

# CITY OF ROXBORO



SUPPLEMENTAL SPECIFICATIONS  
AND DETAIL DRAWINGS  
FOR  
WASTEWATER FORCE MAINS  
STORMWATER DRAINAGE  
WASTEWATER PUMPING SYSTEMS  
MISCELLANEOUS MATERIALS FOR UTILITIES  
RECORD DRAWING CHECKLIST

CITY OF ROXBORO  
105 SOUTH LAMAR STREET  
ROXBORO, NC 27573  
PHONE: (336) 599-3116

## **PREFACE**

The Standard Specifications and Detail Drawings along with the Supplemental Specifications were adopted by the City Council of the City of Roxboro on \_\_\_\_\_.

The purpose of these Specifications and Detail Drawings is to establish a standard for the design and construction of public water and sanitary sewer utilities owned, operated and maintained by the City of Roxboro.

Updates to these Standards may occur periodically through action by the City Council of the City of Roxboro. It will be the responsibility of the holder of these documents to be fully apprised of any updates or amendments to these documents prior to performing any construction.

Copies of these documents may be purchased at the following address:

Public Services – City of Roxboro  
779 Mountain Road  
Roxboro, NC 27573

Any questions about the content or meaning of these documents shall be directed to the Public Service Director at 336-503-0489.

SECTION 04000  
WASTEWATER FORCE MAINS  
TABLE OF CONTENTS

- 04010 GENERAL
  - A. Design Requirements
  
- 04020 WASTEWATER FORCE MAINS
  - A. Design
  - B. Materials
  - C. Installation of Ductile Iron Piping
  - D. Backfilling of Trenches
  - E. Valves and Appurtenances
  - F. Blasting
  
- 04030 INSPECTIONS AND TESTING
  - A. Inspections
  - B. Testing

## **04010 GENERAL**

### **A. DESIGN REQUIREMENTS**

1. These Specifications apply to all force mains that are to be owned, operated, and maintained by the City of Roxboro. Design of private pump stations and force mains and associated facilities are not covered by these Specifications or otherwise herein, and the applicant should look for guidance from other appropriate agencies (NCDENR, NC Plumbing Code, etc.).
2. All aspects of the design of wastewater force mains, and associated facilities will, at a minimum, meet the requirements of the latest version of the NCDENR "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains". Requirements presented in the City of Roxboro Standard Specifications herein that are more restrictive or go above and beyond the requirements of the Minimum Design Criteria are required by the City of Roxboro.
3. All aspects of the design of pump stations, force mains, and associated facilities will be submitted for review and approval to the City of Roxboro. Plan and profile drawings will be prepared by a registered professional engineer signed, sealed and dated showing the various elements of the force main and will include an overall utility plan layout on a single sheet with scale no smaller than 1 inch =200 feet. The force main drawings will be on separate sheets, free of landscaping and other details not pertinent to the utility plans. All force main engineering drawings will be on paper 24 inches by 36 inches. All drawings will show all structures which will include but not be limited to drainage ditches, storm drains, streams, ponds, lakes, buildings, streets, driveways and other existing utilities. Plan/profile drawings will be prepared with a scale no smaller than 1 inch =50 feet.
4. Wastewater force main interconnections will be prohibited, unless authorized by the City of Roxboro. All wastewater force mains will extend to the nearest gravity sewer or pump station wetwell that has sufficient long term capacity.
5. No plans will be approved for construction until all off-site easements have been obtained. All plans will show the existing utilities and their size with the existing easements. Off-site drainage will be indicated on the plans along with the proposed force main.
6. Once installed, "as-built" plans in paper form and digital form will be provided to the City of Roxboro showing the force main. The digital form will be specified by the City of Roxboro. "As-built" drawings for the force main will be submitted to the City of Roxboro at the time of acceptance of the project by the City.

## 04020 WASTEWATER FORCE MAINS

### A. DESIGN

- Force mains will be installed with a minimum cover of 3 feet measured from the top of the pipe to the finished grade. A minimum of 4 feet will be required under any roadway measured from top of pipe to bottom of subgrade.
- Force mains will be installed in dedicated public right-of-way or in dedicated utility easements. When wastewater force mains are constructed adjacent to gravity sewer mains or for construction of parallel wastewater force mains, the minimum horizontal clearance will be at minimum 7-ft from pipe edge to pipe edge when the depth of installation is 8-ft or less. Otherwise, the minimum horizontal separation between pipelines will be 10-ft up to installation depth of 10-ft. Clearances for pipelines greater than 10-ft depth will be designed by Engineer of Record and approved by the City of Roxboro. Easement widths outlined herein will be widened by at least the clearance between the pipelines when constructing a shared gravity sewer and wastewater force main corridor.

Standard Easement Width for Sewer Force Mains

<u>Pipe Size</u> (diameter)	<u>Pipe Depth</u> (feet)	<u>Easement Width</u> (feet)
8-inch to 12-inch	10-ft or less	20-ft
8-inch to 12-inch	10-ft – 12.5-ft	25-ft
8-inch to 12-inch	12.5-ft – 15-ft	30-ft
8-inch to 12-inch	15-ft to 17.5-ft	35-ft
8-inch to 12-inch	17.5-ft to 20-ft	40-ft
12-inch to 24-inch	15-ft or less	30-ft
12-inch to 24-inch	15-ft – 17.5-ft	35-ft
12-inch to 24-inch	17.5-ft – 20-ft	40-ft
Greater than 24-inch	Any Depth	Determined by City
Any Size	Deeper than 20-ft	Determined by City

- Dedicated easements for force mains and appurtenances will be recorded as “City of Roxboro Utility Easement”. City of Roxboro force main easements will contain only City of Roxboro utilities unless otherwise approved by an encroachment agreement.
- Wastewater force main discharge manholes and intermediate air release locations that require odor control will be provided with sufficient easement area to accommodate the odor control systems as designed by the Engineer of Record, whether utilizing passive, forced-air or chemical treatment for odor control. The maintenance easement for odor control systems will be sized based on site specific conditions and will provide sufficient area for routine

maintenance operations, such as refilling media, chemicals, replacing equipment, etc.

5. Force mains will discharge at the invert of the receiving manhole and will be as close as possible to 180 degrees from the outlet pipe.
6. Force main minimum design velocity will not be less than 2.5 feet per second throughout the length of the force main. As a design preference, force main systems when operating at higher flows will reach velocities of 3 to 5 feet per second to resuspend any settled solids.
7. Force main systems will be of adequate sizing and design to effectively convey the ultimate peak flows as applied by the connected pump station to the discharge point.
8. The force main route will be such that the number of high points requiring combination air valves is minimized to the extent possible. Combination Air Valves rated for use with raw wastewater will be installed at all the high points or runs exceeding 3000 feet on all force mains in accordance with the Standard Details. A high point will be determined as any location where the vertical separation between the adjacent low point and high point in the force main is greater than or equal to 5 vertical feet.
9. A plug valve will be installed at least every 3000 feet of force main length, unless otherwise approved by the City of Roxboro.
10. All air release valves, or other appurtenances that have moving or operating parts and require maintenance and routine access will have a manhole placed over them or over the operating portion of the device.
11. Separation Requirements:

a) Separation Between Sewer Force Main and Storm Water Pipes:

Sewer force mains will have a minimum vertical separation of 24 inches between storm pipes when the horizontal separation is 3 feet or less. Where sanitary and storm sewers cross with a vertical separation of less than 24 inches, the entire leg of sanitary sewer will be made of standard ductile iron pipe with joints rated for water main service and the void space between the pipe crossing will be backfilled with 3000-psi concrete or minimum 500-psi, quick setting, non-excavatable flowable fill that meets or exceeds NCDOT specifications.

b) Separation Between Sanitary Sewer and Sewer Force Main:

There will be a minimum 7 foot horizontal separation between parallel gravity and/or force mains in outfall locations when the depth of

04000-4

installation is 8-ft or less. Otherwise, the minimum horizontal separation between pipelines will be 10-ft in outfalls.

c) Separation Between Sewer Force Main and Water Main Parallel Installations:

10-ft lateral separation (pipe edge to pipe edge) or minimum 3-ft lateral separation, and water line at least 18-inches above sewer force main measured vertically from top of sewer pipeline to bottom edge of water main. In unique cases where the sewer force main and the water main are installed with at least 3-ft of lateral separation but less than 10-ft of horizontal separation, and less than 18-inches of vertical separation, both the water main and sewer force main will be constructed of ductile iron pipe with joints in full compliance with water main standards.

d) Crossings (Water Main Over Sewer Force Main):

All water main crossings of sewer sewer force mains will be constructed over the sewer force main in conformance with City of Roxboro specifications. At a minimum, 18-inches of clearance will be maintained between the bottom edge of the water main and the top edge of the sewer force main. If 18-inches of clearance is not maintained, the water main and sewer force main will both be constructed of ductile iron pipe with joints in conformance with water main construction standards. The ductile iron sewer force main will extend 10-ft on both sides of the crossing. When the separation between pipelines is 18-inches or less, the void space between the pipes will be filled with minimum 500- psi, quick setting, non-excavatable flowable fill extending 3-ft on both sides of the crossing. Regardless of pipe material, at least 12-inches of vertical separation is required for sewer force main crossings of potable water mains.

e) Crossings (Water Main Under Sewer Force Main):

Allowed only as approved by City of Roxboro, when it is not possible to cross the water main above the sewer force main. At a minimum, 18-inches of separation will be maintained, (measured from pipe edge to pipe edge) and both the water main and sewer force main will be constructed of ductile iron in conformance with water main construction standards to a minimum of 10-ft on both sides of the crossing. If local conditions prevent providing 18-inches of clearance, then at least 12- inches of clearance will be provided and the void space between the pipes will be filled with minimum 500-psi, quick setting, non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

f) Sanitary Sewer Force Main and Stream Crossings:

The top of the sewer force main will be at least one foot below the stream bed. Concrete encasement and ductile iron pipe will be required when the cover between the top of the pipe and the stream bed is less than 3 feet.

g) Sewer force mains will not be installed under any part of water impoundments.

h) The following minimum horizontal separations will be maintained:

- i. 100 feet from any private or public water supply source, including wells, WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water (except as noted below)
- ii. 50 feet from any waters (from normal high water) classified WS-II, WS-III, B, SA, ORW, HQW or SB (except as noted below)
- iii. 25 feet from any other stream, lake, or impoundment (except as noted below)
- iv. 25 feet from private wells (with no exceptions)
- v. 50 feet from sources of public water supply (with no exceptions)

Where the required minimum separations cannot be obtained, ductile iron sewer force main pipe with joints equivalent to water main standards will be used.

## **B. MATERIALS**

### **1. Pipe Materials**

- a) The minimum wastewater force main size will be 4-inches in diameter, unless otherwise approved by the City of Roxboro.
- b) All wastewater force mains will be constructed with ductile iron pipe provided with interior corrosion protection coating. All ductile iron wastewater force mains and fittings for sewer construction will receive an interior ceramic epoxy coating, consisting of an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment, such as manufactured by Protecto 401. The interior coating will be applied at a nominal dry film interior thickness of 40-mils. All ductile iron pipe bells and spigots will be lined with 8-mils of joint compound by Protecto 401 or approved equal applied by brush to ensure full coverage. All pipe supplied with Protecto 401 interior lining will be provided free of holidays. Pipe

04000-6

installed with defects in the lining will be rejected. Patching of Protecto 401 coating defects after installation will not be approved.

- c) Ductile Iron Pipe will be designed and manufactured in accordance with AWWA C-150 and C-151 and provided in nominal 20-ft lengths. The minimum requirements for ductile iron pipe and required laying conditions are illustrated in Chart 1, unless otherwise approved by the City of Roxboro. For all other installations other than specified, the laying condition, bedding requirements or the minimum pressure class rating and/or thickness class will be increased in accordance with AWWA C-151. In all cases, pipe thickness will meet or exceed the required pressure class plus 100 psi water hammer and a minimum external load of earth of at least 2 feet of cover with a live truck superload of ASHTO H-20 with a 1.5 impact factor. All ductile iron piping will be installed meeting Standard Laying Conditions Type 2 or Type 4 based upon the depth of cover or trench conditions. All ductile iron pipe will meet the following minimum physical grade requirements:

Tensile Strength ----- 60,000 psi  
 Yield Strength ----- 42,000 psi  
 Minimum Elongation ----- 10%

A pipe thickness design will be submitted by a licensed professional engineer in the State of North Carolina for external loading in all cases where the pipe depth exceeds the specified range of depths outlined in Chart 1. Other pipe diameters, laying conditions, pressure class requirements and maximum depth of cover not shown in Chart 1 will be reviewed and approved by the City of Roxboro provided piping meets AWWA C-150 and AWWA C-151 Standards and the Ductile Iron Pipe Association.

### CHART 1

Pressure Class, Max. Depth and Laying Condition for DI Wastewater Force Mains

Pipe Diameter	AWWA C-150, Laying Condition	Pressure Class	Maximum Depth of Cover
4-8 -inch	Type 2	350 psi	20 feet
4-8 -inch	Type 4	350 psi	34 feet
10-12 -inch	Type 2	350 psi	15 feet
10-12 -inch	Type 4	350 psi	28 feet
14-20 -inch	Type 4	350 psi	27 feet
24 -inch	Type 4	350 psi	26 feet

- d) All buried ductile iron pipe and fittings will have bituminous coating on the exterior surface in accordance with AWWA C151. Pipe fittings will be made of ductile iron designed and manufactured per AWWA C110. All fittings up to and including 24 inches in diameter will be designed for a minimum internal pressure of 350 psi, unless otherwise approved by the City of Roxboro. Joints for fittings will be mechanical joint and will be interior coated with Protecto 401 as specified herein for ductile iron pipe.
- e) All ductile iron pipe will be marked in conformance with ASTM A-746.
- f) Pipe joints will be mechanical joint or push-on type per AWWA C-111, except where restrained joints are required.
- g) Force main joints 24 inches and smaller will be restrained at fittings, valves, carrier pipes in bores, and length of piping connected to valves, fittings and bores as determined by calculations submitted to the City of Roxboro for review. The standard joint restraint will consist of stainless steel rodding and concrete blocking and wedge action retainer glands as specified herein. All valves will be restrained in a manner consistent with operation as a dead end, which includes restraining the valve to the pipe and restraining a sufficient number by pipe joints on both sides of the valve to accommodate dead end valve restraint. Resultant force calculations will be provided by a licensed professional engineer to the City of Roxboro for each fitting installed. Calculations will be used to size the required concrete blocking for each fitting and the length of force main piping each side of the fitting that will require restraint using wedge action retainer glands.

Mechanical joint restraint wedge action retainer glands may be used in ductile iron piping larger than 24 inches only after approval has been granted by the City of Roxboro. Otherwise, restraint will be provided such as "Flex-Ring" by American, "Snap-Lok" by Griffin or "TR Flex Restraint Joint" by U.S. Pipe.

All joints inside steel encasement piping such as a carrier pipe in a bore, will be restrained such as "Flex-Ring" by American, "Snap-Lok" by Griffin or "TR Flex Restraint Joint" by U.S. Pipe.

- h) All ductile iron fittings will be provided in conformance with AWWA C-110 for standard ductile iron fittings and AWWA C-153 for compact ductile iron fittings. All fittings will be pressure rated for a minimum 350-psi through 24 inches in diameter and 250 psi for fittings greater than 24-inches in diameter. In cases where minimum pressure standards are less than the pipe specification, fittings will always be pressured rated to meet or exceed the pressure ratings for the specified pipe. All ductile iron fittings will be provided with mechanical joint end connections and restrained with standard concrete blocking and wedge action retainer glands. Gaskets will be provided in conformance with AWWA C-111.

