwell prior to entering electrical cabinetry.

G.

H. All panels shall be certified by UL and bear the UL label.

2.8 PUMP STATION WET WELL

A. Design calculations shall be submitted confirming that storage capacity complies with North Carolina Administrative Code.

B. Reference *Section 33 05 14 – Utility Manholes and Structures* for concrete structures.

C. The interior walls of all wetwells shall be coated as specified in *Section 09 96 59 – Protective Lining for Concrete Exposed to Severe Wastewater Environment* after installation.

D. Buoyancy calculations shall be provided for all wet wells. Assume water to the top of the structure and the structure is empty except for the liquid below the pump-off elevation.

E. Hatches shall be in accordance with *Section 33 05 14 – Utility Manholes and Structures.*

F. All bolts, hardware, etc. for fasten items or bolting piping shall be stainless steel.

G. The wet wells shall be equipped with a vent pipe with insect screen.

H. A sloped invert of non-shrink grout (i.e. hopper bottom) shall be constructed at the base of the wet well. The invert shall have sufficient slope to prevent build-up of solids in the wet well bottom.

I. Exfiltration testing of the wet well shall be conducted in accordance with *Section 33 01 30 – Sanitary Sewer Leakage Testing.*

PART 3 EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. Install all equipment as shown on the drawings and in accordance with manufacturer's instructions.

B. Anchors: Attach all brackets and hardware using Type 316 stainless steel connectors and anchor bolts.

C. After all equipment and appurtenances have been installed, the Contractor shall touch-up any abrasions or scratches in the paint or surface protection of any furnished item of work. In so far as possible, the Contractor shall match exactly the paint or protective coating system and color as originally provided. All deviations from this procedure shall be specifically approved by the ENGINEERING DIRECTOR. Any mud, grease or other extraneous material shall be removed from the completed work using suitable solvents or detergent solutions.

D. All openings made in the wet well for anchorages, conduit runs, pipe runs, etc., shall be sealed using a cement grout. The grout shall be neatly applied to the vacancy and shall be trowelled in, and excess grout shall be immediately removed from the wet well. Grout shall be high strength, non-shrink type.

E. Uni-flange devices are not permitted.

3.2 PUMP TESTS

A. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

1. Impeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.
2. Provide the services of a factory-trained manufacturer’s representative for a minimum of one-day initial start-up and to instruct the Owner’s operating personnel.

B. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment.

3.3 MANUFACTURER'S SERVICE

A. The pump manufacturer shall furnish the services of a competent and experienced person to check the installation and supervise start-up for pumps supplied under this section.

B. Spare parts shall be furnished by the manufacturer at start-up that include one rotating assembly, one full set of gaskets and one drive belt.

END OF SECTION

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SECTION 44 31 00
ODOR TREATMENT EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Multi-stage odor control system.
2. Exhaust Fan.
3. Instrument and System Controls.
4. Water Control Cabinet.

B. Related Sections:

1. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included) and Division 1 Specifications Sections apply to this Section.

1.2 SYSTEM DESCRIPTION

A. Package biological odor control system including two integral treatment stages, exhaust fan, valves, fittings, ductwork, and all other equipment and accessories as specified to provide a complete and functioning system. The biological treatment stage shall utilize a granular inorganic media to facilitate absorption and adsorption of odor compounds. The polishing stage shall utilize a granular media that shall be specifically designed to adsorb odorous compounds with the ability to support biological degradation of the compounds. The first stage shall operate with an independently controlled irrigation system to maintain optimum wetted conditions to support unique microbial growth for biological destruction of the odorous compounds and removal of toxic metabolites.

1.3 PERFORMANCE REQUIREMENTS

A. Operating Conditions to be calculated by the engineer shall be as follows:

Air Flow Rate	Average Inlet H_2S Concentration	Peak H_2S Concentration
XXX cfm	XX ppm	XXX ppm

B. System Performance:

1. Remove a minimum of 99.5% of the inlet hydrogen sulfide or have an outlet concentration of 0.1 ppm, whichever is greater.
2. Remove a minimum of 99% of the inlet odor units or have a maximum outlet concentration of 400 D/T, whichever is greater.

C. Maximum Pressure Drop: 5.0 in.w.c. at the maximum air flow rate specified above.

PART 2 PRODUCTS

2.1 MULTI-STAGE FRP PACKAGED BIOLOGICAL ABSORPTION/ADSORPTION SYSTEM

A. Manufacturers:

1. EVOQUA.
2. Or as approved by ONWASA.

B. Material of Construction:

1. Vessel and Accessories: Contact molded manufactured in accordance with NBS PS 15-69, ASTM D 4097 for contact molding.
2. Resin: Premium vinyl ester type such as Hetron 922 by Ashland Chemicals, Derakane 411 by Dow Chemical, Vipel F010 by AOC, reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.
3. Glass Fiber Reinforcement: Commercial grade corrosion resistance borosilicate glass.
   a. Type C, chemical grade, Type E electrical grade.
   b. Surfacing Veil: 10 mil Nexus 111-00010.
   c. Mat: Type "E" (electrical grade) glass, 1 1/2 oz. per sq. ft with a nominal fiber length of 1.25 $\pm$ 0.25 inches, with a silane finish and styrene soluble binder.
   d. Continuous Glass Roving: Type "E" grade with chrome or silane coupling agent.
   e. Alternate layers of mat and woven roving used for reinforcement.
4. Miscellaneous:
   a. Fasteners and Metal Attachments: ANSI 316SS.
   b. Gaskets: EPDM.

C. Fabrication:

1. General: Fabricate in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. Coat all non-molded surfaces with resin incorporating paraffin to facilitate a full cure of the surface. Seal all cut edges, bolt holes, secondary bonds with a resin coat prior to the final paraffinated resin coat. Fill all voids with a resin paste.
2. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 in length. The total corrosion liner thickness shall be a minimum of 100 mils and have a resin to glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of one inch.
3. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. Actual laminate sequences shall be per the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with gel coat containing ultra violet light inhibitors.

D. Accessories: Air inlet, air outlet, spray headers, baffles, media support, drain and all connections shown on the drawings shall be provided by the manufacturer. Tie down lugs shall be integrally molded into the walls of the vessel. All external bolts shall be 316SS and designed for the specified loads. Interior fasteners shall be of corrosion resistant materials such as PVC or FRP.

E. Neoprene Pad: A 1/4" thick, 60 durometer neoprene rubber sheet; placed underneath the vessel.

2.2 EXHAUST FAN

A. General. Direct driven. Centrifugal design, manufactured of FRP with a statically and dynamically balanced radial blade wheel.

1. Fan Inlet: Slip type.
2. Fan Outlet: Flanged nozzle.
3. Fan Shaft Seal: Neoprene.

B. Motor: TEFC with 1.15 service factor, three-phase, 60 Hz, 480 volt service, inverter-duty, suitable for use with a VFD.

C. Performance.

Exhaust Fan Design Requirements	
Air Flow Rate, cfm	995
S.P. up to System Inlet, in. WC	2.0
Total Pressure Drop, in. WC	5.0
Motor HP	5.0

D. Tested and Rated: in accordance with AMCA and shall bear the AMCA seal.

E. Manufacturer:

1. New York Blower.
2. Hartzell.
3. .

2.3 INSTRUMENTATION AND SYSTEM CONTROLS

A. Exhaust Fan and Water Addition Control Panels: 120 VAC, 1-phase power supply and 480 VAC, 3-phase power supply.

B. Enclosure: Stainless steel construction, NEMA 4X rated, mounted to the system assembly and factory tested to full operation with all other components prior to shipment.

C. Panel components or capabilities:

1. Fan switch (ON-OFF).
2. Push-to-test button for water valve.
3. Timer relay for on/off control of water valve.
4. Blower VFD.
5. Nutrient Pump (ON-OFF-AUTO).

2.4 WATER CONTROL CABINET

A. Enclosure: NEMA 12 rated FRP cabinet.

B. Internal Piping: SCH 80 PVC.

C. Temperature Control:

1. Interior insulation.
2. Thermostatically controlled fan-driven heater.

D. Components:

1. Pressure reducing valve.
2. Nutrient Pump.
3. Irrigation solenoid valve.
4. Pre-humidification valve.
5. Irrigation system pressure gauge.

2.5 ACCESSORIES

A. Water Flow Control: Variable area type reading rotameter with a Teflon float, EPR "O" rings, and PVC fittings.

B. First Stage Water Distribution System: Designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles.

C. Nutrient addition metering system.

D. Heat tape and insulation shall be installed on all exposed waterlines.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions.

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide a minimum of one 8-hour day of service.

3.3 MANUFACTURER'S START-UP SERVICES

A. Provide a minimum of two 8-hour days of service.

END OF SECTION

ONWASA's

Manual of Standards, Specifications and Details

Section VII

STANDARD DETAILS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

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STANDARD DETAILS TABLE OF CONTENTS

ONWASA Standard Details

DETAILS_WS_SBO	SAG BLOW-OFF ASSEMBLY
DETAILS_WS_DE	DEAD END LINE ASSEMBLY
DETAILS_WS_TS	4”and LARGER TAPPING SLEEVE AND VALVE ASSEMBLY
DETAILS_WS_SCM	¾” to 1” SERVICE CONNECTION AND METER
DETAILS_WS_SC	1 ½” and 2” SERVICE CONNECTIONS
DETAILS_WS_MI	¾ “ to 1” METER INSTALLATION
DETAILS_WS_MV3+	METER VAULT INSTALLATION 3” AND LARGER
DETAILS_WS_WMARK	WATER MAIN UTILITY MARKER
DETAILS_WS_RMRK	STANDARD UTILITY MARKER FOR RECLAIMED WATER MAIN
DETAILS_WS_FHB	FIRE HYDRANT BOLLARD DETAIL
DETAILS_WS_BKF	STANDARD COMMERCIAL OUTDOOR BACKFLOW 2 ½” +
DETAIL_WS_BST	BACKSIDE TAP
DETAILS_FHM3/4	¾” FIRE HYDRANT METER INSTALLATION
DETAILS_FHM3	3” HYDRANT METER INSTALLATION

Sewer Detail #	**Description**
DETAILS_SS_LS	TYPICAL LIFT STATION
DETAILS_SS_CPAN1	CONTROL PANEL DETAIL
DETAILS_SS_CPAN2	CONTROL PANEL DETAIL
DETAILS_SS_CLF	CHAIN LINK FENCE AND GATE
DETAILS_SS_BAS	DEBRIS BASKET
DETAILS_SS_EBC	EMERGENCY BYPASS CONNECTION
DETAILS_SS_LAT	LATERAL SADDLE INSTALLATION FOR PVC
DETAILS_SS_OG	OIL AND GREASE TRAP SIZING
DETAILS_SS_OGS	OIL AND GREASE TRAP DIMENSION TABLE
DETAILS_SS_GTRP	GREASE TRAP DUMPSTER W/ELEVATED PAD DRAINED TO SAN. SEWER
DETAILS_SS_SGW	SEWAGE GRINDER UNIT WETWELL INSTALLATION
DETAILS_SS_SGW2	SEWAGE GRINDER UNIT WETWELL INSTALLATION
DETAILS_SS_SGM	SEWAGE GRINDER UNIT MANHOLE INSTALLATION
DETAILS_SS_SGM2	SEWAGE GRINDER UNIT MANHOLE INSTALLATION
DETAILS_SS_ARV	AIR RELEASE/VACUUM VALVE SEWER
DETAILS_SS_GMRK	STANDARD UTILITY MARKER FOR GRAVITY SEWER MAIN
DETAILS_SS_FMRK	STANDARD UTILITY MARKER FOR SEWER FORCE MAIN
DETAILS_SS_SMH	STANDARD MANHOLE INSTALLATION OVER EXISTING SEWER MAIN
DETAILS_SS_MHE	STANDARD PRECAST SANITARY SEWER MANHOLE ECCENTRIC
DETAILS_SS_MHC	STANDARD MANHOLE COVER & FRAME
DETAILS_SS_MHW	MANHOLE FRAME AND WATERTIGHT COVER

DETAILS_SS_MHP	STANDARD MANHOLE FRAME & COVER WITHIN PAVED SURFACE
DETAILS_SS_FMHC	STANDARD FLAT-TOP MANHOLE COVER AND FRAME
DETAILS_SS_LC	TYPICAL SANITARY SEWER LATERAL CONNECTION
DETAILS_SS_GIDM	GRAVITY SEWER INSIDE DROP MANHOLE
DETAILS_SS_FIDM	FORCE MAIN INSIDE DROP MANHOLE
DETAILS_SS_FMED	FORCE MAIN EMBEDMENT DETAIL
DETAILS_SS_GSED	GRAVITY SEWER EMBEDMENT DETAIL
DETAILS_SS_RGRP	RESIDENTIAL GRINDER PUMP STATION & CONTROL PANEL

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CURB AND GUTTER SIDEWALK DETAILS

SCALE:	DETAIL #
Not To Scale	WS_CG
REVISION DATE: May, 2016	SHEET #: 1 of 1

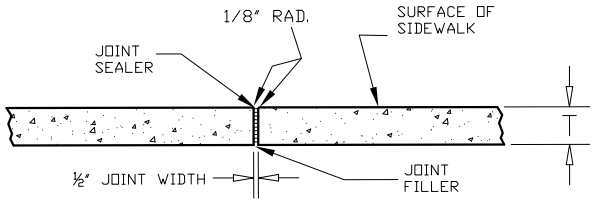
SIDEWALK NOTES:

CONSTRUCT STANDARD SIDEWALK 5' WIDE AND 4" THICK TYPICAL. WHERE EXISTING CONDITIONS ARE DIFFERENT MATCH EXISTING SIDEWALK.

PLACE A GROOVE JOINT 1" DEEP WITH ⅛" RADII IN THE CONCRETE SIDEWALK AT 5' INTERVALS.

ONE ½" EXPANSION JOINT WILL BE REQUIRED AT 50' INTERVALS.

A ½" EXPANSION JOINT WILL BE REQUIRED WHERE THE SIDEWALK JOINS A RIGID STRUCTURE.



T = SIDEWALK THICKNESS

SIDEWALK EXPANSION JOINT DETAIL
NOT TO SCALE

CURB AND GUTTER NOTES:

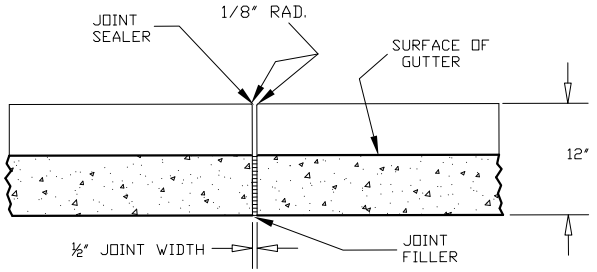
CONSTRUCT CURB AND GUTTER 2' - 6" TYPICAL. WHERE EXISTING CONDITIONS ARE DIFFERENT MATCH EXISTING CURB AND GUTTER.

PLACE CONTRACTION JOINTS AT 10' INTERVALS, EXCEPT THAT A 15' SPACING MAY BE USED WHEN A MACHINE IS USED OR WHEN SATISFACTORY SUPPORT FOR THE FACE FORM CAN BE OBTAINED WITHOUT THE USE OF TEMPLATES AT 10' INTERVALS.

JOINT SPACING MAY BE ALTERED IF REQUIRED BY ENGINEER. CONTRACTION JOINTS MAY BE INSTALLED WITH THE USE OF TEMPLATES OR FORMED BY OTHER APPROVED METHODS. CONSTRUCT NON-TEMPLATE FORMED JOINTS A MIN. OF 1 ½" DEEP.

FILL ALL CONSTRUCTION JOINTS WITH JOINT FILLER AND SEALER.

SPACE EXPANSION JOINTS AT 90' INTERVALS AND ADJACENT TO ALL RIGID OBJECTS.



CURB AND GUTTER EXPANSION JOINT DETAIL
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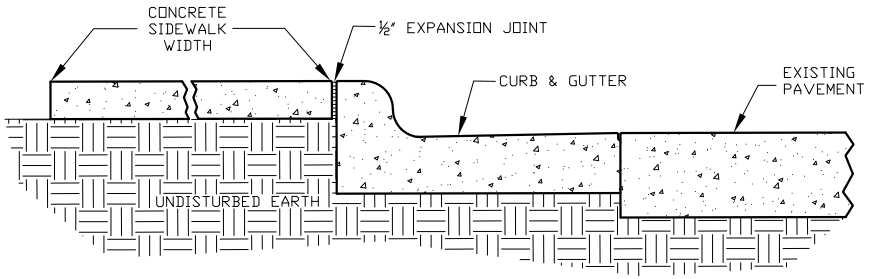
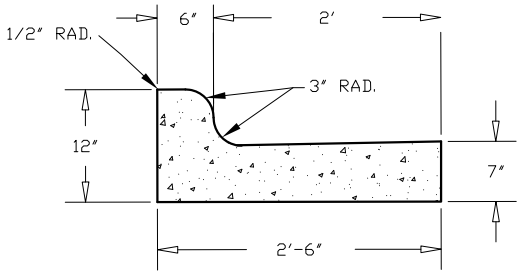
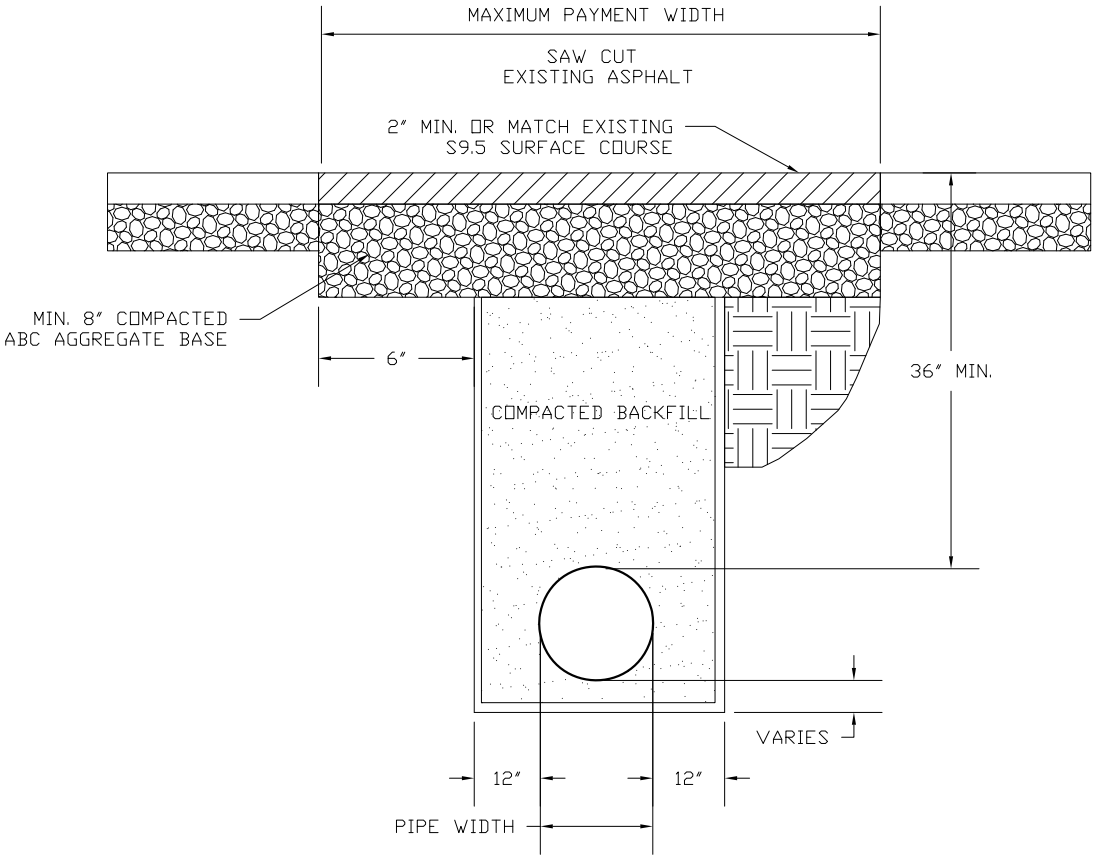


CURB AND GUTTER W/SIDEWALK
NOT TO SCALE



2'-6" CURB AND GUTTER
NOT TO SCALE



NOTES:

1. THE PAVEMENT SHALL BE DEFINED BY A STRAIGHT EDGE, PREFERABLY A MACHINED SAW CUT.
2. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH DRY SOIL OR ABC STONE TO THE BOTTOM OF THE PROPOSED SUBGRADE. THE BACKFILL SHALL BE PLACED AND COMPACTED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
3. WITHIN ROADS MAINTAINED BY NCDOT, THE TRENCH SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH NCDOT STANDARDS.
4. THE ENTIRE THICKNESS/VERTICAL EDGE OF THE CUT SHALL BE TACKED.
5. THE SAME DEPTH OF PAVEMENT MATERIAL WHICH EXISTS SHALL BE REINSTALLED, BUT IN NO CASE SHALL THE ASPHALT BE LESS THAN 2" THICK.
6. THE ASPHALT PAVEMENT MATERIAL SHALL BE INSTALLED AND COMPACTED THOROUGHLY TO ACHIEVE A SMOOTH LEVEL PATCH.

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STANDARD PAVEMENT CUT AND PATCH DETAILS

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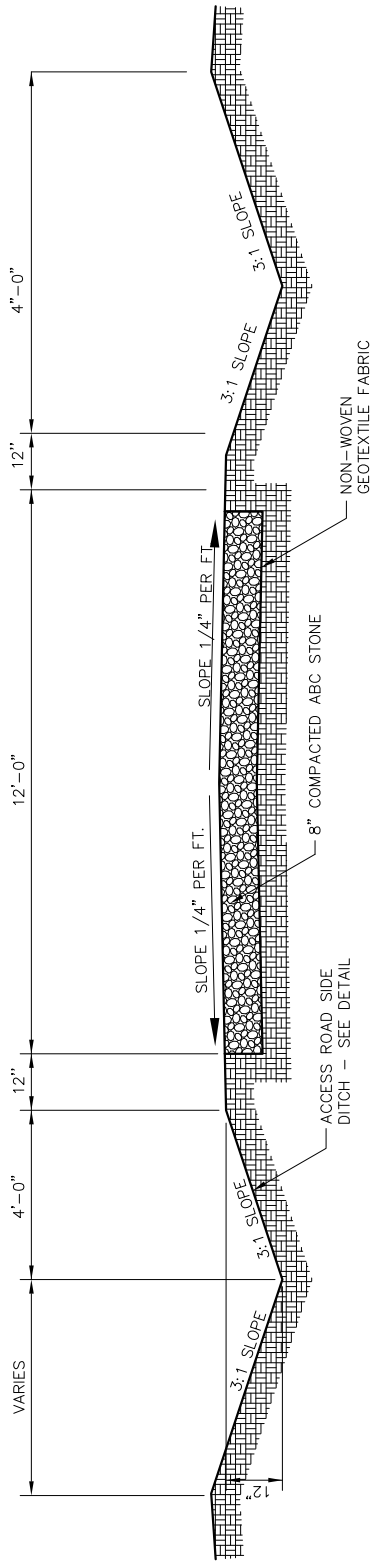

SECTION

NOTES:
1. COMPACT STONE TO CONFORM TO AASHTO STANDARD T-99
2. DIMENSIONS AND ROADSIDE DITCH LOCATIONS MAY VARY DEPENDING ON SITE CONDITIONS
3. NON-WOVEN GEOTEXTILE FABRIC SHALL BE NON-BIODEGRADABLE CONFORMING TO SECTION 1056 OF THE NCDOT STANDARD SPECIFICATIONS FOR TYPE 1 ENGINEERING FABRIC

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GRAVEL ROAD STANDARD

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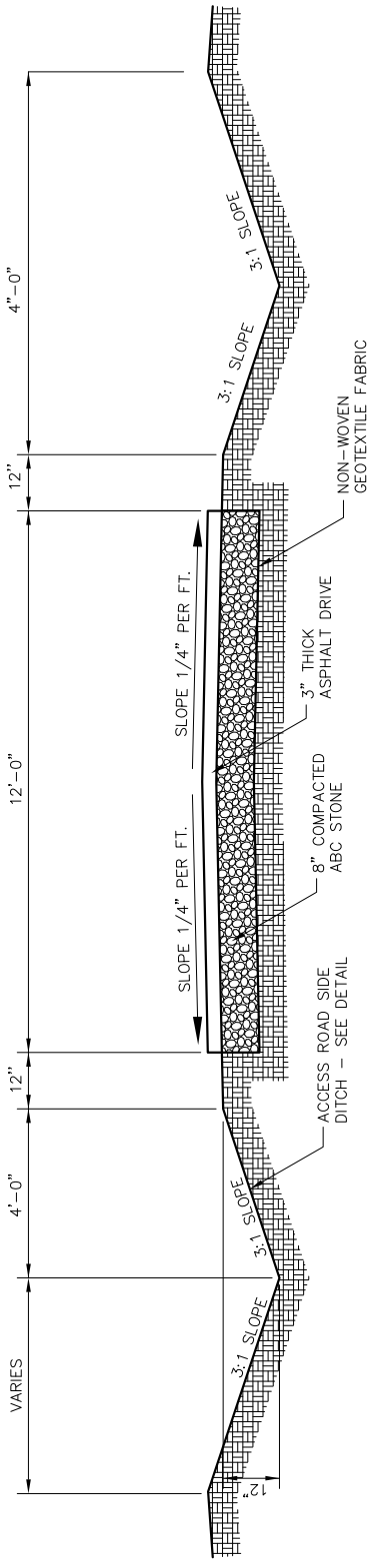

SECTION

NOTES:
1. ASPHALT PAVING SHALL BE S9.5B SURFACE COURSE
2. COMPACT STONE TO CONFORM TO AASHTO STANDARD T-99
3. DIMENSIONS AND ROADSIDE DITCH LOCATIONS MAY VARY DEPENDING ON SITE CONDITIONS
4. NON-WOVEN GEOTEXTILE FABRIC SHALL BE NON-BIODEGRADABLE CONFORMING TO SECTION 1056 OF THE NCDOT STANDARD SPECIFICATIONS FOR TYPE 1 ENGINEERING FABRIC

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PAVED ASPHALT ROAD STANDARD

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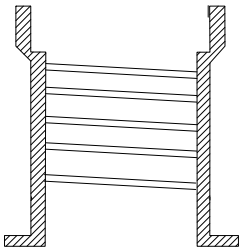
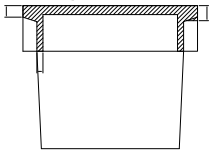
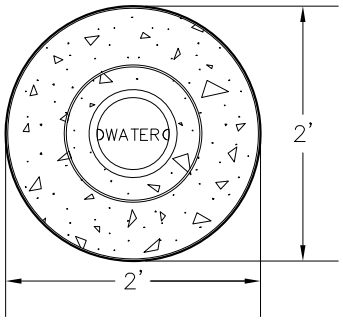
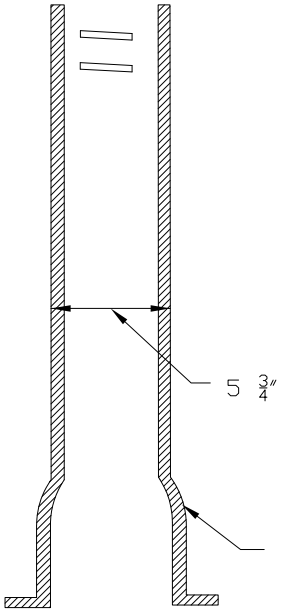
NOTE: CONCRETE VALVE COLLAR REQUIRED ON ALL VALVES.

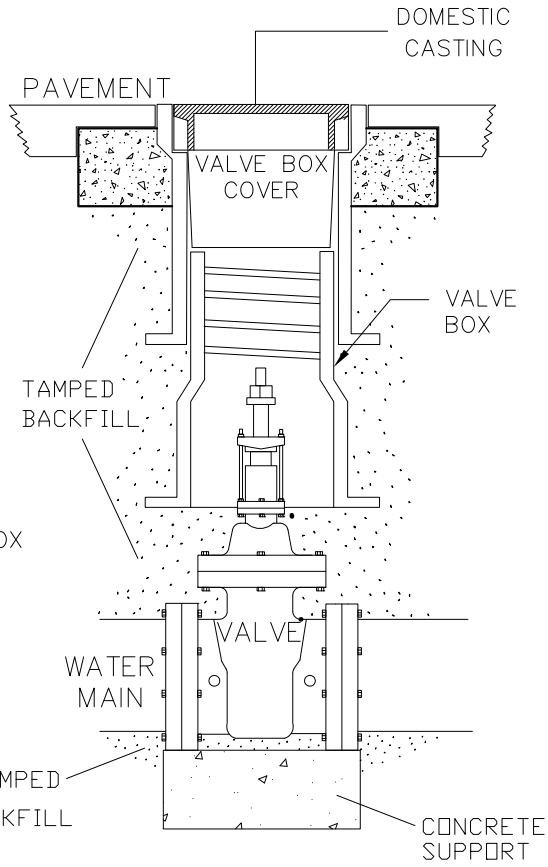
APPROVED METHOD FOR EXTENSION OF VALVE BOX











NOTE:
VALVE BOX SHALL BE PER ONWASA'S SPECIFICATIONS

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VALVE BOX INSTALLATION

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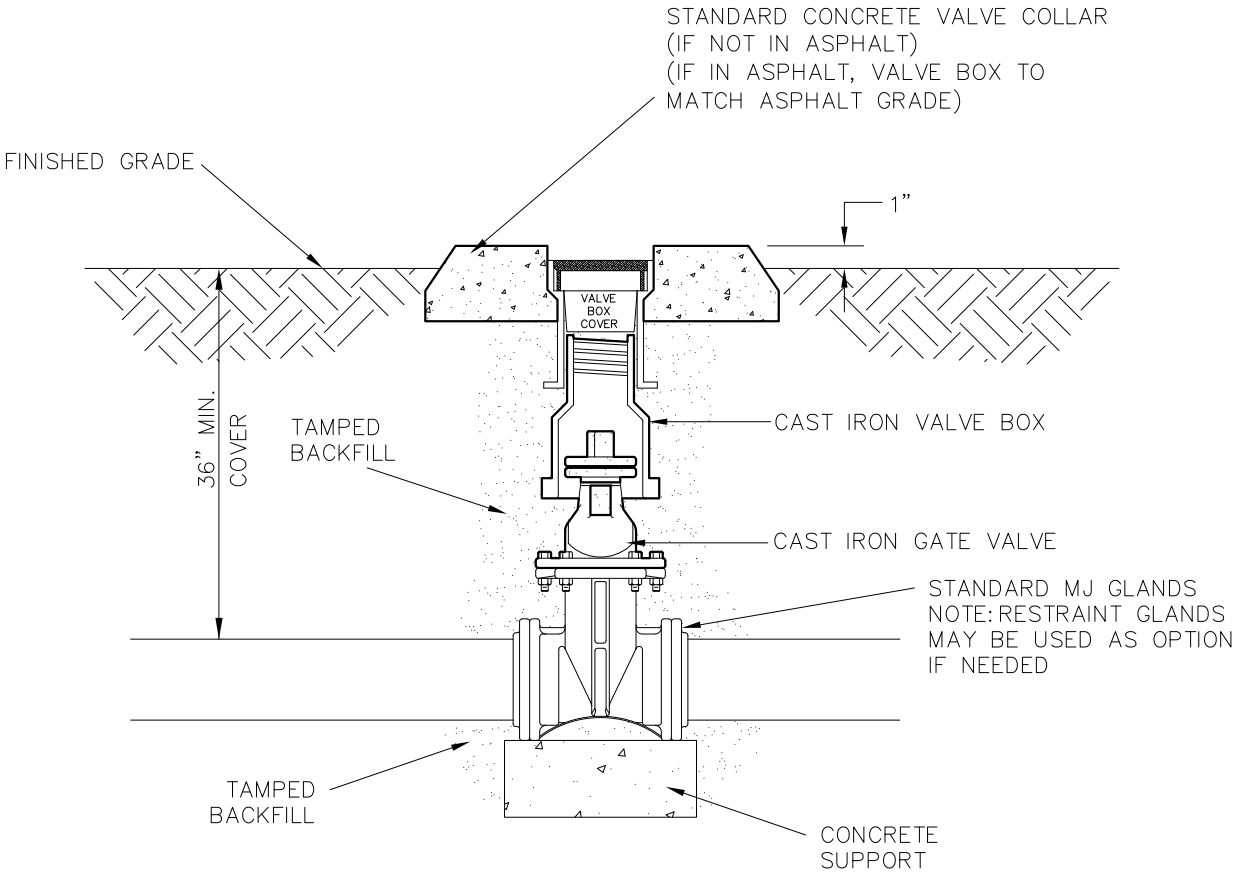

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INLINE VALVE DETAIL

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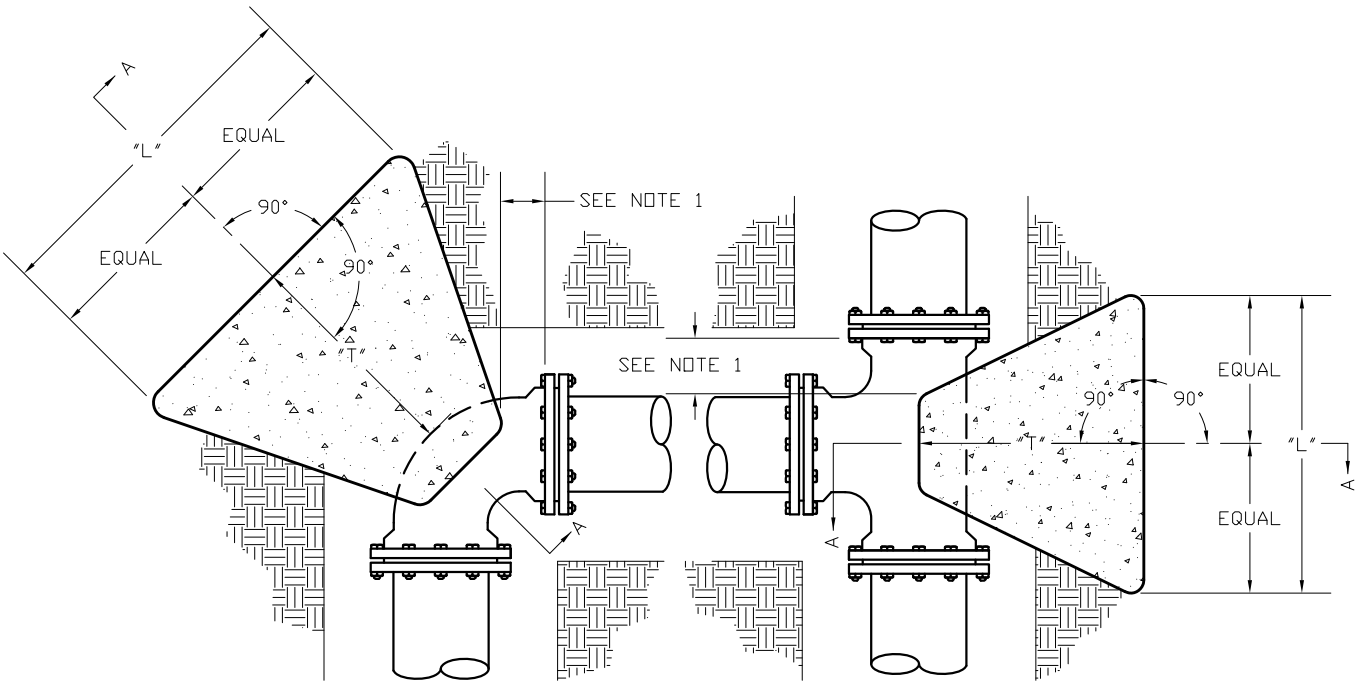
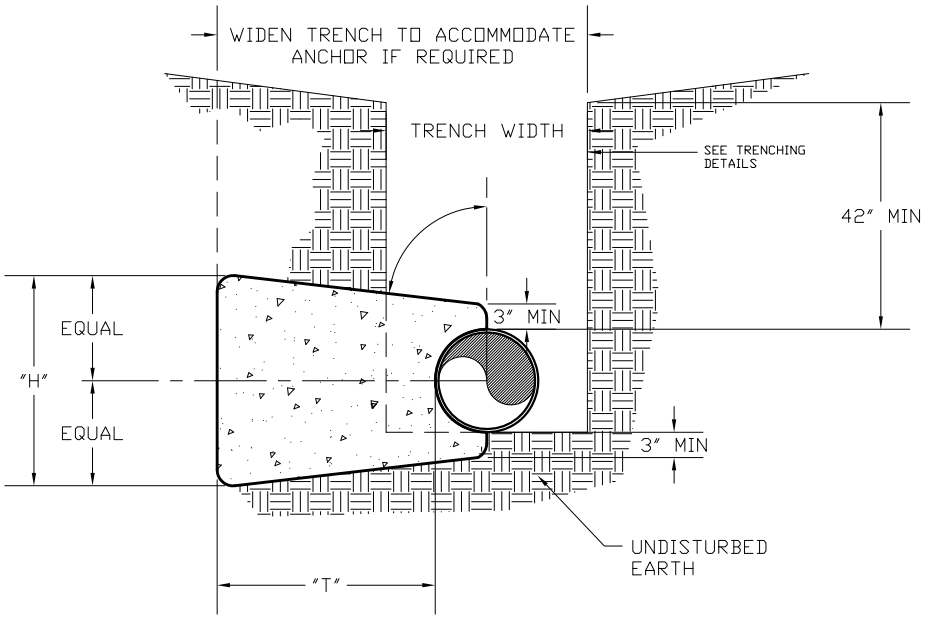


FOR ALL BEND FITTINGS

FOR TEE FITTING



SECTION A–A

NOTES:

1. CONCRETE BLOCKING IS TO BE FORMED TO ENSURE ACCESSIBILITY TO FITTINGS AND POURED AGAINST UNDISTURBED EARTH.
2. ALL FITTINGS SHALL BE WRAPPED IN POLYETHYLENE TO PREVENT CONCRETE FROM CONTACTING FITTINGS, BOLTS, OR ENDS OF MECHANICAL JOINT BENDS.
3. CONCRETE TO BE MINIMUM 3,000 PSI @ 28 DAYS.
4. WHEN SACKRETE IS TO BE USED, IT SHALL BE PROPERLY MIXED PER MANUFACTURER SPECIFICATIONS.
5. FOR REQUIRED DIMENSIONS, SEE WS_TB2

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THRUST BLOCKING

SCALE:	DETAIL #
Not To Scale	WS_TB1
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TEST PRESSURE = 150 PSI

PIPE SIZE	TYPE FITTING	DIMENSIONS (FT)			VOLUME CONCRETE CU. YD.
		"L"	"H"	"T"	
<4 INCHES	11 1/4°	----	----	----	----
	22 1/2°	1.00	1.00	1.50	0.06
	45°	1.00	1.00	1.50	0.06
	90°	1.00	1.00	2.50	0.09
	TEE	1.00	1.00	2.00	0.07
4 INCHES	11 1/4°	1.00	1.00	2.50	0.09
	22 1/2°	1.00	1.00	2.50	0.09
	45°	1.00	1.00	2.50	0.09
	90°	1.50	1.50	2.50	0.15
	TEE	1.50	1.50	2.00	0.12
6 INCHES	11 1/4°	1.50	1.50	2.50	0.15
	22 1/2°	1.50	1.50	2.50	0.15
	45°	1.50	1.50	2.50	0.15
	90°	2.00	2.00	3.00	0.28
	TEE	2.00	2.00	2.50	0.23
8 INCHES	11 1/4°	2.00	2.00	2.50	0.23
	22 1/2°	2.00	2.00	2.50	0.23
	45°	2.00	2.00	2.75	0.25
	90°	3.00	2.00	3.00	0.39
	TEE	3.00	2.00	2.50	0.32
12 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	2.00	2.00	3.00	0.28
	45°	3.00	2.50	3.00	0.47
	90°	4.50	3.00	3.50	0.94
	TEE	4.50	3.00	3.00	0.81
16 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	3.00	2.00	3.00	0.39
	45°	4.00	3.00	3.50	0.84
	90°	6.50	3.50	3.50	1.54
	TEE	6.50	3.50	3.00	1.32

TEST PRESSURE = 200 PSI

PIPE SIZE	TYPE FITTING	DIMENSIONS (FT)			VOLUME CONCRETE CU. YD.
		"L"	"H"	"T"	
<4 INCHES	11 1/4°	1.00	1.00	1.00	0.04
	22 1/2°	1.00	1.00	1.50	0.06
	45°	1.00	1.00	1.50	0.06
	90°	1.50	1.50	2.50	0.15
	TEE	1.50	1.50	2.00	0.12
4 INCHES	11 1/4°	1.00	1.00	2.50	0.09
	22 1/2°	1.00	1.00	2.50	0.09
	45°	1.50	1.50	2.50	0.15
	90°	1.50	1.50	2.50	0.15
	TEE	1.50	1.50	2.00	0.12
6 INCHES	11 1/4°	1.50	1.50	2.50	0.15
	22 1/2°	1.50	1.50	2.50	0.15
	45°	1.50	1.50	2.50	0.15
	90°	2.50	2.00	3.00	0.33
	TEE	2.50	2.00	2.50	0.28
8 INCHES	11 1/4°	2.00	2.00	2.50	0.23
	22 1/2°	2.00	2.00	2.50	0.23
	45°	2.00	2.00	2.75	0.23
	90°	4.00	2.00	3.00	0.50
	TEE	4.00	2.00	2.50	0.42
12 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	3.00	2.00	3.00	0.39
	45°	4.00	2.50	3.00	0.61
	90°	5.50	3.00	3.50	1.13
	TEE	5.50	3.00	3.00	0.97
16 INCHES	11 1/4°	2.00	2.00	3.00	0.28
	22 1/2°	4.00	2.00	3.00	0.50
	45°	5.50	3.00	3.50	1.13
	90°	7.50	4.00	3.50	2.01
	TEE	7.50	4.00	3.00	1.72

CHART NOTES:

1. IF BLOCKING EXCAVATION IS IN LIGHTLY COMPACTED FILL AREAS, OR IN AREAS WHERE BOULDERS OR STUMPS HAVE BEEN REMOVED, BLOCKING SIZE MUST BE RE-SIZED FOR THE SPECIFIC LOCATION/CIRCUMSTANCE BY A NC LICENSED PROFESSIONAL ENGINEER.
2. BLOCKING SIZES SHOWN IN THESE TABLES ASSUME THE FOLLOWING:
   a. BLOCKING IS CONSTRUCTED IN RESIDUAL SOILS AS SHOWN IN DETAIL
   b. SOIL BEARING PRESSURE = 2000 PSF
   c. VELOCITY OF FLOW = 15 FPS
3. THIS DETAIL NOT APPLICABLE TO REDUCING BENDS.
4. NEITHER THE WEIGHT OF THE CONCRETE BLOCKING NOR FRICTION BETWEEN CONCRETE BLOCKING AND SOIL WAS ADDED INTO BLOCKING SIZES COMPUTATION. THEREFORE, BLOCKING SIZE IS CONSERVATIVE.