04000-8

All fittings will be sized to receive and accept the thickness of pipe to which it connects.

- i) Fitting joints 24 inches and smaller will be restrained by using both mechanical joint wedge action retainer glands and concrete blocking. Mechanical joint wedge action retainer glands will be U.L. listed and F.M. approved. Glands will be rated for 350 psi for pipe diameters 16 inches and less and for 250 psi for pipe diameters 18 inches to 24 inches. All restraint glands will have a safety factor 2:1. Restraint glands will conform with standard mechanical joint bells conforming to AWWA C-111. Restrained joint glands will be made from high strength ductile iron conforming to ASTM A-536, Grade 65-45-12. Wedges will be ductile iron, heat treated to a hardness of 370 BHN minimum. Twist off nuts will be incorporated in the design of the wedge screws to insure proper torque. Restrained fitting joints larger than 24 inches will be restrained such as "Flex-Ring" by American, "Snap-Lok" by Griffin or "TR Flex Restrained Joint" by U.S. Pipe.
- j) All fittings will be installed according to AWW C-600. Spigot ends of connecting pipes will be properly installed into fittings and to full depth of the receiving bell. All bolts will be properly tightened to preclude any joint leakage. Concrete blocking will be placed at all fittings, and will be poured between the fitting and solid earth material not damaged from excavation with sufficient bearing area to prevent fitting or connecting pipe moving when subjected to internal pressure. All blocking will be sufficient to withstand test pressures. Concrete will be allowed sufficient curing time prior to any backfilling or pressure being placed on fittings.
- k) Concrete blocking for all fittings will have a minimum 3000 psi compressive strength after 28 days. The size of concrete blocking will be determined by a licensed professional engineer in the State of North Carolina. Calculations will be submitted to the City of Roxboro for approval for the proposed sizing of any concrete blocking. The sizing of concrete blocking will be based upon a 1000 lbs./ft<sup>2</sup> bearing capacity of the soil and a 200 psi test pressure. All blocking will be sized with a 2:1 safety factor. All concrete blocking will be poured against undisturbed earth.
- l) Additional restraint such as rodding may be required by the City of Roxboro particularly where field conditions warrant vertical bends (fittings). All rodding, including bolts, nuts, washers etc... will be 316 stainless steel with rodding sized similar in diameter as the bolts for the fittings. A minimum of 2 rods will be installed and connected at each joint. The City of Roxboro reserves the right to require additional rodding as hereinafter specified. No joints in rodding will be allowed.

## 2. Material Identification

- a) Force mains will be appropriately identified upon installation so they will not be confused with potable water lines or other utility lines.
- b) Identification Tape: Green detector tape 3 inches in width and clearly labeled "Caution Buried Sewer Force Main" will be laid a maximum of 2 to 2.5-feet below the finished grade. The identification tape differentiating wastewater force mains from other utility lines will be consistent throughout the service area.
- c) Marker Balls: Marker balls approved by the City of Roxboro will be installed along wastewater force mains at a maximum spacing of 100-ft and depth not to exceed 2-ft. Additionally, marker balls will be provided at all bends, fittings and reducers. The electronic marker balls will be provided in green color for wastewater and will be designed to reflect a specific signal back to the electronic locator. The electronic marker balls will be installed during pipe laying and provisions will be made to assure they are not damaged during backfill operations. Electronic marker balls will be tested at the completion of backfill operations to assure they are all working properly. Any defective units will be replaced. All marker ball locations will be provided on the as-built drawings and the field locations provided for recording to the City of Roxboro GIS system.
- d) Force main plug valves or ball valves will have valve box covers with the word "Sewer" cast into the cover. See Section 02000 for valve box specification.

## 3. Precast Reinforced Concrete Manholes for Combination Air-Valves

- a) All manholes will be precast reinforced concrete conforming to ASTM Standard C-478 and AASHTO M-199. All manholes will be a flat top. All flat tops will be traffic bearing. Manholes will be constructed with a monolithic base with the sidewall extending at least 48 inches above the base unless invert/rim elevations require a shorter base. The Portland Cement used to fabricate precast manholes will conform to ASTM Standard Specification C-150-78a, Type III, with the concrete developing a minimum strength of 4,000 psi at 28 days. Metal reinforcement will be billet steel, Grade 60, conforming to ASTM Standard Specification C-33, latest revision. Standard joints will be o-ring conforming to ASTM Standard Specification C-443 or butyl rubber seals that meet or exceed the requirements of Federal Specification (GSA FSS) SS-S-00210A and AASHTO M-198B. Exterior joints for all base and riser sections below grade will be wrapped with a butyl resin sealant with polyolefin laminate that meets Federal Specification SS-S-0210A and AASHTO M-198B. Wrap will be minimum of six (6) inches wide applied according to manufacturer's recommendations with the use of a primer.

- b) All manhole frame and covers will be vented with four 1 inch holes for combination air release valves. All manhole frames and covers will be rated heavy duty. Frames and covers will be constructed of cast iron conforming to ASTM A-48 Class 35. Tensile strength will be a minimum of 35,000 psi. All castings will be of superior quality free of any defects. Frames and covers will be machined at contact points to make even and smooth contact between the frame and cover and will be coated with a hot application of quick drying asphalt base dip.
- c) Frames and covers for combination air-release manholes will be cast-in-place flush with the flat manhole top. The frame will be cast in the concrete top with the flange up. Cover for the combination air release valve will be perforated with four 1 inch vent holes. Covers will be secured to the frames with a minimum of 4 stainless steel bolts. Covers will be cast with the word "Sewer" stated across its top. Covers will have a minimum weight of 140 pounds while the frame will have a minimum weight of 165 pounds. Minimum depth dimension for the frame will be 4 inches.
- d) Manhole steps will be reinforced molded polypropylene plastic-steel construction. All manhole steps will be reinforced with a single #6 steel bar ASTM designation A-615 Grade 60. Plastic manhole steps will be installed 12 inches on center and staggered.
- e) Manhole size will be as follows:
  - Combination Air-Valves  
Water Main Size 8 Inch to 12 Inch – 5 Foot Diameter Manhole
  - Combination Air-Valves  
Water Main Size 16 Inch to 24 Inch – 6 Foot Diameter Manhole
  - Valves and Piping Greater Than 24 Inches in Diameter – Manhole  
Sized by City of Roxboro
- f) All manholes for wastewater force mains and force main discharge ' locations will be epoxy coated at minimum 80-mils thickness.
- g) Force Main Manhole Epoxy Coating: Sewer force main receiver manholes, sewer force main combination air valve manholes and other concrete structures subject to high levels of hydrogen sulfide gas will be provided with an approved monolithic epoxy coating system consisting of a 100% solids, solvent-free, two-component epoxy resin that meets the following specifications for up to 100 mils of coating with a manufacturer approved set time of 6-hours or less. The epoxy coating system will be installed in no more than 2 applications with no runs and no holidays. High voltage holiday testing will be utilized to verify there are no voids in the coating.

Epoxy coatings will only be applied to adequately cured concrete structures that have been sufficiently washed and prepared for epoxy coating installation. Properly applied coating will provide a smooth finish at 80-mils or greater and fill all pores in concrete substrate.

- h) Force Main Receiver Manholes: Sewer force mains will not discharge directly into existing gravity sewer lines unless otherwise approved by the City of Roxboro. Sewer force mains will typically discharge into a receiver manhole that has been epoxy coated as specified herein. The receiver manhole will be provided in the typical eccentric tapered design at minimum 5-ft diameter. The bench will be sloped up to 8-inches from the invert channel to the manhole wall. The invert will be provided with a gradual upsloping alignment from the force main entry to the gravity transition point. Sufficient grade will be placed on the invert such that wastewater falls back into the force main when the pumps are not in operation creating a vapor lock between the force main and the manhole. Drop connections into force main receiver manholes will be prohibited.
- i) Combination Air Valve Manholes: Manholes for combination air valve installation will be provided in flat top configuration to accommodate the excess length of wastewater combination air valves. In cases where the combination air valve assembly will be located in a paved area, provide typical eccentric, tapered manhole design with typical manhole frame and cover for paved areas. The minimum manhole diameter for combination air valve assemblies will be 5-ft diameter. Any manholes located in NCDOT or street right-of-way will be provided flush with finished grade.

### **C. INSTALLATION OF DUCTILE IRON PIPING**

1. Restraint: All wastewater force main components with a resultant force in the City of Roxboro force main system will be restrained. The standard joint restraint will consist of mechanical joint wedge action retainer glands and concrete blocking as previously specified. Reaction blocking for all fittings or components subject to hydrostatic thrust will be securely anchored with 3000-psi concrete thrust blocks poured in place. No concrete will interfere with the removal of fittings. A plastic film will be applied to the pipe to prevent concrete from bonding to the pipe material. Concrete blocking will be designed by a licensed professional engineer in the State of North Carolina.
2. All valves will be restrained in a manner consistent with operation as a dead end, which includes restraining the valve to the pipe and restraining a sufficient number of pipe joints on both sides of the valve to accommodate dead end valve restraint. Pipeline restraint, such as wedge action retainer glands, concrete blocking, manufacturer provided restrained joint pipe will be used. All joint restraint products that include the sole means of restraint within the joint gasket will be prohibited for use with

City of Roxboro wastewater force mains.

3. All drawings submitted will include the pipe restraining plan including the number of joints restrained at fittings, valves, etc. Project designers will include sufficient detail on the plan and profile drawings that make it clear to contractors what is required to meet the engineered restraining system specified. The pipe restraint plan will be included under the design responsibility of the NC Professional Engineer sealing the plan drawings. Restraining systems not included within this specification will require approval from the City of Roxboro prior to utilization.
4. Ductile iron force mains will be installed in accordance with the requirements of AWWA C-600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times will be handled with mechanical equipment or in such a manner to protect them from damage. At no time will pipe and fittings be dropped or pushed into ditches.
5. Pipe and fitting interiors will be protected from foreign matter and will be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it will be removed before installation. Open ends of pipe will be plugged or capped when pipe laying is not in progress.
6. All pipe will be constructed with at least 36 inches of cover below the finished surface grade or 48 inches under the subgrade of roads. Pipe will be laid on true lines as shown on approved Drawings by the City of Roxboro. Trenches will be sufficiently wide to adjust the alignment. Bell holes will be dug at each joint to permit proper joint assembly. The pipe will be laid and adjusted so that the alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints will be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected.
7. Pipes will generally be laid on a reasonably uniform grade, with proper alignment, as dictated by existing conditions and shown on the Drawings. Where deflection of pipe is required, such deflection will not exceed 50 percent of that allowed for the size of pipe being laid and the manufacturer's recommendation for such pipe and type of joint being used.
8. The Contractor will have an experienced pipe man in charge of all pipe work. This individual will be at the Site anytime pipe is being installed. Should this individual need to leave the Site for any reason, pipe laying operations will cease until said individual returns to the Site.

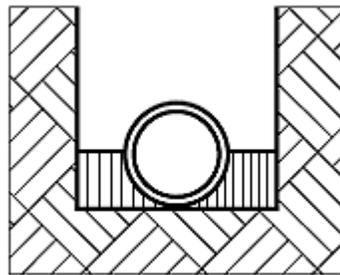
9. No pipe will be laid within ten feet of excavation in earth or within thirty feet of rock that must be blasted for removal. The open end of all pipes will be plugged when pipe laying is not in progress, and all pipe will be protected against injury from falling rock when blasting.
10. Prior to being lowered into the trench, each pipe will be inspected by the pipe foreman with all faulty pipe rejected and removed from the job site. Each joint of pipe will be placed in the trench with the bell end receiving the spigot end of the next joint of pipe being laid. **The barrel of the pipe will be uniformly supported on the foundation.** Joints will be made up as recommended by the manufacturer of the pipe.
11. No pipe will be laid in the trench until the City of Roxboro has been notified of the intention of the Contractor to lay pipe, giving the City of Roxboro sufficient time to check the lines and grades before pipe laying operations commence. The City of Roxboro may order the removal and relaying of any pipe without such notice given and notice from the City of Roxboro received to proceed with pipe laying operations.
12. Excavation or trenching will be performed with equipment of the proper size and type for the work. The Contractor will open no more trench in advance of pipe laying than is necessary to expedite the work. Steps will be taken to avoid excessive damage to any existing curbs, gutters, pavements, etc. Sides of excavated trenches will be as straight as possible, and of sufficient width to allow for proper placement of the pipe and subsequent backfilling operations. Excessive width of excavation for trenches will not be permitted. Excavation will be of sufficient depth to allow a minimum cover of three feet from the top of placed pipe to the existing ground surface over the pipe. Where deeper excavation is required to place pipe under existing utilities, such excavation will be as required by conditions. Bell holes will be excavated at each pipe joint to prevent point loading at the bells or couplings.
13. The width of the trench in rock excavation will be at least two feet greater than the nominal diameter of a pipe. All trench rock excavation will be carried six inches below the invert of the pipe. The excavated area will be brought back to grade with crushed stone (#67 as directed by the City of Roxboro) that provides a proper bed for piping. Stone bedding will extend to the springline of the pipe. All trench rock will be disposed off-site. No trench rock will be allowed as backfill underneath the pavement or other structures or as backfill over piping. Select compactable fill material will be brought to the site as acceptable backfill for the void created by the excavation of rock that previously existed above the springline of the pipe. Installation of pipe in rock will comply with Type 4 bedding.
14. In trenches with unstable bottoms, crushed stone will be placed under and around the pipe as necessary and as directed by the Engineer for a stable trench. Type 4 bedding conditions will be utilized. For severe unstable soil

04000-14

conditions, undercut excavation and an engineer designed foundation plan will be provided to the City of Roxboro prior to pipeline installation.

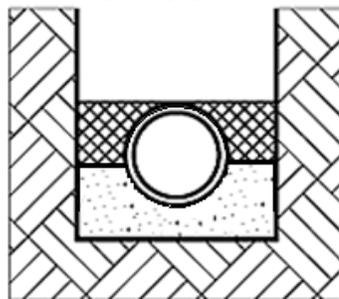
15. All trenching operations will meet or exceed OSHA requirements for shoring, blasting, and the safety of the workers. When conditions require it, the Contractor will use a manufactured steel trench box in accordance with OSHA Specifications and manufacturer's instructions.
16. Laying conditions for ductile iron pipe will be as described in AWWA C-151 and the Ductile Iron Pipe Research Association. Laying conditions will be defined as follows for the City of Roxboro.

Flat-bottom trench (undisturbed earth). Pipe resting on stable earth.  
Backfill lightly consolidated to centerline of pipe, 80% Standard Proctor.



Type 2

Pipe bedded in #67 stone to a depth of 1/2 pipe Diameter, with a minimum of 6 inches below pipe invert.  
Backfill compacted to top of pipe, 95% Standard Proctor



Type 4

NOTE: The laying condition required by the City of Roxboro will be determined by Chart 1 based upon depth of cover over the pipe. Other types of laying conditions are acceptable only after special approval has been granted by the City of Roxboro.

17. Prior to beginning construction, the Contractor will contact local utility companies and verify the location of existing utilities. The Contractor will be completely and solely responsible for locating all existing buried utilities inside the construction zone before beginning excavation. The Contractor will be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it will be exposed prior to beginning construction to prevent damage to the existing utility.
18. Valves in the existing City of Roxboro sanitary sewer system will not be operated without a minimum notice of 24 hours to the City of Roxboro. All valves that are under the ownership and acceptance of the City of Roxboro will be operated only by personnel of the City of Roxboro. Contractor's personnel will only be responsible for operating valves within new construction areas until the force main has been accepted by the City of Roxboro.

**D. BACKFILLING OF TRENCHES**

1. After the pipe has been laid, backfilling will be done as follows: Backfilling along the sides of the pipe above the springline and to a level 12 inches above the pipe will be carefully done by hand using select material placed in layers not more than 6 inches thick and thoroughly compacted with mechanical tampering equipment using care to insure that pipe alignment and grades are not disturbed. Except for lines under drives or paved areas, backfilling from this elevation up may be placed in layers not exceeding 12 inches thick, kept reasonably level and compacted to 95% of maximum density as determined by ASTM Specification D-698 latest revision (Standard Proctor Test). Compaction under drives and pavements where dirt backfill is allowed, will be 100% according to ASTM Specification D-698. Should settlement occur, the Contractor will bring the ditch back to grade, including reseeding as necessary.
2. Where a force main is installed across a N.C.D.O.T. maintained road by open-cutting, the trench will be backfilled to within 13 inches of finish grade by pouring an N.C.D.O.T. approved grout mix (flowable fill) or compacting an N.C.D.O.T. aggregate base material complying with Sections 520 and 1010 of the North Carolina Department of Transportation Standard Specifications. Aggregate used will be Type B. Steel plates or other approved structures to bridge the flowable fill or aggregate base course will be installed temporarily to allow the passage of vehicular traffic until asphalt base and topping can be installed. Finish grades in roads will be obtained by installing asphalt mixes per N.C.D.O.T. Standards which is 11 inches of B-25 Asphalt Base and 2 inches of S9.5B Topping. All asphalt thicknesses represent a thickness after compaction.
3. Backfill will not be permitted when trenches are flooded, or material is too wet (or dry) for proper compaction.

4. Undesirable material, whether rock, muck, or other will not be allowed in the backfilling of trenches. If additional material is needed for the proper filling of trenches, it will be procured and hauled to the site in sufficient amounts to complete the backfill process. Excess and/or unsuitable material will be removed from the job site and properly disposed.
5. Excavated rock will not be used as backfill, except soft sand rock that disintegrates completely on removal from the ditch may be used above the top of the pipe. Rock excavated from trenches, which is not used for backfill, will be hauled away and properly disposed. "Select Backfill" to complete backfilling operations for a final grade acceptable to the City of Roxboro and to fill voids created by rock excavation will be brought to the site as necessary. All "Select Backfill" will be free of debris, stumps, large rocks, and other deleterious material unsuitable for backfilling over the pipe and achieving the desired proper compaction. All "Select Backfill" delivered to the site used for final grading will be acceptable for seeding and mulching operations as specified.
6. All "Select Backfill" will comply with NCDOT Standards, Section 1016, Class I Material.

#### **E. VALVES AND APPURTENANCES**

##### 1. Check Valve:

- a) Check valves will be iron bodied, fully bronze mounted with bronze clapper disc and bronze seat ring, and will have a spring loaded lever arm capable of being mounted on either side of the valve.

##### 2. Plug Valve:

- a) Plug valves will be non-lubricating, eccentric action and resilient plug facing with heavy duty Type 316 stainless steel bearings. Plug valves will be designed for a working pressure of 175 psi for valves 12" and smaller, 150 psi for valves 14" and larger. Valves will provide tight shut-off at rated pressure. The plug valve body will be cast iron ASTM A126 Class B with welded-in overlay of 90% nickel alloy content on all surfaces contacting the face of the plug. Sprayed, plated, nickel welded rings or seats screwed into the body are not acceptable. All plug valves 12" and smaller will have round port design that provides a minimum 80% port area. The valve plug will be ductile iron ASTM A536 Grade 65-45-12, with EPDM, Buna N, or Neoprene resilient seating surface to mate with the body seat. Larger force main plug valves with rectangular plugs will provide clean passage for a solid sphere of at least 67% of the adjoining pipe diameter to facilitate pigging of the force main. Force main plug valves with rectangular port will be "full-port" cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe. All buried plug valves will

be provided with worm and gear actuators with 2-inch operator nut. Plug valves will be provided with typical mechanical joint end connections and restrained with wedge action retainer glands on both ends of the valve assembly.

3. Rubber Seated Ball Valve:

a) For larger diameter force mains, rubber seated ball valves will be of the tight-closing, shaft-mounted type that fully comply with AWWA Standard C507 to provide a full port unobstructed waterway with no additional pressure drop. Design pressure ratings will be 150 psi or greater and provide tight shutoff against flow. With the valve in the closed position, the rubber seated valve will be bubble tight at rated pressure. All buried ball valves will be provided with worm and gear actuators with 2-inch operator nut.

4. Combination air valves will be provided to purge air from the system at startup, vent small pockets of air while the system is being pressurized and running, and prevent critical vacuum conditions during draining. Combination air valves will be designed to prevent failure caused by grease and debris in the wastewater. Combination air valves approved for use in wastewater force main installations will be installed at all high points of wastewater force mains 6 inches in diameter or larger and at other locations, such as major changes in slope, as directed by the Town. A high point will be determined as any high location where the difference between the high elevation and adjacent low elevation exceeds 10-ft unless otherwise determined by the Director of Engineering based on special circumstances. The combination air valve will automatically exhaust large volumes of air from the system when it is being filled and allow air to re-enter the pipe when the system is being drained. The wastewater force main will be installed at a grade which will allow the air to migrate to a high point where the air can be released through an air valve. A minimum pipe slope of 1 foot in 500 feet should be maintained. The valve will have a minimum two (2) inch NPT inlet and 145-PSI working pressure rating unless the pipeline design requires a higher pressure rating. Combination air valves will be sized by the Engineer and approved by the Town.

a) Combination air valves will be of the single housing style with Type 304 or 316 stainless steel body that combines the operation of both an air/vacuum and air release valve. The valve must meet the requirements of AWWA C512 and be installed in accordance with the Detail Drawings.

b) The valve will have a minimum two (2) inch NPT inlet for a 2-inch valve assembly. Combination air valves sized from 3-inches to 8-inches will be provided with studded inlet connectors or flanged connections. The

combination air valve will be provided with cylindrical shaped floats and anti-shock orifice made of high density polyethylene. Combination air valves with spherical floats will not be accepted. All combination air valves will be installed in accordance with the Detail Drawings.

- c) The combination air valve will be installed in standard flat top manhole as shown in the detail drawings. The Engineer of Record will provide ample depth of installation to accommodate the extended design combination air valve as required for wastewater force mains.
- d) The combination air valve will be provided with a tap in the same sizing as the combination air valve assembly and isolated with a ball valve of the same size. All taps for combination air valves will be provided with service saddles. The isolation ball valve will be provided with NPT threads and connected with brass or bronze piping. The isolation ball valve will be rated for 200-psi service or greater. For larger sizes, a standard plug valve and tapping sleeve with flange connections may be required for connection with larger combination air valve assemblies provided with flange connections.

5. Bypass Connection Assembly:

- a) All wastewater force mains will be provided with an above ground blind flange connection to the force main that facilitates bypassing the pump station during emergency operations when the pump station is not functional. The bypass assembly will include either a ball valve or plug valve assembly for isolation from the primary wastewater force main. Additionally, the primary force main will be provided with a main line plug valve or ball valve on the upstream side of the bypass assembly to prevent bypass flow from draining back to the pump station. The bypass assembly will be brought to the final graded surface with a visible blind flange assembly for connection by an outside pumping contractor. The bypass assembly will be sized by the Engineer of Record and located within the pump station secured area in general close proximity to the wet well.

6. Force Main Odor Control Systems:

- a) Force main odor control will be included in the design plans for any proposed force main at discharge locations, intermediate air release locations and otherwise as directed by the City of Roxboro. For small force mains, this requirement may be waived contingent upon a written request and consideration of such exemption provided by the Engineer of Record. Factors included in the waiver request would be the number of residents in close proximity, type of development, size of force main, estimated flows, number of cycles, wastewater characterization, long

term service conditions, etc. The suggested odor control technology will be designed by the Engineer of Record to achieve 95% or greater hydrogen sulfide removal. For forced air systems, the design will include provisions for power to the odor control system. For all odor control systems, the Engineer of Record will provide sufficient easement area for long term maintenance of the system.

## **F. BLASTING**

1. All blasting operations will be conducted in strict accordance with existing ordinances and accepted safe practice relative to the storage and use of explosives. Only experienced men will do blasting, and extreme care and precautions will be used to prevent injury to workmen, to existing pipes, buildings, or other structures either below or above the surface of the ground. Sufficient warning will be given to all persons in the vicinity of the blasting.
2. Rope or wire mats are required to be used in all blasting operations. Trench overburden may be used as a substitute for wire mats. Protective measures, whether rope, wire mats or trench overburden will be adequate to assure that there will be no projection of loose materials or objects that leave the blasting area.
3. Blasting operations will be done in such a manner that damage to existing utilities and structures, whether above or below ground, is prevented. The Contractor will monitor the blasting operations as necessary to insure that the operations are conducted safely and without excessive air or ground pressures or displacements. Monitoring all blasting operations will include measuring air and ground pressures by the use of two seismographs. When blasting, the acceptable level of vibration will be no higher than 2 inches per second at any structure. One seismograph will be located near the closest existing residential structure on the same side of the street nearest the blast.
4. All blasting operations will be conducted in complete accordance with applicable federal, state and local laws. These laws include but are not limited to applicable occupational safety and health standards of the North Carolina Department of Labor.
5. The Contractor will secure the necessary permits required to conduct blasting operations. These include, but are not necessarily limited to a permit from the Fire Prevention Bureau or Fire Marshall.

## **04030      INSPECTIONS AND TESTING**

### **A. INSPECTIONS**

1. All materials and equipment used in the construction of the wastewater pumping system must be verified for compliance with the specifications (or other approval granted by the City of Roxboro) by the Inspector prior to installation. Non-conforming materials or equipment will be immediately removed from the job site.
2. Compliance with plans and specifications will be verified on a regular basis by the Inspector.

### **B. TESTING**

#### 1. General

- a) The Contractor will furnish all materials, labor, and equipment to perform all testing. Water for testing purposes may be obtained from the City of Roxboro at no cost.
- b) All water or wastewater used during testing of the pump station, force main, or any of the systems described in this section, must be returned to the City of Roxboro sanitary sewer system after proper coordination with the City of Roxboro.
- c) All on-site testing and/or installation verification will be performed in the presence of the Inspector or other representative authorized by the City of Roxboro.

#### 2. Force main Testing

- a) The force main will be completely filled with water, all air will be expelled from the pipe, and the discharge end of the pipeline will be plugged and adequately blocked before the hydrostatic test begins.
- b) The force main will be tested to a pressure of 150 psi or three times the rated Total Dynamic Head of the pumps in psi, whichever is larger, as measured at the lowest elevation of the pipeline, for a duration of 2 hours. The pressure gauge used in the hydrostatic test will be calibrated in increments of 5 psi or less. At the end of the test period, the leakage will be measured with an accurate water meter.

- c) All leaks will be located and repaired regardless of the amount of leakage. If the force main does not pass the leakage test requirements, the cause of the failure will be identified and repaired. Testing will be repeated until the force main passes.

$$\text{Allowable Leakage (L)} = \frac{S \times D \times \text{SqRt}(P)}{133,200}$$

Where: L = leakage (gph)  
S = length of pipe (feet)  
D = nominal diameter of pipe segment tested (inches)  
P = test pressure (pounds per square inch)

END OF SECTION 04000

**SECTION 05000  
STORMWATER DRAINAGE**

TABLE OF CONTENTS

05010	DESIGN
	A. Location
	B. Sizing
05020	MATERIALS
	A. Pipe Materials
	B. Structure Materials
	C. Installation
	D. Inlets and Outlets
05030	INSPECTION

## 05010 DESIGN

### A. Location

1. All public storm sewers will be installed in right-of-way or easements. Minimum easement widths will be 25 feet for pipes up to and including 48 inches in diameter, and 30 feet for pipes greater than 48 inches in diameter.
2. See Sections 02000 and 03000 for horizontal and vertical separation requirements between storm drainage pipe, water lines, and sanitary sewer lines.
3. The City will maintain only the storm sewer systems within City maintained right-of-way and on City property. All others will be maintained by the property owner(s).
4. Discharge points will be a minimum of 20 feet downhill from the building envelope.
5. Structures will be spaced to intercept flow at the uphill turnout of intersections unless the street design provides a continuous downhill grade around the radius and down the intersecting street.
6. Stormwater inlets will not be placed within travel areas of roadways or parking lots.
7. Wet detention ponds will reference and adhere to standards set forth by NCDENR in "Stormwater Best Management Practices." Additional requirements by the City of Roxboro require a maximum of 3:1 slopes on all sides of the ponds, unless exempted by the City of Roxboro.

### B. Sizing

1. Systems will be designed based on rainfall intensities of 4 inches per hour for street inlet spacing, the 2 year storm for side ditches, the 10 year storm for street drainage pipe sizing, the 25 year storm for cross-street drainage, and the 100 year storm for flood plain areas.
2. Curb inlets will be spaced to provide a maximum spread of 6 feet for the design storm. In areas of heavy pedestrian traffic, the maximum allowable spread may be decreased by the City of Roxboro.

05000-2

3. Runoff rates will be calculated by the Rational Method (for drainage areas less than 2 square miles), SCS Method (for drainage areas greater than 2 square miles), or other acceptable procedure. Runoff computations will be based on rainfall data published by the National Weather Service for this area.
4. Time of concentration ( $t_c$ ) will be determined using the Kirpich Equation (Bureau of Reclamation, 1974, p.71), and the storm duration will equal  $t_c$ .
5. Pipe will be sized in accordance with the Manning Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second during the 2 year storm.
6. Culverts will be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second during the 2 year storm.
7. The minimum pipe diameter will be 15 inches.
8. Pipe will be installed to provide a true line and grade between structures.
9. Structures will be installed at each deflection of line and/or grade.
10. The maximum length between access points will be 400 feet for all pipe sizes.
11. No inaccessible storm drainage structures will be allowed.
12. Channels and ditches will be designed to carry the design flow at nonerosive velocities. Calculations indicating design velocities will be provided along with typical channel cross-sections. The maximum allowable design velocity in grass channels is 4 feet per second.
13. A Hydraulic Grade Line (HGL) study will be performed for all storm drainage systems. The study will include profiles that show invert slopes, proposed finished grade and hydraulic grade line. Hydraulic grade line will be required to stay within pipe and associated structures to ensure no surcharge on system for the 25-year storm.
14. Stream crossings requiring greater than double culverts will necessitate a back water study on the 25-year storm.

05000-3

15. Limit of two pipe culverts per crossing. Installation will include box culverts, of no more than two barrels, if requiring greater than double pipe culverts.

## 05020 MATERIALS

### A. Pipe Materials

1. Reinforced Concrete Pipe will conform to ASTM C76, Table III or Table IV. Joints will be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.
2. Aluminized Steel Type 2 Pipe will be 36 inches in diameter or greater and be bedded and manufactured according to ASTM A-929 (Manufacturing), 760 (Coating), 796 (Structural Design) and 798 (installation).
3. Corrugated Aluminum Pipe will conform to ASTM B-744 and design standard ASTM B-790. Installation and backfill will comply with standards ASTM B-788 and AASHTO M145. The corrugated aluminum pipe will meet or exceed HS20 loading requirements and NCDOT approvals.
4. High Density Polyethylene (HDPE) Corrugated Pipe will be used only in areas outside of public right of way and easements. When used in private locations, pipe material will be rated on approved plans and include the submission of design criteria. Installation of HDPE pipe will adhere to design criteria standards. Pipe material will meet the product specifications of ASTM F-667 and will have a smooth interior. Pipe joints will consist of an integral bell and spigot type joint with "O" ring rubber gasket meeting ASTM F-477 placed on the spigot end. At least two (2) corrugations of the spigot end must insert in the bell end. Installation will adhere to the specification of ASTM D-2321 and certified by an engineer. HDPE pipe, 24" or under may be used under pavement or curb and gutter in private locations only.
5. Polyvinyl Chloride (PVC) Pipe will be used only in areas outside of public right of way and easements. When used in private locations, material pipe will be rated on approved plans and include the submission of design criteria. Installation of PVC pipe will adhere to design criteria standards. Pipe material will meet the product specifications of ASTM F-949 and will have a smooth interior. PVC pipe, 24" or under may be used under pavement or curb and gutter in private locations only.