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THRUST BLOCKING

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Not To Scale	WS_TB2
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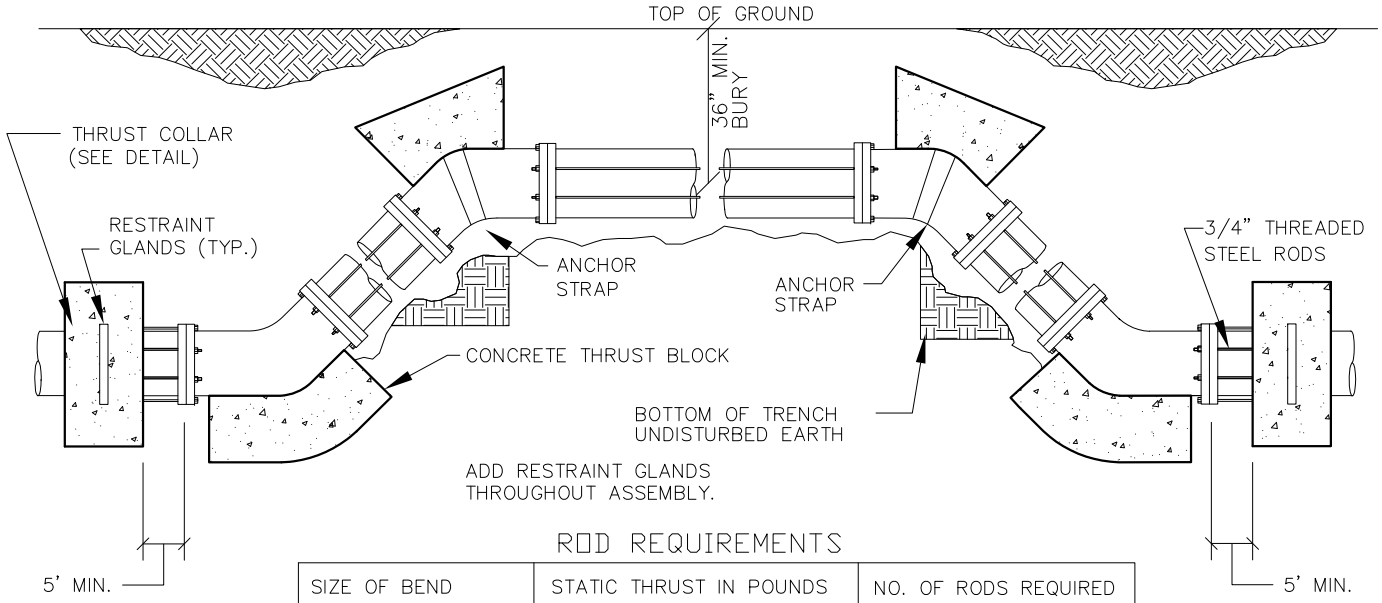
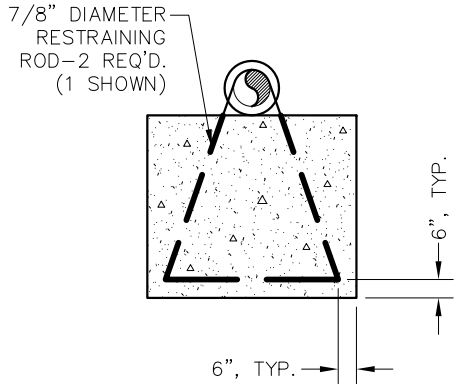
THRUST BLOCKING



ROD REQUIREMENTS

SIZE OF BEND	STATIC THRUST IN POUNDS	NO. OF RODS REQUIRED
6"	4,328	4
8"	7,694	4
12"	17,312	4
16"	30,779	8
24"	69,252	8



BLOCKING CROSS SECTION
NO SCALE

GENERAL NOTES:

1. ALL FITTINGS SHALL BE WRAPPED IN POLYETHYLENE TO PREVENT CONCRETE FROM CONTACTING FITTINGS, BOLTS, OR ENDS OF MECHANICAL JOINT BENDS.
2. EACH FITTING SHALL BE SECURED BY TWO FORMS OF RESTRAINT. RESTRAINING GLANDS AND CONCRETE THRUST BLOCKING ARE PREFERRED. WEDGE–ACTION RESTRAINT GLANDS (I.E. MEGALUGS) ARE APPROVED ONLY FOR USE ON DUCTILE IRON PIPE. FULL–CIRCUMFERENTIAL PIPE RESTRAINT GLANDS (I.E. GRIP RINGS) MAY BE USED ON PVC OR DUCTILE IRON PIPE. ALL RESTRAINT GLANDS SHALL BE SPECIFICALLY DESIGNED FOR USE ON THE TYPE OF PIPE FOR WHICH THEY ARE BEING INSTALLED. OTHER FORMS OF RESTRAINT SUCH AS THREADED ROD, BELL RESTRAINT HARNESSES, ETC. MAY BE APPROVED BY ONWASA ON A CASE–BY–CASE BASIS.
3. IF APPROVED FOR USE BY ONWASA, STEEL RODS AND BOLTS SHALL BE 3/4" HOT DIPPED GALVANIZED.
4. MUST USE DUCTILE IRON EYE BOLTS WHERE NECESSARY.

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Not To Scale	WS_TB3
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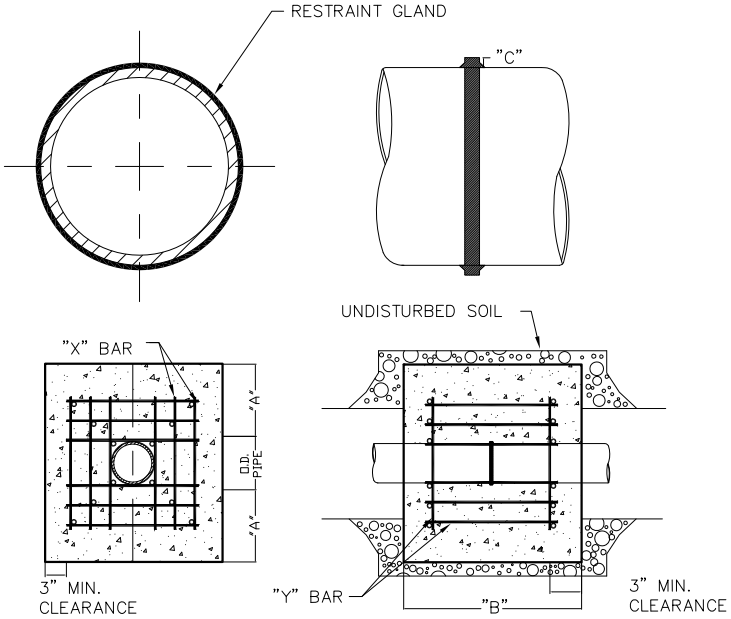

REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6" – 36"	#5	2'–2"+ O.D. PIPE	1.043 LBS/FT	1'–1"	1.1 LBS. EACH	X–24, Y–12
48" & greater	#6	3'–0"+ O.D. PIPE	1.502 LBS/FT	1'–3"	1.9 LBS. EACH	X–24, Y–12

THRUST COLLAR, AND THRUST SCHEDULE

I.D. PIPE	"A"	"B"	"C–6"–16", 20"–24", 30"–36", 48"
6" – 36"	1'–4"	1'–7"	2" 3" 4"
48" & greater	1'–8"	1'–9"	6"

NOTES:

1. CONCRETE SHALL BE 3000 PSI AND TRANSIT MIXED.
2. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
3. TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON STANDARD EMBEDMENT DETAIL.
4. BACKFILL TAMPED IN 6" LIFTS PER STANDARD EMBEDMENT DETAIL.

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THRUST BLOCKING

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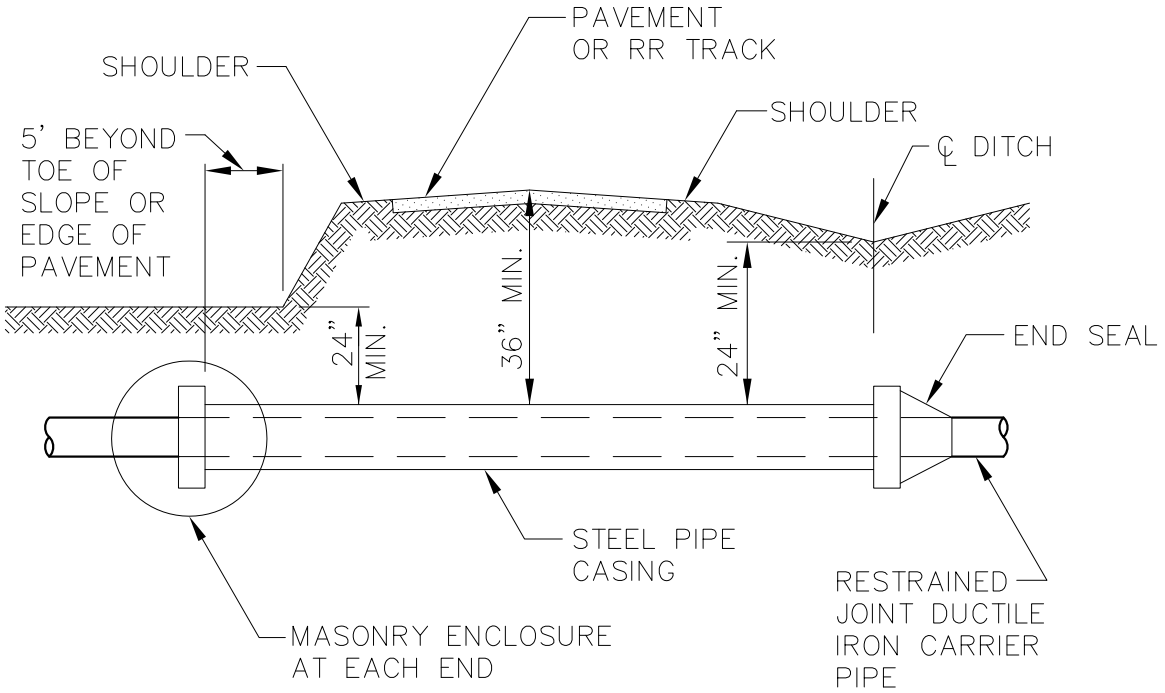

TYPICAL PIPE CROSSING

ENCASEMENTS SHALL EXTEND FROM DITCH LINE TO DITCH LINE IN CUT SECTIONS, FIVE (5) FEET BEYOND THE TOE OF SLOPES IN FILL SECTIONS, AND TEN (10) FEET BEYOND EDGE OF PAVEMENT IN SECTIONS WITH NO DITCH OR FILL AREA.

NOTES:

1. STEEL ENCASEMENT PIPE SHALL CONFORM TO THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS.
2. CARRIER PIPE SHALL BE ADEQUATELY SUPPORTED THE ENTIRE LENGTH WITHIN THE CASING BY USING SPACERS OR "SPIDER" STEEL SUPPORTS AT A MAXIMUM OF 9 FOOT CENTERS (ONE AT EACH JOINT AND ONE INTERMEDIATE). OTHER METHODS MUST MEET APPROVAL OF THE ENGINEER.

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DRY BORE AND JACK PIPE ENCASEMENT

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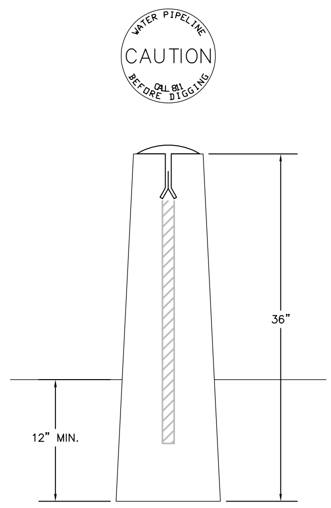


CONCRETE MARKER CROSS SECTION

NOTES:

1. A PROFILE AND PLAN SHALL BE PROVIDED FROM ENTRY TO EXIT FOR EACH DIRECTIONAL BORE SECTION BY THE DIRECTIONAL BORE CONTRACTOR.

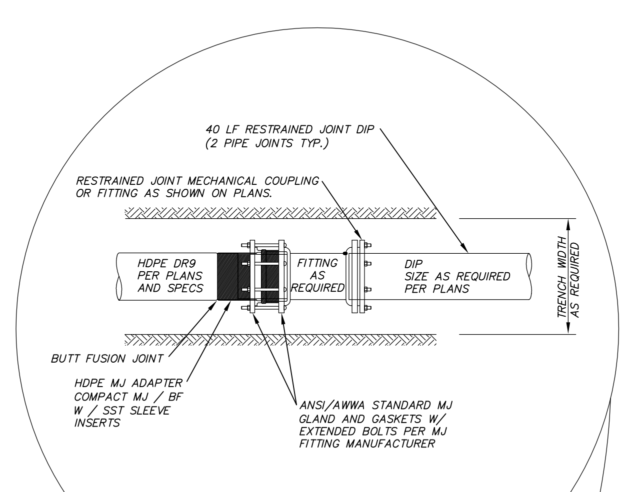
2. ALL BORE SECTIONS SHALL BE HYDROSTATICALLY TESTED, PER SPECIFICATIONS UPON COMPLETION OF INSTALLATION AND PRIOR TO CONNECTION TO THE MAIN WATER LINE.

3. LENM GTH OF CROSSING, LOCATION OF INSPECTION/OBSERVATION EXCAVATION, NUMBER OF P.E. PIPE JOINTS, LOCATION OF BORE MACHINE, AUGER ENTRANCE LOCATION, AND TIE-IN POINTS ARE TO BE APPROVED BY ONWASA PRIOR TO ANY START OF WORK OR ORDERING MATERIALS.

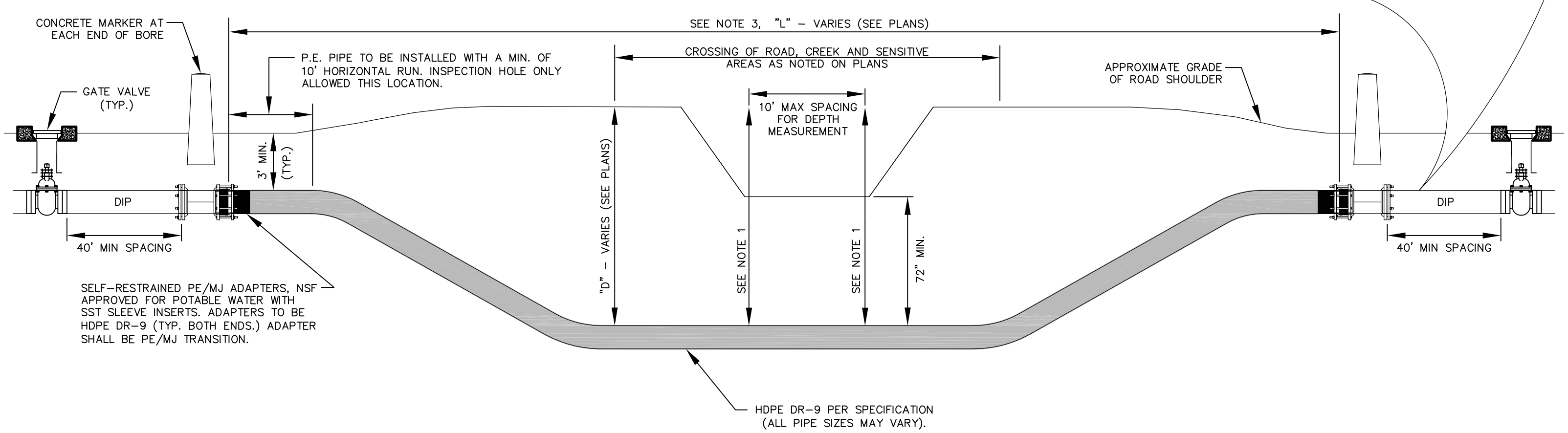
4. CONCRETE MARKERS SHALL BE PLACED AT THE BOTH THE ENTRY AND EXIT POINT OF ALL DIRECTIONAL BORES, REFERENCING THE TYPE OF UTILITY UNDERGROUND.

5. THE BORE DEVELOPED FOR THE LEAD IN END OF THE PIPE SHALL BE KEPT AT A MINIMUM DIAMETER FOR THE PIPE INSTALLATION. THE LEAD IN END SHALL BE PULLED THROUGH WITHOUT THE M.J. FLANGE ATTACHED FOR LARGER THAN 6" PIPE INSTALLATION. THE M.J. FLANGE FOR SAID LEAD IN END SHALL BE INSTALLED AFTER THE PIPE INSTALLATION WITH THE USE OF A SPLIT M.J. FLANGE.

6. IF BURIED OBSTRUCTIONS ARE LOCATED IN THE LENGTH OF THE DIRECTIONAL BORE, DIRECTIONAL BORE CONTRACTOR SHALL AVOID CONFLICT WITH THESE OBSTRUCTIONS BY GOING UNDER A MINIMUM OF 12" WITH PROPOSED PIPE UNLESS OTHERWISE SPECIFIED OR IDENTIFIED IN GENERAL NOTES ON SHEET, OR IN SPECIFICATIONS.



DIP TO HDPE TRANSITION (TYP.)
NOT TO SCALE



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HORIZONTAL DIRECTIONAL DRILL PROFILE (TYP.)

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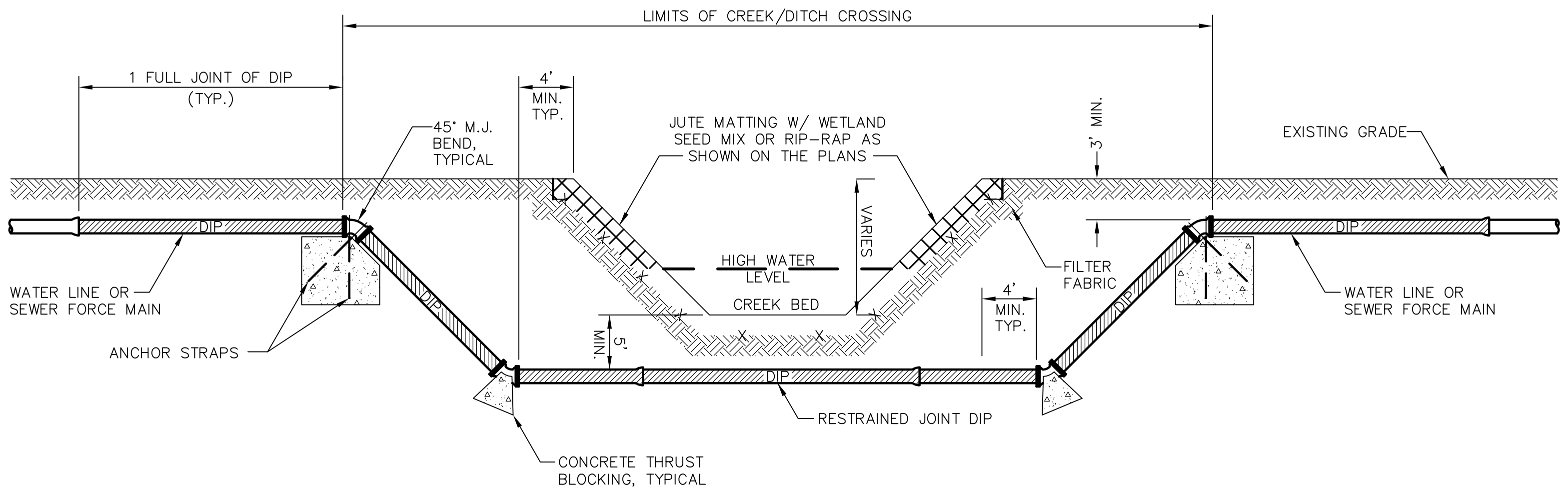

NOTES:

1. ONLY FULL 18' OR 20' JOINTS OF DUCTILE IRON PIPE SHALL BE USED ON EACH SIDE OF UPPER BENDS, UNLESS OTHERWISE APPROVED.
2. IF APPROVED FOR USE, RESTRAINING RODS SHALL BE STAINLESS STEEL OR GALVANIZED RODS WITH FIELD-APPLIED BITUMINOUS COATING.
3. PIPE UPSTREAM AND DOWNSTREAM OF UPPER BENDS, UNDER CREEK, AND BETWEEN UPPER BENDS TO BE RESTRAINED JOINT D.I.P.
4. THRUST AND GRAVITY BLOCKING NOT REQUIRED ON GRAVITY SEWER LINE.
5. OPEN CUT OF CREEKS IS ONLY ACCEPTABLE WHERE SHOWN ON PLAN AND PROFILE
6. EACH FITTING SHALL BE SECURED BY TWO FORMS OF RESTRAINT. RESTRAINING GLANDS AND CONCRETE THRUST BLOCKING ARE PREFERRED. WEDGE-ACTION RESTRAINT GLANDS (i.e. MEGALUGS) ARE APPROVED ONLY FOR USE ON DUCTILE IRON PIPE. FULL-CIRCUMFERENTIAL PIPE RESTRAINT GLANDS (i.e. GRIP RINGS) MAY BE USED ON PVC OR DUCTILE IRON PIPE. ALL RESTRAINT GLANDS SHALL BE SPECIFICALLY DESIGNED FOR USE ON THE TYPE OF PIPE FOR WHICH THEY ARE BEING INSTALLED. OTHER FORMS OF RESTRAINT SUCH AS THREADED ROD, BELL RESTRAINT, HARNESSES, ETC. MAY BE APPROVED BY ONWASA ON A CASE-BY-CASE BASIS.

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CREEK/DITCH CROSSING

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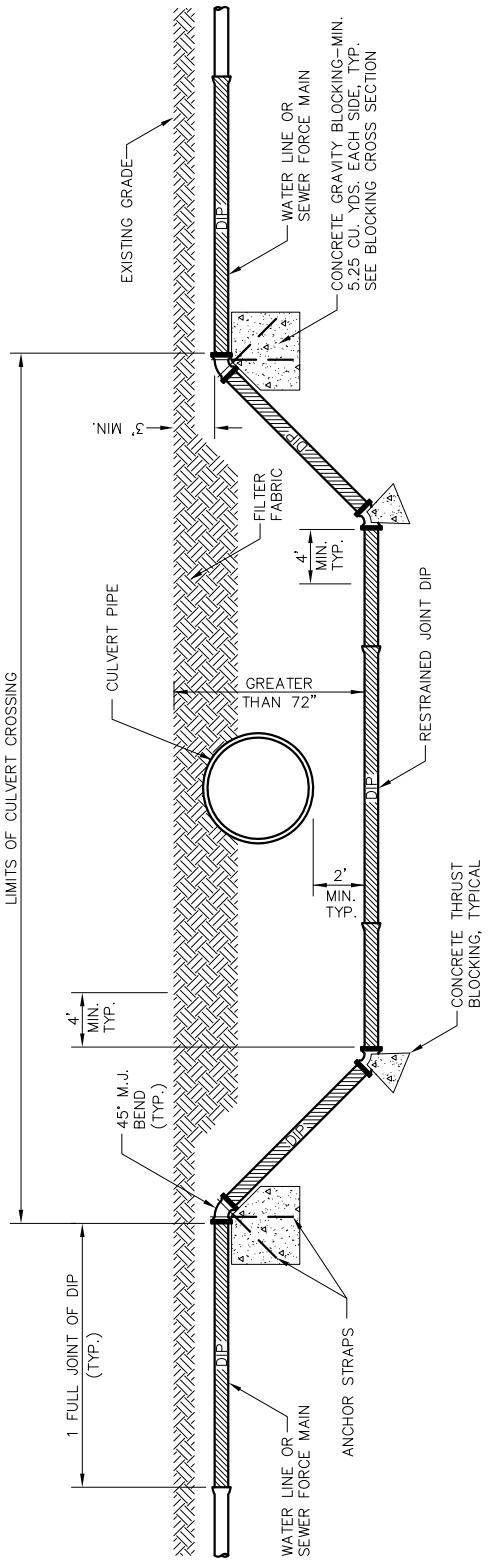

NOTES:

1. ONLY FULL 18' OR 20' JOINTS OF DUCTILE IRON PIPE SHALL BE USED ON EACH SIDE OF UPPER BENDS, UNLESS OTHERWISE APPROVED.
2. IF APPROVED FOR USE, RESTRAINING RODS SHALL BE STAINLESS STEEL OR GALVANIZED RODS WITH FIELD-APPLIED BITUMINOUS COATING.
3. PIPE UPSTREAM AND DOWNSTREAM OF UPPER BENDS, UNDER CREEK, AND BETWEEN UPPER BENDS TO BE RESTRAINED JOINT D.I.P.
4. THRUST AND GRAVITY BLOCKING NOT REQUIRED ON GRAVITY SEWER LINE.
5. EACH FITTING SHALL BE SECURED BY TWO FORMS OF RESTRAINT. RESTRAINING GLANDS AND CONCRETE THRUST BLOCKING ARE PREFERRED. WEDGE-ACTION RESTRAINT GLANDS (i.e. MEGALUGS) ARE APPROVED ONLY FOR USE ON DUCTILE IRON PIPE. FULL-CIRCUMFERENTIAL PIPE RESTRAINT GLANDS (i.e. GRIP RINGS) MAY BE USED ON PVC OR DUCTILE IRON PIPE. ALL RESTRAINT GLANDS SHALL BE SPECIFICALLY DESIGNED FOR USE ON THE TYPE OF PIPE FOR WHICH THEY ARE BEING INSTALLED. OTHER FORMS OF RESTRAINT SUCH AS THREADED ROD, BELL RESTRAINT, HARNESSES, ETC. MAY BE APPROVED BY ONWASA ON A CASE-BY-CASE BASIS.

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CULVERT CROSSING GREATER THAN 72" OF COVER

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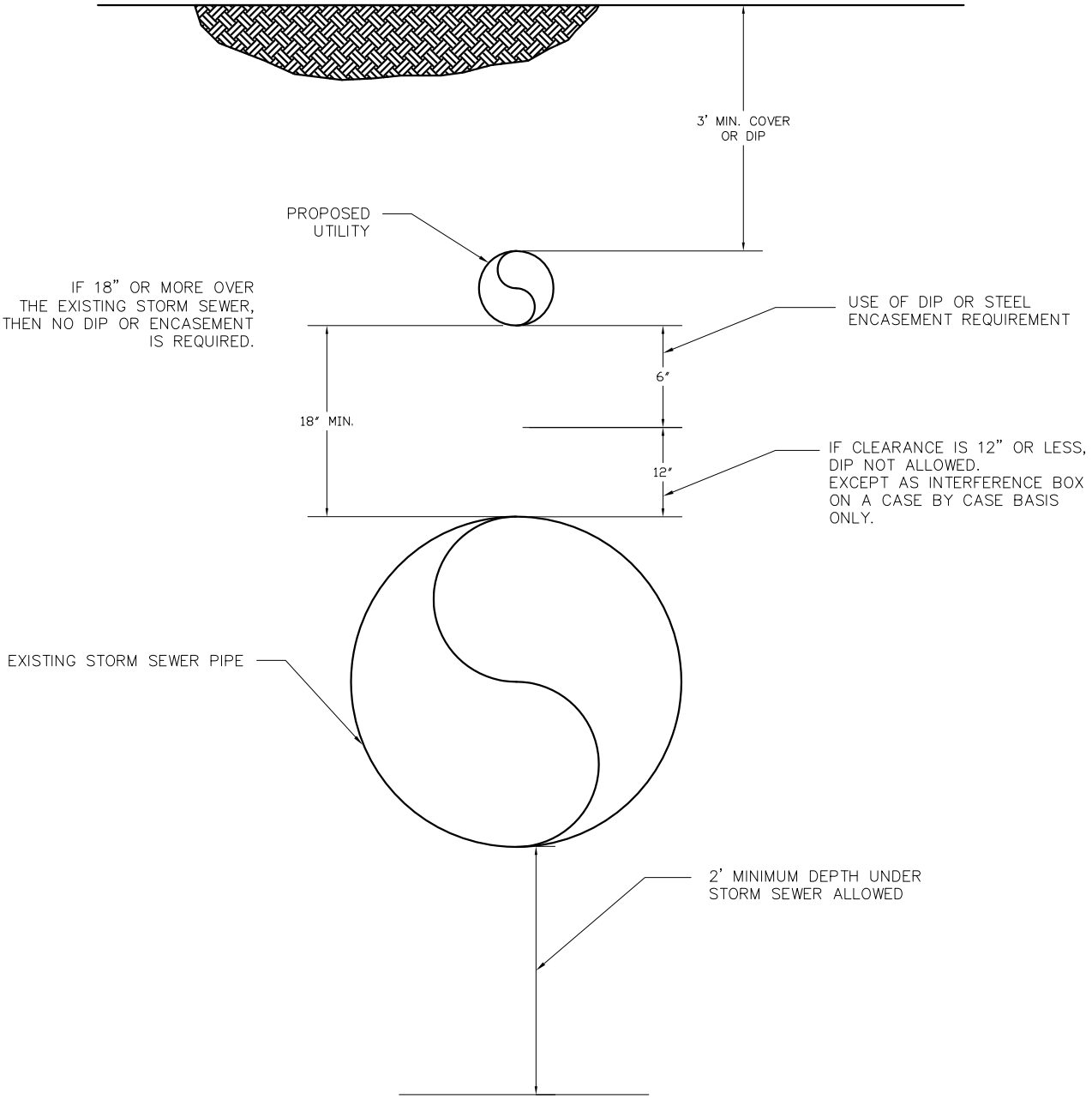

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PROPOSED UTILITY OVER EXISTING STORM SEWER

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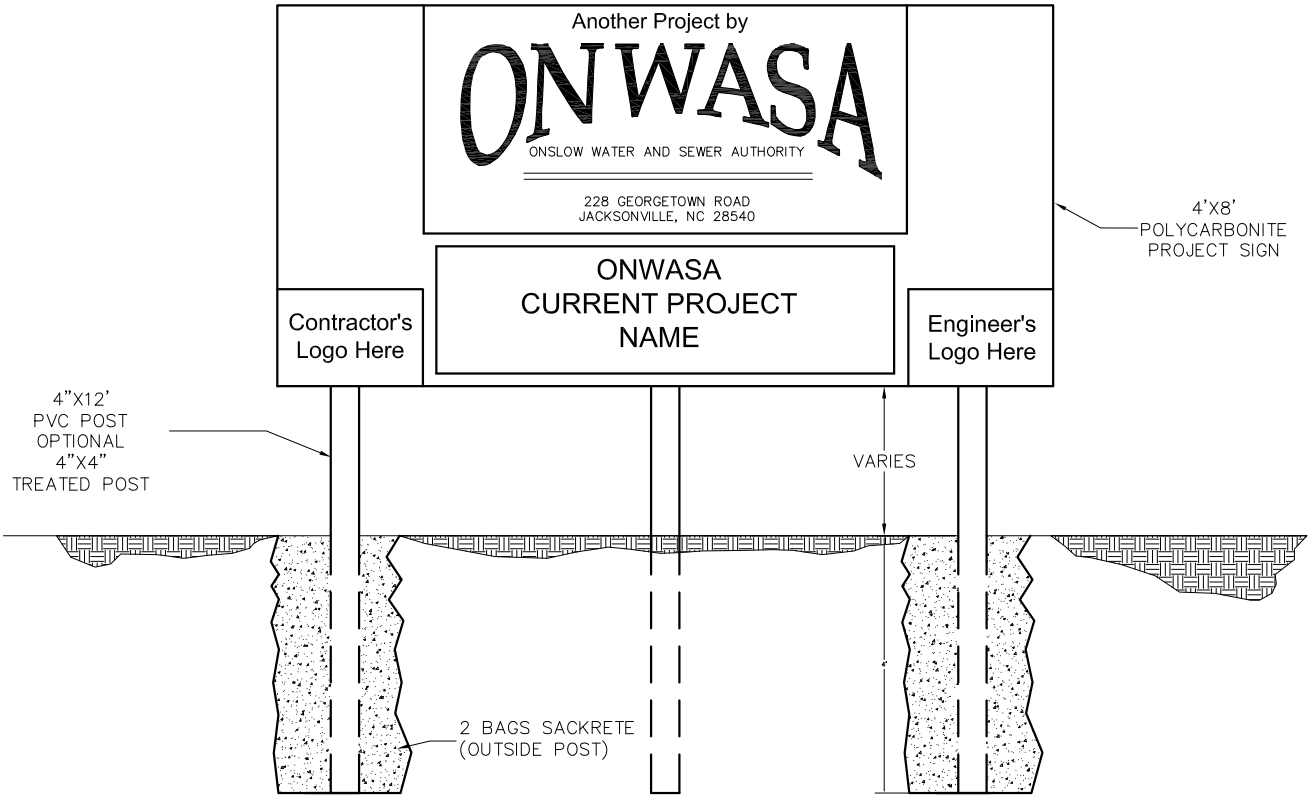

NOTES:
1. (4) BOLTS PER BOARD.
2. (3) 4"x 12' PVC POST.
3. (4) BAGS SACKRETE.

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ONWASA PROJECT SIGN

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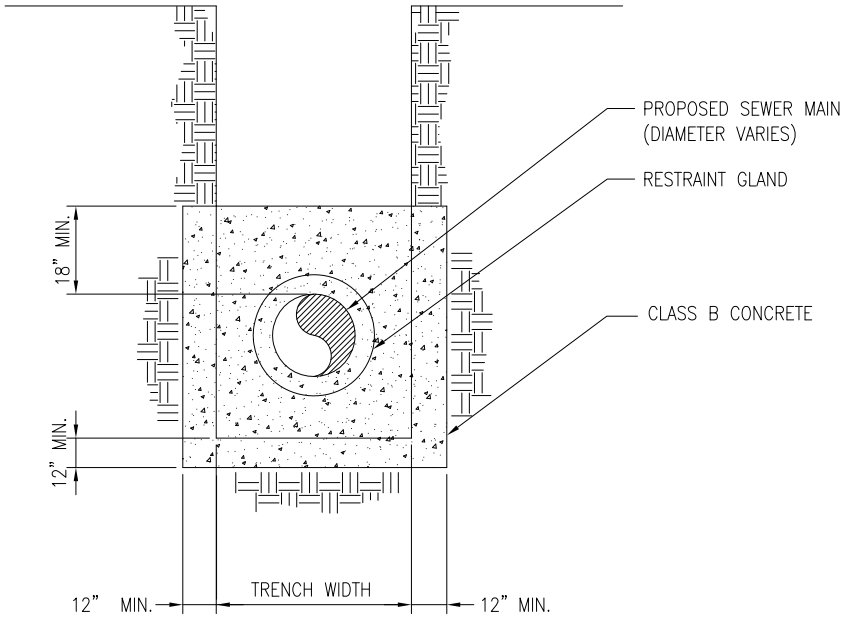
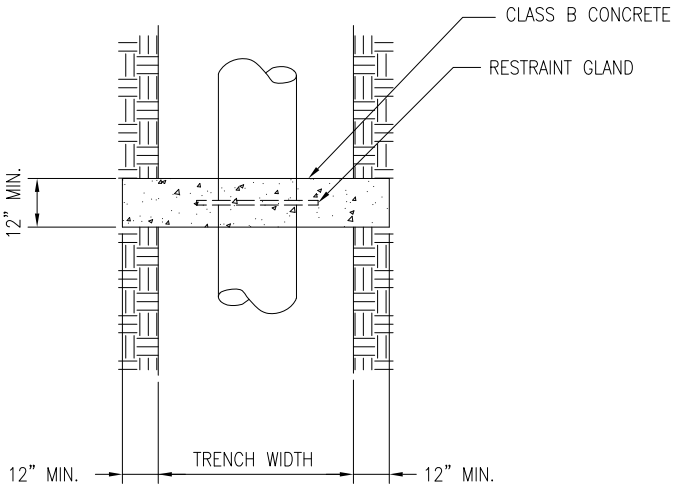


SECTION

NOTES:
1. DO NOT EXCEED 150 FEET BETWEEN COLLARS.