05000-4

## **B. Structure Materials**

All storm drainage structures such as manholes, inlets, junction boxes and catch basins will be constructed of either solid brick, solid block, or precast concrete.

1. Clay Brick will be solid, rough, sound clay brick conforming to ASTM C-32, Grade MS. The brick will be laid with full shove joints, filling up the joints with mortar. The thickness of the joints will not exceed 3/8 of an inch. Only Portland cement mortar is allowed.
2. Concrete Block or brick will be solid and conform to ASTM C-139 as to design and manufacture. The block or brick will be embedded in a mortar bed to form a 1/2 inch mortar joint. Only Portland cement mortar is allowed.
3. Precast Concrete Manholes will meet ASTM C-478 as to design and manufacture. All manhole cones will be the eccentric type. Joints will be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.
4. Manhole Frames and Covers will be as specified in Section 03000, with "STORM SEWER", "CITY OF ROXBORO" and the City Seal stamped on the cover with two 1-inch vent holes.
5. Steps will meet the material, strength, and installation requirements as specified in Section 03000.
6. Headwalls and Endwalls may be constructed in accordance with NCDOT details, or precast concrete with wing walls and apron by an approved manufacturer. Installation of precast headwalls and endwalls will be in accordance with the manufacturer's recommendations.
7. Retention/Detention outlet structures will be cast in-place or precast concrete or aluminum pipe only.
8. Frame, Grate & Hood will be cast iron and meet the ASTM requirements set forth in the latest edition of the NCDOT "Standard Specifications for Roads and Structures" and the dimensional requirements set forth in the latest edition of the NCDOT "Roadway Standard Drawings #840.03". Grate will be stamped with the NCDOT specification number as evidence of satisfying the above requirements.

05000-5

**C. Installation**

1. Pipe may enter through the corner of all structure material types except precast concrete "waffle" boxes.
2. A reinforced concrete slab designed by a licensed professional engineer may be used at oversized structures to adjust an inlet to standard dimensions. They must meet H-2O loading.
3. The minimum cover for storm sewer pipe will be 2 feet to finished subgrade under roads and 1 foot to finished grade in non load-bearing areas. Trench excavation and backfilling will be in accordance with Section 03000 of the Specifications unless more stringent installation requirements are listed with specific material type and certified by an engineer.
4. Pipe will not project into a drainage structure but will be finished flush with the inside of the structure.
5. Catch basins between 5 and 15 feet in depth will have minimum interior dimensions of 4 feet by 4 feet, and those over 15 feet in depth will have minimum interior dimensions of 5 feet by 5 feet.
6. Each drainage structure will have an invert constructed from concrete and shaped to conform with the pipe ID, and a bench with a maximum 5:1 slope. The bench will begin at a height of one-half the pipe diameter for 12 to 24 inch pipe, one-third the pipe diameter for 30 to 48 inch pipe, and one-fourth the diameter for pipe greater than 48 inches in diameter. Precast headwalls and endwalls will only be installed at single pipe culverts.
7. Precast concrete structures may be installed only to depths certified as acceptable by the manufacturer.
8. Each curb's inlet must be installed such that the front wall is straight and aligned with the curb and gutter.

**D. Inlets and Outlets**

1. Headwalls, endwalls or flared end sections will be installed at all discharge points, and inlets where there is not a structure.
2. Flared end sections will be installed on single pipe culverts up to and including 48 inches in diameter, and on multiple pipe culverts up to and including 36 inches in diameter.

3. Headwalls and endwalls will be installed on single pipe culverts greater than 48 inches in diameter, and on multiple pipe culverts greater than 36 inches in diameter.
4. Energy dissipaters will be installed at all discharge points and will be properly sized to ensure that stormwater is released at a nonerosive velocity.
5. A fabric barrier will be installed between dissipation pads and the natural ground.
6. The system will include scour protection for drainage ways.
7. Details and design of headwalls, endwalls and flared end sections will be in accordance with NCDOT standard detail requirements. These details will be shown on plan submissions.
8. Additional information on the impact of stormwater discharge onto adjacent properties may be required by the City of Roxboro.

05000-7

## **05030 INSPECTION**

### **A. Visual Inspection**

1. All materials used must be approved by the City of Roxboro prior to installation. Rejected materials will be immediately removed from the job.
2. Storm drain lines will be clean and free from obstruction and will be visually inspected from every structure or opening. Lines which do not exhibit a true line and grade or which have structural defects will be corrected.
3. All piping and structures must be approved by the City of Roxboro prior to paving.

END OF SECTION 05000

05000-8

SECTION 06000  
WASTEWATER PUMPING SYSTEMS  
TABLE OF CONTENTS

- 06010 GENERAL
  - A. Design Requirements
  - B. Warranty
  - C. Submittals
  
- 06020 PUMP STATION SITE AND STRUCTURES
  - A. General
  - B. Site Work
  - C. Structures
  - D. Piping and Valves
  - E. Electrical - General
  
- 06030 PUMP STATION EQUIPMENT
  - A. Pumps
  - B. Pump Control Systems
  - C. Alarm Dialer/SCADA/Telemetry
  - D. Grinders
  - E. Generators
  - F. Automatic Transfer Switches
  
- 06040 ODOR/CHEMICAL FACILITIES
  
- 06050 INSPECTIONS, TESTING AND TRAINING
  - A. Inspections
  - B. Testing
  - C. Operator Training

## **06010 GENERAL**

### **A. DESIGN REQUIREMENTS**

1. These specifications apply to all pump stations and associated facilities that are to be owned, operated, and maintained by the City of Roxboro. Designers of private pump stations and force mains and associated should look for guidance from the appropriate permitting agency (NCDENR, NC Plumbing Code, etc.).
2. All aspects of the design of pump stations, and associated facilities will, at a minimum, meet the requirements of the latest version of the NCDENR "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains". Requirements presented in the City of Roxboro Standard Specifications hereunder that are more restrictive or go above and beyond the requirements of the Minimum Design Criteria are required by the City of Roxboro.
3. All aspects of the design of pump stations, and associated facilities will be submitted for review and approval to the City of Roxboro. Materials necessary for the review and requiring approval include complete plans, specifications, design reports, and specific equipment submittals for the specific pump station, as described hereunder.
4. Prior to approval of any pump station plan, a detailed economic analysis consisting of minimum 20-year present worth evaluation will be submitted by the Engineer-of-Record comparing the extension of gravity sewer service with the construction of a pump station and force main alternative. Gravity sewer systems will always be preferred over pump station and force main construction. The City of Roxboro reserves its right to consider economic evaluations, service area configuration, operating costs and other external factors before approving pump station plan submittals in lieu of gravity sewer extensions.
5. All equipment, except for the generator, included in this specification will be designed for a sound rating of 55dB(A) or less at a distance of 7 meters from the operating equipment. The generator will include a sound attenuating enclosure and hospital grade silencer. The generator will have a sound rating of less than 71 dbA for generators rated below 150KW and less than 73 dba for generators, rated between 150KW and 250KW, at a distance of 7 meters from the operating equipment. The allowable sound levels may be modified at any time by the City of Roxboro. The City will consider individual site conditions and the technology that is available. Warning horns and sirens have no sound restrictions.

The pump station design will incorporate ways to minimize the sound levels leaving the site property. Factors to consider include equipment layout, cumulative sound levels, and walls that reflect the sound. Equipment submittals that include the sound ratings for the major equipment to be installed at the pump station will be supplied to and approved by the City of Roxboro prior to ordering the equipment.

The pump station will not be approved for routine operation until sound testing has demonstrated that the noise levels are in accordance with the requirements of this section. All sound testing will be performed by reputable personnel and testing equipment to assure accuracy. The City reserves the right to require certified sound engineers in cases when the accuracy of the testing equipment is uncertain. The City may also require sound testing to be redone prior to the end of the warranty period to further demonstrate that the pump station, including the generator, is performing as designed.

Generator testing and operation other than for urgent necessity in the interest of public health and safety will be during the time periods of Monday through Friday between the hours of 9:00 a.m. and 4:00 p.m., not including holidays which are observed by the State of North Carolina.

6. All pump station facility design plans will evaluate surge and water hammer, and incorporate sufficient surge suppression based on the range of flows, pressure and other variables included in the pump station design.

## **B. WARRANTY**

1. All equipment, materials, and systems supplied under this specification will be provided with a warranty from the manufacturer to the City of Roxboro that the subject equipment, material's, and systems will be free of defects in workmanship and material, and will operate as intended under the known conditions, for a minimum period of one year. The warranty will be in printed form and made applicable to the City of Roxboro (as Warrantee) at the time of acceptance for maintenance by the City of Roxboro.

## **C. SUBMITTALS**

1. Design Report
  - a) A design report signed and sealed by a NCPE is required with the submittal of plans and specifications for any facilities covered under this section that are proposed for construction. This design report will contain, at a minimum, the following design criteria:

- i. Total dynamic head calculation for all applicable pumping situations.
- ii. System curve and pump curve analysis used to determine pump selection and operating point.
- iii. Pump station cycle and pump run times covering the high, low and average flows over the entire expected operating period of the pump station.
- iv. Response time available in event of an emergency (time between the high water alarm and the first system overflow at average design flow and peak design flow).
- v. Pump station flotation/buoyancy calculations.
- vi. Minimum velocity within the force main, including an analysis of the capabilities of the pumps to completely flush any depressed sections of the force main in a single pumping cycle.
- vii. Maximum detention times within the pump station and force main covering the low flows over the entire expected operating period of the pump station.
- viii. An evaluation of the capability of the receiving sewer to handle the peak flow discharge from the proposed facility in addition to the existing or planned peak flows currently handled by the receiving sewer or sewage facility.
- ix. Airflow calculations and chemical dosing calculations for the odor control facilities (if applicable).
- x. Flow capacity and headloss calculations for the grinder unit.
- xi. Calculations for the sizing of the backup power generator.

## 2. Project Review Submittals

- a) Project Review Submittals will be submitted to the City of Roxboro for review and approval prior to application for a permit for the pump station or force main, and prior to entering into construction contracts or purchasing any equipment for the pump station or force main. Obtaining permits, entering into construction contracts, or purchasing any equipment in no way obligates the City of Roxboro to accepting designs or equipment that do not meet the specified standards or other requirements the City of Roxboro may have.
- b) The Project Review Submittals will include, at a minimum, complete plans and specifications, a design report as described above, and manufacturer's information on specific major equipment listed in this specification section. The information submitted on equipment will include, at a minimum, the name of the manufacturer and the specific model being supplied, fabrication and assembly drawings, detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished. It will also include any system hydraulic schematics, electrical wiring diagrams, and control panel schematics.

Additional detailed information that may be required for submittal for specific equipment is listed in the appropriate equipment section.

### 3. Pre-Approved Equal Submittals

- a) Equipment and systems of equal quality and efficiency may be available from manufacturers and suppliers other than those listed in the Approved Manufacturers List. No attempt is made to preclude the furnishing of similar quality items by other manufacturers. The use of alternate equipment and products will be considered if it can be demonstrated that these items have equal or superior construction performance, operating and maintenance costs, offer a present worth cost equal to or less than the specified items, and do not adversely affect other system components.
- b) Equipment and systems other than those listed in the Approved Manufacturers List must receive approval from the City of Roxboro prior to application for a permit for the pump station or force main, and prior to entering into construction contracts or purchasing any equipment or systems for the pump station or force main. Purchasing equipment in no way obligates the City of Roxboro to accepting equipment that does not meet the specified standards or other requirements the City of Roxboro may have.
- c) Pre-Approved Equal packages will include the following information as a minimum:
  - i. Current catalog data sheets and complete technical data to support specification compliance.
  - ii. A point-by-point list clearly stating all differences between the named item and the proposed alternate and a separate list clearly stating all exceptions to the Specifications. If no exceptions are listed, then no exceptions to the Specifications will be allowed.
  - iii. Installation list with name, address and phone number of contact person for each of at least three (3) installations where the proposed equipment has been in similar service and satisfactory operation for at least two (2) years. The date of placing equipment in service at each listed installation will be provided.
  - iv. Three (3) copies of Pre-Approved Equal information will be submitted.
- d) Equipment that meets the Pre-Approved Equal submittal requirements, the technical specification requirements, and all other requirements of the City of Roxboro, will be approved by the City of Roxboro via letter within 14 calendar days of receipt of a complete package. Approval of Equal equipment or systems in no way eliminates the requirement for complete submittals at a later date.

06000-5

#### 4. Testing Results Submittals

- a) The results of all testing will be submitted to the City of Roxboro for review prior to continuing progress on the particular equipment. If shop testing is required, results will be submitted prior to delivery of the equipment. If installation verification is required, results will be submitted prior to start-up and testing of the equipment. If final start-up tests are required, results will be submitted prior to final acceptance of the equipment.
- b) Three printed copies of all test results are required to be submitted for review.
- c) A final, compiled summary of all testing done on all equipment will be provided to the City of Roxboro upon completion of the project prior to project closeout and final acceptance. This final, compiled summary will consist of a single bound printed copy, and an electronic copy (CD).

#### 5. Operation and Maintenance Manuals (O&M)

- a) Operation and Maintenance (O&M) manuals are required for all equipment and systems furnished under this Specification Section. Three copies will be supplied to the City of Roxboro in printed format prior to startup of the subject equipment or systems. The O&M manuals will contain all of the necessary information for proper operation and maintenance of the subject equipment and systems. At a minimum, the O&M manuals will contain the following:
  - i. Final approved shop drawings.
  - ii. Design data including pump curves and system curves.
  - iii. Wiring diagrams and control schematics.
  - iv. Detailed inventory of installed equipment, including its functional description, and manufacturer name, address, and phone number (and the same for a local representative of the manufacturer).
  - v. Operating instructions.
  - vi. Troubleshooting techniques.
  - vii. Maintenance schedules.
  - viii. Assembly and disassembly instructions.
  - ix. Instructions for start-up and shutdown, as well as calibration and adjustment.
  - x. Annotated hard copy and downloadable electronic copy of application program for all field programmable equipment (eg PLCs, operator interfaces, etc.)
- b) A final, compiled Operation and Maintenance (O&M) manual covering all equipment and systems supplied, will be provided to the City of Roxboro upon completion of the project prior to project closeout and

06000-6

final acceptance. This final, compiled summary will consist of a single bound printed copy, and an electronic copy (CD).

## **06020 PUMP STATION SITE AND STRUCTURES**

### **A. GENERAL**

1. Pump stations will be located on a parcel or an easement that is dedicated to the City of Roxboro. The site will be directly connected to a dedicated public right-of-way or have a dedicated access easement to a public right-of-way.
2. The City of Roxboro requires sewage grinders, on-site backup power, and odor control facilities at all pump stations, unless the City of Roxboro grants approval otherwise. Sizing of these items will be based on expected flow volumes and characteristics.
3. All stations will have a minimum of 2 pumps of equal capacity. The pumps will be solids handling, submersible, centrifugal pumps each capable of pumping flows equal to the expected peak hourly flow. The allowable peak flow can be found in Section 07010 A.2.(c). The City of Roxboro may require that higher peaking factors be used. The City of Roxboro may require wetwell/dry well pumping systems when peak flows exceed 1-MGD. Where 3 or more pumps are required, they should be of such capacity that with the largest unit out of service, the remaining units will have capacity to handle the peak hourly flows. Pumps and force mains will be sized to provide a minimum velocity in the force main of 2.5 feet per second and a maximum velocity of 7 feet per second.
4. Pump stations will remain fully functional, operational, accessible and free from physical damage during a 100-year flood.