PLAN

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ANTI-SEEP COLLAR

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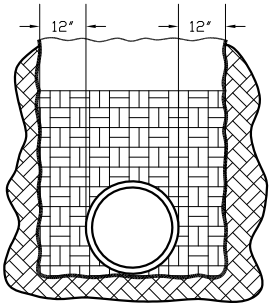
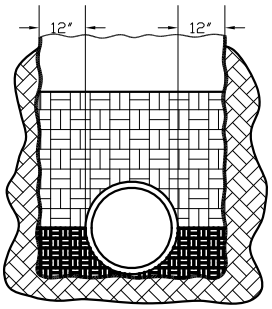


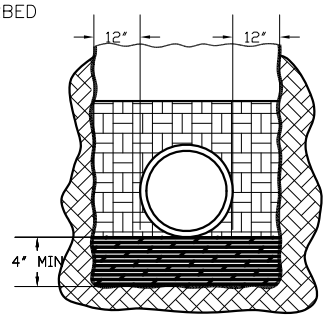
TYPE 1

(NOTE 1)
FLAT BOTTOM TRENCH WITH LOOSE DIRT
(FLAT BOTTOM IS DEFINED AS UNDISTURBED EARTH)



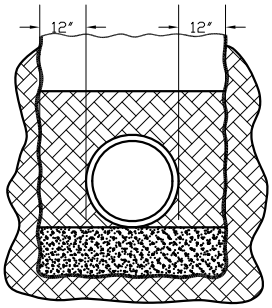
TYPE 2

FLAT BOTTOM TRENCH WITH BACKFILL LIGHTLY CONSOLIDATED TO CENTERLINE OF PIPE
(FLAT BOTTOM IS DEFINED AS UNDISTURBED EARTH)



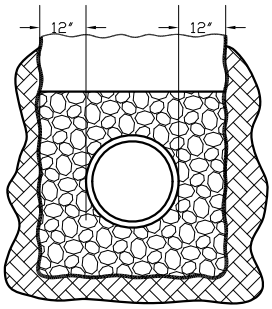
TYPE 3

PIPE BEDDED IN 4" MINIMUM LOOSE SOIL WITH BACKFILL LIGHTLY CONSOLIDATED TO TOP OF PIPE
(LOOSE SOIL IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCK, ORGANIC MATERIAL, FOREIGN MATERIALS AND FROZEN EARTH.)



TYPE 4

PIPE BEDDED IN SAND, GRAVEL, OR CRUSHED STONE TO A DEPTH OF 1/8 PIPE DIAMETER, 4" MINIMUM WITH BACKFILL COMPACTED TO TOP OF PIPE.
(APPROXIMATELY 80 PERCENT STANDARD PROCTOR, AASHTO T-99)



TYPE 5

PIPE BEDDED TO IT'S CENTERLINE IN COMPACTED GRANULAR MATERIAL, 4" MINIMUM UNDER PIPE. COMPACTED GRANULAR OR SELECT MATERIAL TO TOP OF PIPE. (APPROXIMATELY 90 PERCENT STANDARD PROCTOR, AASTO T-99)
(SELECT MATERIAL IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCKS, ORGANIC MATERIAL, FOREIGN MATERIALS AND FROZEN EARTH)

NOTES:

1. FOR NORMAL PIPE SIZES 14 INCH AND LARGER, CONSIDERATION SHOULD BE GIVEN TO THE USE OF LAYING CONDITIONS OTHER THAN TYPE 1.

2. CONSIDERATION OF THE PIPE-ZONE EMBEDMENT CONDITIONS INCLUDED IN THIS FIGURE MAY BE INFLUENCED BY FACTORS OTHER THAN PIPE STRENGTH. FOR ADDITIONAL INFORMATION ON PIPE BEDDING AND BACKFILL, SEE ANSI/AWWA C600.

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WATER MAIN EMBEDMENT DETAILS

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REQUIREMENTS FOR ABOVE GROUND INSTALLATIONS OF REDUCED PRESSURE PRINCIPLE AND DOUBLE CHECK VALVE ASSEMBLIES

1. The backflow preventer must be installed a Maximum distance of five (5) feet from the meter service or before any wyes, tees, or bypasses. Installation of backflow preventers within the DOT right–of–way will not be accepted, it must be installed on the customers property.
2. Reduced pressure principle assemblies must be installed in a horizontal position and so located in which no portion of the assembly can become submerged under any circumstances.
3. Double check valves can be installed in a vertical position provided the water flows in an upward direction.
4. All backflow preventers must be installed above ground. Backflow preventers installed inside must be a minimum of twelve (12) inches above the floor, and no higher than four (4) feet above the floor. Customer must maintain adequate clearance around the assembly for testing, and/or repair of the assembly. Wherever a reduced pressure principle backflow preventer is installed inside a building an air gap drain of adequate size must be installed. Below ground installations are prohibited for RP's. Surface or Sub–surface obstacles which prohibit the installation of the device in accordance with the specifications shall be subject to the review and approval of the Engineering Director for alternative locations.
5. Backflow prevention assemblies installed outside must be protected with a ASSE 1060 approved enclosure. The assembly must maintain a minimum distance of twelve (12) inches and a maximum distance of thirty (30) inches above the ground. Landscaping is allowed around any assembly provided it does not interfere with the testing and/or repairing of the assembly.
6. Protective enclosures must be used to prevent freezing or vandalism for backflow prevention assemblies installed outside above ground. Freeze proof enclosures that meet of exceed North Carolina Plumbing Code Standards are acceptable provided that the insulation is at least 7.05 R factor, and have the 1060 ASSE approval plate. Adequate drainage shall be provided by a hinged door or drain ports along the bottom walls of the protective enclosure. The enclosure will require to be mounted to the ground or existing grade. If the structure is not removable it must be accessible by doors large enough for entrance and repair.
7. Backflow prevention assemblies two and one half ($2\ \frac{1}{2}$) inches or larger must be supported to allow for the weight of the backflow prevention assembly. Support construction can consist of concrete block, brick or steel. Supports must have a proper footing to rest on. Supports should be spaced so they do not cause interference with the testing and/or repair of the assemblies.
8. All piping must be of ductile iron, pvc, copper, or brass.
9. All backflow prevention assembly installations shall be inspected by the Onslow Water and Sewer Authority Technical Operations Section or an authorized representative prior to initial connection to the potable water system.
10. Before installation of any backflow preventer, contact the Backflow Cross Connection ORC at 910–455–0722 to assist in proper selection and installation.

Note: Appendices within these regulations are subject to change periodically or as required by the State of North Carolina.

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3/4" to 2" Meter
RP / DCVA / PRV Assembly

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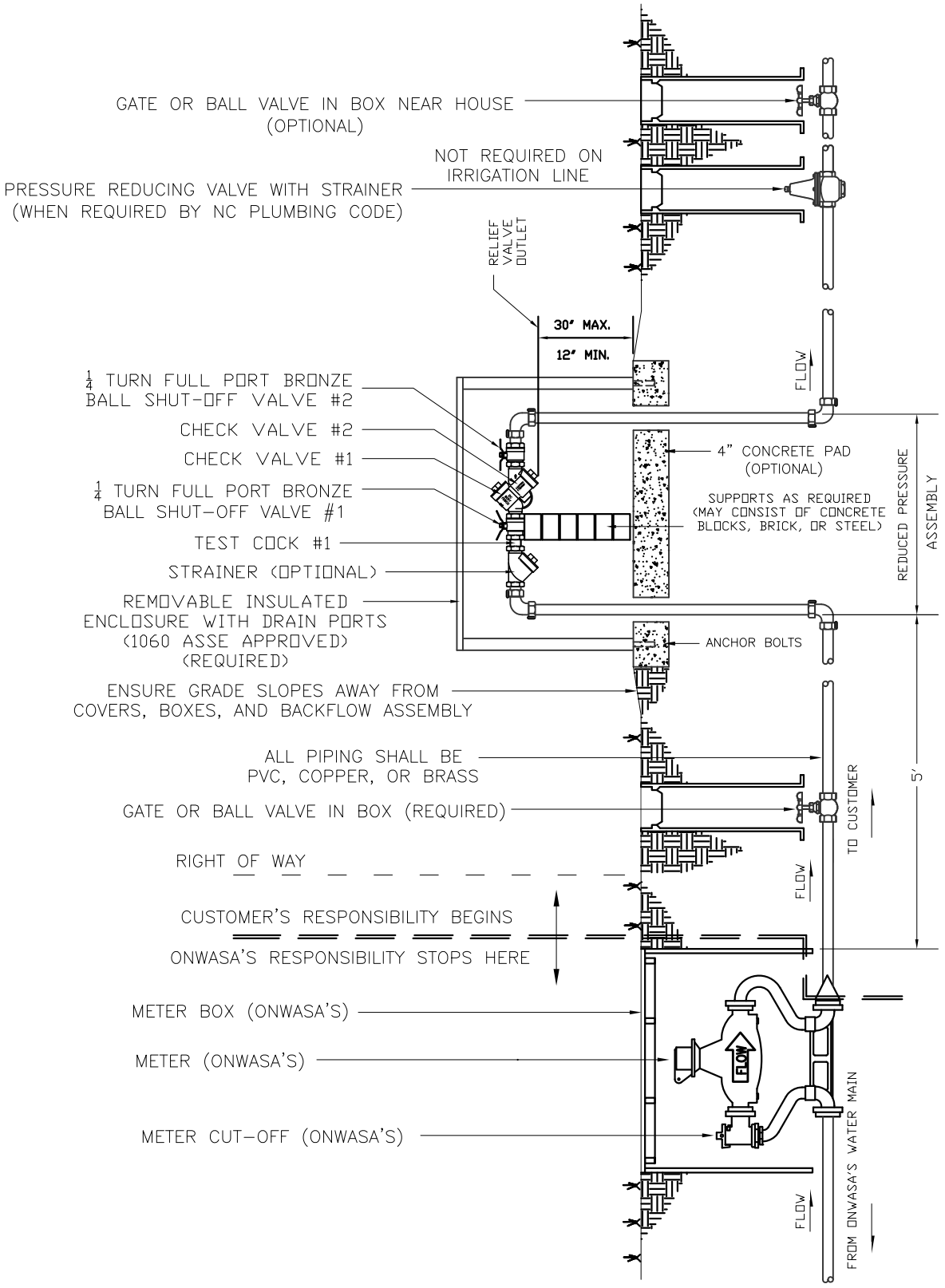

NOTES:
1. THE INSTALLER HAS THE OPTION TO INSTALL THE GATE OR BALL VALVES AND THE PRESSURE REDUCING VALVE INSIDE OF THE ENCLOSURE.
2. IN ORDER TO PREVENT OBSTRUCTION DURING THE TESTING OR REPAIR OF THE ASSEMBLY, IT IS RECOMMENDED THAT THE GATE OR BALL VALVES AND THE PRESSURE REDUCING VALVE BE INSTALLED OUTSIDE THE ENCLOSURE.

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3/4" - 2" Meter RP Assembly with PRV Assembly

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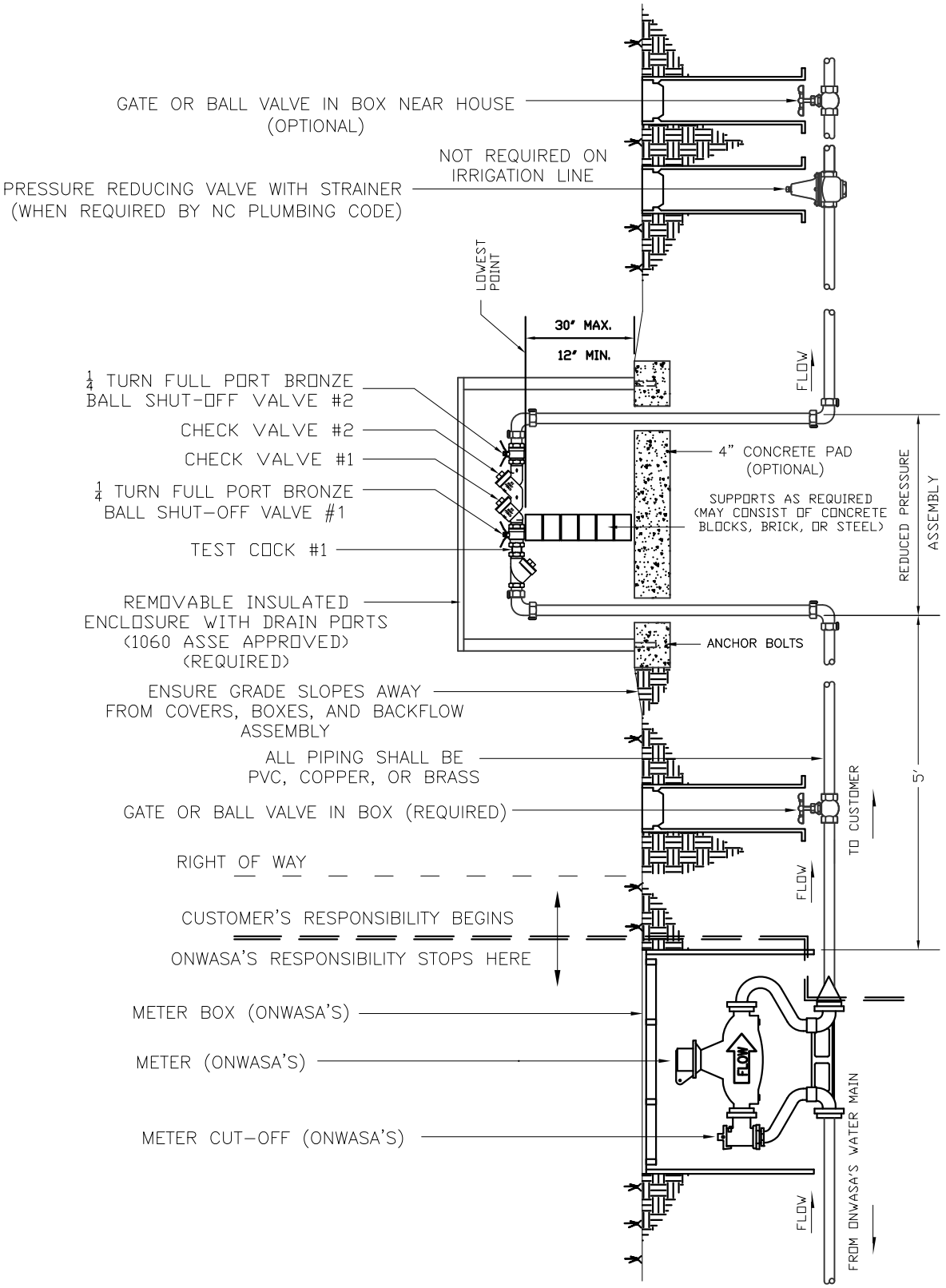

NOTES:
1. THE INSTALLER HAS THE OPTION TO INSTALL THE GATE OR BALL VALVES AND THE PRESSURE REDUCING VALVE INSIDE OF THE ENCLOSURE.
2. IN ORDER TO PREVENT OBSTRUCTION DURING THE TESTING OR REPAIR OF THE ASSEMBLY, IT IS RECOMMENDED THAT THE GATE OR BALL VALVES AND THE PRESSURE REDUCING VALVE BE INSTALLED OUTSIDE THE ENCLOSURE.

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3/4" - 2" Meter DCVA with PRV Assembly

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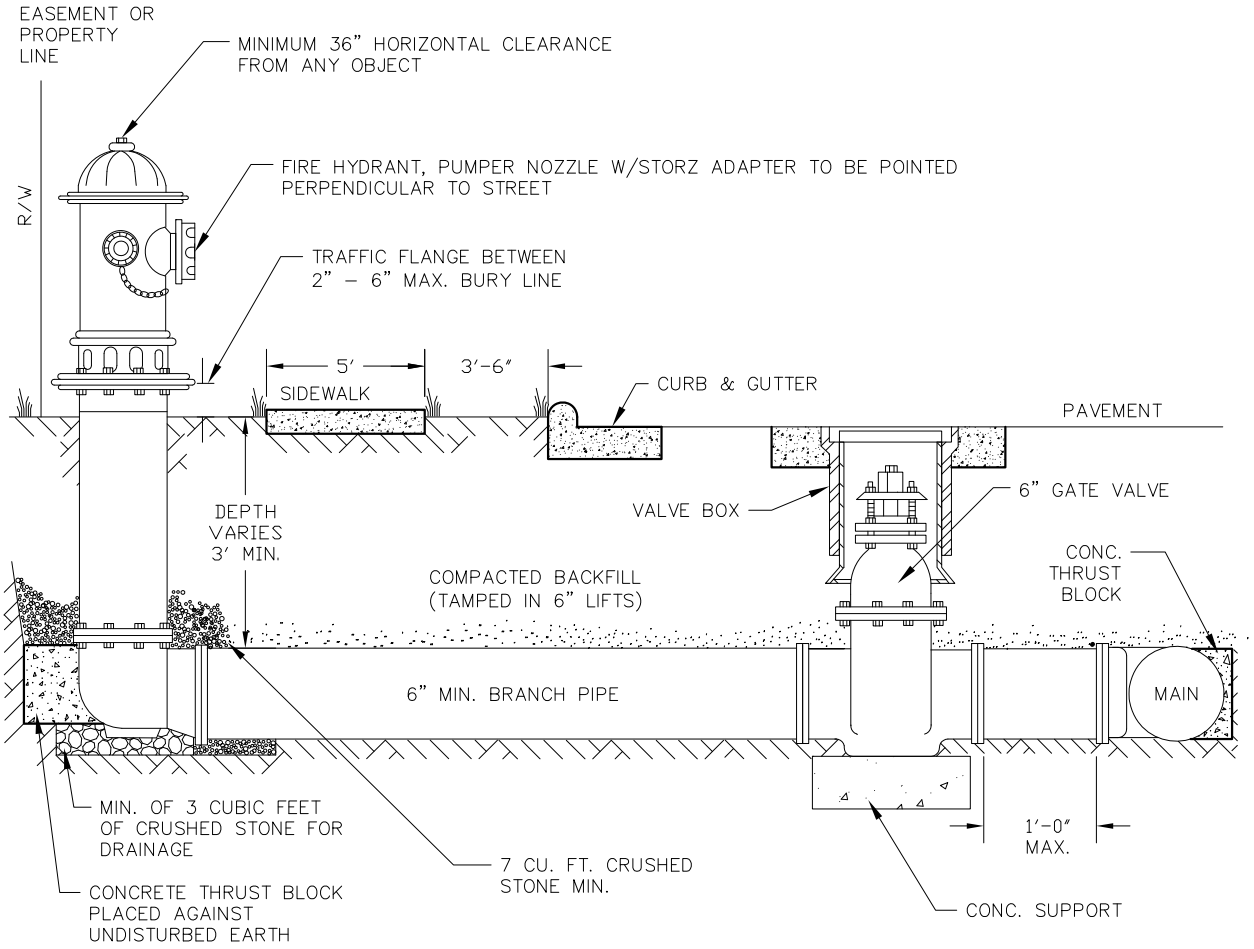

NOTES:

1. FIRE HYDRANT MANUFACTURER SHALL BE AS REQUIRED BY PROJECT SPECIFICATIONS.
2. FIRE HYDRANT SHALL BE INSTALLED USING HYDRANT TEE.
3. BRANCH PIPE SHALL BE DUCTILE IRON.
4. FIRE HYDRANTS WILL BE INSTALLED IN TRUE VERTICAL POSITION.
5. ALL JOINTS ON FIRE HYDRANT ASSEMBLIES SHALL BE RESTRAINED.
6. ALL FIRE HYDRANTS SHALL BE LOCATED WITHIN DEDICATED STREET RIGHT–OF–WAY OR A 20–FOOT PUBLICLY DEDICATED PERMANENT UTILITY EASEMENT TO ONWASA.
7. INSTALL BOLLARD GUARD POST AS PER DRAWINGS OR CONDITIONS MANDATE.
8. HYDRANT SHALL NOT BE INSTALLED SO THAT THE FINISHED ELEVATION OF SURROUNDING AREA (INCLUDING LANDSCAPING, MULCH, GRAVEL, ETC.) IS ABOVE THE MAXIMUM BURY LINE OF THE HYDRANT.
9. MAXIMUM PERMISSIBLE EXTENSION LENGTH IS 2–FEET.
10. IF HYDRANT LEG IS LESS THAN 10–FEET LONG, THE HYDRANT SHALL BE RODDED BACK TO THE VALVE.

ANYTIME SITE WORK, CONSTRUCTION, ROAD WORK, OR ANY OTHER WORK CHANGES THE GRADE OF THE FIRE HYDRANT, THE CONTRACTOR IS RESPONSIBLE FOR ADJUSTING THE FIRE HYDRANT TO STAY WITHIN COMPLIANCE.

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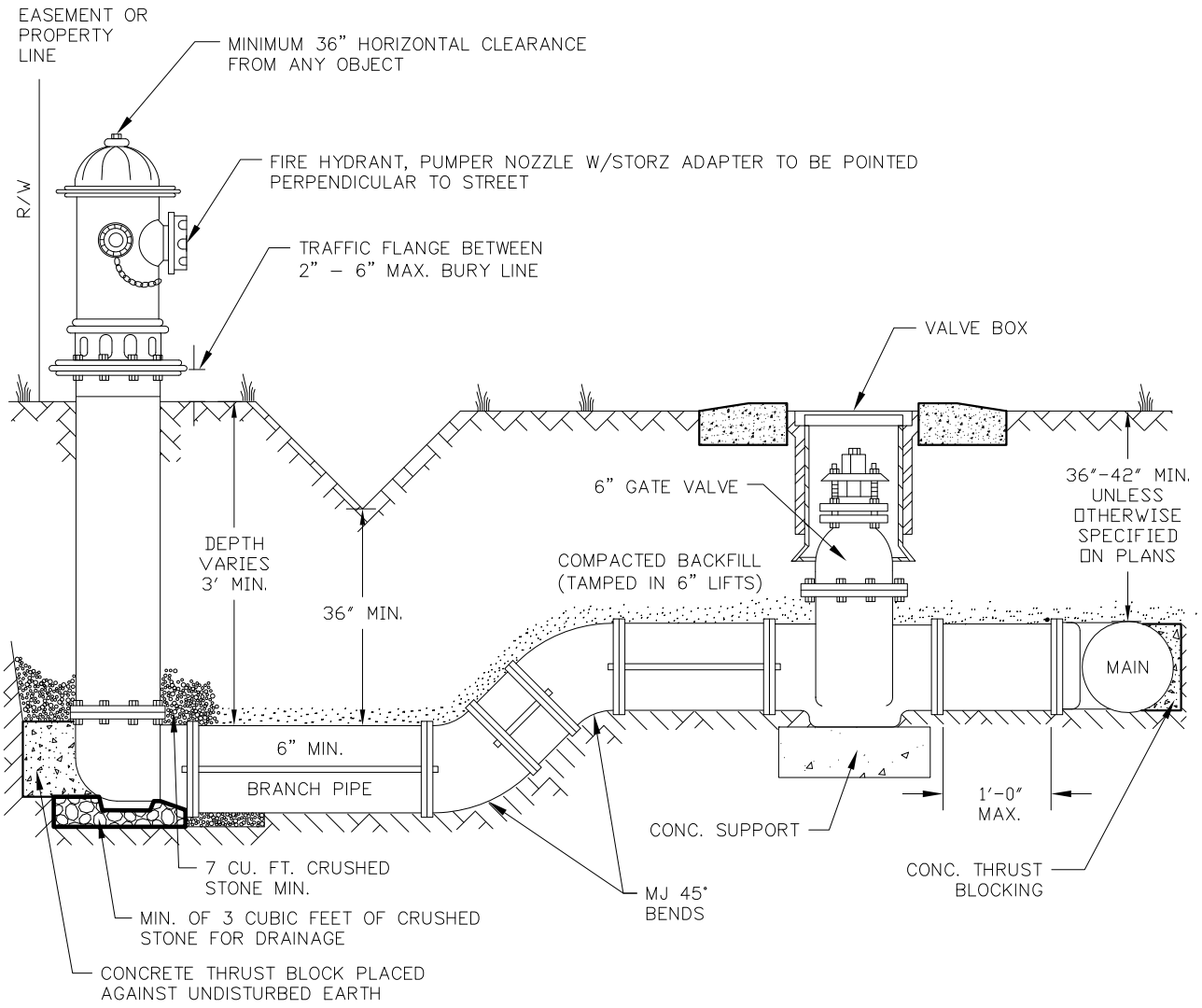
FIRE HYDRANT ASSEMBLY CURB AND GUTTER SECTION

SCALE:	DETAIL #
Not To Scale	WS_ FHC
REVISION DATE:	SHEET #:
May, 2016	1 of 1



NOTES:

1. FIRE HYDRANT MANUFACTURER SHALL BE AS REQUIRED BY PROJECT SPECIFICATIONS.
2. FIRE HYDRANT SHALL BE INSTALLED USING HYDRANT TEE.
3. BRANCH PIPE SHALL BE DUCTILE IRON.
4. FIRE HYDRANTS WILL BE INSTALLED IN TRUE VERTICAL POSITION.
5. ALL JOINTS ON FIRE HYDRANT ASSEMBLIES SHALL BE RESTRAINED.
6. ALL FIRE HYDRANTS SHALL BE LOCATED WITHIN DEDICATED STREET RIGHT-OF-WAY OR A 20-FOOT PUBLICLY DEDICATED PERMANENT UTILITY EASEMENT TO ONWASA.
7. INSTALL BOLLARD GUARD POST AS PER DRAWINGS OR CONDITIONS MANDATE.
8. HYDRANT SHALL NOT BE INSTALLED SO THAT THE FINISHED ELEVATION OF SURROUNDING AREA (INCLUDING LANDSCAPING, MULCH, GRAVEL, ETC.) IS ABOVE THE MAXIMUM BURY LINE OF THE HYDRANT.
9. MAXIMUM PERMISSIBLE EXTENSION LENGTH IS 2-FEET.
10. IF HYDRANT LEG IS LESS THAN 10-FEET LONG, THE HYDRANT SHALL BE RODDED BACK TO THE VALVE.

ANYTIME SITE WORK, CONSTRUCTION, ROAD WORK, OR ANY OTHER WORK CHANGES THE GRADE OF THE FIRE HYDRANT, THE CONTRACTOR IS RESPONSIBLE FOR ADJUSTING THE FIRE HYDRANT TO STAY WITHIN COMPLIANCE.

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FIRE HYDRANT ASSEMBLY SHOULDER / DITCH SECTION

SCALE:	DETAIL #
Not To Scale	WS_FHD
REVISION DATE:	SHEET #:
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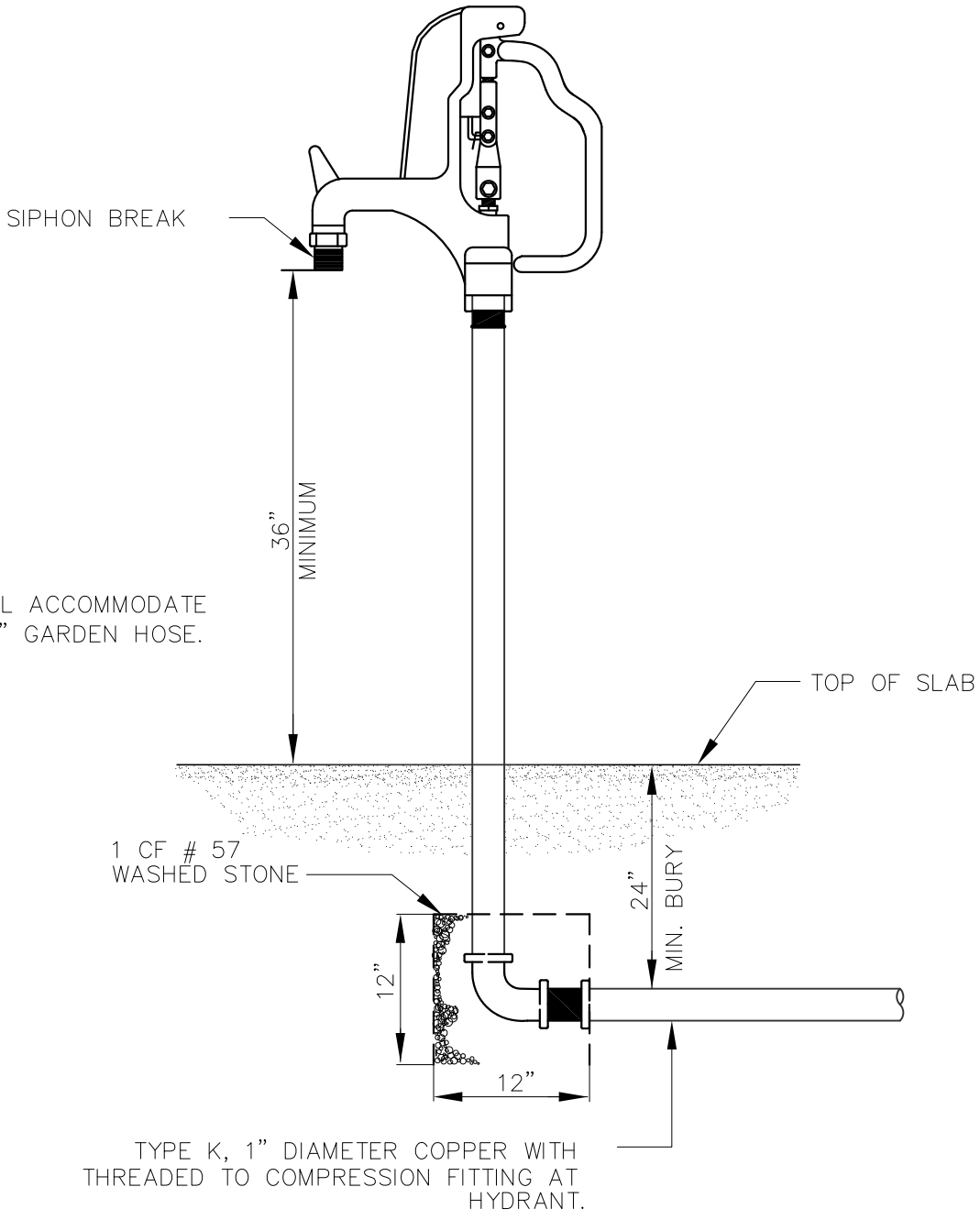

NOTE:
HOSE BIB SHALL ACCOMMODATE STANDARD 3/4" GARDEN HOSE.

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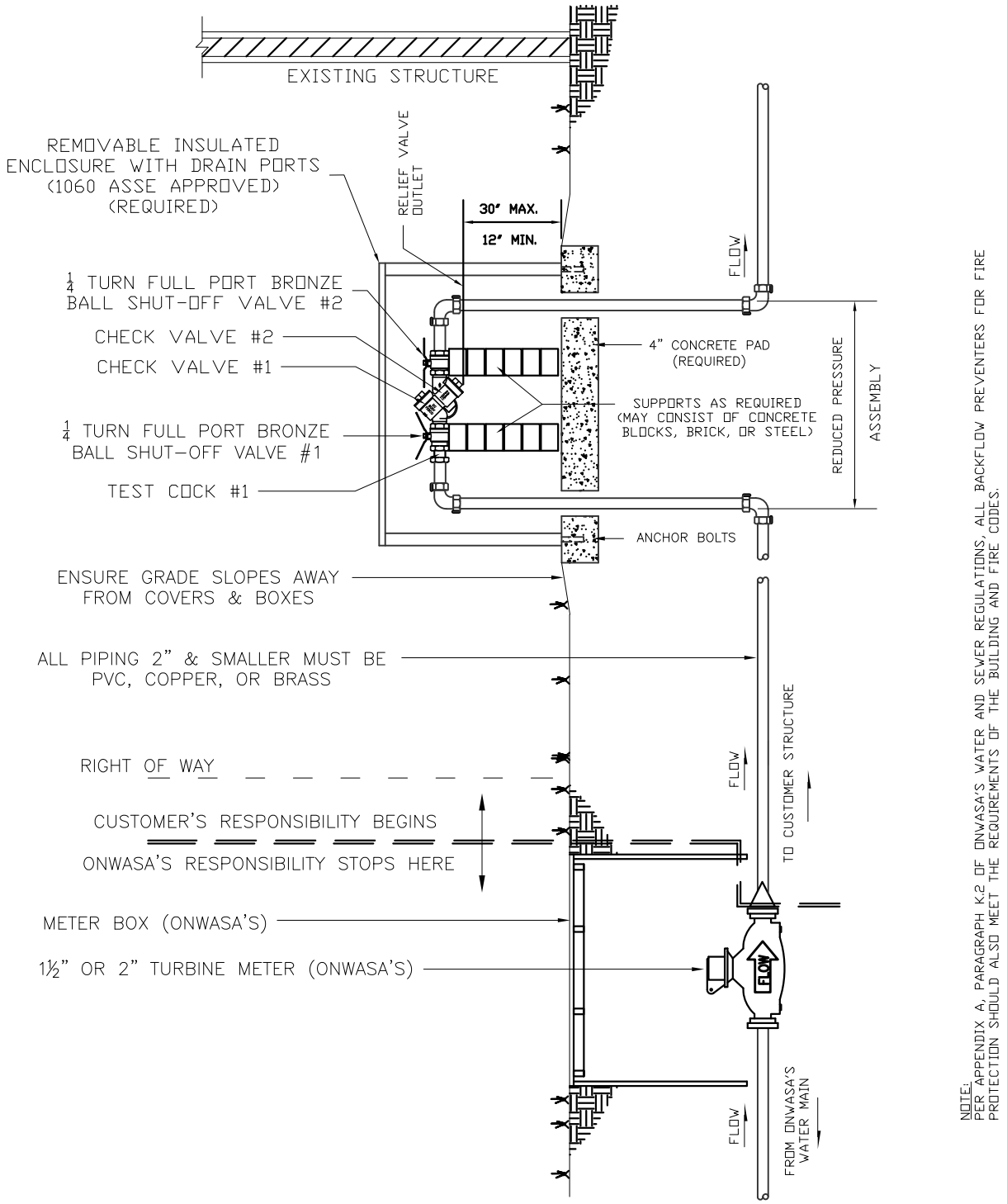
YARD HYDRANT NON-FREEZE

SCALE:	DETAIL #
Not To Scale	WS_YH
REVISION DATE:	SHEET #:
May, 2016	1 of 1



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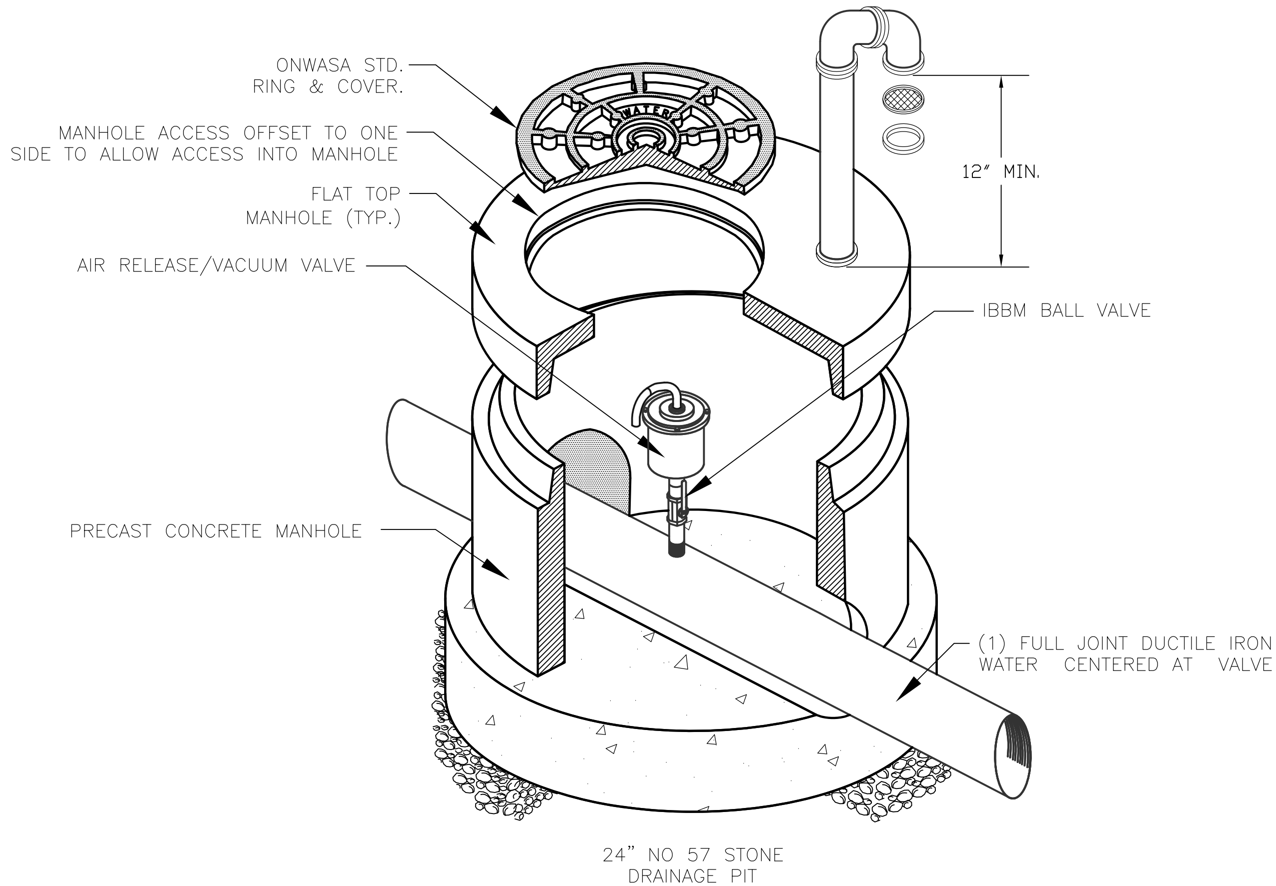
1½" TO 2" FIRE SERVICE LINE