### **B. SITE WORK**

1. The site will be graded to drain and direct stormwater runoff away from the pump station, and to remove storm water runoff from the site in a non-erosive manner.
2. The site will be stabilized by crushed stone, low maintenance vegetative ground cover or other suitable materials. No vegetative ground cover is allowed within the fenced area. Visual screening and landscaping will be provided in accordance with the approved site plan.
3. The site will be secured by an 8-ft high vinyl coated chain link fence. It will have 3-wire vinyl coated barb arms, set at an outward facing 45 degree angle and located at the top of each post. Each wire to be 3 strand barb wire class III galvanized or aluminized. The outer barb wire will hold a load of

06000-7

250-lbs. The 8-ft height does not include the barb arms. The vinyl coating will be black and provided with UV resistant vinyl. The fence will also be provided with a black vinyl coated polyester privacy screen rated for a minimum life span of 12-years. The privacy screen will be provided across the entire surface area of the fence including gates. Fencing will be provided around the entire perimeter of the pump station property maintaining an offset of 10-12 feet from the property boundary. All fence posts will also be vinyl coated over the galvanized steel in black color to match fencing and privacy screening. Manual gates for smaller pump stations will permit 180-degree opening and be provided in minimum width of 12-ft. Gates at larger pump stations receiving chemical deliveries will accommodate tractor trailer accessibility and be provided with electrically operated gates. All gate posts and corner posts will be provided with minimum 4-inch diameter fence posts.

4. The pump station site will permit the loading and removal of all equipment (pumps, grinders, generators, etc.) from the pump station site with an appropriately sized truck and/or crane.
5. The site will feature adequate turn around areas for a WB-40 service vehicle and provide a minimum 12 foot wide access road to the site with grades not to exceed 10%. If chemical feed systems are included, additional turning radius may be required.
6. A high pressure sodium vapor light of minimum 600 watt capacity in compliance with City of Roxboro standards, is required. The light will be mounted on a Class V utility pole at a height of 30 feet and be controlled by a photo cell with a switch that overrides photo cell (on/off) mounted on the pole. All area lighting will be provided in a downward projecting fixture, such as shoe box type light or approved equal. Open globe lighting will be prohibited on all pump station sites.
7. Pump stations will have a metered potable water supply from the City of Roxboro public water distribution system at minimum sizing of 1-inch service, but provided with sufficient volume and pressure for operations including wash downs, etc. The supply will have an approved reduced pressure principle, RPZ, backflow prevention system. A minimum of one (1) freeze proof yard hydrant is required within the fenced area. Emergency shower and eye washing basin will be provided in pump stations with chemical odor control facilities. Separate reduced pressure principle, RPZ, backflow preventers will be required as necessary to protect eye wash and/or emergency shower stations from potential chemical contamination within the pump station site.

## C. STRUCTURES

### 1. General

- a) The submersible pump station structures will consist, at a minimum, of a grinder manhole, a wetwell, and a valve vault. Large, integrated structures are permissible, however, there will be walls separating the portions of the structure listed above. Grinders are required unless authorized differently by the City of Roxboro. Pump station structures other than the wetwell will be provided with a means to remove accumulated water and wastewater from the structure. Access hatches for equipment and personnel will be provided for all structures, and sized appropriately.
- b) Any portion of a pump station structure that is open and would allow floodwater entry into the wastewater system will be built with a top elevation of 2 feet above the 100 year flood elevation. All structures not meeting the elevation requirement that could allow entry of floodwater into the wastewater system will be sealed watertight with a vent elevated a minimum of 2 feet above the 100 year flood elevation.

### 2. Wetwell

- a) The wetwell will have a minimum diameter of 6 feet, and will be large enough to easily accommodate the removal of each pump and a basket strainer. The wetwell will be designed to have an operating volume sufficient to provide pump operating cycles to match the manufacturer's recommendations. The pump operating cycles must be between two and eight times per hour at design daily flow (without being excessively deep), unless otherwise authorized by the City of Roxboro.
- b) The wetwell will be constructed of precast concrete manhole sections or cast-in-place concrete. Extended bases or another foundation will be used to provide adequate bearing surface and flotation protection, if needed. All concrete will have a minimum 28 day compressive strength of 4000 psi.
- c) Precast concrete manhole wetwells will conform to ASTM C-78. Manhole section joints will be of a durable mastic sealing material. The exterior of manhole wetwells will have a factory applied bitumastic or asphaltic coating. The exterior of wetwell joints will be overlapped by an approved material such as Conwrap, Conseal, etc. The interior side of the joints will be plastered smooth with portland cement grout.
- d) Cast-in-place wetwells will be properly designed by a NCPE and include appropriate structural support, waterproofing, exterior coating, structure covers, access hatches, etc.

- e) At a minimum, wetwells will have a vent made from ductile iron with flanged joint pipe fittings. An insect screen will be included at the exposed end of the vent pipe. The screen will be bronze or aluminum insect screening. Forced air venting is also allowed and will be required on individual pump stations in conjunction with odor control measures, depending on circumstances.
- f) Wetwells and wetwell piping will be coated with at least 80-mils of an approved monolithic epoxy coating system consisting of a 100% solids, solvent-free, two-component epoxy resin for up to 100 mils of coating with a manufacturer approved set time of 6-hours or less. The epoxy coating system will be installed in no more than 2 applications with no runs and no holidays. High voltage holiday testing will be utilized to verify there are no voids in the coating. Epoxy coatings will only be applied to adequately cured concrete structures that have been sufficiently washed and prepared for epoxy coating installation. Properly applied coating will provide a smooth finish at 80-mils or greater and fill all pores in concrete substrate.
- g) Care will be taken to ensure no epoxy coating is applied to the pump coupling face, the guide rails, or any other part that needs to allow movement or replacement on a regular basis.

### 3. Valve Vaults

- a) The valve vault will, at a minimum, consist of a precast concrete manhole base section at least 6 feet in diameter, or a cast in place concrete, custom built section, or a precast concrete rectangular structure at least 6 feet square. The valve vault will be complete with a drain that goes to the wetwell, access ladder attached to the vault wall, and access cover cast in the top slab. The drain pipe between the valve vault and the wetwell will have a back water valve at the wetwell end. The access cover for the valve vault will be a square hatch of 1/4 inch aluminum diamond pattern plate with steel hinges on an aluminum frame cast in place in the cover slab.

### 4. Manholes

- a) Any manholes installed on the pump station site need to meet the standards described in Section 04000 of the City of Roxboro Standard Specifications. All manholes installed on the pump station site will receive an interior coating of an approved epoxy resin, as previously specified for the pump station wetwell. All manholes located within the 100 year flood elevation will receive an exterior coating as specified in Section 04000.

## 5. Buildings

- a) Building systems to house chemical feed facilities will be adequate to provide sufficient storage, clearance, and full containment of chemicals in the event of a chemical tank or other failure. A removable roof or roof sections will be required to allow sufficient access to all equipment and tanks within the building. All supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation will be designed and sealed by a NCPE.
- b) On a case by case basis, a building may be required to house all electrical and control equipment. This building will be of precast, prefabricated, or built in place construction.
- c) All buildings located on a pump station site will have the first floor elevation a minimum of 2 feet above the 100 year flood elevation.

## **D. PIPING AND VALVES**

1. Piping: Suction and discharge piping will be Class 50 ductile iron flanged pipe in accordance with AWWA C-141. Discharge piping and valves will produce a minimum head loss while maintaining a minimum velocity of 2.5 feet per second. All exposed piping will have adequately sized and located thrust rods.
2. Pump piping: The discharge connection elbow will be a straight through fitting with no flap valve and will be permanently installed in the wetwell along with the discharge piping. The pumps will be automatically connected to the discharge connection elbow when lowered into place. The entire weight of the pump will bear upon the guides and base support with no part of the pump bearing directly on the floor of the wetwell. A stainless steel chain will be provided for lifting each pump from the wetwell. All hardware used will be 316 stainless steel.
3. Check Valve: An external weight check valve and a plug valve will be provided for the discharge pipe of each pump. A 1/4 turn plug valve will be provided on the discharge pipe from the valve vault (the beginning of the force main). Check valves will be ductile iron bodied, fully bronze mounted with bronze clapper disc and bronze seat ring, and will have a spring loaded lever arm capable of being mounted on either side of the valve.
4. Plug Valve: Plug valves will be 1/4 turn, eccentric action and resilient plug facing with heavy duty stainless steel bearings and welded-in corrosion resistant nickel seat. Pump station plug valves will be "full-port" cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe.
5. Plug valves and check valves on the discharge side of each pump will be

06000-11

located in a valve vault separate from and adjacent to the wetwell. A Victaulic type coupling will be installed on each discharge main between the wetwell and the valve vault.

6. Pressure gauge: A +/- 2% accuracy pressure gauge with a 3 inch or larger liquid filled dial, stainless steel case, and graduated to 150% of force main static pressure\_ will be provided on each discharge pipe. The gauge will be installed between the check and plug valves. Isolation seals and cut-off ball valve will be provided between the gauge and force main. The gauge will be oriented so that it is easily visible and legible from the valve vault hatch opening.

7. Anchor Bolts.

a) Anchor bolts and nuts will be furnished as required for each item of equipment. Anchor bolts, together with templates or setting drawings, will be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts will be at least 3/4 inch in diameter.

b) Anchor bolts will be accurately located and centered in pipe sleeves having an inside diameter approximately 2.5 times the bolt diameter and a length approximately 8 times the bolt diameter. A square anchor plate with thickness of approximately 0.5 the bolt diameter and side dimensions 4 times the bolt diameter will be welded to the bottom of each sleeve, with the anchor bolt extended through the plate and welded thereto. Two nuts and a washer will be furnished with each anchor bolt.

c) Anchor bolts will be long enough to accommodate 1.5 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete. Bolts will have a "J" bend anchoring them into the concrete.

d) Anti-seize compound will be applied to the threads of all stainless steel bolts before assembly.

**E. ELECTRICAL - GENERAL**

1. All electrical systems associated with any of the items covered under this section will meet all applicable electrical standards and code requirements, including, but not limited to: ANSI, ASTM, NEMA, IEEE, DEMA, EEI, HEI, ISO, NFPA, SAE, NEC, UL508, as well as any other federal, state, or local codes.

2. Electrical service to all pump stations will be three phase, 240 VAC or 480 VAC, with automatic transfer switches to automatically starting on-site emergency generators. The electrical power entrance will be through a 06000-12

meter base, followed by a NEMA 3R heavy duty, single throw, fusible safety switch with a solid neutral. This will be followed by a heavy duty automatic transfer switch that transfers between the utility power and the on-site generator. This will be followed by a NEMA 3R heavy duty, double throw, three pole safety switch which feeds the control panel from one side and heavy duty, circuit breaking 4 wire, 4 pole male receptacle assembly as manufactured by Crouse-Hinds or other approved equal from the other side. There will be a NEMA 3R heavy duty single throw fusible safety switch between the generator and the automatic transfer switch.

3. Electrical equipment inside the wetwell will meet the requirements for Class I, Division I, Group C/D service.
4. All of these electrical components will be suitably sized to be capable of service with all electrically powered equipment running.
5. All electrical components, including panels, will be sealed off from the wetwell in accordance with the N.C. Electrical Code requirements for electrical service to class 1 division 1.
6. The use of rigid conduits is required. PVC will be used below ground and pvc coated galvanized steel will be used above ground. Flexible conduits are only allowed with approval of the City of Roxboro.
7. Pump station electrical and control equipment will be located in a building as described above, or under a weatherhood. An aluminum weatherhood with a clear height of 7 feet, an overhang of at least 4 feet and a thickness of 3/16 inch will be provided for control equipment exposed to the weather. The back panel and side panel will also be 3/16 inch thick aluminum. The support structure for the weatherhood will be made from structural steel members assembled to provide individual, direct support to the control equipment panel, transfer switch, safety switches, meter base and the weatherhood. The steel frame will be painted with a two component, high build epoxy polyamide paint system designed for severe service. All weatherhoods will be provided with a light and GFI protected 120V outlet.
8. All electrical equipment, including non-submersible motors, electrical panels, control panels, alarm/telemetry systems, backup generators, etc., will be located a minimum of 2 feet above the 100 year flood elevation. Weatherhoods will be installed to eliminate runoff to the front side. All electrical enclosures will have hinged doors/covers.
9. An intermediate terminating junction box is to be supplied and installed mid-way from the wetwell and the pump control panel. This box will be NEMA type 4X stainless steel suitably sized to house all pump power and control wiring. Terminal strips will be provided to properly split the power termination

06000-13

to facilitate pump removal from the junction box and not the pump control panel.

Exposed outlet boxes for outdoor and indoor wet process areas used for lighting fixtures, switches, and receptacles will be aluminum provided with rubber neoprene gasketed covers of similar metal. Junction and pull boxes will be NEMA 4X construction and of ample size to house the required devices. Boxes will be provided with hasps.

The minimum size of boxes will be according to the NEC. No box will be filled to more than 40% of capacity.

Where control wires must be interconnected in a junction box, terminal strips consisting of an adequate number of screw terminals will be installed. Current carrying parts of the terminal blocks will be of ample capacity to carry the full load current of the circuits connected. Approximately 20 % of the terminals provided will consist of spare terminals. Terminals will be lettered and/or numbered to conform with the wiring diagram.

The City of Roxboro may allow the use of NEMA 3R junction boxes made with materials other than stainless steel under certain applications.

# 06030 PUMP STATION EQUIPMENT

## A. PUMPS

### 1. General

- a) Pumps, motors, and major accessories will be supplied by a single manufacturer as listed in the City of Roxboro Approved Manufacturer's List.
- b) Each pumping unit will be complete with a close-coupled, submersible electric motor, and all other appurtenances specified, or otherwise required for proper operation.
- c) The equipment provided under this section will be suitable for the service conditions and will be capable of meeting all operating requirements of the pumping system.
- d) Each pumping unit including motor and all integral controls will be rated and labeled for use in a Class 1, Division 1 or Division 2, Group C/D area as defined by the National Electric Code.
- e) Each item of equipment and each part shipped separately will be identified with indelible markings for the intended service. Tag numbers will be clearly marked on all shipping labels and on the outside of all containers.
- f) Abbreviations. Reference to standards and organizations herein will be as indicated by the following designations.

i.	AFBMA	Antifriction Bearing Manufacturers Association
ii.	AGMA	American Gear Manufacturers Association
iii.	AISI	American Iron and Steel Institute
iv.	ANSI	American National Standards Institute
v.	ASME	American Society of Mechanical Engineers
vi.	ASTM	American Society of Testing and Materials
vii.	NPT	National Pipe Thread
viii.	SAE	Society of Automotive Engineers

### 2. Submittals

- a) Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, will be submitted in

06000-15

accordance with the submittals section. The data and specifications for each unit will include, but not be limited to, the following:

i. Pumps

- Name of Manufacturer
- Type and model
- Rotating speed
- Direction of rotation
- Size of suction elbow inlet
- Size of discharge elbow outlet or nozzle
- Net weight (mass) of pump and motor only
- Complete performance curves showing capacity versus head, bhp (brake kW), NPSH required, and efficiency
- Data on shop painting

ii. Motors

- Name of manufacturer
- Type and model
- Type of bearings and method of lubrication
- Rated size of motor, hp (kW), and service factor
- Insulation class and temperature rise
- Full load rotative speed
- Net weight
- Efficiency at full load and rated pump condition
- Full load current
- Locked rotor current

b) Operation and Maintenance Manuals will include, at a minimum, the following information:

- i. Equipment function, normal operating characteristics, and limiting conditions.
- ii. Assembly, installation, alignment, adjustment, and checking instructions.
- iii. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
- iv. Lubrication and maintenance instructions.
- v. Guide to troubleshooting.
- vi. Parts lists and predicted life of parts subject to wear.
- vii. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
- viii. Test data and performance curves.

### 3. Quality Assurance

#### a) Performance and Balance Requirements

- i. All specified conditions will be at rated speed unless otherwise indicated.
- ii. Overall (wire-to-water) efficiency for constant speed pumps will include losses in the pump and motor. Overall (wire-to-water) efficiency for variable speed pumps will include losses in the pump, motor, adjustable frequency drive, and any transformers supplied as part of the adjustable frequency drive equipment.
- iii. The minimum hydrostatic test pressure will be 1.5 times shutoff head plus max suction pressure.
- iv. Pump performance will be stable and free from cavitation and noise throughout the specified operating head range at minimum suction submergences. The design running clearance between the impeller inlet and the casing wearing ring (if provided) will be not less than 0.01 inch or 1 mil per inch of casing wearing ring diameter, whichever is greater.
- v. When required, pumping units will be designed so that maximum reverse rotation due to reverse flow at the head as required will not cause damage to any component. Pump supplier will coordinate this provision with the motor supplier.
- vi. All rotating parts will be accurately machined and will be in as nearly perfect rotational balance as practicable. Excessive vibration will be sufficient cause for rejection of the equipment. The mass of the unit and its distribution will be such that resonance at normal operation speeds is avoided. In any case, the unfiltered vibration velocity, as measured at any point on the machine including top of motor, will not exceed the maximum velocity as indicated for vertical, end suction, solids handling pumps. At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components will be less than 0.8 or more than 1.3.

### 4. Materials

- a) Stator housing, oil chamber housing, impeller casing, and impeller will be cast iron, ASTM A48.
- b) Casing wearing ring will be bronze, ASTM B62, or rubber, or martensitic

stainless steel, Brinell 300+.

- c) Bottom wearing plate will be cast iron, ASTM A48 with spiral grooves.
- d) Impeller wearing plate will be martensitic stainless steel, Brinell 200-250.
- e) Shaft will be alloy steel, hard chrome plated, or martensitic stainless steel, AISI type 416.
- f) Mechanical seals will be 2 tandem single type, oil lubricated with silicon or tungsten carbide seal rings at all points, except the upper rotating seal, which will be carbon.
- g) Discharge base will be cast iron or fabricated steel.
- h) Guiderails will be stainless steel pipe, ASTM A312, Schedule 40S.
- i) Upper guiderail bracket, cable hooks, and chain hooks will be AISI type 304 stainless steel.
- j) Pedestal base will be cast iron or fabricated steel.

## 5. Pumps

- a) Pumps will be submersible, non-clog centrifugal sewage pumps capable of passing a 3 inch sphere. Pumps will be capable of handling raw, unscreened sewage. Major pump components will be of gray cast iron devoid of burrs, pits or other irregularities.
- b) The impeller casing will have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The discharge nozzle will be flanged, with dimensions and drilling conforming to ANSI B16.1, Class 125. The discharge nozzle will be flanged and sufficiently rigid to support the pumping unit under all operating conditions.
- c) The impeller will be a semi-open and enclosed recessed one-piece casting with not more than two nonclog passages with the impeller completely out of the flow path. The interior water passages will have uniform sections and smooth surfaces and will be free from cracks and porosity. The impeller will be dynamically balanced and securely locked to the shaft by means of a key and self-locking bolt or nut.
- d) For pumping units 20 hp and larger, renewable wearing rings will be provided in the casing and on the impeller. The rings will be positively locked in place. For pumping units less than 20 hp a renewable wearing ring or axially adjustable wearing plate will be provided in the casing.

06000-18

Casing wearing ring will be securely fastened to the impeller casing front cover to provide either an axial or radial running clearance. Axially adjustable wearing plate will be arranged to permit adjustment of the axial running clearance between the impeller and plate. The wearing plate will have an outward spiraling groove designed to force stringy solids outward and away from the impeller.

- e) The oil chamber will contain a drain plug and a vent plug. Food grade oil will be used.
- f) Each pump will be provided with two mechanical rotating shaft seals arranged in tandem and running in an oil chamber. Each interface will be held in contact by an independent spring system designed to withstand maximum suction submergence. The seals will require neither maintenance nor adjustment and will be readily accessible for inspection and replacement. Shaft seals lacking positively driven rotating members or conventional double mechanical seals which utilize a common single or double spring acting between the upper and lower units and requiring a pressure differential to offset external pressure and effect sealing, will not be acceptable. The seals will not rely upon the pumped media for lubrication and will not be damaged if the pumps are run unsubmerged for extended period while pumping under load.
- g) All mating surfaces of major components will be machined and fitted with O-rings where watertight sealing is needed. Sealing will be accomplished by O-ring contact on four surfaces and O-ring compression in two planes, without reliance on a specific fastener torque or tension to obtain a watertight joint. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain compression and watertightness will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

## 6. Pump Motors

- a) The pump motors will be sealed submersible type, and will be three phase, 60 Hertz, 240v/480v motors with a maximum speed of 1800 RPM. The motors will meet the U.S. requirements of Class I, Division I, Group C/D for hazardous locations, and will be sized to non-overloading throughout the entire operating range of the pump.
- b) A heat sensor thermostat will be attached to and embedded in the winding and be connected in series with the motor starter contactor coil to stop motor if temperature of winding is more than 220 degrees F. Thermostat will reset automatically when motor cools to safe operating temperature. The common pump motor shaft will be of 416 stainless steel. (See 4E)

06000-19

- c) The motor will be protected by mechanical seal system as described above. A double electrode will be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber will cause a red light to turn on at the control panel. This signal will not stop the motor but will act as a warning only.
- d) Power cables to pumps will be AWG (min) hypalon jacketed type SPC cable a minimum of thirty (30) feet in length.
- e) Motors will be provided by the pump manufacturer and will be air-filled, totally submersible. Motor nameplate rating will exceed the maximum power required by the pump in the operating head range. Each motor will have a voltage, frequency, and phase rating as required and will have a service factor of 1.15. The stator housing will be an air-filled, watertight casing. A cooling jacket will encase the motor housing for each pump where needed to maintain adequate cooling. Cooling jacket will require no external source of cooling water. Motor insulation will be moisture resistant, Class F, 180 degrees Celcius. Each motor will be NEMA Design B for continuous duty at 40 degrees Celcius ambient temperature, and designed for at least 10 starts per hour.
- f) Each motor housing will be provided with a moisture detection system complete with all sensors, control power transformer, intrinsically safe control modules, and relays. The moisture detection system will be rated for a 120V AC AC supply. The moisture detection system will provide two normally open dry output contacts rated 5 amps at 120 volts AC. The contacts will close when moisture is detected in the motor housing and an alarm relay energized. The pump will not be shut down. All moisture detection system components will be furnished by the pump supplier and will be shipped loose for installation into the motor controller enclosure, or if required to be mounted separately all components will be mounted in a NEMA 4 stainless steel enclosure.
- g) The motor bearings will be antifriction, permanently lubricated type. The lower bearing will be fixed to carry the pump thrust and the upper bearing free to move axially. The bearings will have a calculated AFBMA L10 Live Rating of 40,000 hours when operating at maximum operating head. Maximum shaft runout at the mechanical seals will not exceed 2 mils at any point in the operating head range.
- h) Thrust bearings will be protected by bearing temperature switches. The switches will be normally closed automatic reset type rated 5 amps at 120V AC.
- i) Each motor will be capable of continuous operation in air (unsubmerged) for at least 24 hours under pump full load conditions, without exceeding the

06000-20

temperature rise limits for the motor insulation system.

- j) Each pump will be equipped with one or more multiconductor cable assemblies for power and control. Each multiconductor assembly containing power cables will be provided with a separate grounding conductor. Each cable assembly will bear a permanently embossed code or legend indicating the cable is suitable for submerged use. Cable sizing will conform to NEC requirements.
- k) All cables will be of sufficient length to terminate in a junction box outside the wetwell as indicated on the drawings, with 10 feet of slack that will be coiled on a cable hook at the top of the wetwell. Each cable will be supported by AISI Series 300 corrosion-resistant stainless steel Kellems type woven grips to prevent damage to the cable insulation. Mounting of cable supports in the wetwell will be coordinated to prevent damage to the cable.
- l) The cable entry water seal will include a strain relief and a grommet type seal designed so that a specific fastener torque is not required to ensure a watertight submersible seal. The cable entry junction box and motor will be separated by a stator lead sealing gland or a terminal board. The junction box will isolate the motor interior from moisture gaining access through the top of the stator housing.
- m) Motors with an adjustable frequency type speed controller will be derated to compensate for harmonic heating effects and reduced self-cooling capability at low speed operation so that the motor does not exceed Class B temperature rise when operating in the installed condition at load with power received from the adjustable frequency drive. All motors driven by adjustable frequency drives will be supplied with full phase insulation on the end turns and will meet the requirements of NEMA MG 1, Part 31. In addition to the requirements of NEMA MG 1, Part 31, motors will be designed to be continually pulsed at the motor terminals with a voltage of 1600 volts ac.
- n) Adjustable Speed Drives. Adjustable frequency drives will be provided as specified by the City of Roxboro on a case by case basis.

## 7. Appurtenances

- a) The lift out systems will consist of a straight elbow that bolts to the bottom of the basin, a combination disconnect assembly with a seal flange that mounts to the pump, rail support guides that fasten to the wall of the basin and guide and support brackets that mount to the pump. The guide rails will be type 316 stainless steel.
- b) Guiderail Mounted Base. A discharge base and discharge elbow will be

furnished by the pump manufacturer. The base will be sufficiently rigid to firmly support the guiderails, discharge piping, and pumping unit under all operating conditions. The base will be provided with one or more integral support legs or pads suitable for bolting to the floor of the wetwell. The face of the discharge elbow inlet flange will be perpendicular to the floor and will make contact with the face of the pump discharge nozzle flange. The diameter and drilling of the elbow outlet flange will conform to ANSI B16.1, Class 125. The pump and motor assembly will be automatically connected to and supported by the discharge base and guiderails so that the unit can be removed from the wetwell and replaced without the need for operating personnel to enter the wetwell.

- c) Sliding Bracket. Each guiderail mounted pumping unit will be provided with an integral, self-aligning guiderail sliding bracket. The bracket will be designed to obtain a wedging action between flange faces as final alignment of the pump occurs in the connected position. The bracket will maintain proper contact and a suitably sealed connection between flange faces under all operating conditions. The sliding bracket will be non-sparking.
- d) Guiderails. Each guide rail mounted pumping unit will be equipped with one or more guiderails. Guiderails will be sized to fit the discharge base and the sliding bracket and will extend upwards from the discharge base to just below the bottom of the access hatch. An upper guiderail bracket will be provided at the pump access opening. Guiderails will be made of stainless steel.
- e) Lifting Chain. Each guide rail mounted pumping unit will be provided with a chain suitable for removing and installing. The chain will be stainless steel with 4x6 lifting eyes at 10ft intervals starting at the top. A suitable chain hook will be provided at the top of the wetwell.
- f) Special Tools and Accessories. Equipment requiring periodic repair and adjustment will be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling will be furnished complete with those devices.

## 8. Shop Painting

- a) All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the casing, the impeller, and the discharge elbow, will be shop cleaned in accordance with the coating manufacturer's recommendations and painted with the epoxy coating system specified. The coating will have a dry film thickness of at least 10 mils and will consist of a prime coat and one or more finish coats. At least 1 quart of the finish coat material will be furnished with each

06000-22

pump for field touchup.

- b) All other iron and steel surfaces, except stainless steel and machined surfaces, will be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly will be protected for the life of the equipment. Exposed surfaces will be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components will be shop primed or finished with an oil resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.
- c) Surfaces to be coated after installation will be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

## **B. PUMP CONTROL SYSTEMS**

1. All components of the Pump Control Systems will be properly designed and installed to meet all NEC and other industry standards, as well as all federal, state, and local requirements.
2. Submittals: Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, will be submitted in accordance with the submittals section. The data and specifications for the Control Panel and Components will include, but not be limited to, the following:
  - Name of manufacturer
  - Type and model
  - Enclosure rating
  - Dimensions of complete panel
  - Electrical schematics and wiring diagram
  - Liquid level sensors with mounting details and cable lengths, and pump controls
  - Published descriptive data on each item of equipment and all accessories, indicating all specific characteristics and options.
3. Enclosure: The Control Equipment Enclosure will be a NEMA type 3R steel or type 4X fiberglass and be of suitable size to house all components. A locking hasp will be provided with no screw clamp type latches. Enclosure will be fabricated from fiberglass or 14 gauge steel. The top of the enclosure will serve as a drip shield and the seam free sides will prevent rain and sleet from entering. Inner panel will be made of 12 gauge steel and will be painted

white. Steel enclosures and interior panels will be painted with heat fused modified polyester powder, electrostatically applied over a phosphatized base. Enclosure will be ANSI/ASA 61 grey.

4. Hinged Inner Door: An inner door will be furnished. Overload reset push buttons, circuit breakers, switches pilot lights, and hr. meters will be the only components accessible with door closed. Door will be hinged and may be opened when service is required.
5. Line Terminal Block: A terminal block will be furnished with properly sized line lugs to accept the main power source entering the control panel. Load lugs will be adequate to accept all required load side wiring requirements. All live parts will be fully shielded.
6. Motor Circuit Breaker (440-480 VAC): A properly sized, molded case, thermal hydraulic-magnetic circuit breaker or motor protector will be provided for each pump motor. Line and load sides will be equipped with lugs properly sized for the horsepower and current rating of the motor(s). The interrupting rating will be 5,000 RMS symmetrical amps.
7. Transformer Primary Circuit Breaker: A properly sized, two pole, molded case circuit breaker will be furnished ahead of the control power 120-VAC power transformer for short circuit protection and disconnecting power to the transformer. The circuit breaker will conform to the specifications for the motor circuit breaker(s).
8. Control Power Transformer: An industrial quality control transformer will be furnished to provide control voltage. The transformer will be furnished to provide more than adequate KVA rating to provide 120-VAC power for all items required in the control and alarm circuits. Transformer will be protected in its secondary by properly sized supplemental circuit breaker(s).
9. Magnetic Contactors and Overload Relays: A magnetic contactor will be furnished for each motor. A separate, panel mounted, 3 leg (three phase) overload relay or motor protector will be supplied for each motor. Each leg of the overload relay will be equipped with a properly sized overload heater. Electronic overloads are not acceptable. Contactor and overload relay will be properly sized for the required horsepower, voltage and phase.
10. Elapsed Time Meters: Six digit, non-resettable elapsed time meters will be mounted in the control panel enclosure inner door to record the running time of each pump.
11. Condensation Strip Heater With Thermostat: A strip heater will be furnished to prevent condensation within the control panel enclosure. The heater will be controlled by a panel mounted, adjustable thermostat.