SCALE:	DETAIL #
Not To Scale	WS_DFSL
REVISION DATE:	SHEET #:
March, 2012	1 of 1



1. WHEN TAPPING THE WATER MAIN, DO NOT EXCEED THE PIPE MANUFACTURERS ALLOWANCES.
2. ON ALL AIR RELEASE/VACUUM VALVES USE DOUBLE STRAP SERVICE SADDLE.
3. UNLESS OTHERWISE INDICATED ON THE PLANS, MANHOLE SHALL BE FLAT-TOP.
4. AIR RELEASE/VACUUM VALVES SHALL BE CRISPIN AL SERIES OR VAL-MATIC SERIES 100.
5. AIR RELEASE/VACUUM VALVE MANHOLES SHALL BE 5' MINIMUM INSIDE DIAMETER.
6. BOTTOM OF VENT PIPE SHALL BE A MINIMUM OF 12" OR 3' ABOVE FLOOD ELEVATION, WHICHEVER IS APPLICABLE

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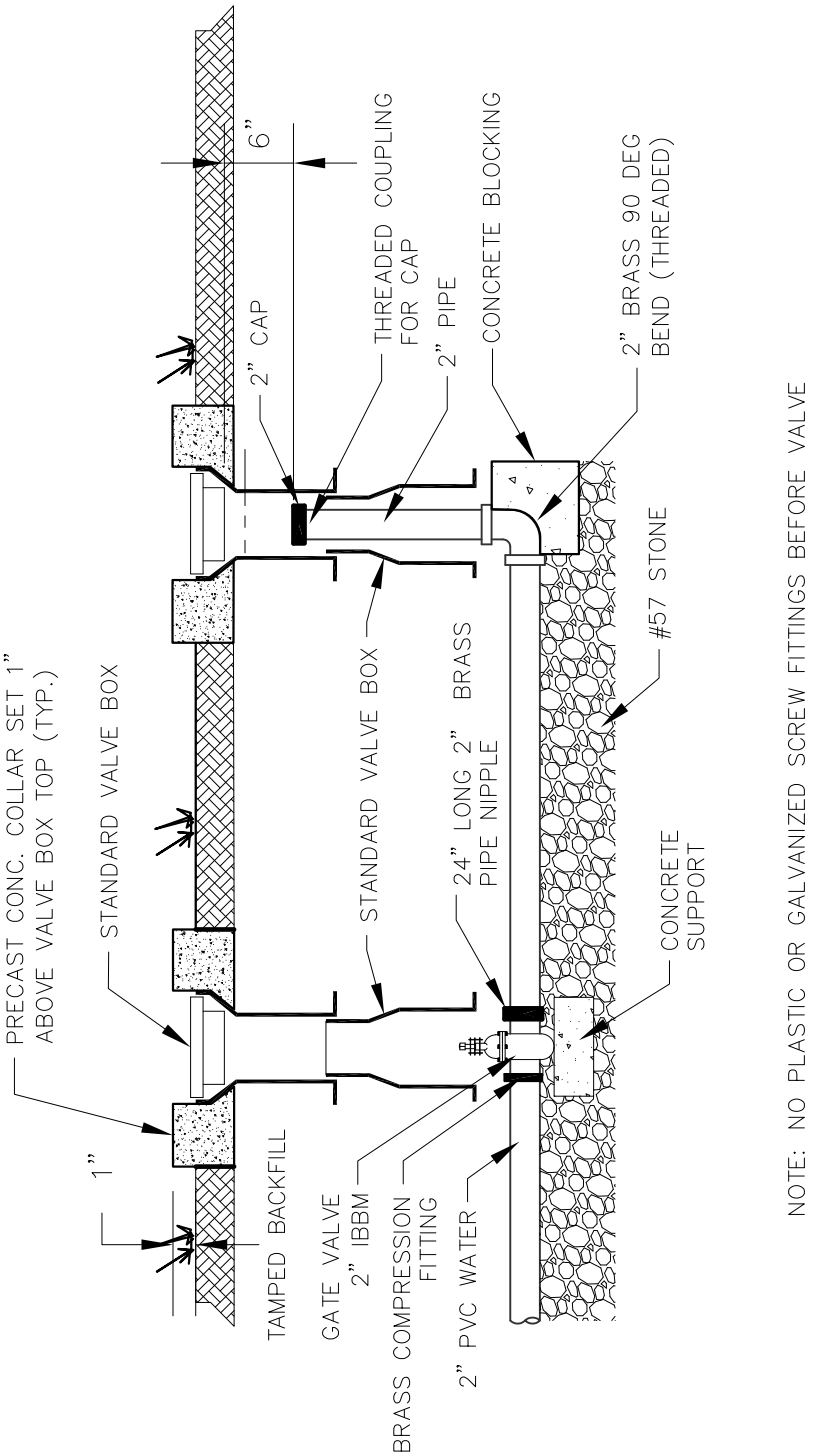
AIR RELEASE/VACUUM VALVE WATER

SCALE: Not To Scale	DETAIL # WS_ARV
REVISION DATE: May, 2016	SHEET #: 1 of 1



NOTE: NO PLASTIC OR GALVANIZED SCREW FITTINGS BEFORE VALVE

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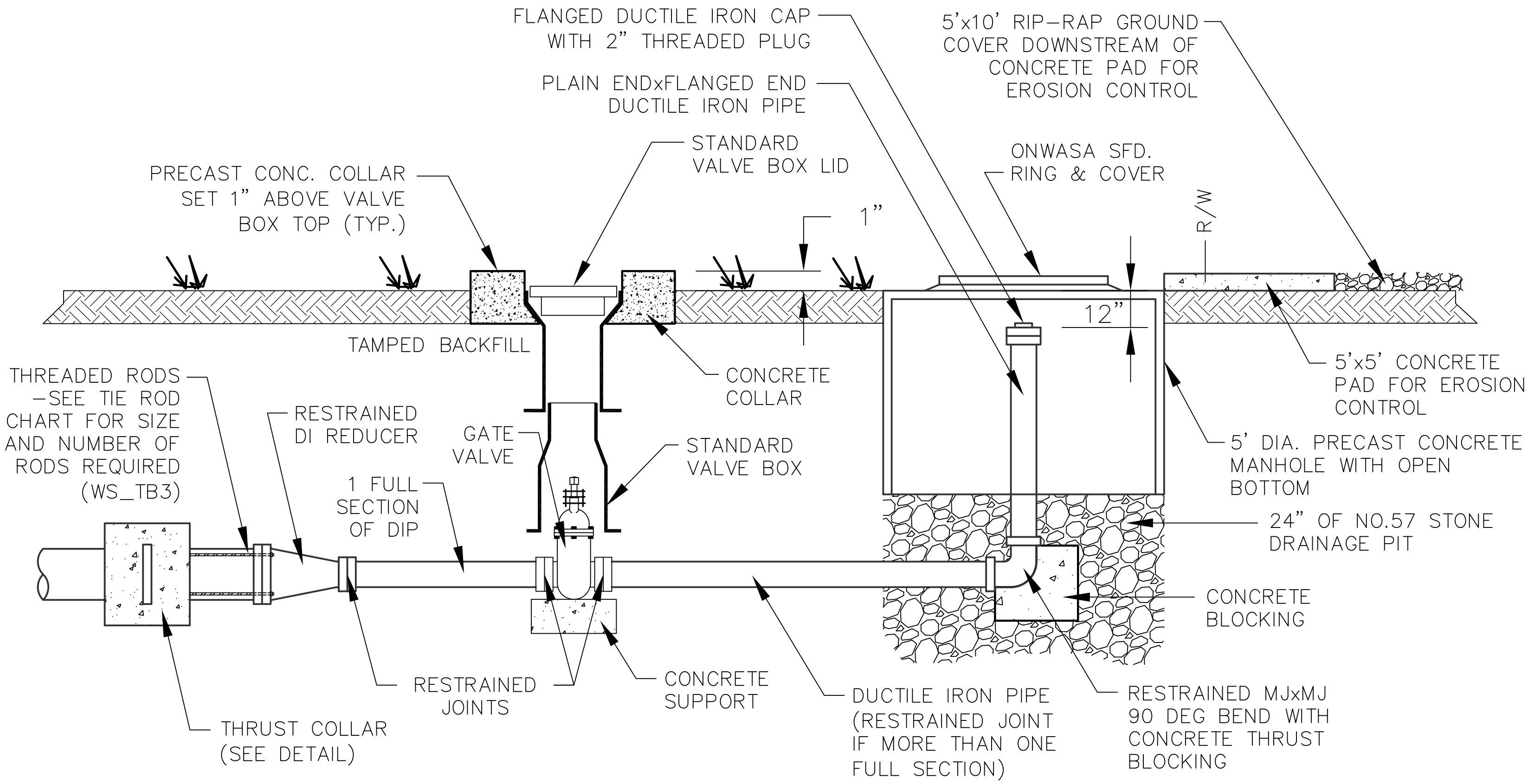
2-INCH PERMANENT BLOW OFF ASSEMBLY

SCALE:	DETAIL #
Not To Scale	WS_BO2
REVISION DATE:	SHEET #:
May, 2016	1 of 1



MAIN	REDUCER	GATE VALVE, PIPING, FITTINGS, ETC.
12"	12"x4"	4"
16"	16"x6"	6"
18"	18"x6"	6"
20"	20"x6"	6"
24"	24"x8"	8"
30"	30"x12"	12"

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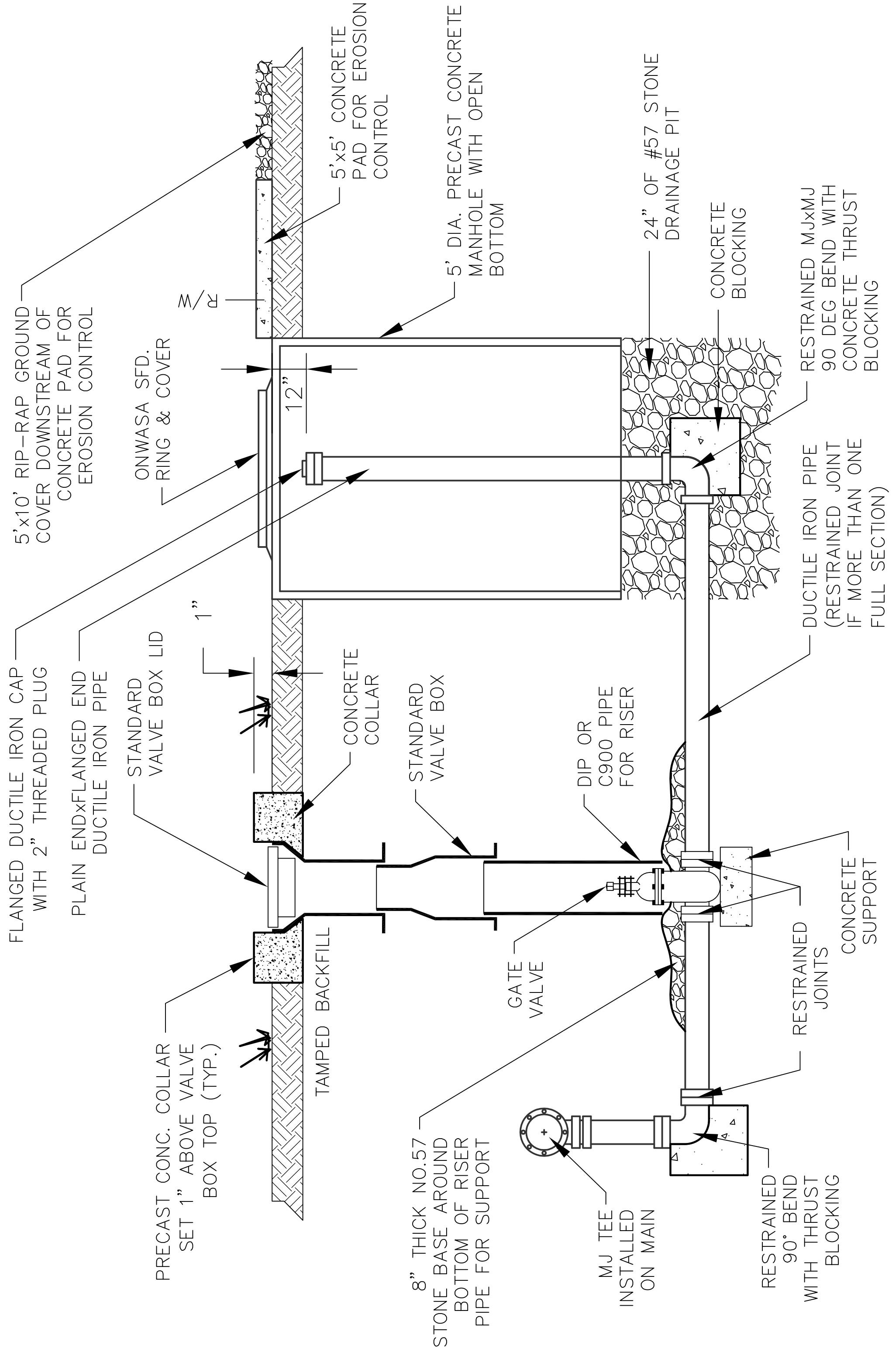
BLOW OFF ASSEMBLY LARGER THAN 2-INCH

SCALE: Not To Scale

REVISION DATE: May, 2016

DETAIL # WS_BO>2

SHEET #: 1 of 1



NOTES:
1. INSTALL REDUCER BETWEEN TEE AND BLOW-OFF ASSEMBLY AS NECESSARY. REDUCERS SHALL BE RESTRAINED AS WELL.
2. SAG BLOW-OFF ASSEMBLIES SHALL BE MINIMUM 6-INCH DIAMETER (PIPING, FITTINGS, VALVES, ETC.) LARGER DIAMETER ASSEMBLIES MAY BE REQUIRED AS DIRECTED BY ONWASA.

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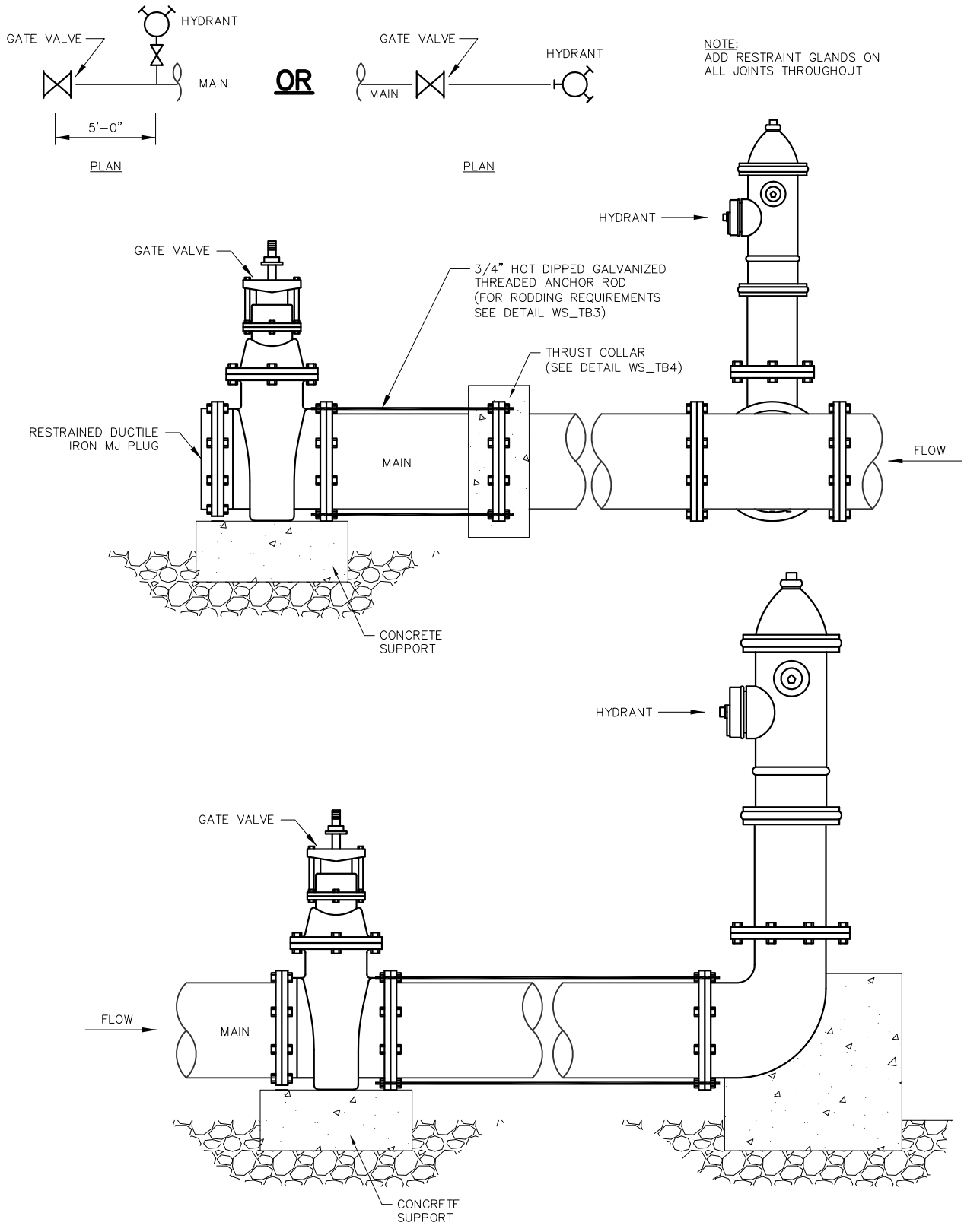
SAG BLOW OFF ASSEMBLY

SCALE: Not To Scale	DETAIL # WS_SBO
REVISION DATE: May, 2016	SHEET #: 1 of 1



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DEAD END LINE ASSEMBLY

SCALE:	DETAIL #
Not To Scale	WS_DE
REVISION DATE:	SHEET #:
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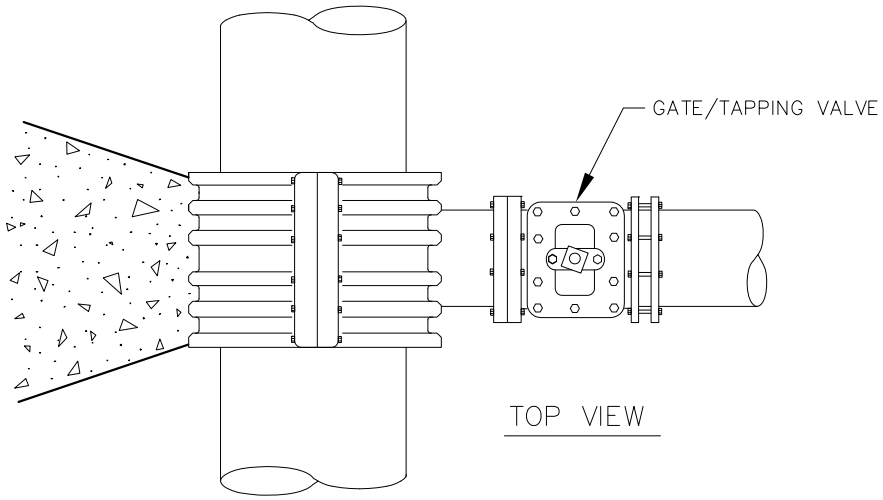
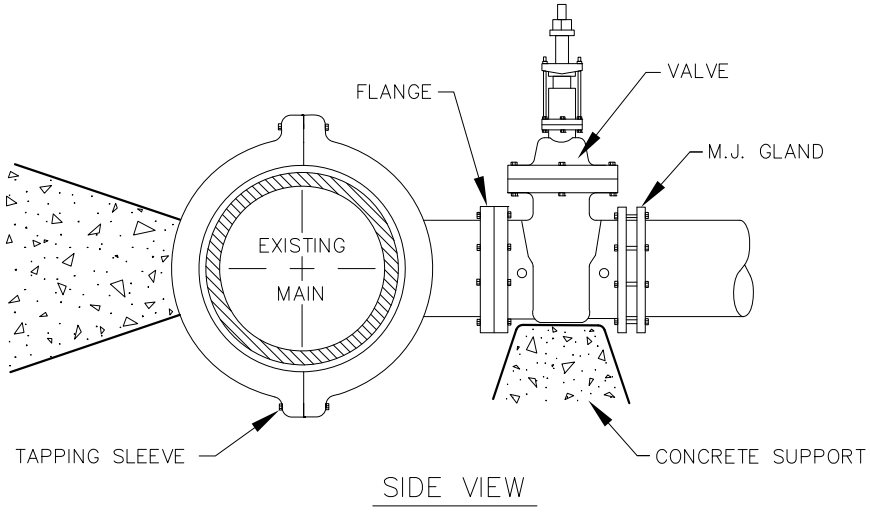


TOP VIEW



SIDE VIEW

NOTES:

1. CONCRETE SHALL NOT CONTACT GLANDS, BOLTS OR ENDS OF MECHANICAL BOLTS, OR ENDS OF MECHANICAL JOINT FITTINGS. TAPPING SLEEVE AND BOTTOM OF VALVE SHALL BE WRAPPED IN POLYETHYLENE.
2. SEE STANDARD THRUST BLOCK TABLE FOR AREA OF CONCRETE REQUIRED.
3. TAPPING SLEEVE SHALL BE TESTED IN ACCORDANCE WITH ONWASA REQUIREMENTS.
4. TAPS ON SDR26 PIPE SHALL REQUIRE LONG SS TAPPING SLEEVES.

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4" AND LARGER TAPPING SLEEVE AND VALVE ASSEMBLY

SCALE:	DETAIL #
Not To Scale	WS_TS
REVISION DATE:	SHEET #:
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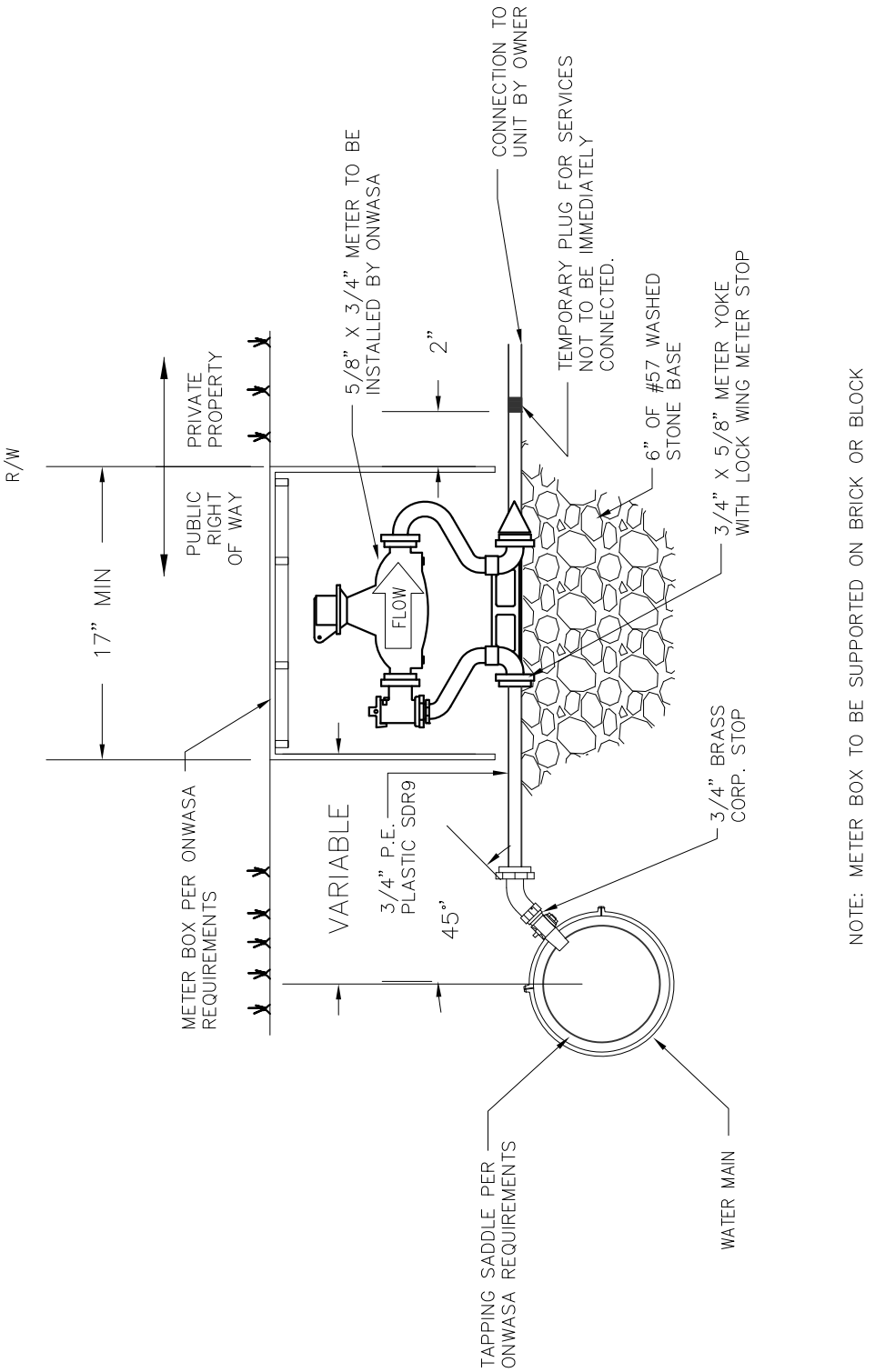

NOTE: METER BOX TO BE SUPPORTED ON BRICK OR BLOCK

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USE WITH "ONWASA MANUAL OF SPECIFICATIONS, STANDARDS and DETAILS, latest revision"

3/4" TO 1" SERVICE CONNECTION AND METER

SCALE:	DETAIL #
Not To Scale	WS_SCM
REVISION DATE:	SHEET #:
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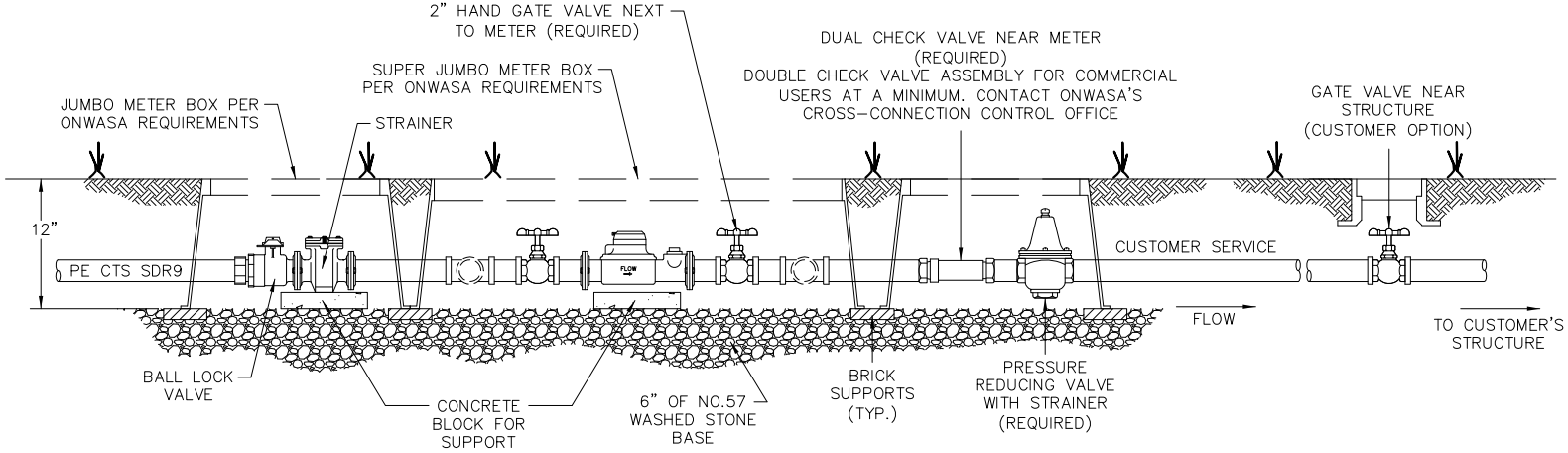
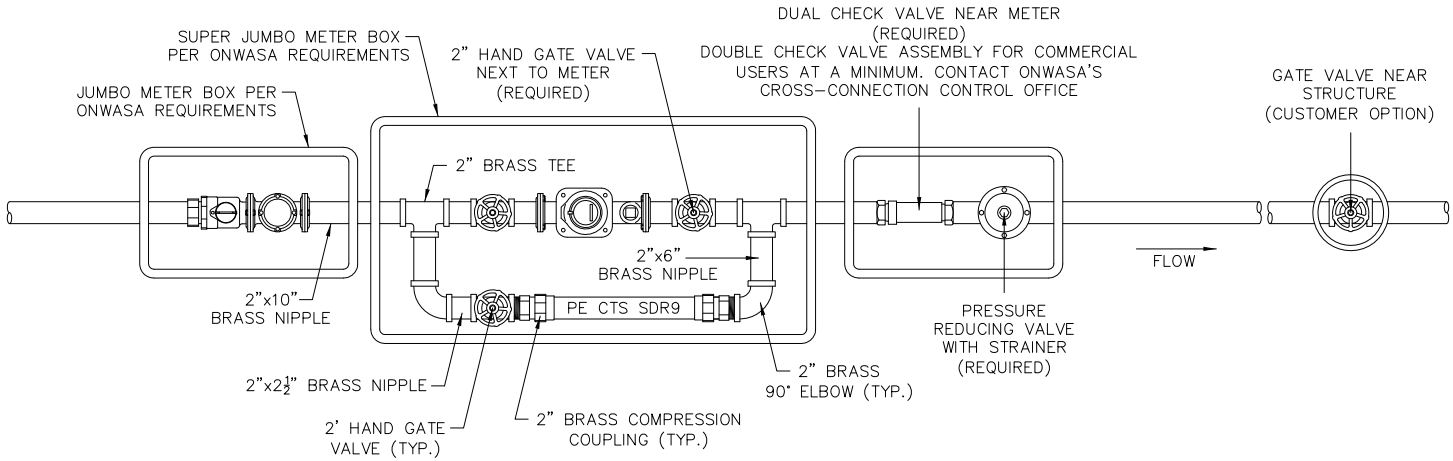
1½" AND 2" SERVICE CONNECTION (TYP.)





NOTES:
1. ALL SERVICE APPURTENANCES SHALL BE THE SAME SIZE AS METER (1½" OR 2").
2. METER SHALL BE SIZED PER AWWA MANUAL M22 OR NC PLUMBING CODE GUIDELINES, WHICHEVER IS MORE RESTRICTIVE.
3. REFERENCE ONWASA DETAIL WS_MI (METER INSTALLATION) FOR COMPLETE SERVICE INSTALLATION REQUIREMENTS.
4. TO ENSURE POSITIVE DRAINAGE, THE BOX SHALL HAVE AN OPEN BOTTOM TO ALLOW DRAINAGE THROUGH STONE.
5. A BYPASS ASSEMBLY, AS SHOWN ABOVE, SHALL BE REQUIRED FOR 1½" and 2" METERS.

SCALE:	DETAIL #
Not To Scale	WS_SC1.5&2
REVISION DATE:	SHEET #:
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3/4" TO 1" METER INSTALLATION

SCALE:	DETAIL #
Not To Scale	WS_MI
REVISION DATE:	SHEET #:
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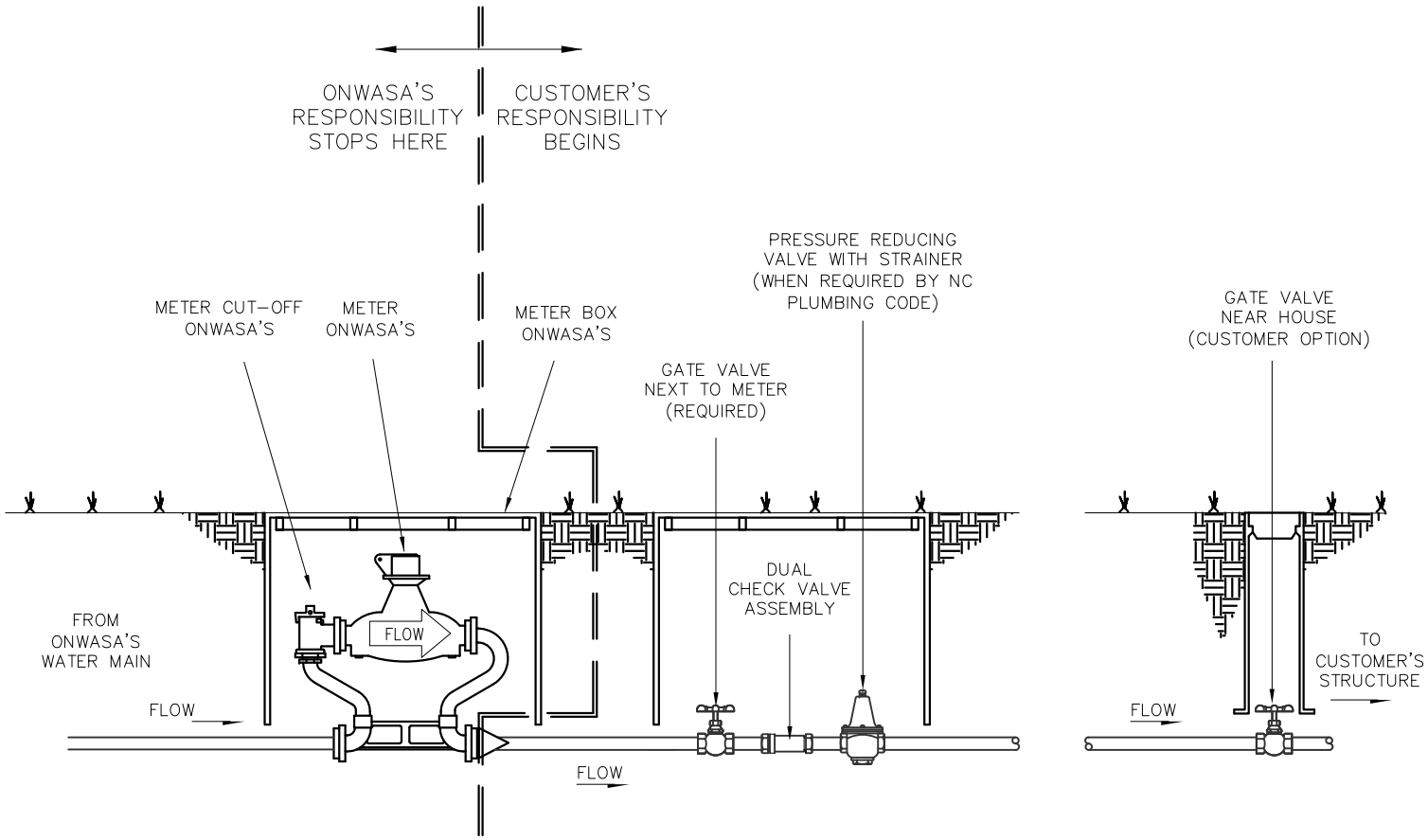
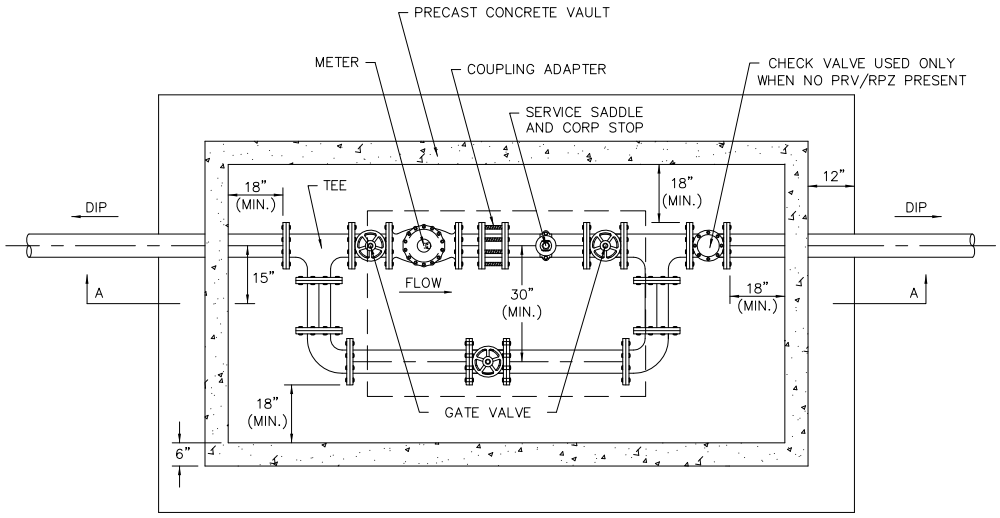


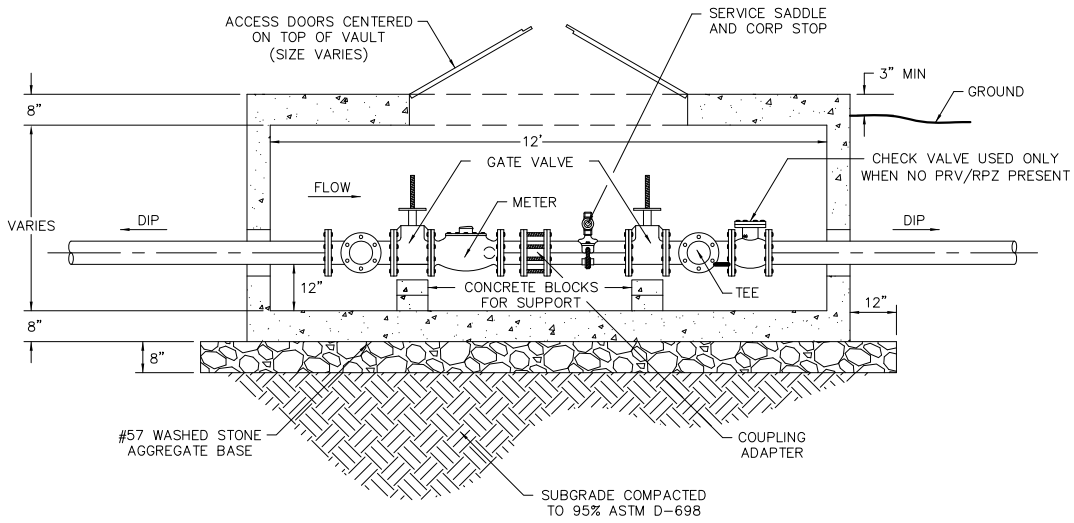
North Carolina Plumbing Code Section 608 requires a gate valve, backflow prevention and a pressure reducing valve on all connections with the Public Water Supply.

1. A gate valve and a pressure reducing valve MUST be installed directly behind the meter (see diagram above).
2. An additional gate valve located near the house is recommended, but not required.
3. All materials shall be pressure rated to one hundred–fifty (150 psi).
4. The water meter will be locked upon installation. Please contact the Onslow Water and Sewer Authority (ONWASA) twenty–four (24) hours in advance to schedule the inspection of the valves.
5. All valves MUST be installed prior to unlocking the meter.

Meter Placement Note:

Place the blue flag approximately thirty (30) feet from the center of the road Utility Right of Way for proper placement of ONWASA's water meter. All efforts will be made to install the meter where it is marked; however, ONWASA reserves the right to place the meter in the most feasible location to all parties involved. If the blue flag is not placed in a feasible location, it may result in a delay of installation.