12. Phase & Voltage Monitor: A phase failure, reversal and under voltage monitor will be supplied to prevent the motors from running under low voltage, phase loss, or phase reversal conditions. The monitor will lock out the control circuit until the problem is corrected and automatically reset.
13. Lightning and Surge Arrestor: Suitable lightning and surge arrestors will be provided to protect motors and control equipment from lightning induced or other line surges.
14. Thru - Door Overload Reset Push Buttons: Overload reset push buttons will be provided for each overload relay. Push buttons will be mounted so that with inner door closed, overload relays may be reset without entering high voltage compartment.
15. Switches: Heavy-duty industrial grade oil-tight 22mm switches will be provided for each pump for "Hand/Off/Automatic" operation selection. All switch components will be made of corrosion resistant metals and polyesters. Contact blocks will be made of see-through polycarbonate for simplified inspection of contacts. Cams and strokers will be Teflon impregnated for abrasion free service without lubrication. The switches required will be as follows:

Switch Function (Name Plate)	Voltage
HOA	120 VAC

16. Pilot Lights: Full voltage heavy-duty industrial grade oil-tight pilot lights will be provided. All pilot light components will be made of corrosion resistant metals and polyesters. An insulated socket will be furnished to eliminate the possibility of shock during bulb change. Bulb change will not require removal of the socket. Bulbs will be "super bright" LED type. Lens will be 22mm and made of lexan. The pilot lights required will be as follows:

Pilot Light Function (Name Plate)	Voltage	Lens Color
PUMP 1	120 VAC	GREEN
PUMP 2	120 VAC	GREEN

17. Seal Fail Alarm Circuit With Test Push Button (Required For Submersible Pumps and Motors): The control panel will be equipped with a conductance actuated control relay that will respond to current from a moisture sensor in the pump seal chamber. Relay contacts will be rated at 10 amps minimum. All molded structural parts will be of high mechanical and dielectric strength, structural dimensionally stable, arc resistant, thermosetting plastic. Base plate will be high strength, diecast aluminum alloy. Solid state type relays will not be considered acceptable for seal fail monitoring

06000-25

applications. An amber alarm pilot light will illuminate upon alarm condition. Each pilot light will include contacts that will allow testing of the seal failure circuit and pilot light bulb by pushing. Bulb change will not require removal of the socket. Bulbs will be “super bright” LED type.

18. Seal Failure Circuit Test Push Button (Illuminated): Heavy-duty industrial grade oil-tight push buttons will be provided for each submersible pump motor. All push button components will be made of corrosion resistant metals and polyesters. An insulated socket will be furnished to eliminate the possibility of shock during bulb change. Bulb change will not require removal of the socket. Bulbs will be “super bright” LED type. Lens will be 22mm and made of lexan. The push buttons required will be as follows:

Push Button Function (Name Plate)	Voltage	Lens Color
P1 SEAL FAIL	120 VAC	AMBER
P2 SEAL FAIL	120 VAC	AMBER

19. Pump Alternator Circuit (For Duplex Pump Operation): The electro-mechanical alternator relay will be of industrial design specifically for use in pump applications. It will have single-pole double-throw heavy-duty 10-amp silver cadmium oxide contacts enclosed in a transparent cover. The snap action contacts will transfer when the unit is de-energized. The circuit will never be closed or opened while current is being conducted. The alternator circuit will alternate the lead pump position between the pumps and will allow the lag pump to start in response to a rising water level in the wetwell. A four position switch will be provided on the exterior of the pump control panel inner door. The switch will have a position for: Pump 1, Pump 2, Off, Auto.

20. Control Relay(s): Plug-in control relays with 120-VAC coils will be provided as required. Contact rating will be 5-amperes (minimum). Sockets will be of the same manufacture as the relays and hold-down clips will be furnished to prevent relay from sliding out of the socket. Relays will have indicator lights showing when they are engaged.

21. High Wet Well Level Alarm: The control panel will be provided with a suitable alarm circuit, activated by a separate level control. This alarm will signal a high water condition in the wetwell. Terminals will be furnished in the control panel for connection of externally mounted alarm devices. A red flashing light will be provided as a visual alarm of the high water in the wet well condition. A continuous sounding alarm will also be provided as an audible alarm of the high water in the wetwell condition.

22. Liquid Level Controls: Float-actuated mercury level control switches will be provided for: low level alarm, pumps off, lead pump on, lag pump on, and high level alarm functions. The mercury switch will be encapsulated in

polyurethane foam for corrosion and shock resistance. Level switches will be weighted to hold desired position in the wetwell. The cord connection to the control will be numbered 16-2, rated for 13-amps, and will be type SJTO. To ensure optimum longevity contacts will be rated for 20-amps at 115-VAC and will be sealed in a heavy-duty glass enclosure. No junction boxes or cable splices of any kind will be allowed in the wetwell.

23. High Temperature Shutdown Circuit(s): The pump motor high temperature circuit will provide terminals for connection of the leads from the temperature sensor provided in the pump motor windings. Upon a high temperature condition in the pump windings, the control power to the pump motor contactor will be disconnected, thus stopping the pump motor. The pump will automatically restart when the pump motor temperature returns to an acceptable level.
24. Ground Lug(s): Equipment ground lug(s) will be provided for grounding the enclosure. The ground lug(s) will be suitable for the service provided the enclosure sized per table 250-95 of the N.E.C. In all cases, the enclosure must be adequately grounded per article 250 of the N.E.C. except for fiberglass enclosures, where a grounding bus will be provided.
25. Terminals: Terminals will be provided for connecting mercury float switch leads, temperature sensor and seal fail sensor leads. Terminal blocks will be rated for 600 volt use and accept a wire range of #22-8. All live parts will have insulating walls on all sides of the lug. Blocks must be U.S. recognized.
26. Construction Standards: Subpanel will be drilled and tapped to accept machine thread bolts (self tapping screws are not acceptable). All control wiring will be 16-AWG machine tool wire, Carol type 76512 or equal. All control wire will be color coded or numbered in accordance with applicable standards. Power (motor) will be in accordance with the current National Electrical Code. Major groups of wires will be contained in plastic wiring trough equal to Panduit type E.
27. Nameplates: All indicator lights, alarms, selector switches, pushbuttons and major control system components will be identified with engraved phenolic plastic nameplates, white lettering on a black background.

### **C. ALARM DIALER/SCADA/TELEMETRY**

1. The pump station will be provided with an alarm dialer in a lockable NEMA 4 enclosure. The operating environment will withstand from  $-5^{\circ}$  Fahrenheit to  $130^{\circ}$  Fahrenheit with a 90% relative humidity, non-condensing. The alarm dialer will operate on 120-VAC, and will have a rechargeable battery backup capable of providing 4 hours of standby power with surge protectors on the power and telephone lines. The alarm dialer will monitor high water conditions and grinder jams through normally open/normally closed contacts,

06000-27

will have the capability of dialing four phone numbers, and will work on a standard telephone service. The dialer will be provided by a manufacturer listed in the City of Roxboro Approved Manufacturers List. Seal failure and high temperature signals from all pumps will be combined into a common “pump trouble” alarm to be transmitted from the dialer.

2. The pump station telemetry units will be compatible with the City of Roxboro’s current SCADA system. The City of Roxboro will not be required to purchase additional software to operate the telemetry unit.

#### **D. GRINDERS**

##### 2. General

- a) A wastewater grinder will be provided at each pump station for the intended purpose of grinding solids in the influent flow to the pump station.
- b) The entire grinder unit and accessories necessary to provide a fully functional wastewater grinder system, will be supplied and warranted by a single manufacturer. The list of acceptable manufacturers is provided in the City of Roxboro Approved Manufacturers List.
- c) The wastewater grinder will be placed in a separate manhole or other influent structure prior to the wetwell, but still within the pump station site. The grinder will be able to be removed from the influent structure without entering the influent structure by means of a guide rail and lifting chain with 4x6 lifting eyes at 10ft intervals starting at the top assembly. Another means of solids removal such as a trash basket or bar rack must be provided for installation when the grinder unit is out of service for extended periods.
- d) The wastewater grinder will be hydraulically driven. The electric motor and hydraulic power unit will be above ground in a sound attenuated weatherproof enclosure. The hydraulic hoses will extend down to the drive unit on the grinder in the influent structure.
- e) The wastewater grinder unit will have a complete and separate control panel providing all settings, monitoring, and control options required, as well as the ability to send alarm signals back to the alarm dialer and telemetry system.
- f) The equipment will be installed as recommended by the manufacturer, and in compliance with all OSHA, local, state and federal codes and regulations.
- g) The grinder unit power supply will match the pump station power supply.

Standard pump station power supply is 3 phase AC, either 240V or 480V.

- h) Identification. Each unit of equipment will be provided with a corrosion resistant substantial metal nameplate, securely affixed in a conspicuous place. Nameplate information will include equipment model number, serial number, manufacturer's name and location, and important performance data.

### 3. Submittals

- a) Submittals will include system hydraulic schematics, electrical wiring diagrams complete for field wiring, terminal identifications, and control panel schematics. Electrical and control information will be provided to allow coordination of field wiring to place the system in the desired operation. Submittals will also include complete mounting and installation instructions, including size, length and spacing of all supports and anchor bolts. Submittals will include painting instructions.

### 4. Quality Assurance

- a) All equipment will meet the requirements of the following standards:
  - i. ASTM A-536-84 - Standard Specifications for Ductile Iron Castings
  - ii. ASTM A-36 - Standard Specifications for Carbon Steel Plate
  - iii. AISI 304 - Stainless Steel
  - iv. AISI 4140 - Heat Treated Hexagon Steel
  - v. AISI 4130 - Heat Treated Alloy Steel
  - vi. AISI 1018 - Carbon Steel
  - vii. 45-50 Rockwell C
  - viii. National Electrical Manufacturers Association (NEMA)
  - ix. National Electrical Code (NEC)
  - x. Underwriters Laboratory (UL and cUL)
- b) Qualified manufacturers will have a minimum of 5 years experience in the manufacturing of grinding and controlling equipment and a minimum of 20 installations at equivalent applications. Manufacturer will submit a listing of names and dates of installations for verification by the City of Roxboro.
  - i. The hydraulic power unit will be rain resistant, suitable for outdoor installation. The unit will be installed in accordance with the manufacturer's recommendations.
  - ii. The entire hydraulic system will be designed for 3,000 psi maximum pressure.
  - iii. If the obstruction has been cleared, the unit will continue to

operate in the forward direction. If the obstruction has not cleared, the reversing sequence will repeat until the torque requirement is reduced or until it has had to repeat the reversing cycle nine (9) times within a short time span. If nine (9) reversals have occurred within 45 seconds, the controller will shut down the hydraulic unit and activate an overload relay and illuminate an indicating light.

- iv. Hydraulic connections between the torque motor and the power pack will consist of two ½-inch flexible hoses rated for 4,200psi each. The manufacturer will supply sufficient length of hydraulic hose to accommodate location of the power pack and hydraulic drive motor as shown on the drawings. Hoses will be Aeroquip Matchmate Plus 00 or equivalent.
  - v. Upon completion of installation, the hydraulic power unit will be filled with a high quality fluid with a viscosity of approximately 100 to 250 SSU at 100 °F, with good chemical stability and anti-foaming properties. The grades of hydraulic fluid will be in accordance with the manufacturer's recommendations.
- c) Enclosure. A fiberglass enclosure will be provided to completely cover the hydraulic power pack and motor. The enclosure cover will be of one- piece FRP construction, mounting on a one-piece FRP flanged base unless otherwise approved by the City of Roxboro. The enclosure cover will be hinged on one side with a spring-loaded hook on the opposite side. The entire hydraulic power pack will be exposed when the cover is opened. Hinges and hook assemblies will be stainless steel. The enclosure base will be secured to the concrete slab with stainless steel anchor bolts. An adjustable polypropylene weather proof vent will be provided on the top side of the enclosure to prevent heat buildup and trapped vapors. A thermostatically controlled exhaust fan with FRP weather hood will be provided. The exhaust fan will be powered from the control panel. Finished exterior surface will be white polyester gelcoat with UV inhibitor. The enclosure will be provided with dual purpose accoustical foam unless otherwise directed by the City of Roxboro.
- d) Electric Motors.
- i. Electric motors for the grinder will be suitable for the intended service. Typical motor sizing is 5 HP, 60 Hz, 240V or 480V AC. All motors will be NEMA Design "B" and TEFC.
  - ii. The motor will be Baldor, Reliance, U.S. Motor, or equal.

e) System Controls.

- i. Each grinder system will be provided with a single control panel suitable for mounting on an electrical rack, building wall, or as a secondary panel located under the weathershield. The control panel will include all power and control circuits to provide the functional requirements specified herein.
- ii. A programmable controller will be included in the panel. Upon the grinder encountering a jam or overload condition, the controller will stop the grinder and screen and reverse their direction of rotation to clear the obstruction. If the jam is cleared, the controller will return to normal operation. If the jam condition persists, the controller will repeat the reversing cycle up to eight additional times within 45-seconds (total of nine cycles) before signaling a grinder overload condition. Upon a grinder overload condition, the controller will shut down the grinder and screen and activate an overload contact.
- iii. If a power failure occurs while the grinder is running, the grinder will resume running when power is restored. A 0-60 second adjustable time delay device will be included in the control panel to select time delay until restart after power restoration. If the grinder is stopped due to an overload condition and a power failure occurs, the overload indicator will reactivate when power is restored.
- iv. The control panel will provide overcurrent protection. The overload relay will be adjustable so that the range selected includes the FLA rating and service factor.
- v. The control panel will be equipped with a Hand-Off/Reset-Auto (HOA) selector switch. In the Off/Reset position, the motor will not run. In the Hand position, the motor will run continuously. In the Auto position, the grinder will stop and start by remote control signal. The control panel will include dry contacts for future addition by others of a remote maintained contact start/stop control signal when in Auto mode. The control panel will not allow remote resetting of overload condition. Overload reset will be accomplished by switching the HOA switch to the Off/Remote position.
- vi. The oil temperature limit switch, oil level switch, pressure switch and 4-way solenoid valve will all be pre-wired to a single, manufacturer-provided, NEMA 4X junction box on the power pack. Terminals will be provided in the control panel and in the

06000-31

power pack-mounted junction box for field wiring between these devices and the control panel. Terminals will also be provided in the control panel and in the junction box for field wiring between the control panel and the hydraulic power pack motor.

- vii. The controller will indicate each of the following statuses with an indicator light on the panel face:
  - Power On
  - Grinder Overload
  - Motor Overload
  - Run
  - Oil Overtemperature
  - Low Oil Level
- viii. Engraved phenolic laminate plastic identification nameplates, with white letters on black background, will be provided for each switch, indicator light, gauge, etc. on the control panel and in the system.
- ix. The controller will be rated at 208/230/460 VAC, three phase, 60 Hertz.
- x. A single enclosure will house all power and control devices, relays, terminal blocks and motor starter. Control and indicating devices will be mounted in the front of the enclosure. Indicating lights will be integral transformer type with low voltage long life 6-volt lamps. Lamps and selector switches will be heavy duty type. The control panel and all control devices will be NEMA 4X. Enclosure will be NEMA 4X stainless steel, equipped with full hinged door, suitable for exterior mounting as shown on the drawings.
- xi. A lockable disconnect switch will be provided on the outside of the control panel to disconnect power to the entire grinder system.
- xii. One set of normally open (NO) contacts will be provided in the control panel for remote indication of each of grinder "fail" and grinder "run" status. Grinder overload, motor overload, oil overtemperature, low oil level and oil pressure alarms will be ganged together to a common grinder "fail" alarm. The control panel will provide 120 VAC power to these alarm circuits for remote indication at an existing alarm dialer system.
- xiii. Contacts will be provided for a future remote maintained contact emergency stop pushbutton, to be provided by others. These

contacts will be jumpered.

- xiv. Motor starter will be full voltage type with 120-volt operating coil and captive terminal screws. Overload relay will be mounted directly to the contactor. The relay will be sized to the motor full load amperage (FLA).

f) Spare Parts

- i. The following spare parts will be provided for each grinder as a minimum:
  - Three (3) of each type of fuse found in the system
  - Three (3) of each type of lamp bulb found in the system
  - One (1) complete set of gaskets
  - Three (3) cutters
  - Three (3) Spacers
- ii. The motor controller will have sufficient space within its enclosure for the storage of motor controller spare parts. Grinder spare parts will be packaged in suitable containers for long term storage and will bear labels clearly designating the contents of each package and the equipment for which they are intended.