SECTION A–A

NOTES:
1. ALL PIPING SHOWN TO BE DUCTILE IRON.
2. BURIED FITTINGS TO BE MJ WITH RESTRAINT GLANDS.
3. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT ALL MINIMUM CLEARANCE REQUIREMENTS INSIDE THE VAULT ARE MET.
4. ONWASA SHALL FURNISH 1.5" AND LARGER METERS AT THE CURRENT COST TO ONWASA. CONTACT ONWASA FOR CURRENT PRICING.

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METER VAULT INSTALLATION 3-INCH AND LARGER

SCALE:	DETAIL #
Not To Scale	WS_MV3+
REVISION DATE:	SHEET #:
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Parts List

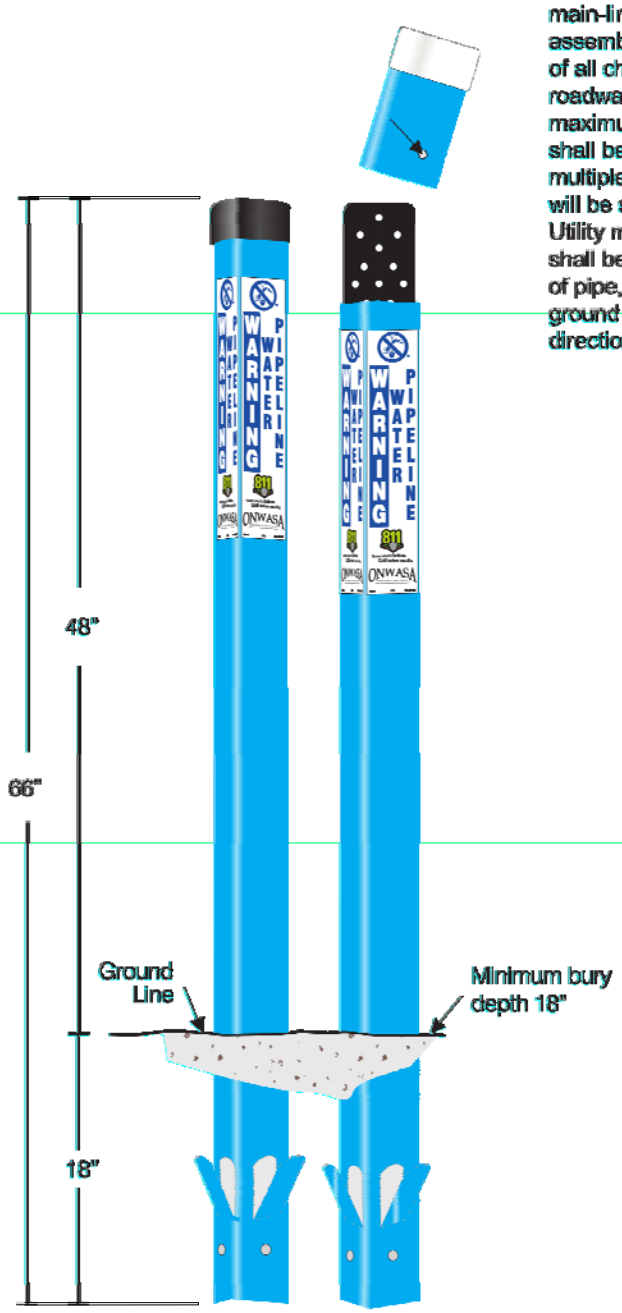
1 - Rhino # TVF66UB - Rhino TriView Flex™, 66" Blue with Black Cap OR
1 - Rhino # TVTI66UW2 - Rhino TriView™ Test Station, 66", 2 Inside Terminals, Blue with White Cap
1 - Cap Lock - TS-LOCK for Test Stations
3 - Decal # SD-8516K Custom Decals

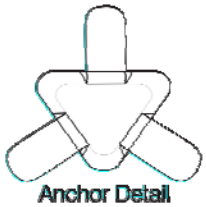
NOTES:

The TriGrip Anchor Flaps™ shall be extended priorty to burial of the post. Soil shall be compacted during placement of marker post.

All materials shall be provided by Rhino Marking & Protection Sytems, Inc.

Install above-ground utility markers at horizontal bends, main-line valve boxes (not within 10 feet of a fire hydrant assembly branch), ends of directional bores, bank edge of all channels crossed by directionl bores, each side of a roadway crossing, and along the piping alignment. The maximum spacing for the above-ground utility markers shall be 500 linear feet. In locations where there are multiple horizontal bends in close proximity, one marker will be sufficient to demonstrate the change in direction. Utility markers designed to provide access to tracer wire shall be installed at every third marker, or every 1000 feet of pipe, whichever is lesser. Tracer wire accesible above-ground utility markers shall also be installed at ends of directional bores.





Anchor Detail

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STANDARD UTILITY MARKER FOR WATER MAIN

SCALE:	DETAIL #
Not To Scale	WS_WMRK
REVISION DATE:	SHEET #:
May, 2016	1 of 1

Parts List

1 - Rhino # TVF66PB - Rhino TriView Flex™, 66" Purple with Black Cap OR

1 - Rhino # TVTI66PW2 - Rhino TriView™ Test Station, 66", 2 Inside Terminals, Purple with White Cap

1 - Cap Lock - TS-LOCK for Test Stations

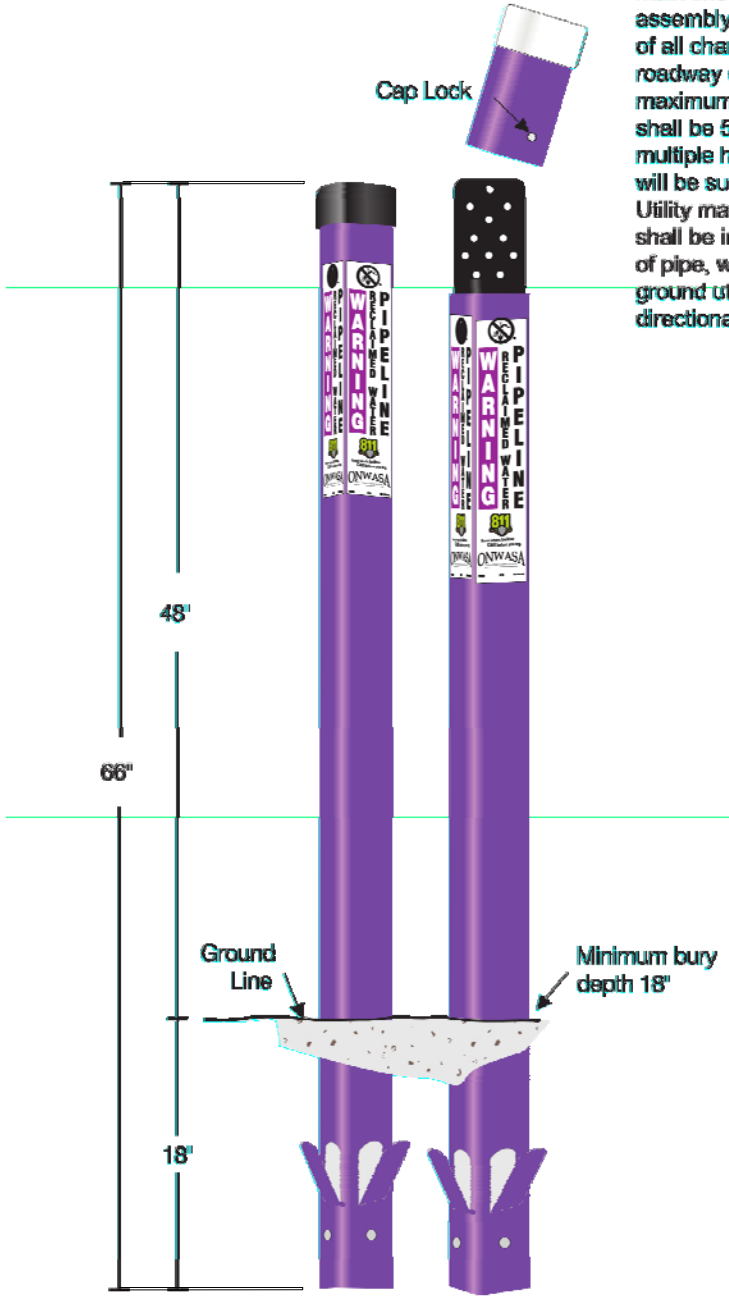
3 - Decal # SD-8515K Custom Decals

NOTES:

The TriGrip Anchor Flaps™ shall be extended priorty to burial of the post. Soil shall be compacted during placement of marker post.

All materials shall be provided by Rhino Marking & Protection Sytems, Inc.

Install above-ground utility markers at horizontal bends, main-line valve boxes (not within 10 feet of a fire hydrant assembly branch), ends of directional bores, bank edge of all channels crossed by directionl bores, each side of a roadway crossing, and along the piping alignment. The maximum spacing for the above-ground utility markers shall be 500 linear feet. In locations where there are multiple horizontal bends in close proximity, one marker will be sufficient to demonstrate the change in direction. Utility markers designed to provide access to tracer wire shall be installed at every third marker, or every 1000 feet of pipe, whichever is lesser. Tracer wire accesible above-ground utility markers shall also be installed at ends of directional bores.




Anchor Detail

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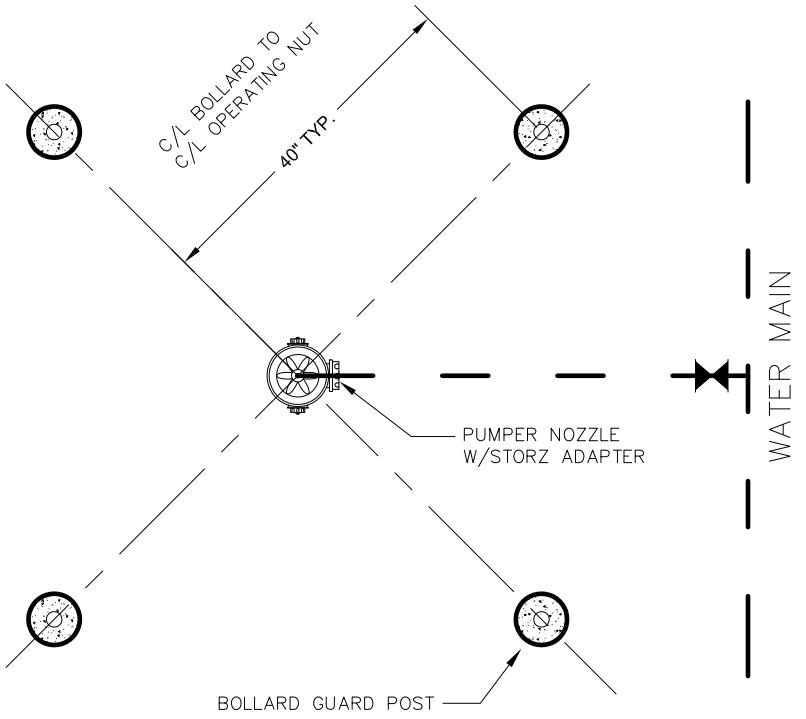
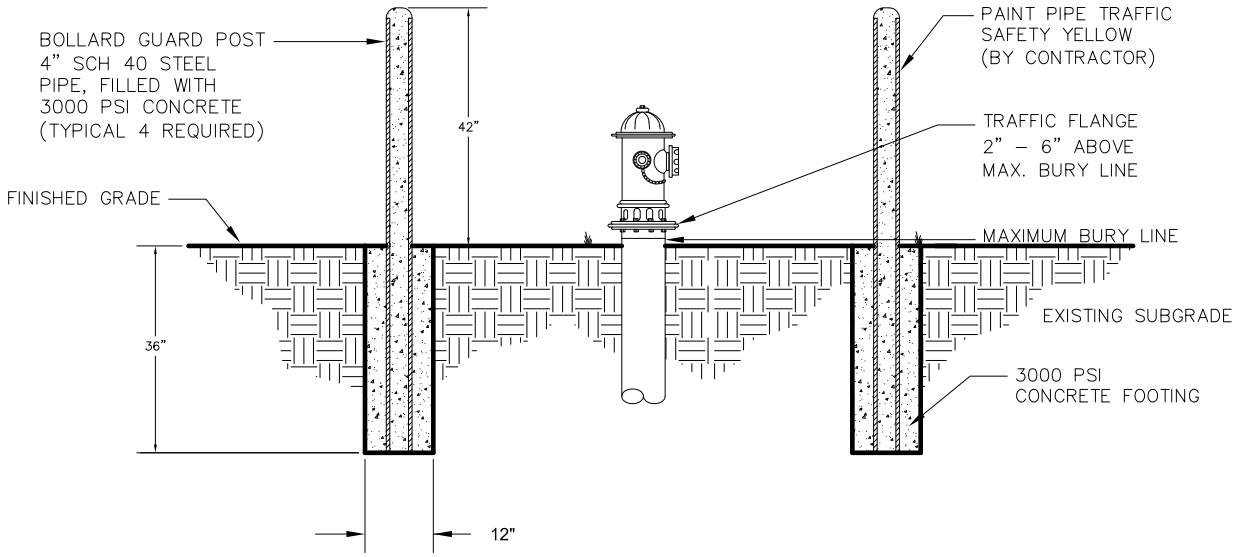
STANDARD UTILITY MARKER FOR RECLAIMED WATER MAIN

SCALE:	DETAIL #
Not To Scale	WS_RMRK
REVISION DATE:	SHEET #:
May, 2016	1 of 1





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FIRE HYDRANT BOLLARD DETAIL

SCALE:	DETAIL #
Not To Scale	WS_FHB
REVISION DATE:	SHEET #:
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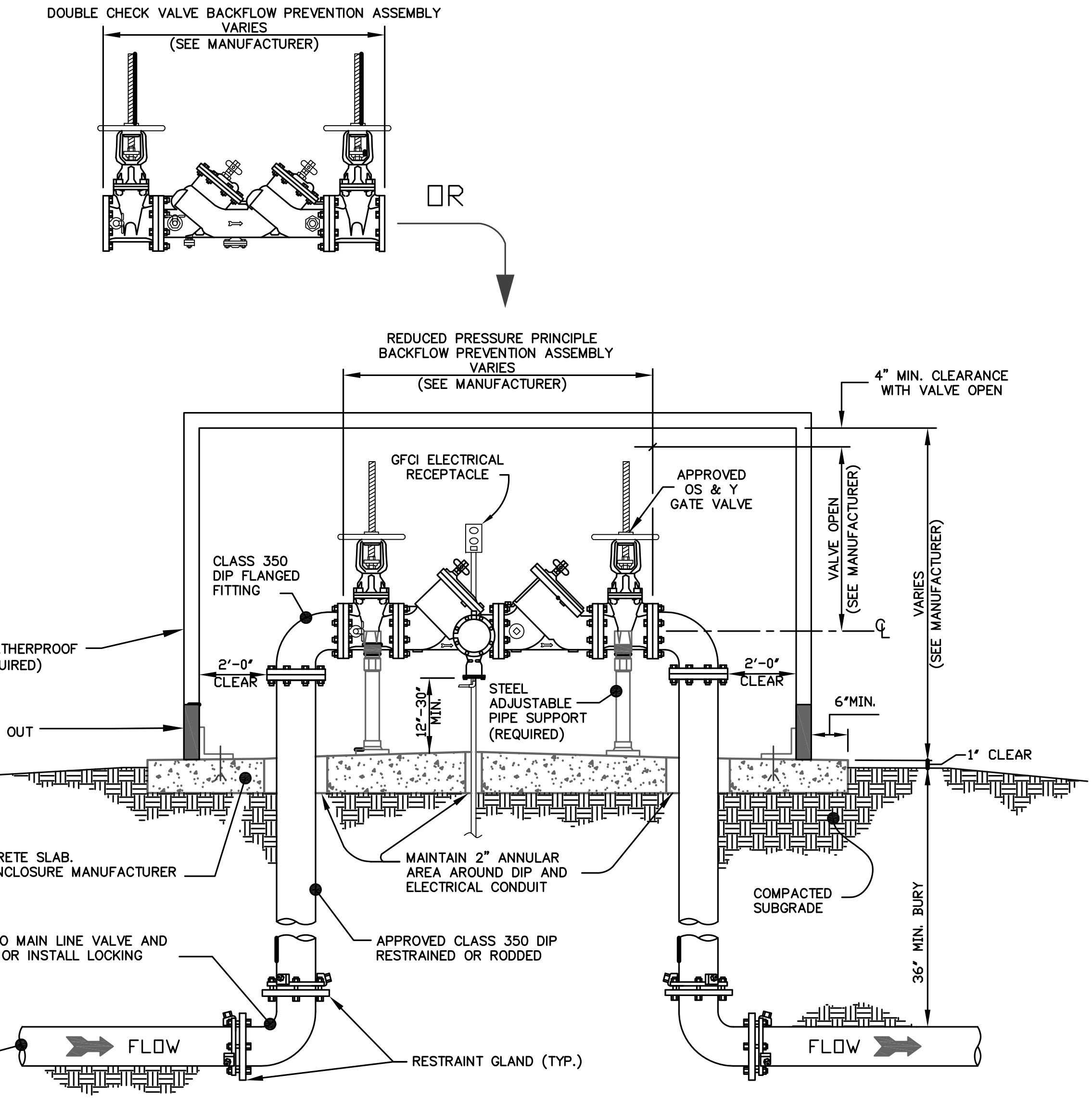
NOTES:
1. REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY SHALL COMPLY WITH ASSE 1013 & AWWA C511.
2. REDUCED PRESSURE DETECTOR BACKFLOW PREVENTION ASSEMBLY SHALL COMPLY WITH ASSE 1047.
3. DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY SHALL COMPLY WITH ASSE 1015 & AWWA C510.
4. DOUBLE CHECK DETECTOR BACKFLOW PREVENTION ASSEMBLY SHALL COMPLY WITH ASSE 1048.
5. BACKFLOW ASSEMBLY SHALL BE CENTERED ON CONCRETE PAD AND CENTERED WITHIN ENCLOSURE.
6. CLASS I, ASSE 1060 INSULATED WEATHERPROOF ENCLOSURE REQUIRED.
7. STANDARD 120V GFCI ELECTRICAL RECEPTACLE TO BE INSTALLED IN ACCORDANCE WITH THE N.C. ELECTRICAL CODE FOR OUTDOOR OPERATION.
8. PIPE MATERIAL SHALL BE CLASS 350 DIP APPROVED BY THE ONWASA.
9. INSTALLATION SHALL BE IN COMPLIANCE WITH ALL APPLICABLE TOWN ORDINANCES AND SPECIFICATIONS IN ADDITION TO THE N.C. PLUMBING CODE & ONWASA BFCC REGULATIONS & APPROVAL.
10. PROPERTY OWNER SHALL BE RESPONSIBLE FOR MAINTENANCE AND OPERATION OF BACKFLOW ASSEMBLY AND COMPLIANCE WITH REPORTING AND TESTING REQUIREMENTS.



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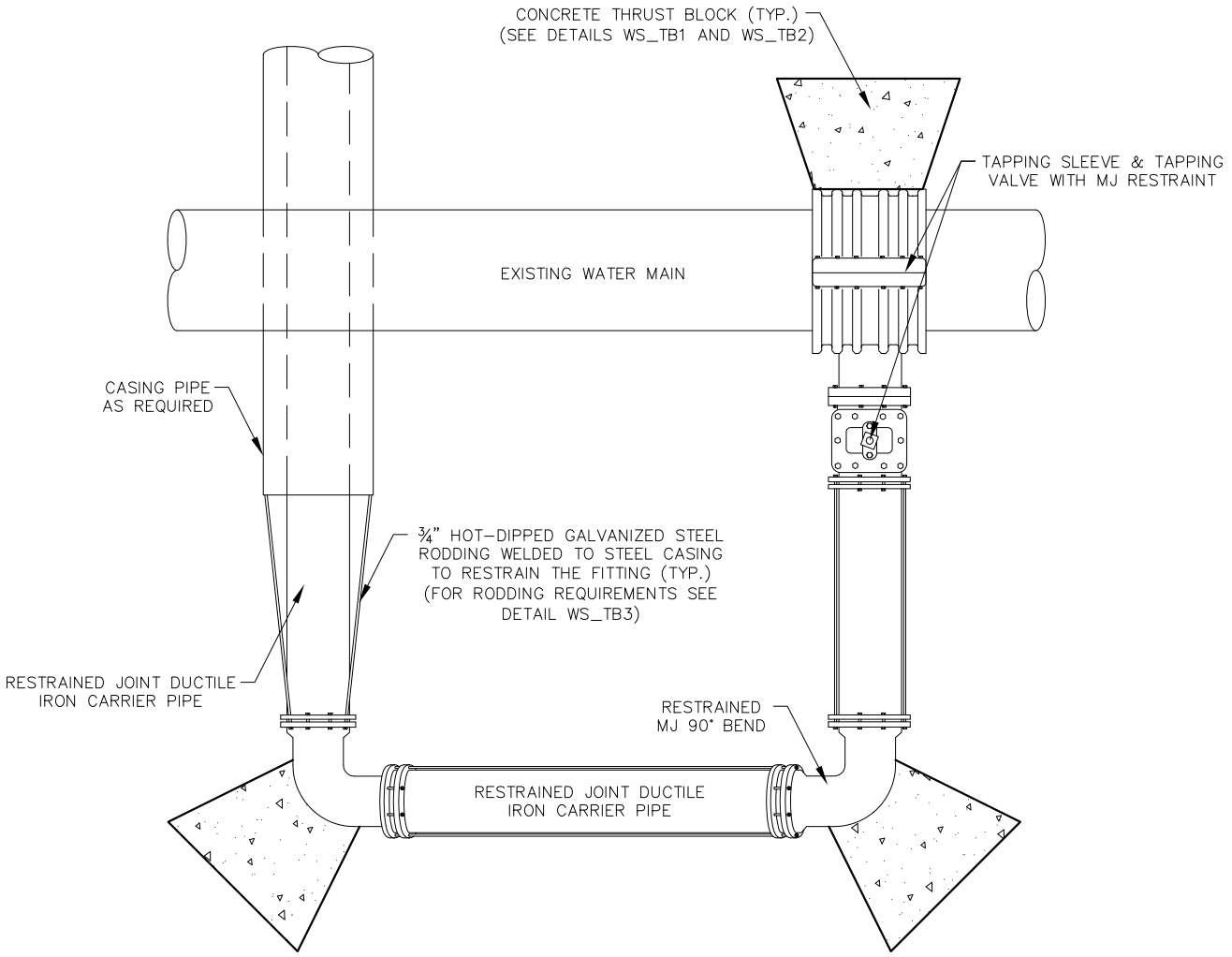
STANDARD COMMERCIAL OUTDOOR BACKFLOW ASSEMBLY (2 $\frac{1}{2}$" DIAMETER & LARGER)

SCALE:	DETAIL #
Not To Scale	WS_BKF
REVISION DATE: May, 2016	SHEET #: 1 of 1



NOTE:
1. ALL JOINTS THROUGHOUT ENTIRE ASSEMBLY SHALL BE RESTRAINED.
2. MUST USE DUCTILE IRON EYE BOLTS WHERE NECESSARY.
3. ANGLE FITTINGS AS NECESSARY.

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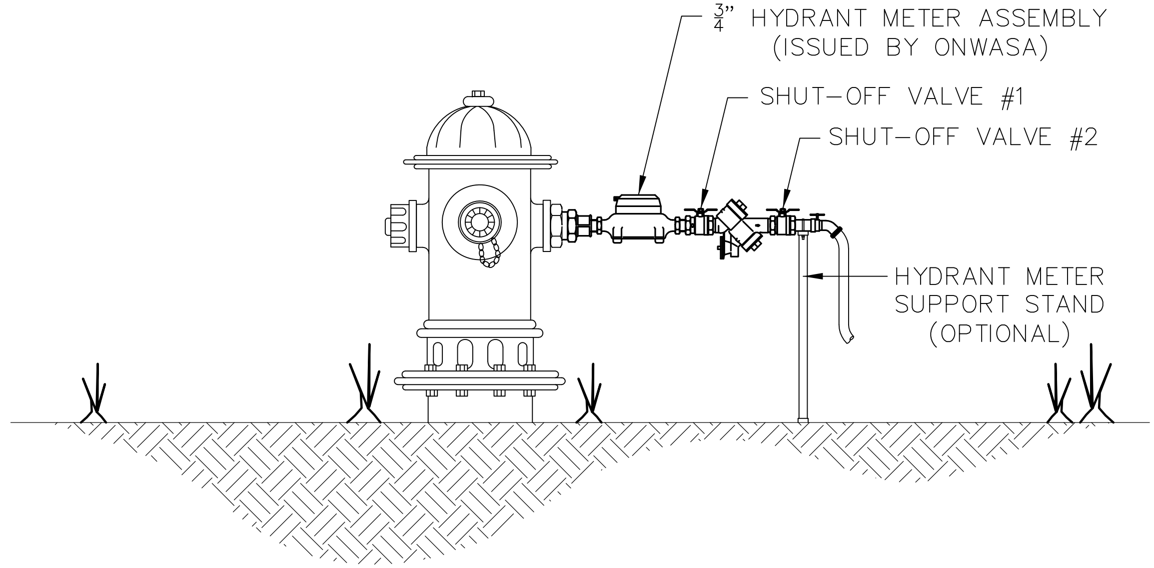
BACKSIDE TAP

SCALE:	DETAIL #
Not To Scale	WS_BST
REVISION DATE:	SHEET #:
May, 2016	1 of 1



NOTES:

1. HYDRANT METER SUPPORT IS OPTIONAL. ACCEPTABLE FORMS OF SUPPORT INCLUDE (BUT ARE NOT LIMITED TO) BRICKS, CONCRETE BLOCKS, AND METER BOXES. OTHER FORMS OF SUPPORT SHALL BE APPROVED BY ONWASA.
2. IN ACCORDANCE WITH ONWASA'S STANDARD FEE SCHEDULE, ANY DAMAGE DONE TO AN ONWASA ISSUED FIRE HYDRANT METER, AND/OR BACKFLOW ASSEMBLY, WILL RESULT IN A $100.00 HYDRANT METER TESTING FEE. THE CONTRACTOR WILL ALSO BE RESPONSIBLE FOR THE COST OF REPLACEMENT PARTS.
3. WHEN FLOWING, HYDRANT SHALL BE OPENED FULLY AND THROTTLING SHALL BE DONE USING THE NUMBER 2 SHUT OFF VALVE.

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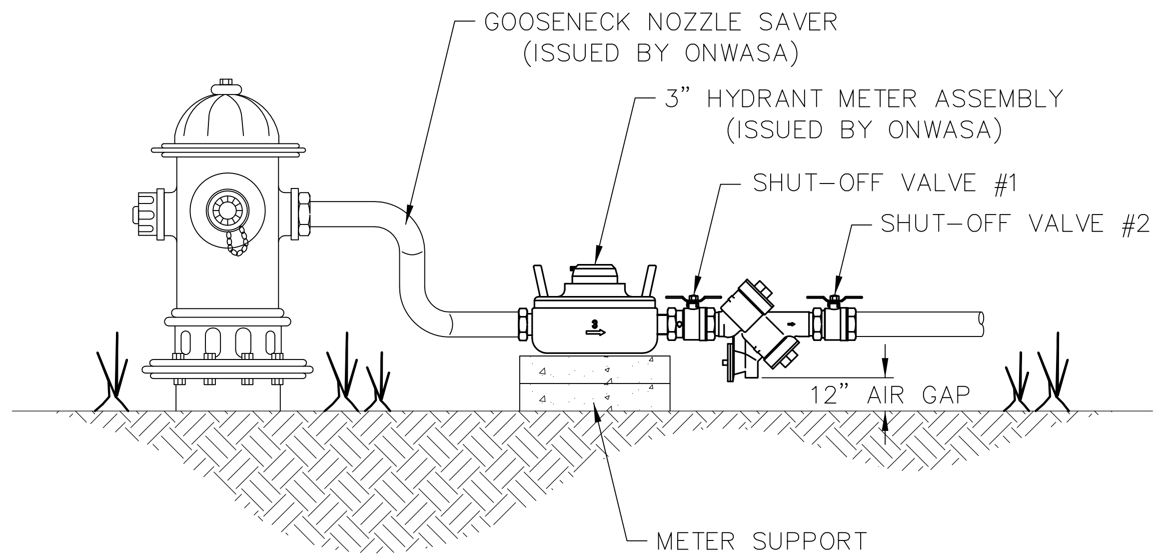
3/4" Fire Hydrant Meter Installation

SCALE: Not To Scale

DETAIL # WS_FHM3/4

REVISION DATE: May, 2016

SHEET #: 1 of 1



NOTES:

1. HYDRANT METER MUST BE SUPPORTED AT ALL TIMES WHILE IN USE. ACCEPTABLE FORMS OF SUPPORT INCLUDE (BUT ARE NOT LIMITED TO) BRICKS, CONCRETE BLOCKS, AND METER BOXES. OTHER FORMS OF SUPPORT SHALL BE APPROVED BY ONWASA.
2. IN ACCORDANCE WITH ONWASA'S STANDARD FEE SCHEDULE, ANY DAMAGE DONE TO AN ONWASA ISSUED FIRE HYDRANT METER, AND/OR BACKFLOW ASSEMBLY, WILL RESULT IN A $100.00 HYDRANT METER TESTING FEE. THE CONTRACTOR WILL ALSO BE RESPONSIBLE FOR THE COST OF REPLACEMENT PARTS.
3. WHEN FLOWING, HYDRANT SHALL BE OPENED FULLY AND THROTTLING SHALL BE DONE USING THE NUMBER 2 SHUT OFF VALVE.

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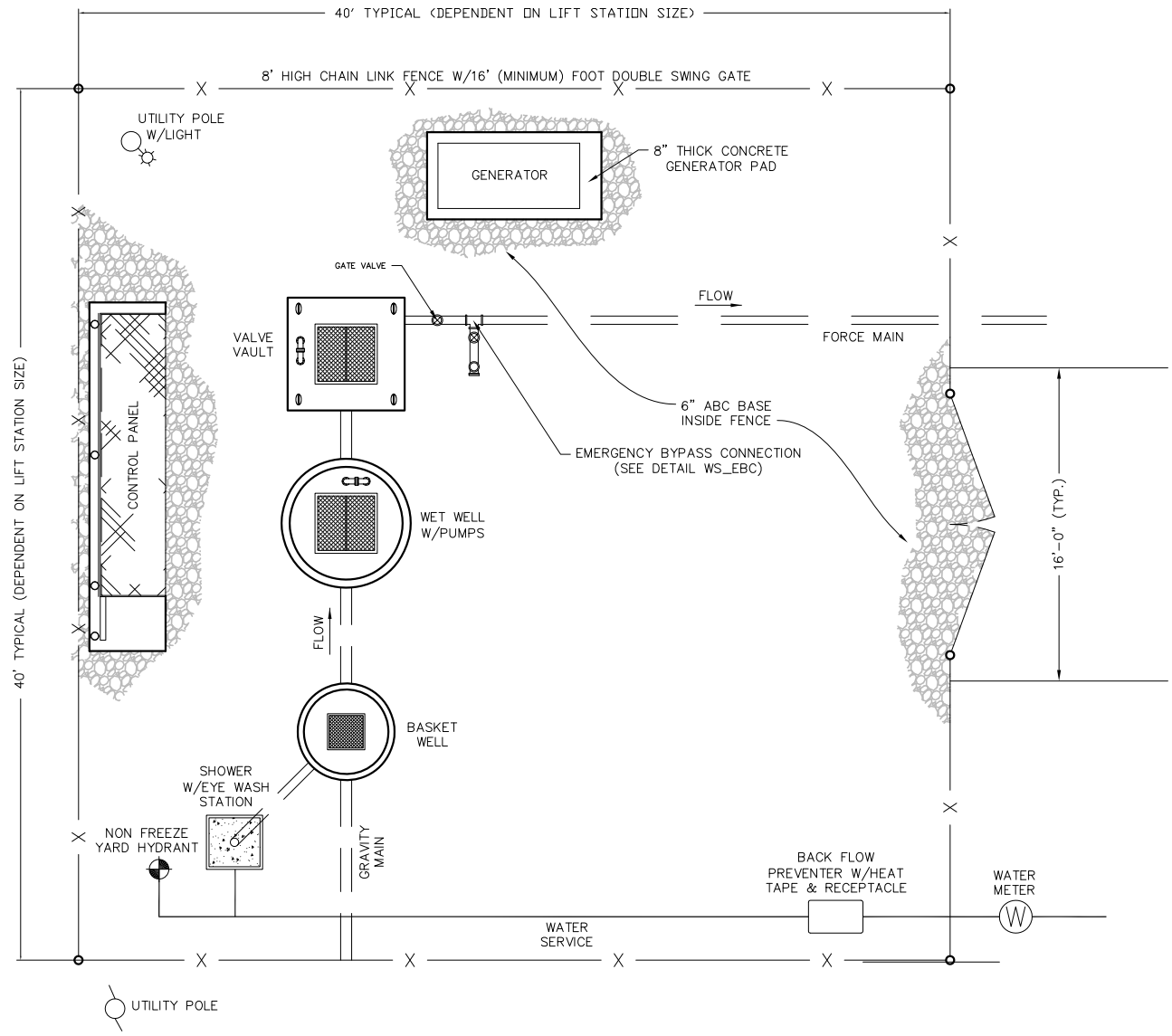
3" Fire Hydrant Meter Installation

SCALE: Not To Scale

DETAIL # WS_FHM3

REVISION DATE: May, 2016

SHEET #: 1 of 1



NOTES:
1. EYE WASH STATION MAY BE REQUIRED IF A CHEMICAL FEED SYSTEM IS REQUIRED.

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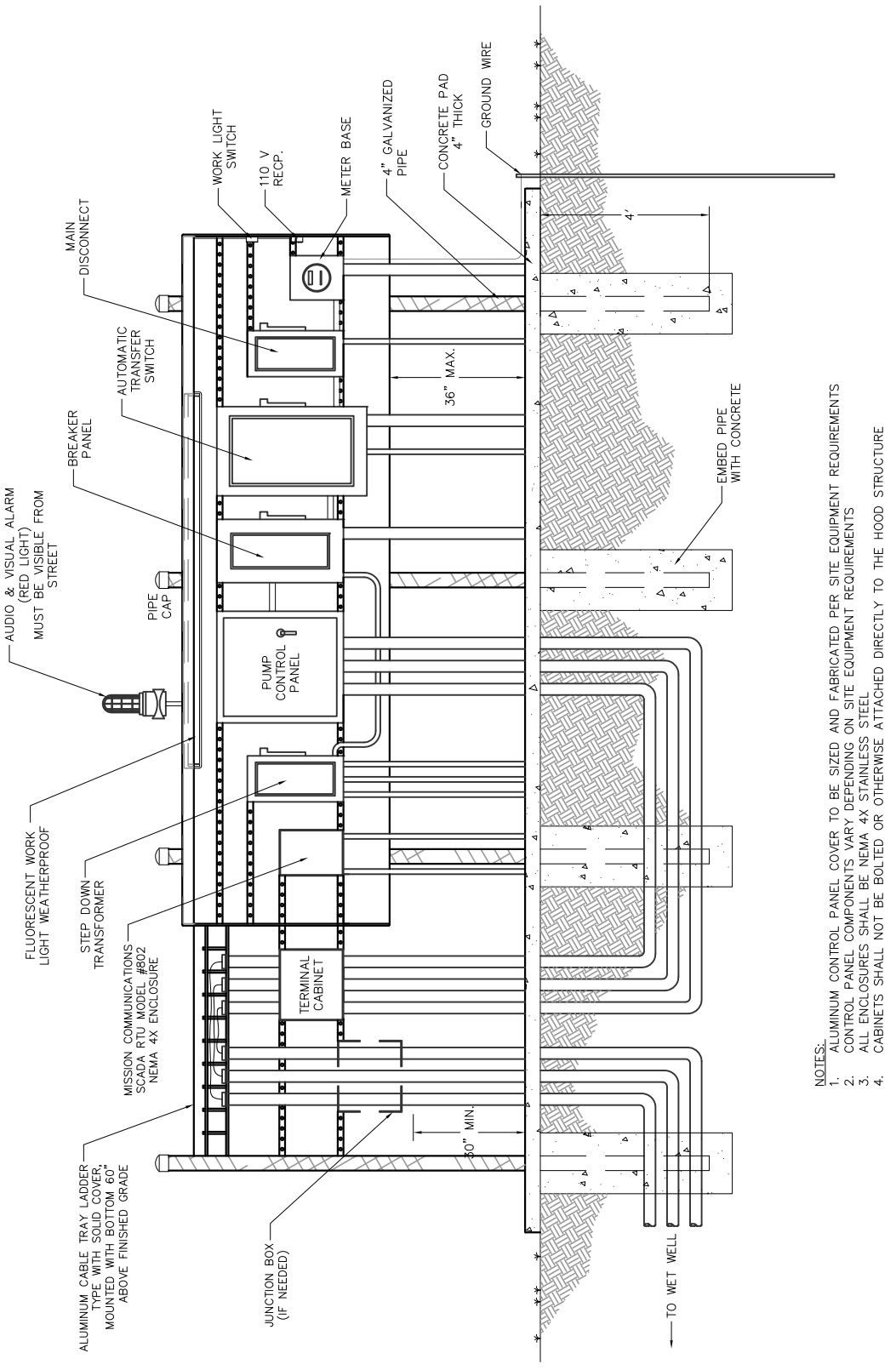
TYPICAL LIFT STATION DETAIL

SCALE:	DETAIL #
Not To Scale	SS_LS
REVISION DATE:	SHEET #:
May, 2016	1 of 1



NOTES:
1. ALUMINUM CONTROL PANEL COVER TO BE SIZED AND FABRICATED PER SITE EQUIPMENT REQUIREMENTS
2. CONTROL PANEL COMPONENTS VARY DEPENDING ON SITE EQUIPMENT REQUIREMENTS
3. ALL ENCLOSURES SHALL BE NEMA 4X STAINLESS STEEL
4. CABINETS SHALL NOT BE BOLTED OR OTHERWISE ATTACHED DIRECTLY TO THE HOOD STRUCTURE

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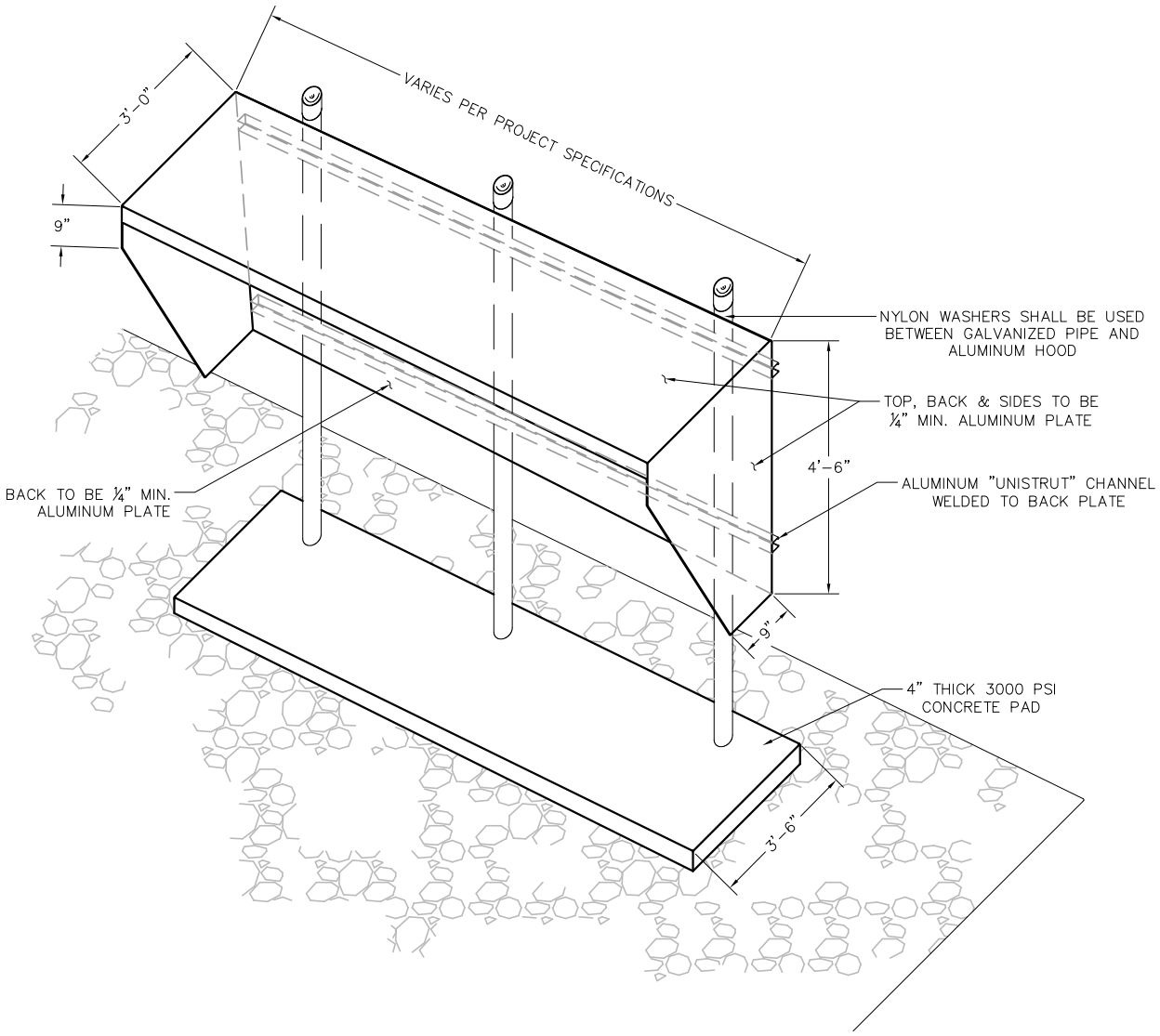
CONTROL PANEL DETAIL

SCALE:	DETAIL #
Not To Scale	SS_CPAN
REVISION DATE:	SHEET #:
May, 2016	1 of 2



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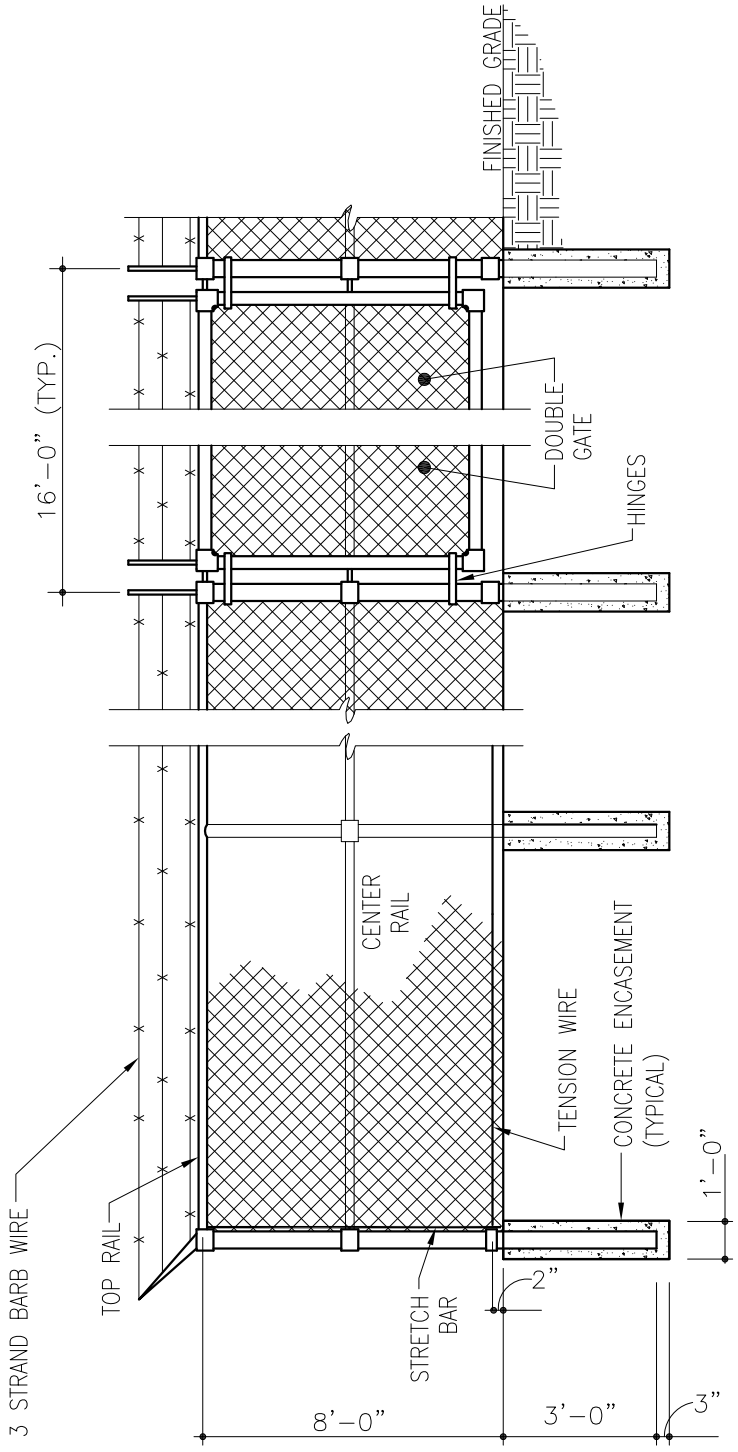
CONTROL PANEL DETAIL

SCALE:	DETAIL #
Not To Scale	SS_CPAN
REVISION DATE:	SHEET #:
May, 2016	2 of 2



NOTES:

1. DOUBLE GATE SHALL HAVE A LOCKING MECHANISM, DROP ROD, AND TRUSS ROD.
2. ALL FENCE COMPONENT MATERIALS SHALL BE THERMALLY FUSED AND BONDED VINYL COATED (GREEN OR BLACK) WITH A 9 GAUGE CORE

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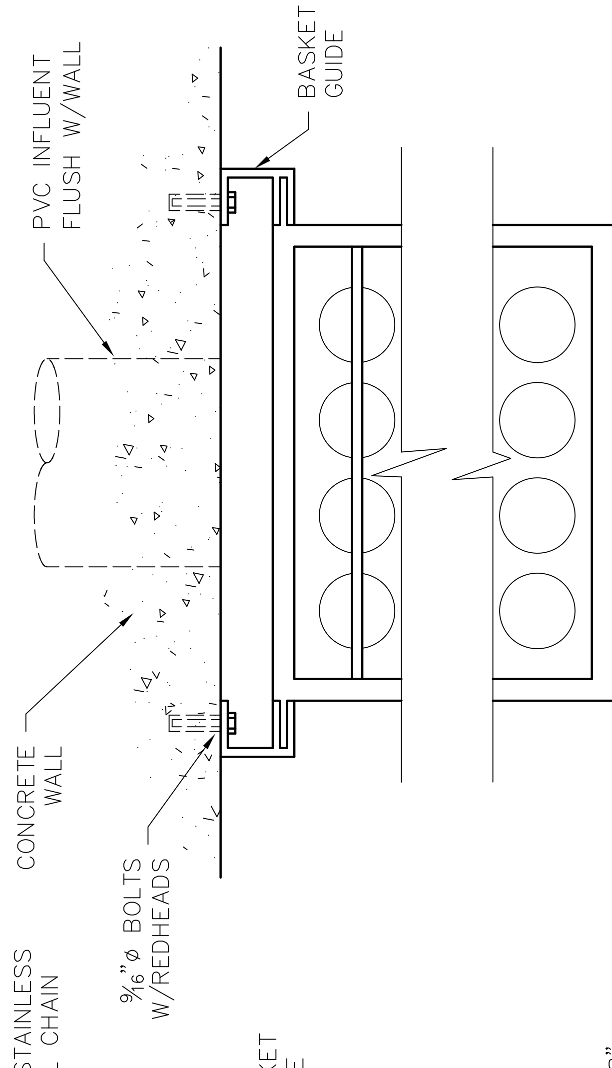
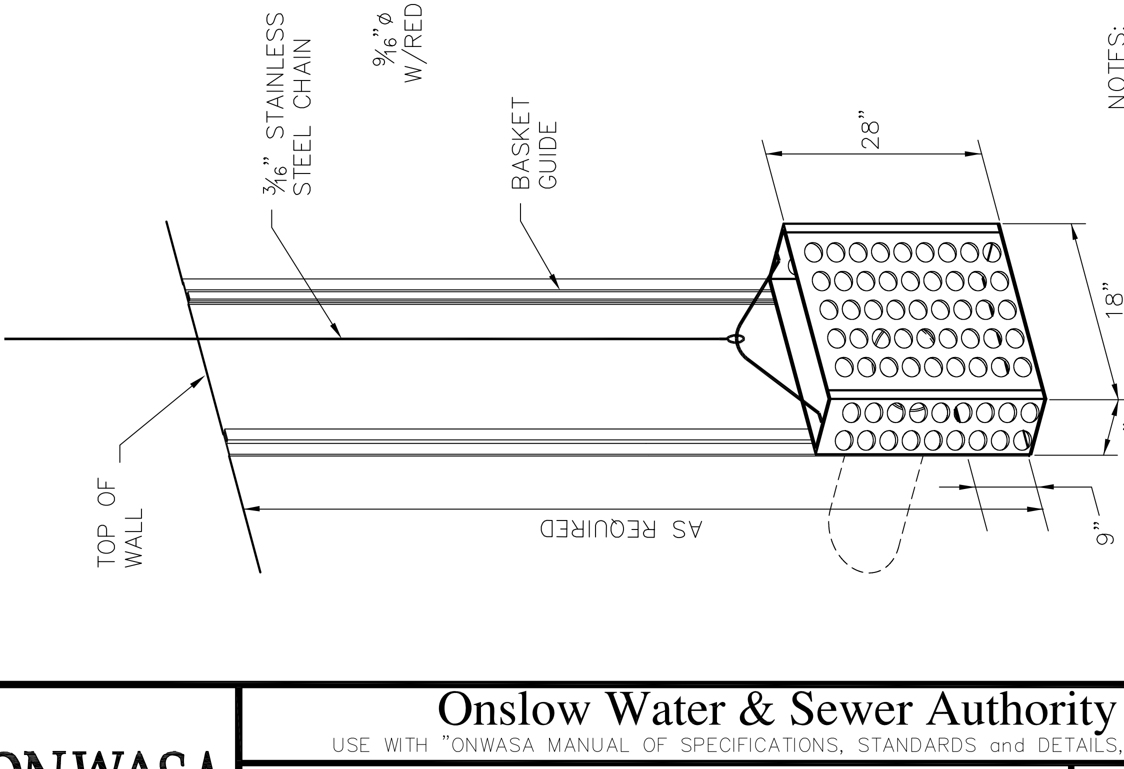
CHAIN LINK FENCE AND GATE

SCALE:	DETAIL #
Not To Scale	SS_CLF
REVISION DATE:	SHEET #:
May, 2016	1 of 1



BASKET GUIDE DETAIL



NOTES:
1. DEBRIS BASKET SHALL BE HALLIDAY SERIES B1A OR APPROVED EQUAL
2. ALL HARDWARE SHALL BE STAINLESS STEEL.
3. BASKET AND GUIDE SHALL BE ALUMINUM ALLOY.
4. BASKET AND GUIDE RAILS SHALL BE EASILY ACCESSIBLE FROM ACCESS HATCH.

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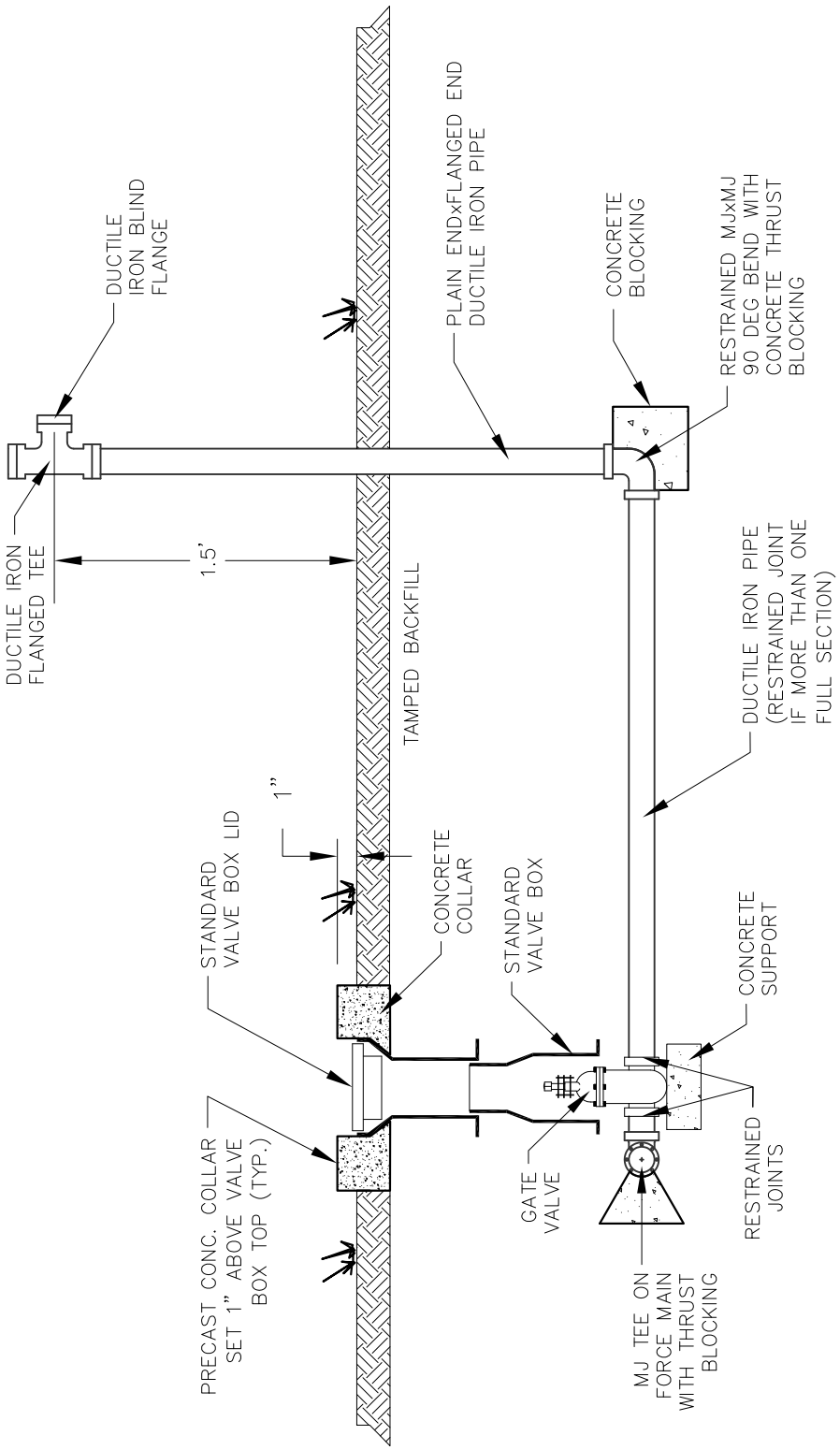
DEBRIS BASKET

SCALE: Not To Scale	DETAIL # SS_BAS
REVISION DATE: May, 2016	SHEET #: 1 of 1



NOTES:
1. EMERGENCY BYPASS CONNECTION ASSEMBLIES SHALL BE MINIMUM 6-INCH DIAMETER (PIPING, FITTINGS, VALVES, ETC.). LARGER DIAMETER ASSEMBLIES MAY BE REQUIRED AS DIRECTED BY ONWASA.
2. ALL JOINTS SHALL BE RESTRAINED

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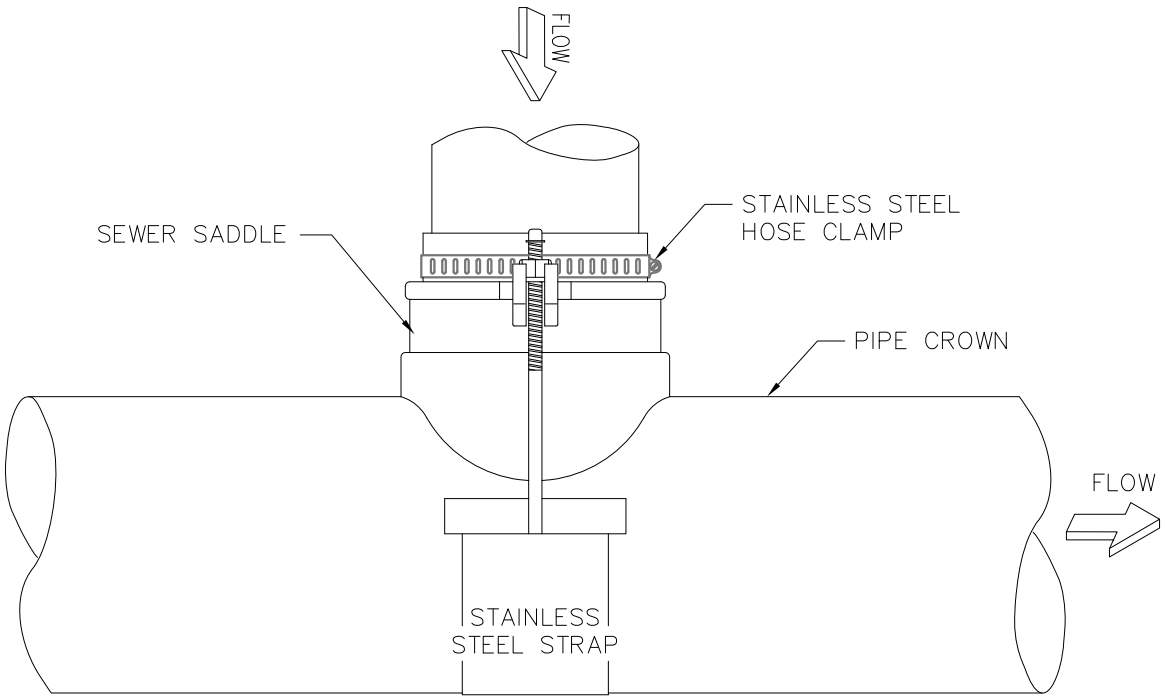
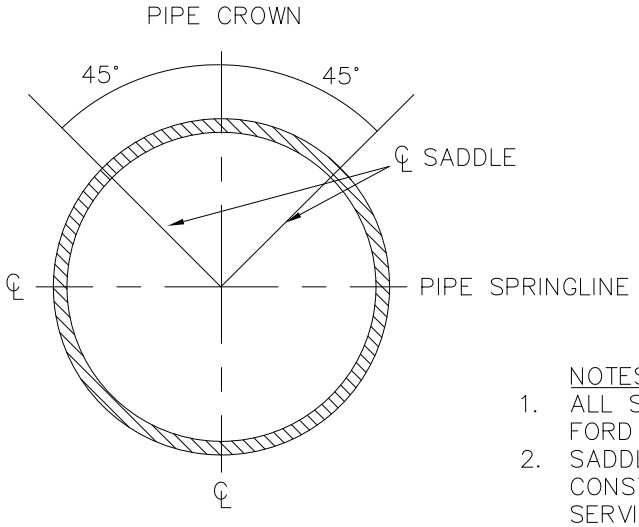
EMERGENCY BYPASS CONNECTION

SCALE: Not To Scale	DETAIL # SS_EBC
REVISION DATE: May, 2016	SHEET #: 1 of 1



BACKFILL UNDER SADDLE, ADAPTOR, AND PIPE BEND WITH NO.57 STONE AS SHOWN ON PIPE EMBEDMENT DETAIL.



SADDLE INSTALLATION LIMITS

NOTES:

1. ALL SEWER SADDLES SHALL BE ROMAC CB OR FORD FFS STYLE, UNLESS OTHERWISE APPROVED
2. SADDLES ARE NOT PERMITTED FOR USE ON NEW CONSTRUCTION. WYES SHALL BE INSTALLED FOR SERVICE CONNECTIONS ON ALL NEW CONSTRUCTION
3. USE AT DEPTHS FROM 3 TO 6–FEET

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LATERAL SADDLE INSTALLATION DETAIL FOR PVC PIPE

SCALE:	DETAIL #
Not To Scale	SS_LAT
REVISION DATE:	SHEET #:
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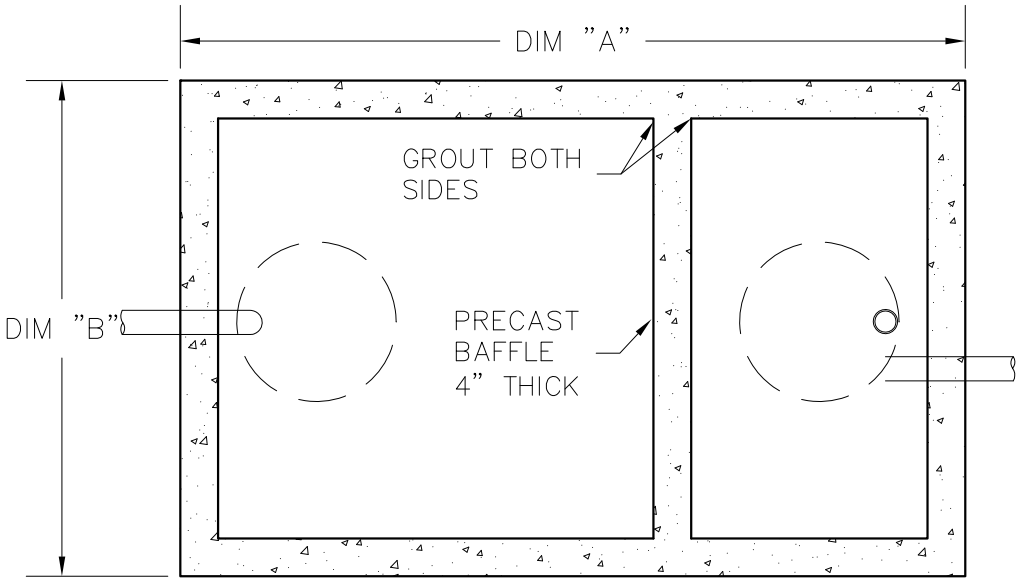

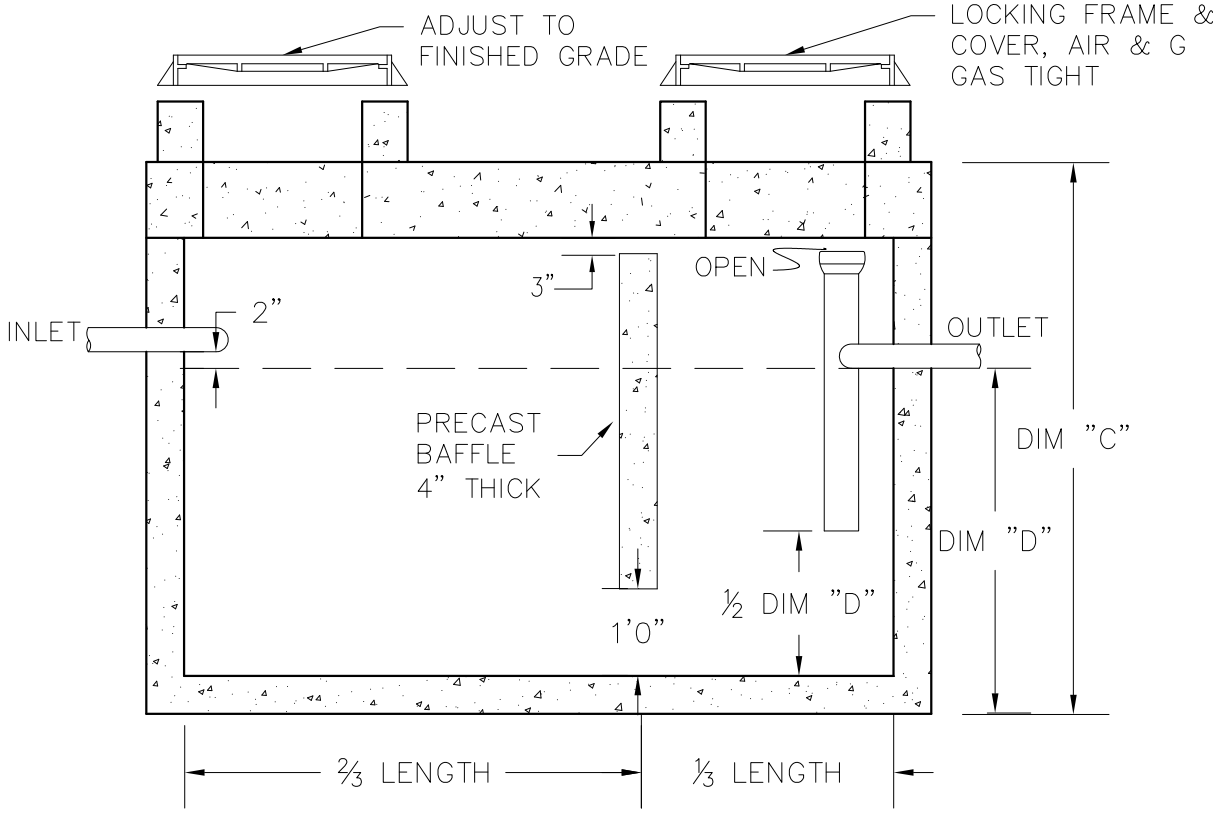

THE OIL AND GREASE TRAP DIMENSIONAL DETAIL CONTAINS THE DIMENSION CHART FOR THE OIL/GREASE TRAP

NOTE: GREASE TRAPS SHALL BE A MINIMUM OF 1,000 GAL.

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OIL AND GREASE TRAP SIZING

SCALE:	DETAIL #
Not To Scale	SS_OG
REVISION DATE:	SHEET #:
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OIL AND GREASE TRAP DIMENSION CHART

CAP (GAL.)	DIM "A"	DIM "B"	DIM "C"	DIM "D"
1000	9'0"	5'0"	7'2"	4'2"
1250	9'0"	5'0"	7'2"	5'2"
1500	11'2"	5'8"	7'2"	4'4"
1750	11'2"	5'8"	7'2"	4'11"
2000	12'8"	6'8"	8'0"	4'7"
2500	12'8"	6'8"	8'0"	5'6"
2750	12'8"	6'8"	8'0"	6'0"
3000	15'7"	9'7"	8'6.5"	5'0"
4000	15'7"	9'7"	8'6.5"	6'3"
5000	19'11"	9'11"	8'11"	6'2"
6000	19'11"	9'11"	10'5"	7'2"

NOTES:

1. CONCRETE: 28 DAY fc=4500 psi
2. REBAR: ASTM A-615 GRADE 60
3. MESH: ASTM A-185 GRADE 65
4. DESIGN: ACI 318-83 BUILDING CODE ASTM C-857 MINIMUM STRUCTURAL DESIGN LOADING FOR UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES
5. LOADS: H-20 TRUCK WHEEL WITH 30% IMPACT PER AASHTO
6. FILL WITH CLEAN WATER PRIOR TO START UP OF SYSTEM
7. CONTRACTOR TO SUPPLY AND INSTALL ALL PIPING, SANITARY TEE's, AND 4" DUAL SWEEP CLEAN OUTS (FOR CLEANING TOWARD AND AWAY FROM TRAP ON BOTH THE INLET AND OUTLET SIDE).
8. GRAY WATER ONLY, BLACK WATER SHALL BE CARRIED BY SEPARATE SEWER.
9. ALL PIPE PENETRATIONS SHALL BE THROUGH A FLEXIBLE CONNECTOR AND SEALED WATERTIGHT WITH GROUT.

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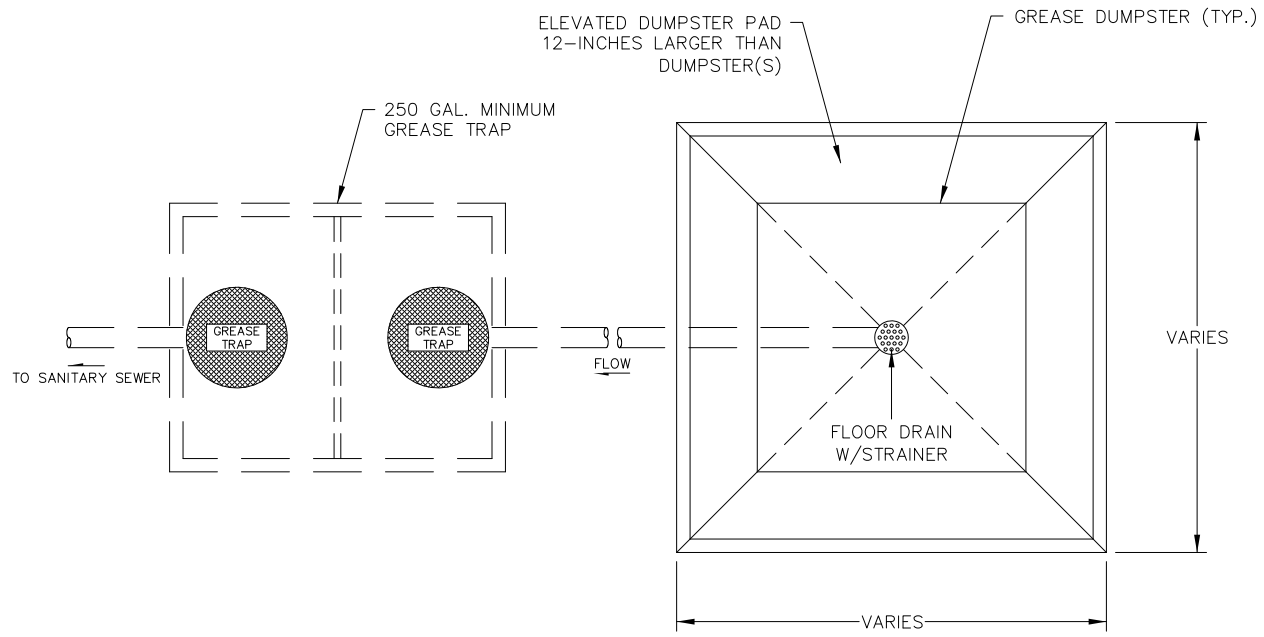
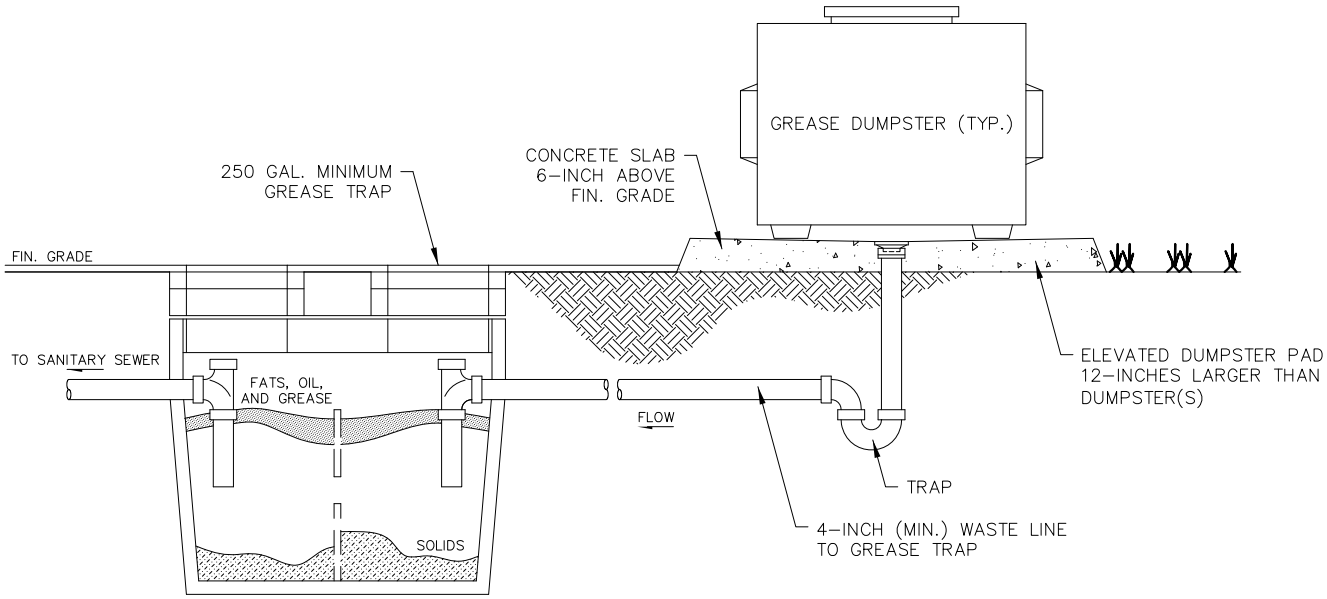
OIL AND GREASE TRAP DIMENSIONS TABLE

SCALE:	DETAIL #
Not To Scale	SS_OGS
REVISION DATE: May, 2016	SHEET #: 2 of 2





NOTES:

1. REFER TO THIS DETAIL WHEN OTHER JURISDICTIONAL AGENCIES ARE REQUIRED TO FACILITATE DUMPSTER/COMPACTORS TO BE DRAINED TO SEWER. THIS IS NOT REQUIRED BY ONWASA.
2. DUMPSTERS AND TRASH COMPACTORS SHALL INCLUDE A MIN. 250 GAL. CAPACITY GREASE TRAP (AS ILLUSTRATED ABOVE).
3. ALL SURROUNDING SURFACES SHALL BE GRADED TO SLOPE AWAY FROM DUMPSTER PAD.

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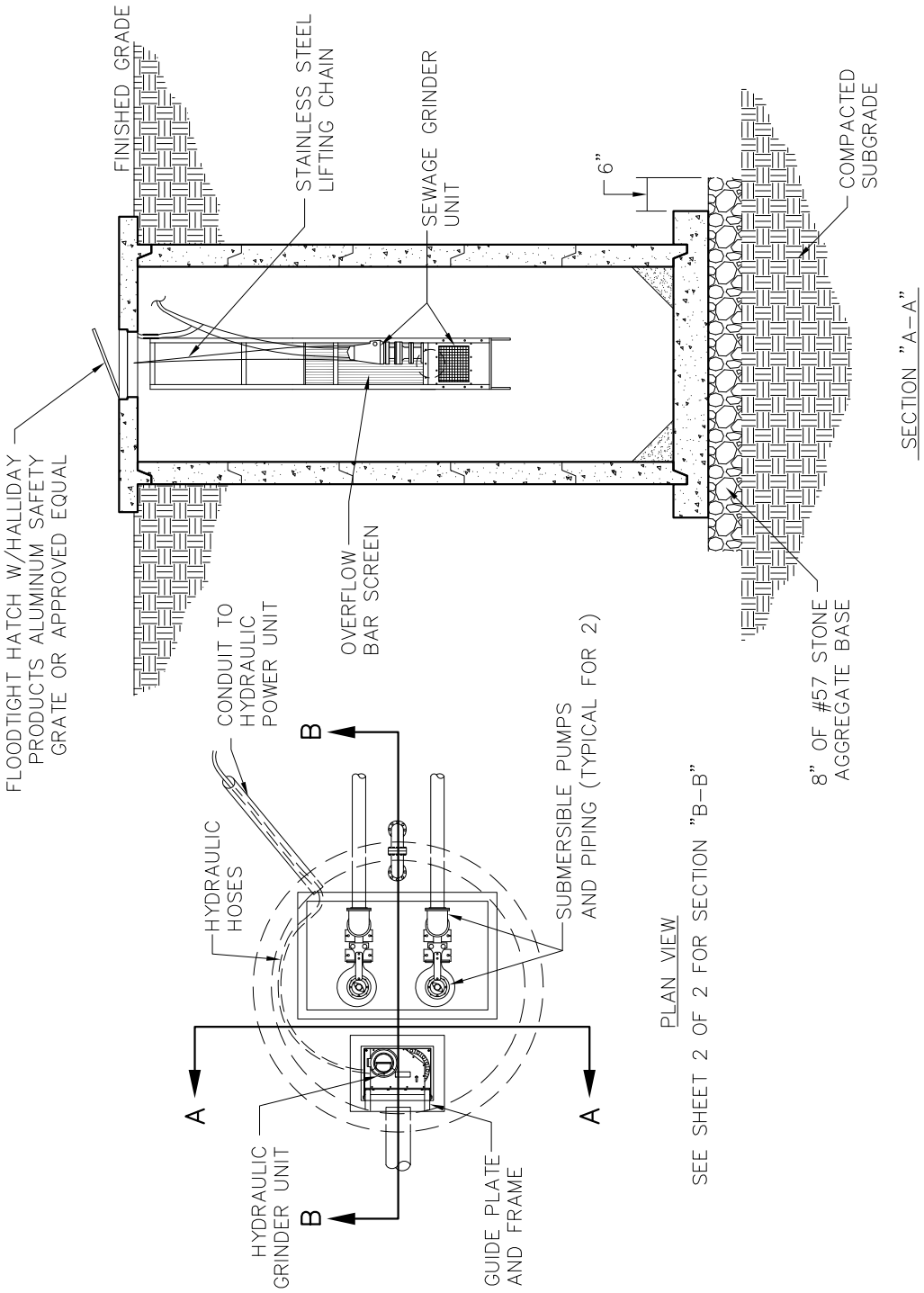
GREASE TRAP DUMPSTER W/ELEVATED PAD DRAINED TO SANITARY SEWER

SCALE:	DETAIL #
Not To Scale	SS_GTRP
REVISION DATE:	SHEET #:
May, 2016	1 of 1



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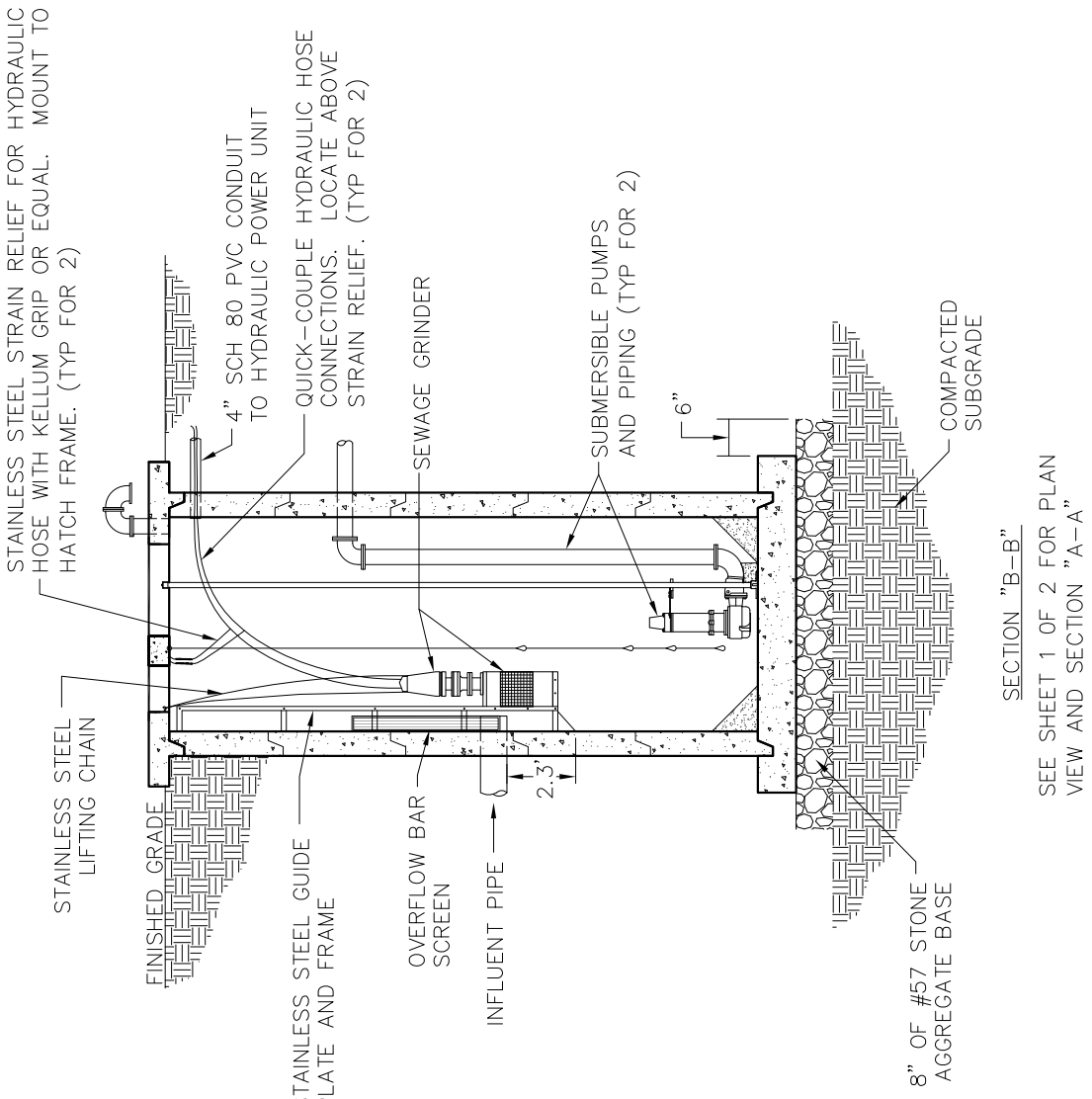
SEWAGE GRINDER UNIT WET WELL INSTALLATION

SCALE:	DETAIL #
Not To Scale	SS_SGW
REVISION DATE:	SHEET #:
May, 2016	1 of 2



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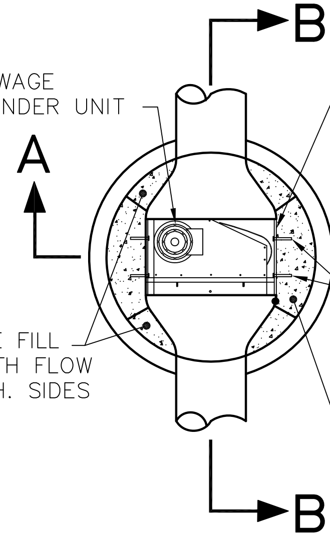
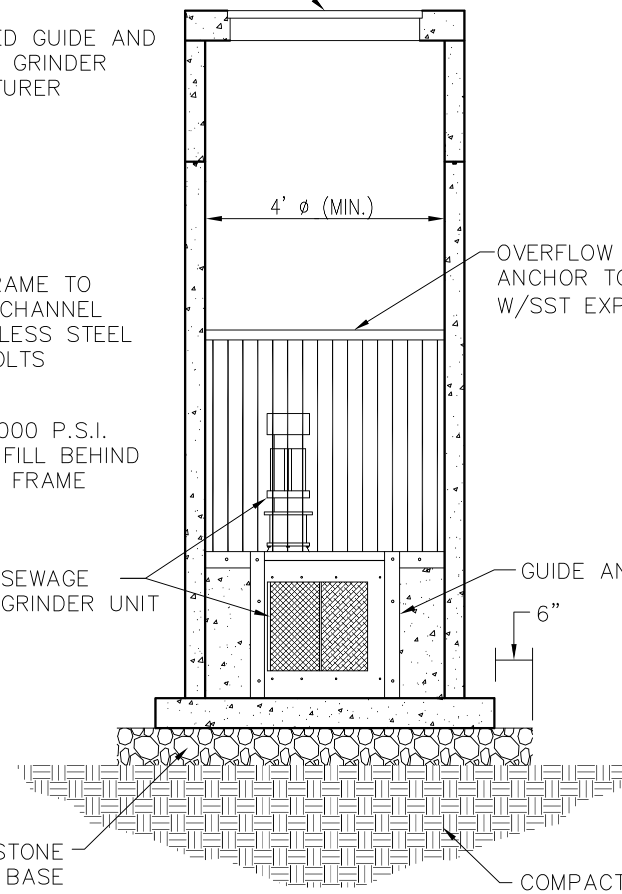
SEWAGE GRINDER UNIT WET WELL INSTALLATION

SCALE:	DETAIL #
Not To Scale	SS-SGW2
REVISION DATE:	SHEET #:
May, 2016	2 of 2



PLAN VIEW

SEE SHEET 2 OF 2 FOR SECTION "B-B"



SECTION "A-A"

NOTES:

1. THERE SHALL ONLY BE A SINGLE INFLUENT LINE INTO THE GRINDER MANHOLE.

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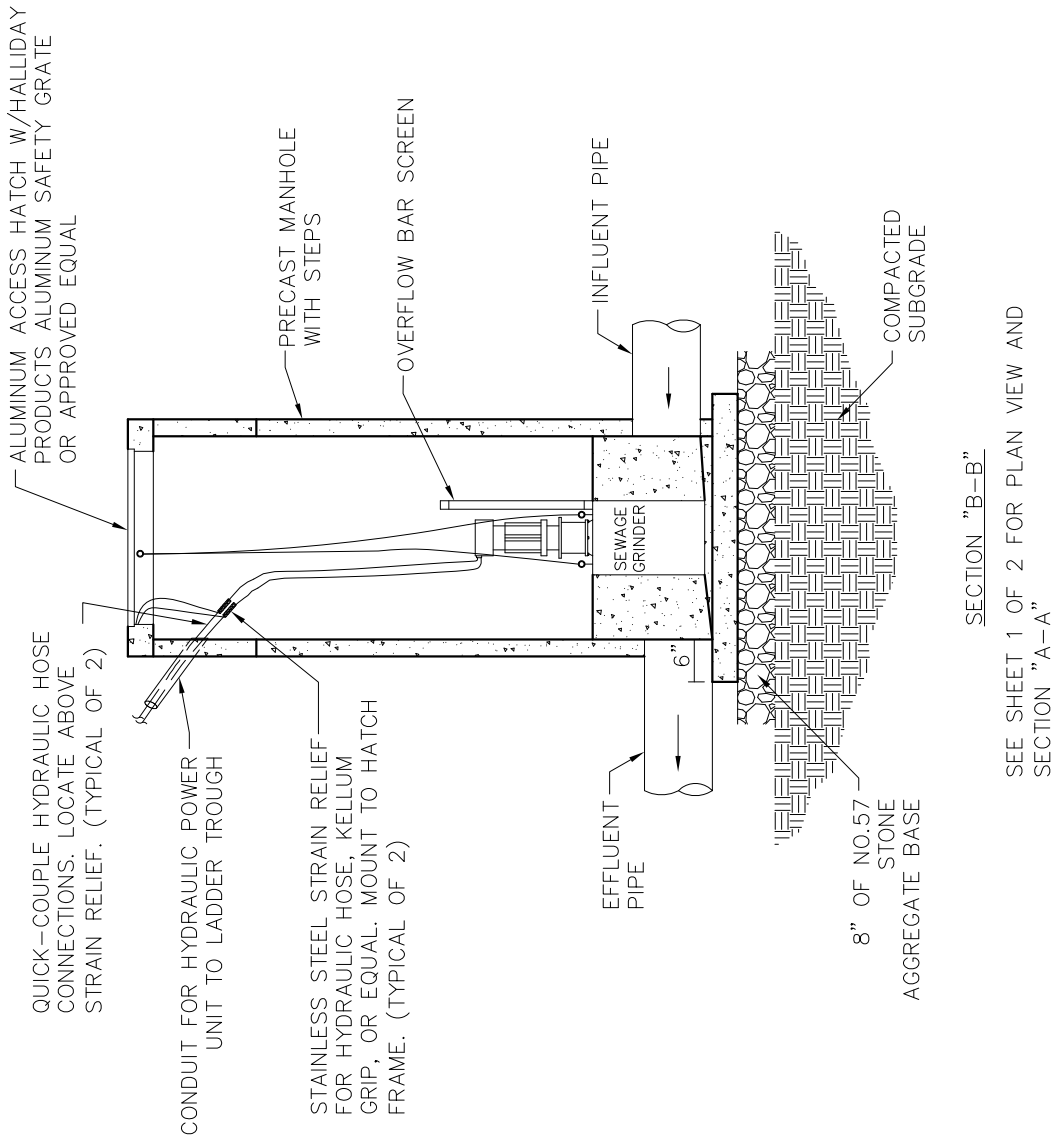
SEWAGE GRINDER UNIT MANHOLE INSTALLATION

SCALE: Not To Scale	DETAIL # SS_SGM
REVISION DATE: May, 2016	SHEET #: 1 of 2



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SEWAGE GRINDER UNIT MANHOLE INSTALLATION

SCALE:	DETAIL #
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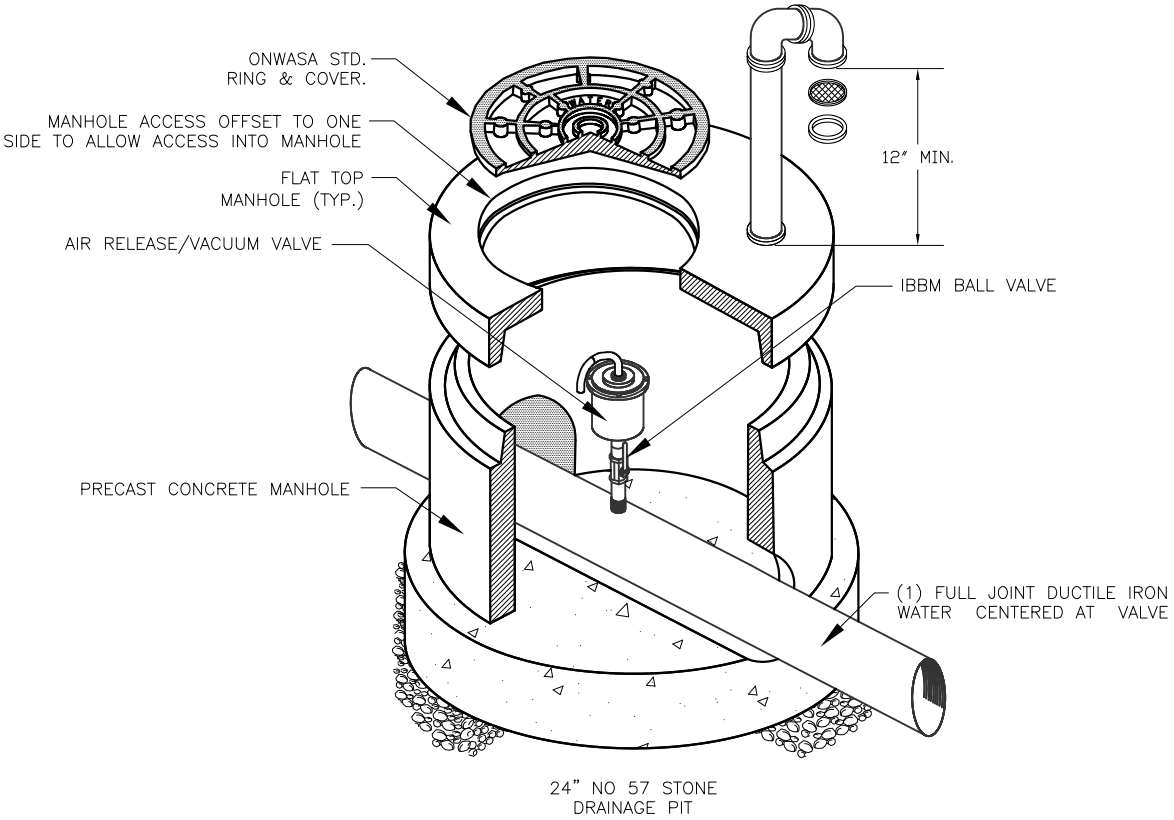
AIR RELEASE/VACUUM VALVE SEWER



1. WHEN TAPPING THE SEWER MAIN, DO NOT EXCEED THE PIPE MANUFACTURERS ALLOWANCES.
2. ON ALL AIR RELEASE VALVES USE DOUBLE STRAP SERVICE SADDLE.
3. UNLESS OTHERWISE INDICATED ON THE PLANS, MANHOLE SHALL BE FLAT-TOP.
4. AIR RELEASE/VACUUM VALVE SHALL BE CRISPIN S SERIES OR VAL-MATIC SERIES 300.
5. IF FORCE MAIN IS DUCTILE IRON UPSTREAM AND DOWNSTREAM OF AIR RELEASE VALVE, 5 FULL SECTIONS OF DUCTILE IRON PIPE, WITH EPOXY LINING PER THE PROJECT SPECIFICATIONS, SHALL BE CENTERED AT THE VALVE.
6. AIR RELEASE/VACUUM VALVE MANHOLES SHALL BE 5' MINIMUM INSIDE DIAMETER.
7. BOTTOM OF VENT PIPE SHALL BE A MINIMUM OF 12" OR 3' ABOVE FLOOD ELEVATION, WHICHEVER IS APPLICABLE

SCALE:	DETAIL #
Not To Scale	SS_ARV
REVISION DATE:	SHEET #:
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Parts List

1 - Rhino # TVF66GB - Rhino TriView Flex™, 66" Green with Black Cap OR

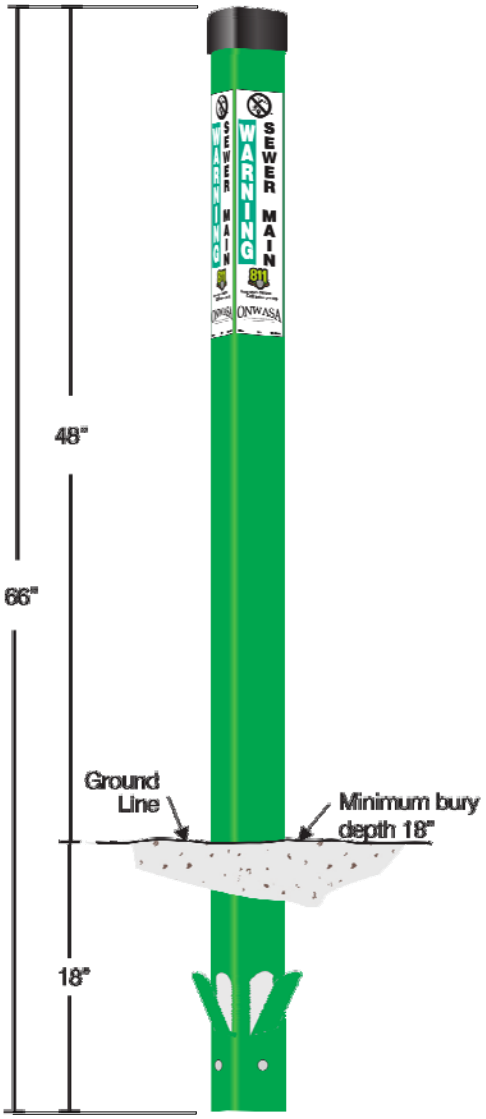
3 - Decal # SD-8354K Custom Decals

NOTES:

The TriGrip Anchor Flaps™ shall be extended prior to burial of the post. Soil shall be compacted during placement of marker post.

All materials shall be provided by Rhino Marking & Protection Sytems, Inc.

Install above-ground utility markers at all manholes



Anchor Detail

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STANDARD UTILITY MARKER FOR GRAVITY SEWER MAIN

SCALE:	DETAIL #
Not To Scale	SS_GMRK
REVISION DATE: May, 2016	SHEET #: 1 of 1

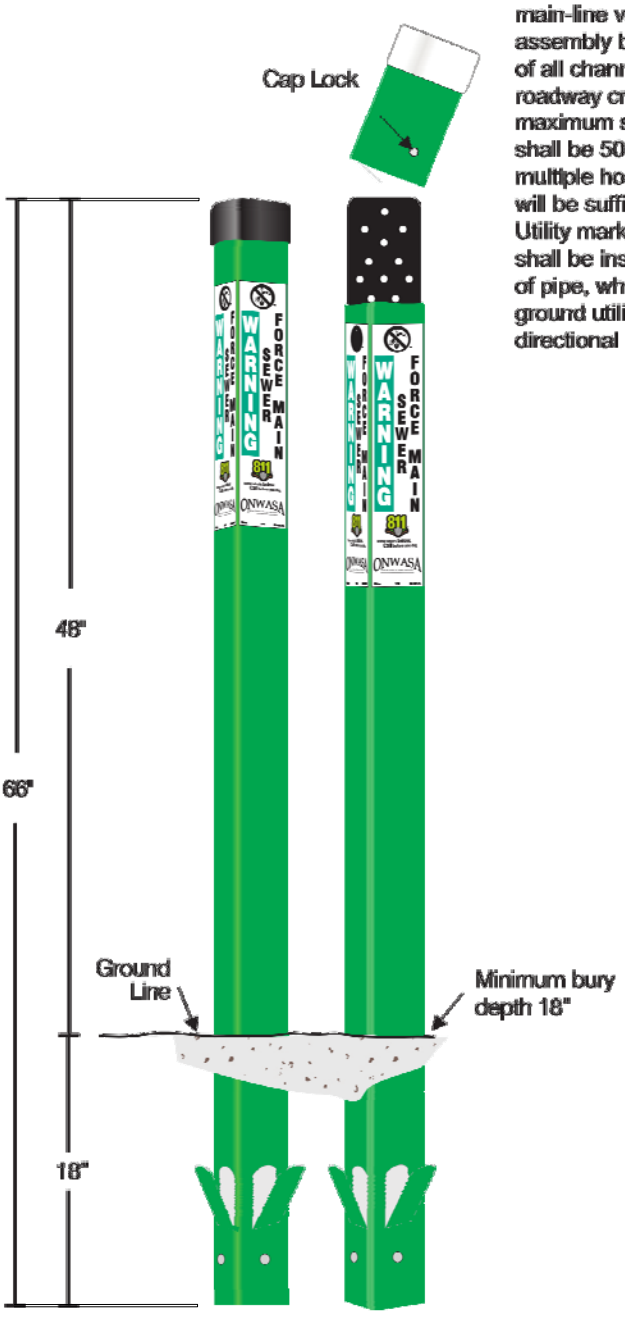
Parts List

1 - Rhino # TVF66GB - Rhino TriView Flex™, 66" Green with Black Cap OR

1 - Rhino # TVTI66GW2 - Rhino TriView™ Test Station, 66", 2 Inside Terminals, Green with White Cap

1 - Cap Lock - TS-LOCK for Test Stations

3 - Decal # SD-8517K Custom Decals



NOTES:

The TriGrip Anchor Flaps™ shall be extended priorty to burial of the post. Soil shall be compacted during placement of marker post.

All materials shall be provided by Rhino Marking & Protection Sytems, Inc.

Install above-ground utility markers at horizontal bends, main-line valve boxes (not within 10 feet of a fire hydrant assembly branch), ends of directional bores, bank edge of all channels crossed by directionl bores, each side of a roadway crossing, and along the piping alignment. The maximum spacing for the above-ground utility markers shall be 500 linear feet. In locations where there are multiple horizontal bends in close proximity, one marker will be sufficient to demonstrate the change in direction. Utility markers designed to provide access to tracer wire shall be installed at every third marker, or every 1000 feet of pipe, whichever is lesser. Tracer wire accesible above-ground utility markers shall also be installed at ends of directional bores.

Anchor Detail

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STANDARD UTILITY MARKER FOR SEWER FORCE MAIN

SCALE:	DETAIL #
Not To Scale	SS_FMRK
REVISION DATE:	SHEET #:
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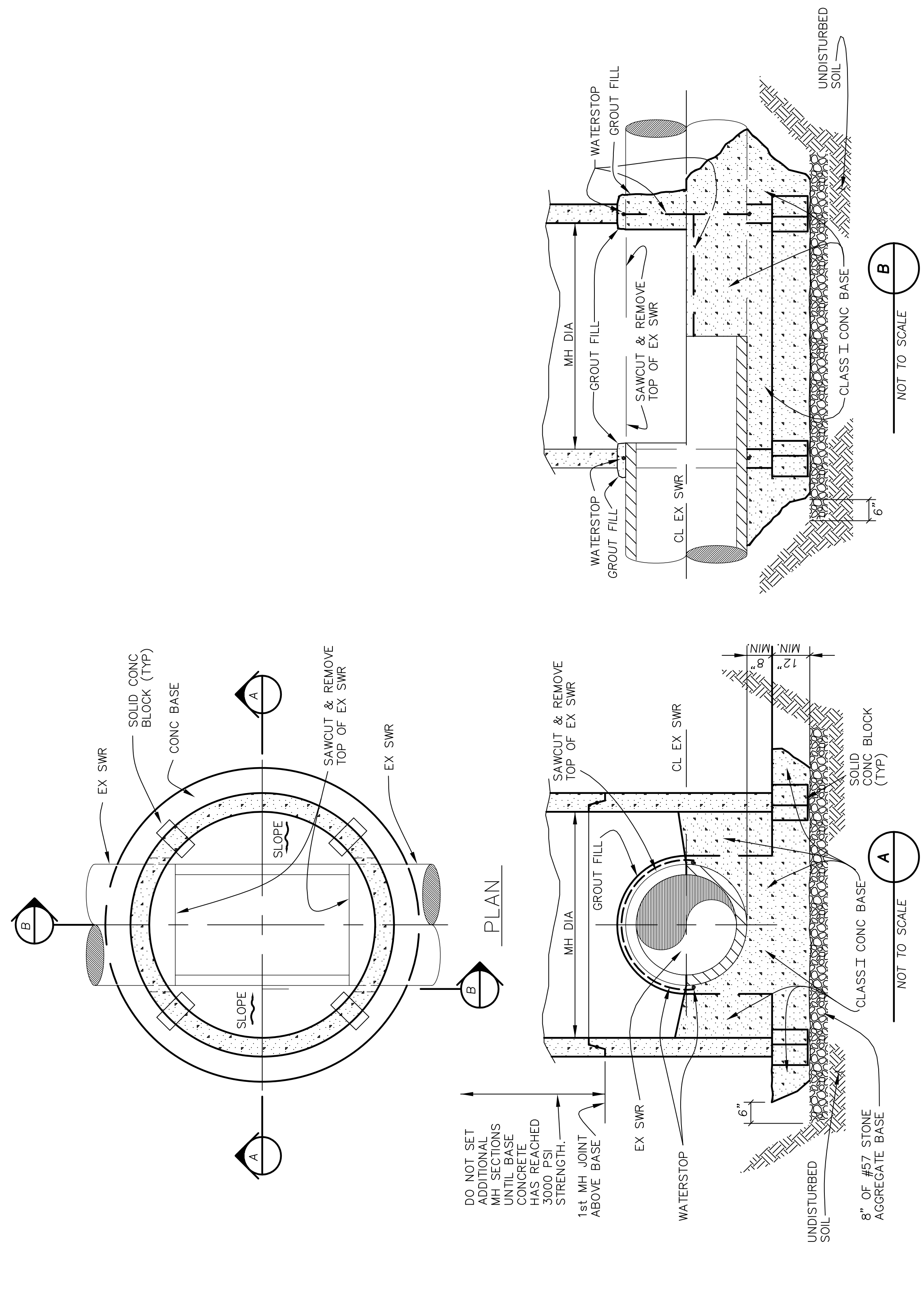

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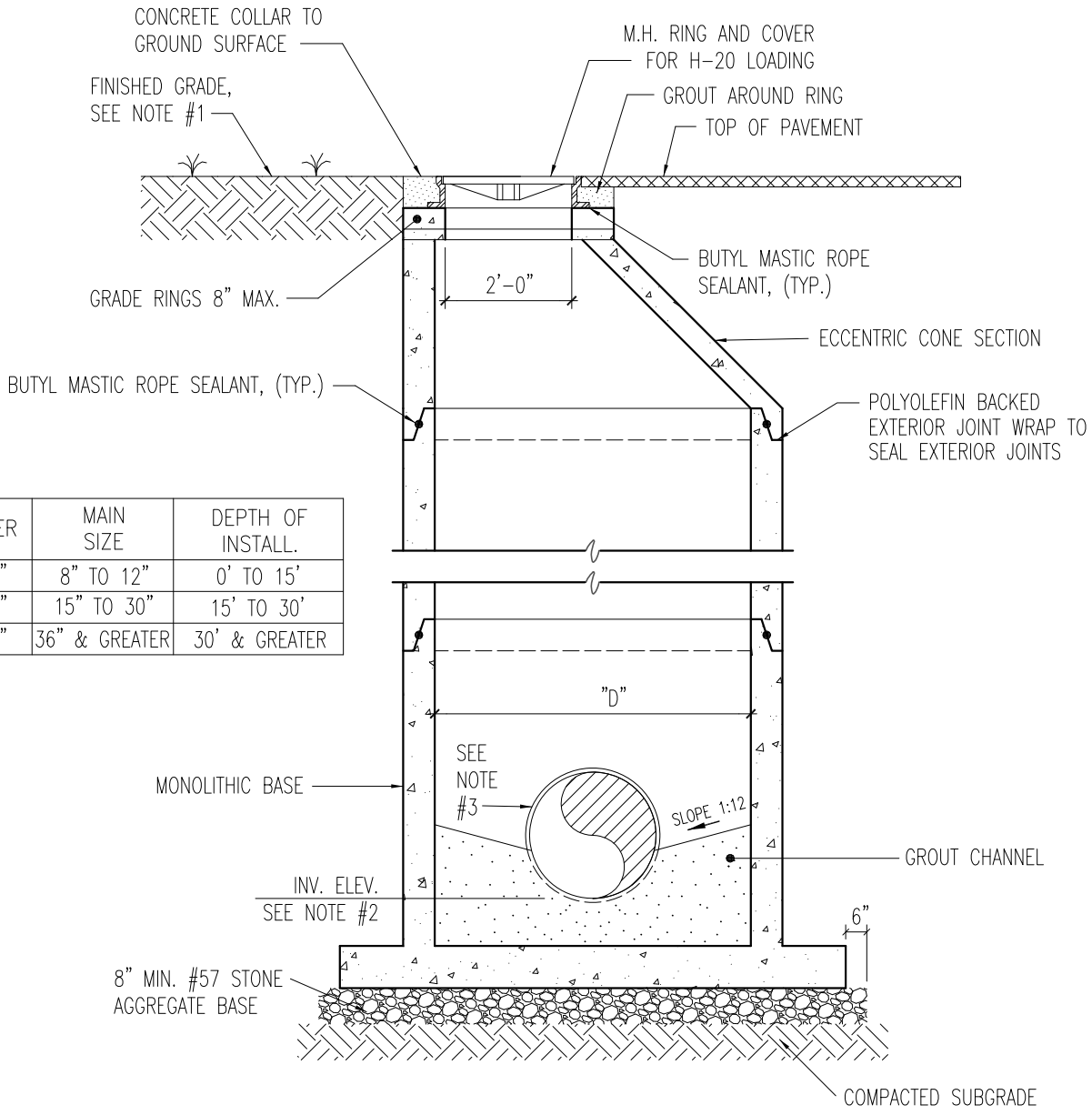
STANDARD MANHOLE INSTALLATION OVER EXISTING SEWER MAIN

SCALE: Not To Scale	DETAIL # SS_SMH
REVISION DATE: May, 2016	SHEET #: 1 of 1



DIAMETER	MAIN SIZE	DEPTH OF INSTALL.
4' – 0"	8" TO 12"	0' TO 15'
5' – 0"	15" TO 30"	15' TO 30'
6' – 0"	36" & GREATER	30' & GREATER

NOTES:
1. THE DISTANCE FROM THE TOP OF M.H. RING AND COVER MAY VARY WIDELY. SEE GRADING PLAN, AND/OR MANHOLE SCHEDULE
2. INVERT ELEV. SHOWN ON THE PLANS OR MANHOLE SCHEDULE ARE AT THE INLET AND OUTLET OF MANHOLE UNLESS OTHERWISE NOTED
3. CARRIER PIPE TO MANHOLE CONNECTIONS SHALL BE RUBBER SLEEVE WITH DUAL S.S. BANDS
4. ALL MANHOLES ARE TO BE EXTENDED BASE
5. ALL INTERIOR JOINTS AND LIFTING POINTS SHALL BE SEALED WITH GROUT
6. MANHOLES SHALL NOT HAVE STEPS

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STANDARD PRECAST SANITARY SEWER MANHOLE (ECCENTRIC)

SCALE:	DETAIL #
Not To Scale	SS_MHE
REVISION DATE:	SHEET #:
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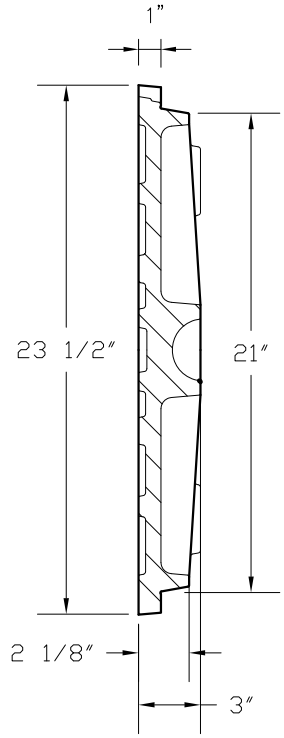
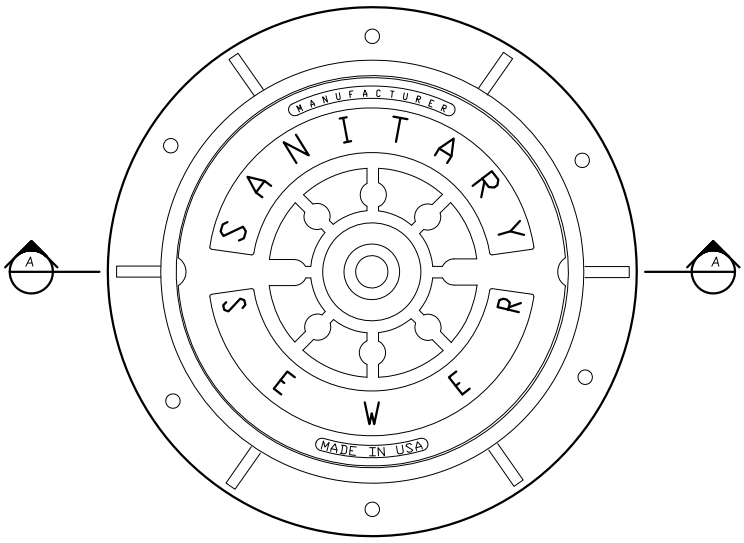
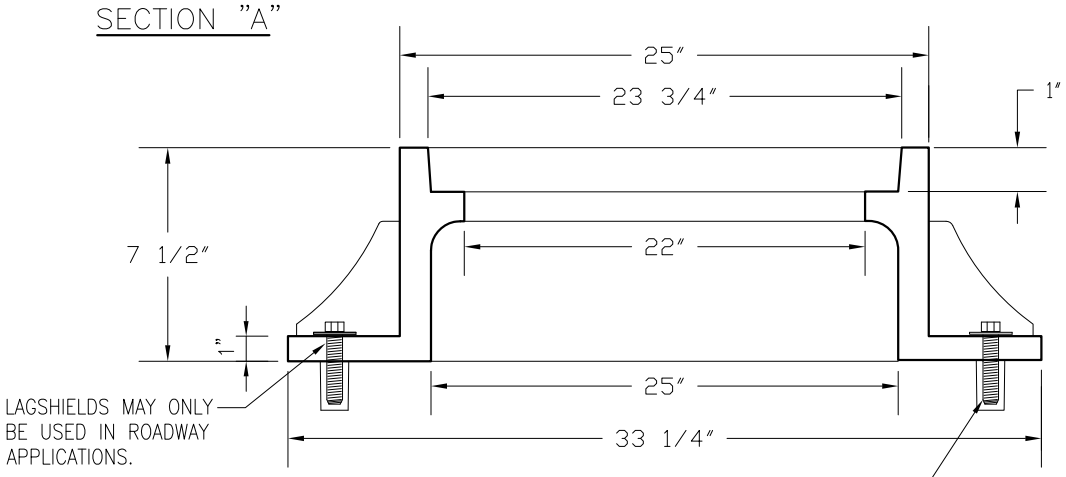


SECTION "A"

COVER 120 LBS. MINIMUM



PLAN



NOTES:

1. ALL MANHOLE FRAMES SHALL BE DOMESTICALLY CAST
2. FRAME SHALL BE A MINIMUM WEIGHT OF 182 LBS.
3. COVER SHALL WEIGH A MIN. OF 120 LBS.
4. MANHOLES WITHIN PAVED SURFACES SHALL BE CONSTRUCTED IN ACCORDANCE WITH DETAIL.
5. CONSEAL SHALL BE USED BETWEEN RING AND CONE

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STANDARD MANHOLE COVER & FRAME

SCALE:	DETAIL #
Not To Scale	SS_MHC
REVISION DATE:	SHEET #:
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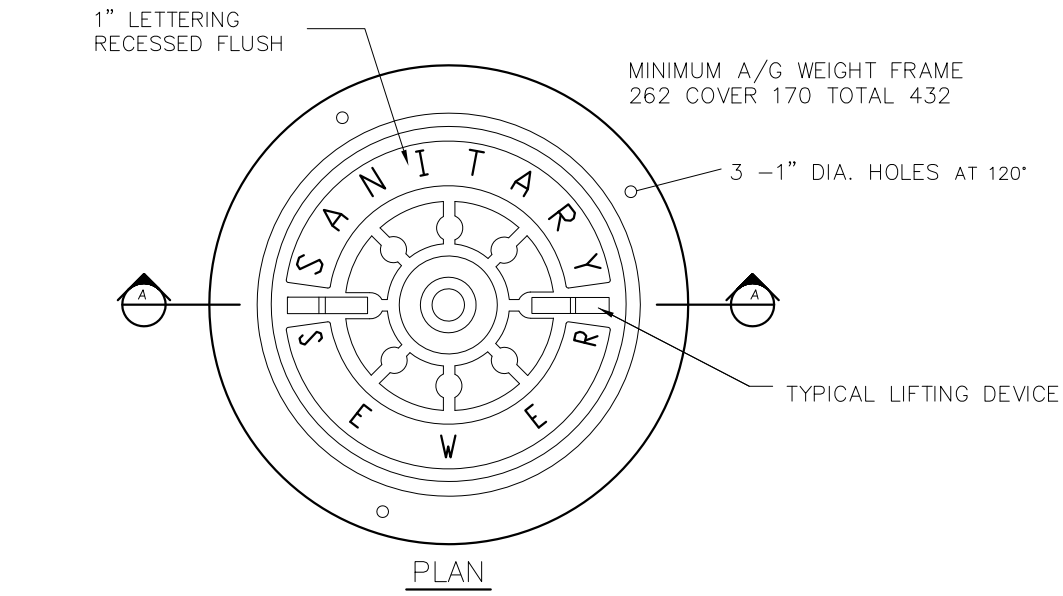

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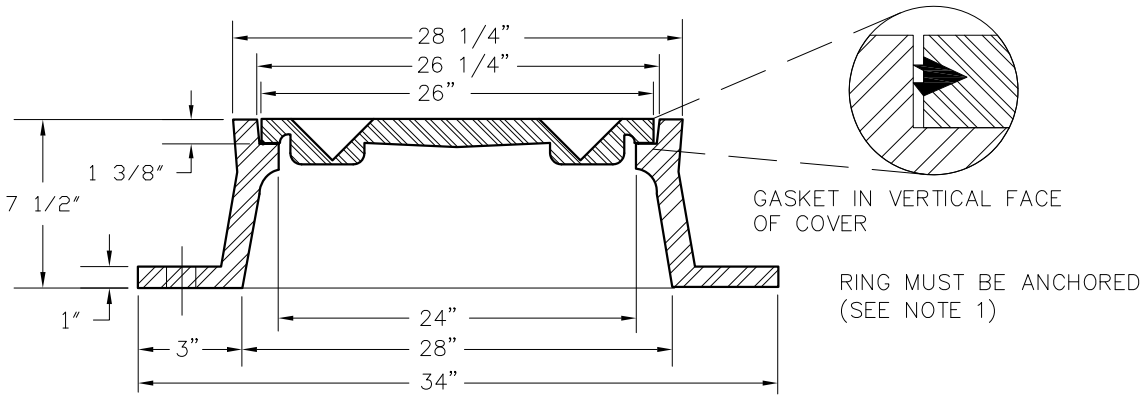

TYPICAL LIFTING DEVICE

SECTION A

NOTES:

1. REFER TO THE "STANDARD MANHOLE COVER" DETAIL

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MANHOLE FRAME AND WATERTIGHT COVER

SCALE:	DETAIL #
Not To Scale	SS_MHW
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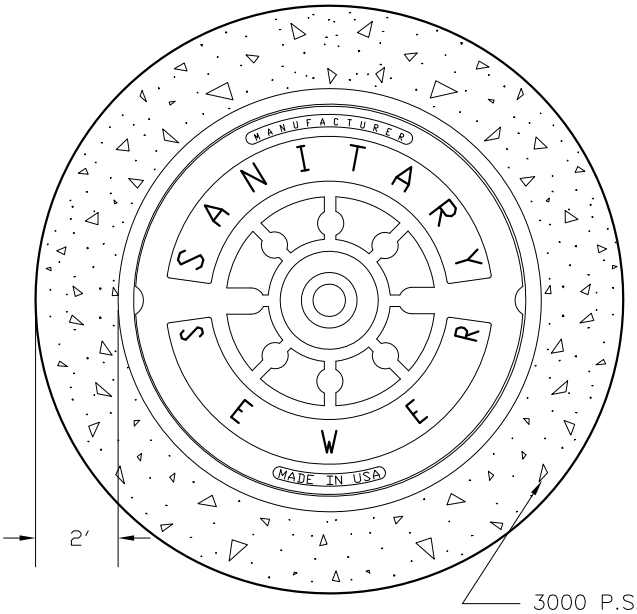
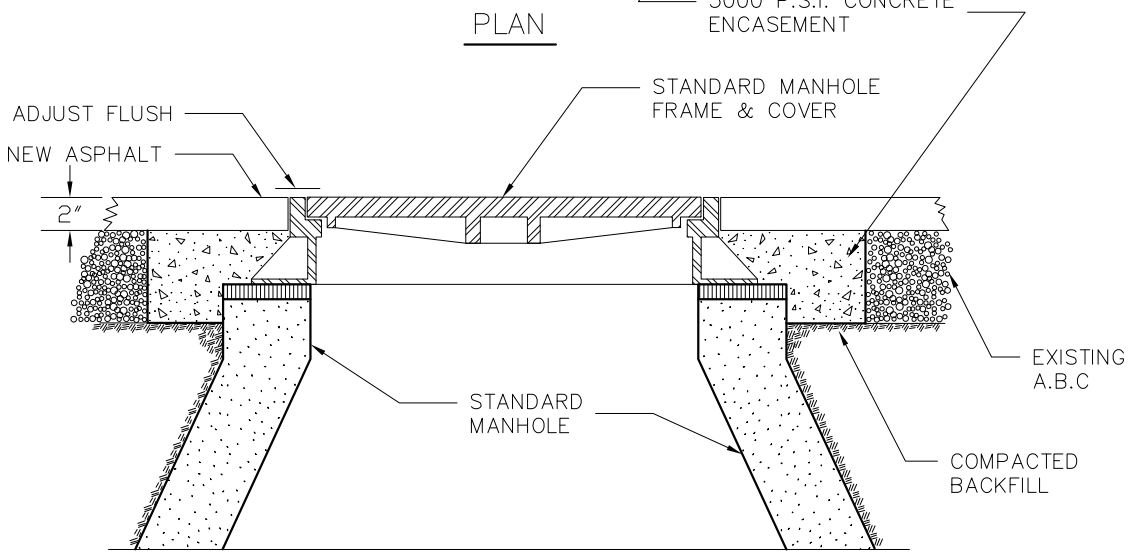


PLAN



SECTION

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STD. MANHOLE FRAME AND COVER DETAIL WITHIN PAVED SURFACES

SCALE:	DETAIL #
Not To Scale	SS_MHP
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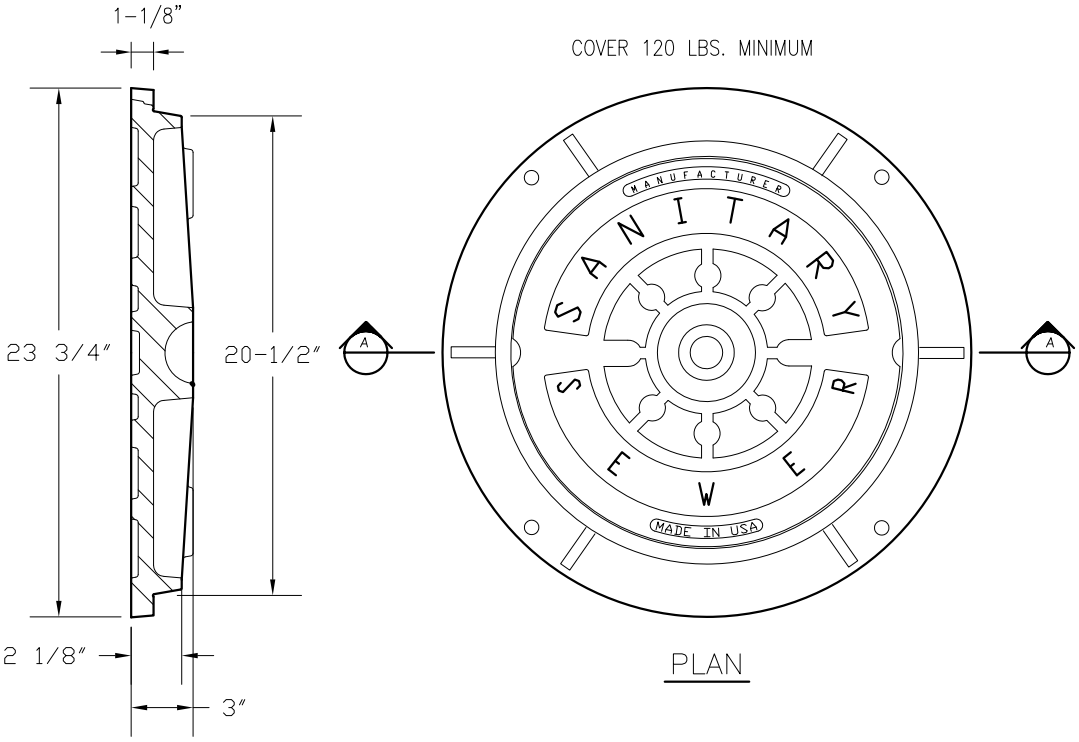

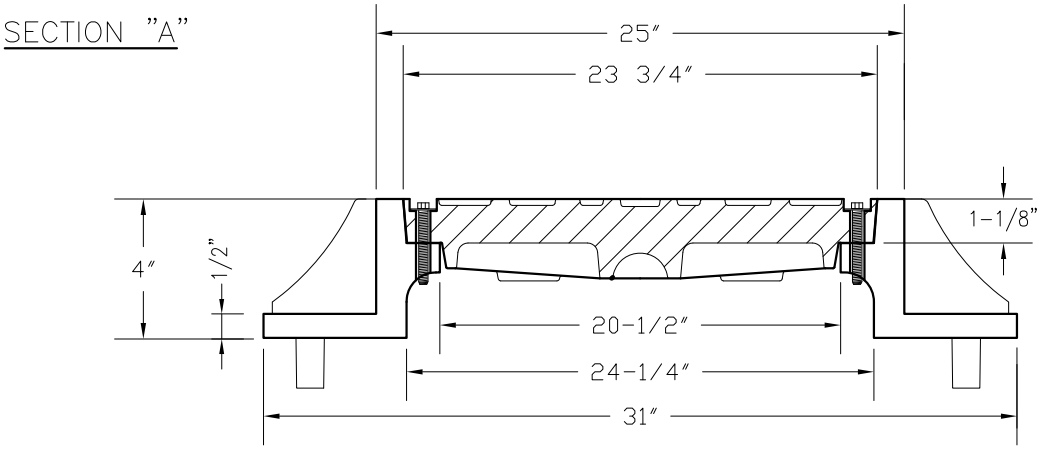

NOTES:

1. ALL MANHOLE FRAMES SHALL BE DOMESTICALLY CAST
2. FRAME SHALL BE A MINIMUM WEIGHT OF 182 LBS.
3. COVER SHALL WEIGH A MIN. OF 120 LBS.
4. MANHOLES WITHIN PAVED SURFACES SHALL BE CONSTRUCTED IN ACCORDANCE WITH DETAIL.
5. CONSEAL SHALL BE USED BETWEEN RING AND CONE

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STANDARD FLAT-TOP MANHOLE COVER & FRAME

SCALE:	DETAIL #
Not To Scale	SS_FMHC
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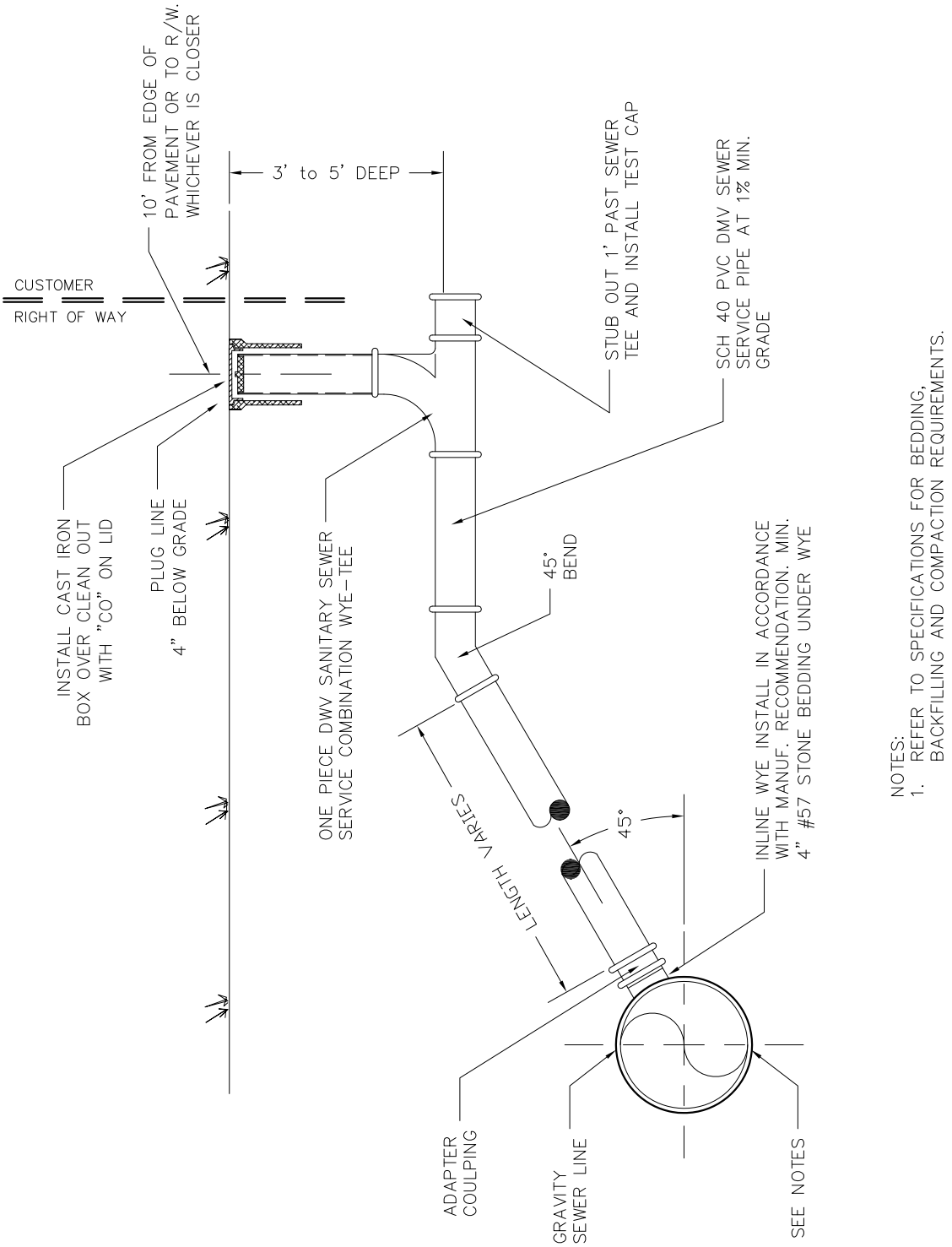

NOTES:
1. REFER TO SPECIFICATIONS FOR BEDDING, BACKFILLING AND COMPACTION REQUIREMENTS.

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TYPICAL SANITARY SEWER LATERAL CONNECTION

SCALE:	DETAIL #
Not To Scale	SS_LC
REVISION DATE:	SHEET #:
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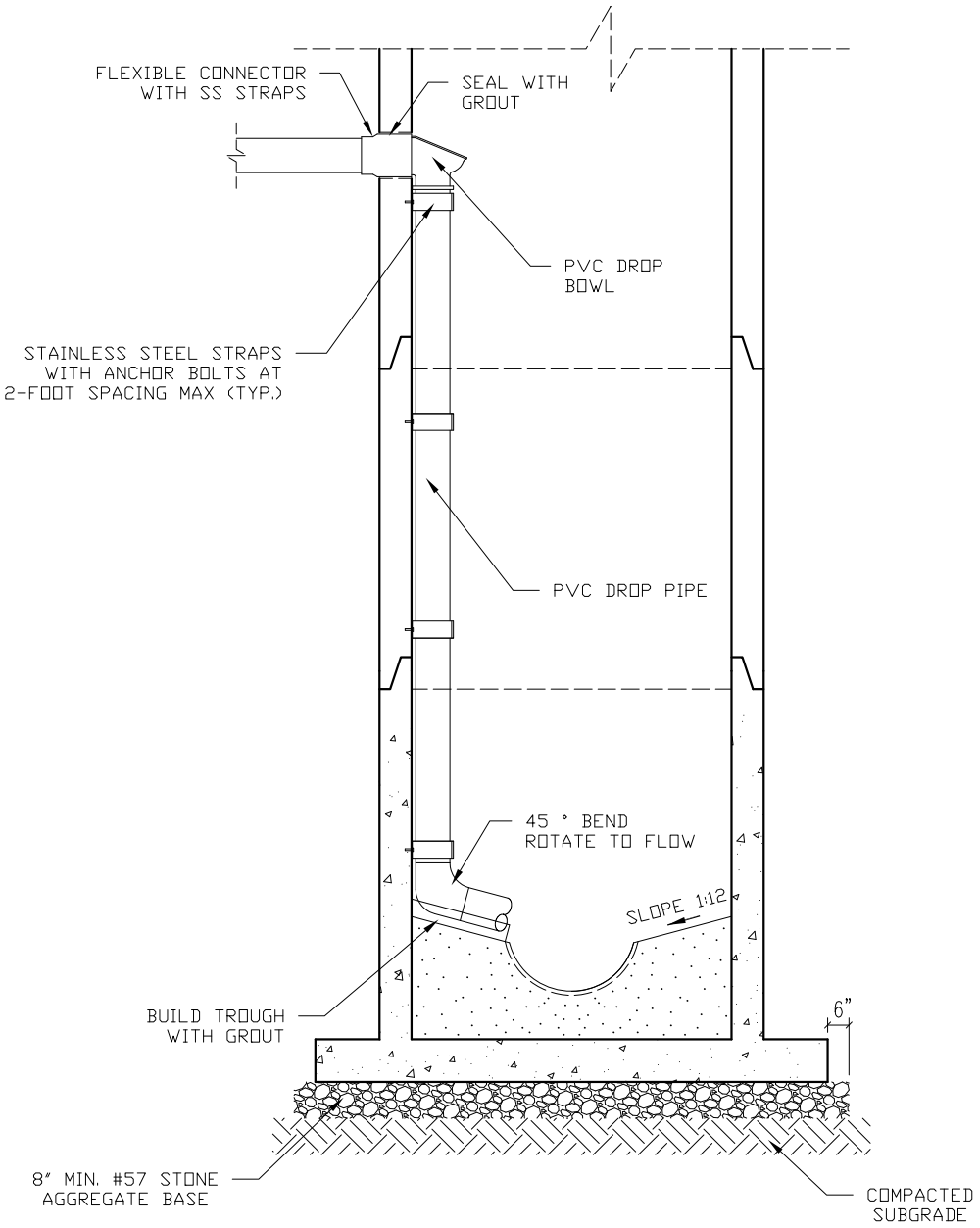

NOTES:

1. THE DROP ASSEMBLY MUST BE SECURED AS CLOSE TO THE INTERIOR MANHOLE WALL AS POSSIBLE TO MINIMIZE RESTRICTION OF ACCESS
2. MANHOLES THAT REQUIRE A DROP ASSEMBLY SHALL BE MINIMUM 5-FOOT INSIDE DIAMETER
3. LOCATE STRAPS AT TOP OF DROP PIPE JUST BELOW THE DROP BOWL AND BELL OF 45° BEND AS SHOWN. ADD EXTRA STRAPS AS NECESSARY TO MAINTAIN MAXIMUM SPACING OF 2-FEET

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GRAVITY SEWER
INSIDE DROP MANHOLE

SCALE:	DETAIL #
Not To Scale	SS_GIDM
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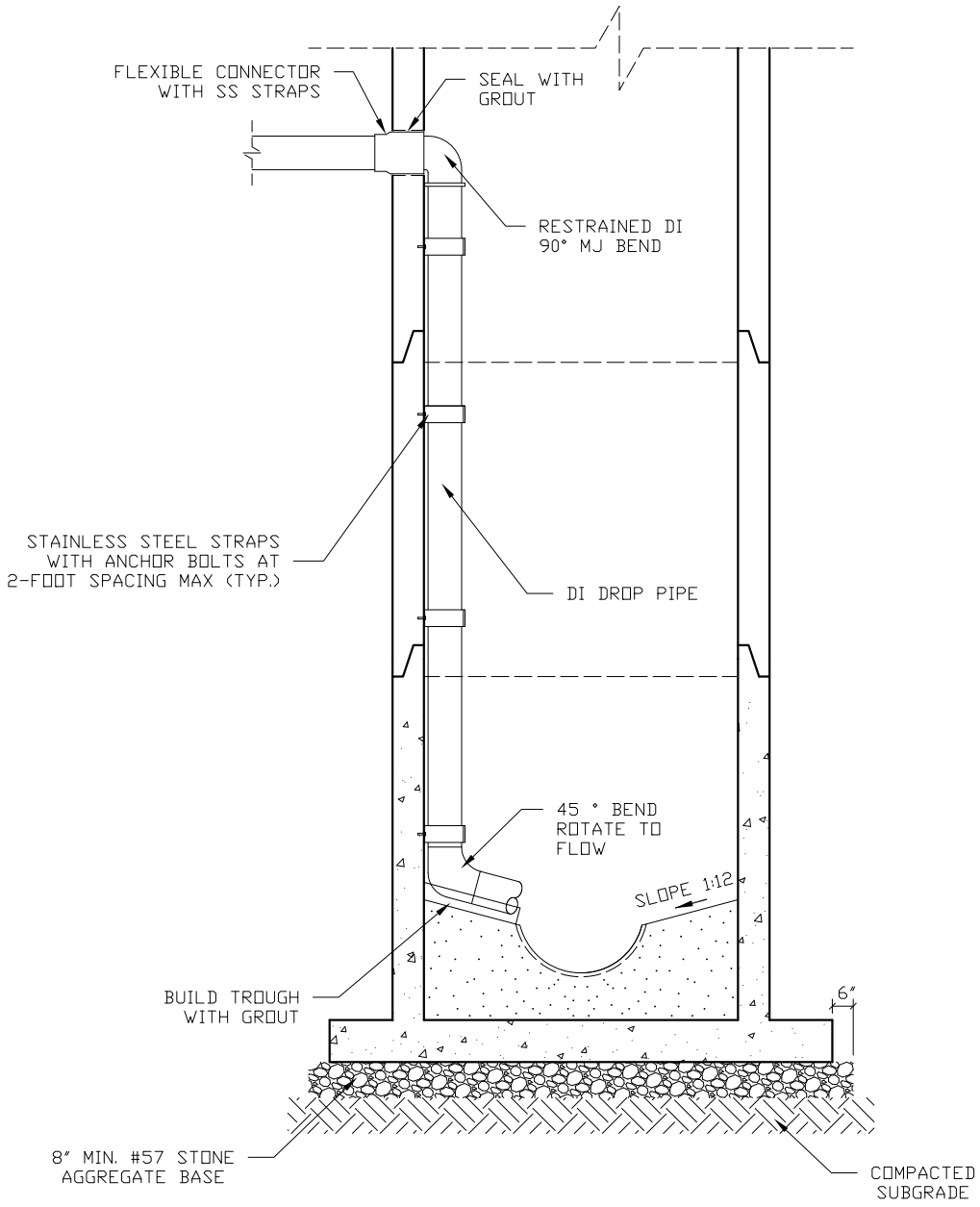

NOTE:
1. THE DROP ASSEMBLY MUST BE SECURED AS CLOSE TO THE INTERIOR MANHOLE WALL AS POSSIBLE TO MINIMIZE RESTRICTION OF ACCESS
2. MANHOLES THAT REQUIRE A DROP ASSEMBLY SHALL BE MINIMUM 5-FOOT INSIDE DIAMETER.

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FORCE MAIN
INSIDE DROP MANHOLE

SCALE:	DETAIL #
Not To Scale	SS_FIDM
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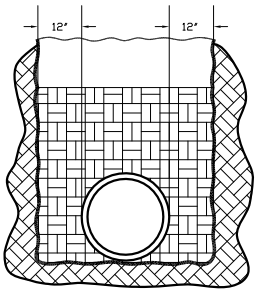
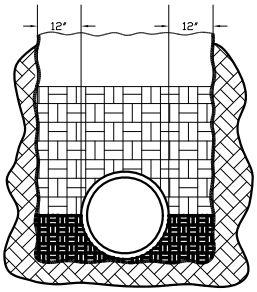


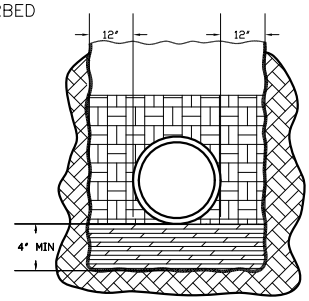
TYPE 1

(NOTE 1)
FLAT BOTTOM TRENCH WITH LOOSE DIRT
(FLAT BOTTOM IS DEFINED AS UNDISTURBED EARTH)



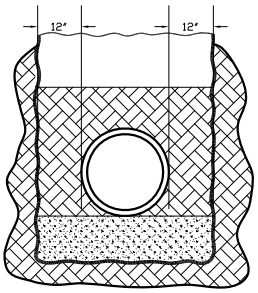
TYPE 2

FLAT BOTTOM TRENCH WITH BACKFILL LIGHTLY CONSOLIDATED TO CENTERLINE OF PIPE
(FLAT BOTTOM IS DEFINED AS UNDISTURBED EARTH)



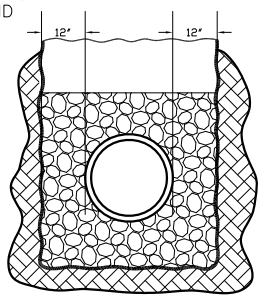
TYPE 3

PIPE BEDDED IN 4" MINIMUM LOOSE SOIL WITH BACKFILL
LIGHTLY CONSOLIDATED TO TOP OF PIPE
(LOOSE SOIL IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCK, ORGANIC MATERIAL, FOREIGN MATERIALS AND FROZEN EARTH.)



TYPE 4

PIPE BEDDED IN SAND, GRAVEL, OR CRUSHED STONE TO A DEPTH OF 1/8 PIPE DIAMETER, 4" MINIMUM WITH BACKFILL COMPACTED TO TOP OF PIPE.
(APPROXIMATELY 80 PERCENT STANDARD PROCTOR, AASHTO T-99)



TYPE 5

PIPE BEDDED TO IT'S CENTERLINE IN COMPACTED GRANULAR MATERIAL, 4" MINIMUM UNDER PIPE. COMPACTED GRANULAR OR SELECT MATERIAL TO TOP OF PIPE.
(APPROXIMATELY 90 PERCENT STANDARD PROCTOR, AASTO T-99)
(SELECT MATERIAL IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCKS, ORGANIC MATERIAL, FOREIGN MATERIALS AND FROZEN EARTH)

NOTES:

1. FOR NORMAL PIPE SIZES 14 INCH AND LARGER, CONSIDERATION SHOULD BE GIVEN TO THE USE OF LAYING CONDITIONS OTHER THAN TYPE 1.

2. CONSIDERATION OF THE PIPE-ZONE EMBEDMENT CONDITIONS INCLUDED IN THIS FIGURE MAY BE INFLUENCE BY FACTORS OTHER THAN PIPE STRENGTH. FOR ADDITIONAL INFORMATION ON PIPE BEDDING AND BACKFILL, SEE ANSI/AWWA C600.

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SEWER FORCE MAIN EMBEDMENT DETAIL

SCALE:	DETAIL #
Not To Scale	SS_FMED
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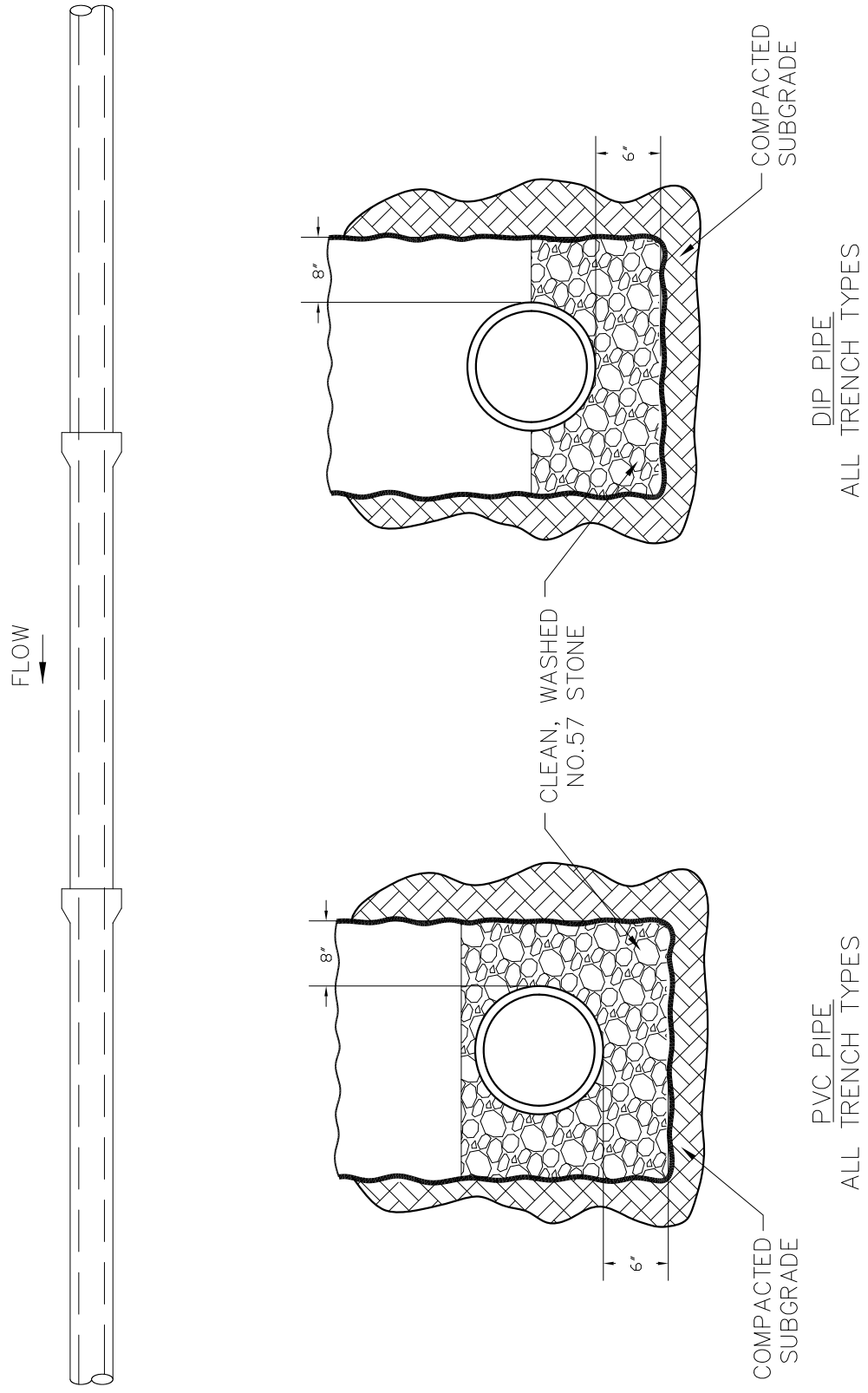

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GRAVITY SEWER EMBEDMENT DETAIL

SCALE:	DETAIL #
Not To Scale	SS_GSED
REVISION DATE:	SHEET #:
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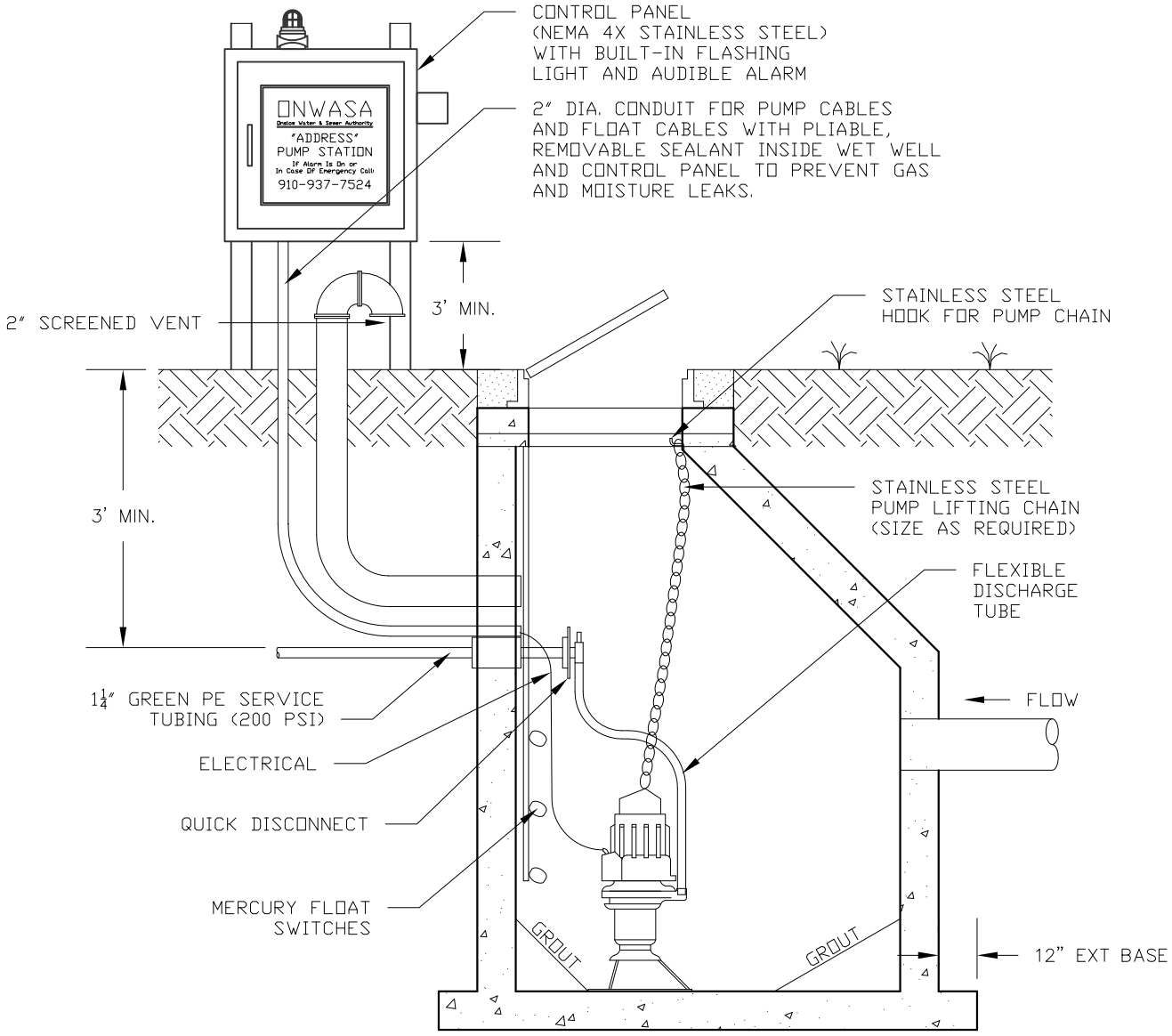

NOTES:

1. GRINDER PUMP STATIONS SHALL BE LOCATED AT THE R/W, FRONT OR SIDE YARD, AND ACCESSIBLE TO MAINTENANCE PERSONNEL AT ALL TIMES. REFER TO ONWASA EASEMENT REQUIREMENTS.
2. ALTERNATE WET WELL MATERIAL MAY BE FIBERGLASS OR HDPE PACKAGE UNITS.
3. SERVICE POLE METER, DISCONNECT, AND 110V WEATHERPROOF GFI DUPLEX RECEPTACLE SHALL BE PROVIDED BY THE CONTRACTOR..
4. AUXILIARY POWER CONNECTION SHALL ADHERE TO ONWASA'S PORTABLE AUXILIARY POWER SOURCE REQUIREMENTS.
5. NO LANDSCAPING MATERIAL SHALL BE PLACED WITHIN THE PUBLIC UTILITY EASEMENT.
6. SIGN SHALL BE 10"x10" IN SIZE AND CONSTRUCTED OF .08 GAUGE ALUMINUM. VINYL SHALL BE A MINIMUM OF 4 MIL THICKNESS IN SAPHIRE BLUE AND WHITE AS MANUFACTURED BY ORACAL.
7. NYLON WASHERS SHALL BE PLACED ON THE BOLTS/SCREWS BETWEEN THE SIGN AND THE STAINLESS STEEL CONTROL CABINET

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RESIDENTIAL GRINDER PUMP STATION AND CONTROL PANEL

SCALE:	DETAIL #
Not To Scale	SS_RGRP
REVISION DATE:	SHEET #:
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ONWASA's

Manual of Standards, Specifications and Details

Section VIII

APPENDIX - REVISIONS

Approved By ONWASA BOARD

August 28, 2008

Revised May 20, 2010

Revision 2, September 20, 2012

Revision 3, May 19, 2016

ONWASA's MANUAL OF STANDARDS, SPECIFICATIONS and DETAILS

Revisions Summary 05/19/16

This section identifies the revisions incorporated into "ONWASA WATER SYSTEM SPECIFICATIONS and DETAILS" manual first published and adopted on August 28, 2008. This document will be adopted and titled as "ONWASA's MANUAL OF STANDARDS, SPECIFICATIONS and DETAILS- Water System Section-Revision 3, May 19, 2016".

THIS DOCUMENT SUPERSEDES ALL PREVIOUS RELEASES AND REVISIONS.

In this section, the revisions will be summarized and listed to assist the reader in locating the revisions made in each Section and Article Number. Detailed information of each revision can be found at the end of each individual Section. Each revision has been underlined in the manual for easy identification.

General revisions relating to document such as formatting, spelling and punctuation were made to the manual. These changes, though important will not be individually listed.

Questions in regards to the manual or to the revisions made should be forwarded to:

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SECTION NAME	ARTICLE # REVISION
Throughout document, North Carolina Department of Environment and Natural Resources was changed to North Carolina Department of Environmental Quality.	
Section II Water Design Specifications	(1.1, A) (2.1, A, 3) (2.1, B, 1) (2.1,B, 3) (2.1, B, 7) (2.1, B, 10) (2.1, C, 2) (2.1,C, 4) (2.1, F, 4) (2.1, F, 5) (2.1, G, 3) (2.1, H) (2.1, H, 1) (2.1, J, 5) (2.1, R) (2.1, S) (2.1, T) (2.1, U)
Section III General System Section	
Section Table of Contents	Revised some section numbers
Section 31 23 00 Excavation and Fill	(1.1, B) (3.3, A) (3.3, F)
Section 31 23 16.13 Trenching	(1.1, B) (3.2, A) (3.2, E) (3.4, D) (3.4, E) (3.4, M) (3.9, F)
Section 31 23 16.26 Rock Removal	(1.1, B, 1-2)
Section 32 31 13 Chain link fences & Gates	(2.1, A) (2.1, C) (2.1, C, 3)
Section 33 05 13 Utility Manholes and Structures	(1.1, B, 2-3) (1.1, B, 8) (1.1, B, 9) (2.3, B removed) (2.3, C, 3) (2.3, G, 2) (3.2, A, 1) (3.2, A, 2) (3.6, C) (3.6, J)
Section 33 05 19 Pressure Piping Tied Restraint System	(1.1, B, 1-2) (2.3, B, 6) (3.3, A) (3.3, B)
Section 33 05 23 Trenchless Utility Installation	(1.1, B, 1-2) (3.5, C)
Section 33 05 23.13 Utility Horizontal Directional Drilling	(1.1, B, 1-2) (2.1, C) (2.1, D) (4.3 A) (4.9, E) (4.11, B) (4.12, E)
Section IV Water System Specifications	
Section 33 11 00 Water Utility Distribution Piping	(1.1, B, 2-3) (1.1, B,6) (1.3, C) (1.4, A) (1.5, C) (1.5, F) (2.1, A, 1-2) (2.6, A, 2) (2.6, D, 3) (2.6, F) (2.8, A) (2.9, B) (3.2, C) (3.4, H, 2-3) (3.4, H, 5) (3.4, N, 4) (3.4,O) (3.4, R) (3.4, U) (3.5, B-C) (3.6, B) (3.6,E) (3.7, A) (3.8, C-D) (3.9, C) (3.15, B) 3.15, E-G) (3.17, C-D)
Section 33 12 13 Water Service Connections	(1.1, B) (1.3, C) (2.2, A) (2.3, B-C) (2.5, B) (2.6, A-C) (2.7, Section 33 13 00 Disinfecting of Water Utility
Distribution	(1.2, 2) (3.3, 5)
Section V Sanitary Sewer Design Specifications	(2) (2.1, D) (2.3, M) (2.5, F) (2.6, D) (3,E) (3.1, D)
	(3.3, D-E) (3.2, N) (3.2, Z) (3.2, CC, 12) (3.4, A) (3.4, I) (3.5, C) (3.5, E) (3.5, I)
Section VI Sanitary Sewer System Technical Specifications	Changed some section numbers and titles
Section 09 96 59 Protective Lining for Concrete	(1.1, A, 4) (1.1, A, 5)
Section 26 32 13 Packaged Engine-Generator System	(1.1, B, 2-3)
Section 33 01 30 Operation and Maintenance of Sewer Utilities	(New Title) (1.1, B, 1-4)
Section 33 01 30.16 Television Inspection of Sewer Pipelines	(1.3, B)
Section 33 01 30.51 Maintenance of Sewers	(1.1, B, 1-3) (3.3)

Section 33 31 13 Gravity Sewers	(1.1, B, 2-7) (2.1, A) (2.3, A) (3.2, C, 1) (3.2, C, 3) (3.6, H)
Section 33 32 16.13 Grinder Pump Station Installation	New Section
Section 33 34 00 Force Mains	(1.1, B, 2) (1.1, B, 5-7) (2.6, A) (Part 3) (3.2, C, 1) (3.2, C, 3) (3.4, A) (3.4, S) (3.6, A) (3.7, C) (3.12, B) (3.12, F) (3.12, H, 8) (3.12, H, 11-12) (3.14, A)
Section 43 25 00 Submersible Pumps	(1.1, B, 3) (2.2) (2.3, D-E) (2.6, A) (2.7, G) (2.7, I) (2.8, A) (2.8, E) (2.11, B-C)
Section 43 23 00 Self-Priming Centrifugal Pumps	(1.1, B, 2-3) (2.3, A-B) (2.6, A-B) (2.7, F) (2.8, C) (3.3, B)
Section 44 31 00 Odor Treatment Equipment	(2.1, A) (2.3, B)
Section VII Standard Sewer Details	General, water and sewer details combined into one section. Revisions made to details reflect text changes listed above.

Changes to the detail drawings (AutoCAD) were made also. If you previously received the details drawing file from ONWASA, please send a request for the new file. Please identify which version of AutoCAD you would like to receive the file.