## **E. GENERATORS**

### **5. General**

- a) Backup power will be provided by an automatically starting on-site generator controlled by an automatic transfer switch. The generator will be capable of supplying all necessary electrical power for complete operation of the pump station in the event of a failure of the electrical feed supplied by the local grid.
- b) The entire generator set, switchgear, and accessories necessary to provide a fully functional backup power system, will be supplied and warranted by a single manufacturer. The list of acceptable manufacturers is provided in the City of Roxboro Approved Manufacturers List.
- c) Each engine-generator unit will be new and a standard product of the manufacturer and will be a packaged type unit, fully shop assembled, wired and tested, requiring no field assembly of critical moving parts.
- d) The generator will be sized to start and continuously run all pumps, motors, and other electrical equipment at the pump station site. The pump starting conditions (including delay timers, VFDs, soft starts, reduced voltage starters, etc.) should be verified for the particular site. The kW rating needed for a particular pump station will be calculated by a licensed

06000-33

professional engineer or by the generator manufacturer.

- e) The voltage, amps, phase, etc., will be coordinated with the design of the electrical equipment for the particular site. In general, most generators will be 3 phase, 60 hertz, and 240V or 480V AC.
- f) The engine generator set will have a complete and separate control panel mounted inside the generator enclosure providing all settings, monitoring, and control options required, as well as the ability to send alarm signals back to the alarm dialer and telemetry system.
- g) Each unit of equipment will be provided with a corrosion resistant substantial metal nameplate, securely affixed in a conspicuous place. Nameplate information will include equipment model number, serial number, manufacturer's name and location, and important performance data.

## 6. Submittals

- a) The Contractor will submit to the City of Roxboro, complete shop drawings for assembly and installation, together with detailed specification and data covering materials, drive unit, parts, devices and accessories forming a part of the equipment furnished, with the submittals section. The data and specifications for each unit will include, but will not be limited to, the following:
  - Manufacturer, model, and type: engine, alternator, enclosure, battery charger and battery, silencer, switchgear, transformer, etc.
  - Listing of standard and optional accessories.
  - Engine output horsepower and efficiency curves at specified conditions.
  - Engine mechanical data including heat rejection, exhaust gas emission data (maximum values at loads of 1/4, 1/2, 3/4, and full for: carbon monoxide (CO)(lb/hr), nitrogen oxides (NOx)(lb/hr), temperature (F), flow (ACFM)), combustion air and ventilation air flows, and fuel consumption at specified conditions.
  - Generator electrical data including temperature and insulation data, winding pitch, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
  - Ratings at specified conditions: engine (net horsepower), engine (maximum performance horsepower bare engine), generator kW at specified power factor, volts, amperes.
  - Overall dimensions (length, width, height) and net weight.

- Concrete pad recommendation (including size, length, and spacing of all necessary supports and anchor bolts) and layout/stub-up locations for electrical conduits.
- Wiring diagrams and schematics for the entire system, including the engine control panel, generator breaker, automatic transfer switch, auxiliary transformer, and remote alarm indicators.
- Calculations or test results showing compliance with specified motor starting and voltage dip requirements.
- Line circuit breaker rating.
- Control panel layout, identifying location of all instrumentation being supplied.
- Operation instructions.
- Letter from the engine-generator manufacturer confirming that the unit will provide the specified minimum kW rating at the specified design conditions and time duration.
- Battery sizing calculations.
- Battery charger sizing calculations.
- Maximum output short circuit kVA available.
- A certificate of compliance, when required.
- Manufacturer's and dealer's written warranty.

## 7. Quality Control

- a) Quality Standards. Except where modified or supplemented by these specifications, all equipment and materials will be designed and constructed in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, ASTM, NEMA, IEEE, DEMA, EEI, HEI, ISO, NFPA, SAE, NEC, UL508, and other such regularly published and accepted standards as well as state and local codes.

## 8. Generator Equipment

### a) Engine.

- i. Engine will be compression ignition type diesel powered, 4 stroke, liquid cooled, American made, with a minimum of 130 HP, or equal.
- ii. Engine will operate at an RPM of no more than 1800.
- iii. The engine will be equipped with an electronic governor to maintain 4% droop from no load to full load and +/-0.25% steady state. The electronic governor control will be furnished as a complete governor and control package.
- iv. Engine will have a dry type air cleaner, coolant, fuel filters, and

06000-35

oil filters with replaceable elements.

- v. Engine will have a lube oil cooler and a fuel lift pump.

b) Generator.

- i. The synchronous generator will be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel.
- ii. Voltage regulation will be within +/-0.5% at steady state from no load to full load. The momentary voltage drop will not exceed the specified percent without starter coils dropping out or stalling the engine at any time when applying or starting the specified loads. Recovery to stable operation will occur within 2 seconds. Unit will be capable of adjusting voltage under varying load conditions within 16 milliseconds.
- iii. The voltage regulator will be a totally solid state design, and include electronic voltage buildup, volts per hertz regulation, overexcitation protection, will limit voltage overshoot on startup, and will be environmentally sealed.
- iv. The insulation material will meet NEMA standards for Class H insulation and be fungus resistant.
- v. The generator will be a self-excited generator type. The excitation system will be of brushless construction.
- vi. The generator will be supplied with a 240V single phase anti-condensation heater protected by a fuse inside the main control panel. When the generator set is not running the heater is automatically connected to the AC supply through a power relay mounted in the control panel. Upon receiving a start signal the AC supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed and the engine has stopped.

c) Fuel System.

- i. Each engine-generator unit will be furnished with a complete fuel system, including an integral fuel tank, fuel filter, fuel shut off valve, and all accessories as required for proper operation. All items will be suitable for the specified fuel and located inside the enclosure above the base plate and serviceable from inside the enclosure.
- ii. The fuel tank will have the capacity to provide fuel for a  
06000-36

minimum run time of 24 continuous hours at 100% prime load.

- iii. The fuel tank will be double walled with a rupture basin of 110% capacity. It will be pressure tested for leaks prior to shipment and have all necessary venting per US142 standards. A locking fill cap, a mechanical reading fuel level gage, low fuel level alarm contact, and fuel tank rupture alarm contact will be provided.

d) Lubrication.

- i. Equipment will be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems will not require attention during startup or shutdown and will not waste lubricants.
- ii. Lubricants will be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.
- iii. Lubrication facilities will be convenient and accessible. Oil drains and fill openings will be easily accessible from the normal operating area or platform. Drains will allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

e) Exhaust System.

- i. Each engine-generator unit will be furnished with a complete exhaust system including an exhaust silencer, exhaust piping, expansion joints, and accessories as required for a complete operating system.
- ii. A raincap will be provided to prevent rain from entering the exhaust pipe. The rain cap will open from exhaust pressure from the engine and will close when exhaust flow tops. The cap will be stainless steel counter-balancing with vertical discharge.

f) Starting System.

- i. Each engine-generator unit will be furnished with a complete electric motor start system including starting motors, battery pack with rack, cables, and battery charger.

- ii. The engine starter will be a 12-volt DC or 24-volt DC, solenoid shaft, electric starting system with positive engagement.
- iii. The batteries will be of the high rate, diesel starting, lead acid type. The batteries will be sized for five 10 second cranks with battery and engine oil temperature of 30 degrees F and a battery end voltage of 70 percent of system voltage.
- iv. The battery charger will be current limiting and will be furnished to automatically recharge the batteries. The charger will be dual charge rate with automatic switching to the boost rate when required. Output voltage regulation will not exceed 1%. The charger will include temperature compensation, NEMA 2 corrosion resistant enclosure, overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input, on/off switch, remote annunciation of loss of AC power, low battery voltage, and high battery voltage, AC input and DC output circuit breakers or fuses, floating voltage equalization, equalizing timer. AC input voltage will be 120 volts or 240 volts, single phase.
- v. The battery charger will have a DC output suitable to supply power for all continuous loads and to recharge the batteries from a full discharge state to normal operating voltage within 8 hours.
- vi. The batteries, battery rack, and battery charger will be located within the engine-generator enclosure. The battery rack frame will be constructed of corrosion resistant material.
- vii. The engine-generator will automatically supply power to the battery charger when it is operating and utility power is not available.

g) Cooling System.

- i. Each engine-generator unit will be cooled with unit-mounted radiator cooling system complete with radiator, expansion tank, water pump, belt-driven fan, fan guard, thermostatic temperature control, high-water temperature cutout, and all accessories as required for proper operation. The radiator will be sized to provide sufficient capacity for cooling of the engine and all other accessories required for proper operation at an ambient temperature of 125 degrees F and taking into account the enclosure static pressure restriction. The fan will draw air over the engine and discharge through the radiator.
- ii. The cooling system will be filled with a permanent antifreeze

mixture of the ethylene glycol type with rust inhibitor.

- iii. The engine generator unit will have a 240V coolant heater protected by a safeguard breaker inside the main control panel. A controller will be included to regulate the output temperature to within safe limits. When the generator set is not running the heater is automatically connected to the AC supply through a power relay mounted in the control panel. Upon receiving a start signal the AC supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed and the engine has stopped.

h) Enclosure.

- i. The engine-generator unit, fuel system, control panel, battery rack, battery charger, power panel, exhaust silencer, and other ancillary equipment, will be housed in a weatherproof enclosure.
- ii. The enclosure will consist of a roof, side walls, and end walls, and will be weatherproof and sufficiently sealed to prevent the entry of rodents.
- iii. The enclosure will be constructed of 12 gage or heavier metal panels that can be easily removed, or doors.
- iv. Doors will be lockable with stainless steel hardware for access to the engine-generator, controls, and accessories. Doors will also provide easy accessibility for maintenance. Doors will have lock arm to prevent swinging when open.
- v. The enclosure will be provided pre-wired, requiring only external connection to the power panel and ATS.
- vi. Lube oil and coolant drains will be extended to the exterior of the enclosure and terminated with drain valves.
- vii. All moving parts inside of enclosure, including cooling fan and charging alternator, will be fully guarded to prevent injury.
- viii. Lifting points will be provided on base frame suitable for lifting combined weight of base tank, engine generator unit, and enclosure.
- ix. A floodlight will be provided inside the enclosure to illuminate the generator equipment located within the interior of the enclosure. The floodlight will be provided with a switch mounted on the generator control panel.

i) Control System.

- i. Provide a generator set mounted control panel for complete control and monitoring of the engine and generator set functions. Critical components will be environmentally sealed to protect against failure from moisture and dirt. Components will be housed in a NEMA 1/IP22 enclosure with hinged door secured with a twist lock latch. The panel door will have a voltage shunt switch. The panel itself will be mounted on a separate support stand will be mounted inside the enclosure such that the face of the panel faces outward and is isolated from vibrations of the engine/generator arrangement. Panel/breaker arrangements will be mounted in such a manner as to not restrict access to the generator, engine, or other parts of the system that need periodic maintenance or repair.
- ii. The control panel will be automatic and safety type and will include at least all items required by NFPS 110 Level 1.
- iii. Panel will include the following instrumentation and controls (at a minimum): voltmeter, ammeter, frequency/tachometer, engine running hours, coolant temperature gauge, lube oil pressure gauge, battery condition voltmeter, run/off/auto switch, emergency stop push-button, lamp test pushbutton, 7 position voltmeter phase selector switch, 4 position ammeter phase selector switch, 3 attempt start timer, and cooldown timer.
- iv. Panel will include the following emergency shutdowns with individual warning lamps (at a minimum): fail to start, high coolant temperature, low lube oil pressure, and overspeed.
- v. Panel will include the following alarms with individual warning lamps (at a minimum): approaching low oil pressure, approaching high engine temperature, low/high battery voltage, battery charger failure, control switch not in auto mode.
- vi. Panel will have at least 2 spare shutdown channels and 1 spare alarm channel and 4 additional fault channels for shutdown or alarm programming.
- vii. Panel will have the ability to send up to 8 channels back to the existing SCADA system at the pump station.
- viii. Engine generator unit will be provided with a fuel level gauge indicating relative fuel tank level in % values.
- ix. The panel will be provided with a switched light that illuminates

06000-40

the panel face.

- j) Circuit Breaker. Provide a generator mounted, molded case or insulated case construction, UL rated, 3 pole, circuit breaker, sized as required. Breaker will utilize a thermal magnetic trip. Breaker will be housed in a steel NEMA 1 enclosure mounted on a separate support stand vibration isolated from the engine/generator arrangement. Bus bars, sized for the cable type shown on drawing, will be supplied on the load side of breaker.
- k) Receptacles. The engine generator will be supplied with two 120V, 15 amp duplex receptacles and two 120V, 20 amp twist lock receptacles. Receptacles will have individual circuit breakers, and will be placed inside the enclosure or will have weatherproof covers.
- l) Shop Painting.
  - i. All steel and iron surfaces will be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly will be protected for the life of the equipment. Coatings will be suitable for the environment where the equipment is installed. Exposed surfaces will be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, engine, alternator, enclosure, piping, and valves will be shop primed and finish painted prior to shipment to the site.
  - ii. Stainless steel, nonferrous, and nonmetallic surfaces will not be painted.
- m) Power Transformer. An externally mounted power transformer will be supplied to provide required 240V single phase power to the coolant heater and anti-condensation heater for each engine generator unit. The amp load will be calculated by a licensed engineer or the generator manufacturer.

## **F. AUTOMATIC TRANSFER SWITCH (ATS)**

1. An automatic transfer switch (ATS) will be provided on all pump stations for switching power to the onsite backup generator when normal grid power fails. The ATS will be provided by the same manufacturer as the generator, and included under the same warranty as the generator.
2. General
  - a) The ATS will be rated for the voltage and ampacity as shown on the plans and will have 600 volt insulation on all parts in accordance with NEMA

standards.

- b) The current rating will be a continuous rating when the switch is installed in an unventilated enclosure, and will conform to NEMA temperature rise standards. Designs which require cabinet ventilation are unacceptable and do not meet this specification.
- c) The unit will be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less will be UL listed for 100% tungsten lamp load.
- d) As a precondition for approval, all transfer switches complete with accessories will be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems.
- e) The withstand current capacity of the main contacts will not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data. Refer to required withstand and close ratings as detailed in this specification.
- f) Temperature rise tests in accordance with UL 1008 will have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- g) Transfer switches will comply with the applicable standards of UL, CSA, ANSI, NFPA, IEEE, NEMA, and IEC.
- h) The transfer switches will be supplied with a microprocessor based control panel as detailed further in these specifications.
- i) The transfer switch will be capable of detecting if the source switch was successful and if the pump station is receiving power. It will also be capable of transmitting a failure signal if it was not successful in switching sources and the pump station is not receiving power.

### 3. Sequence of Operation

- a. The ATS will incorporate adjustable three phase under-voltage sensing of the normal source and emergency source.
- b. When the voltage of any phase of the normal source is reduced to 80% of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact will close to initiate starting of the engine generator.
- c. When the emergency source has reached a voltage value within 10% of

06000-42

nominal voltage and achieved frequency within 5% of the rated value, the load will be transferred to the emergency source after a programmable time delay.

- d. When the normal source has been restored to not less than 90% of rated voltage on all phases, the load will be re-transferred to the normal source after a time delay of 0-30 minutes (programmable). The generator will run unloaded for 5 minutes (programmable) and then automatically shut down. The generator will be ready for automatic operation upon the next failure of the normal source.
- e. If the engine generator should fail while carrying the load, retransfer to the normal source will be made instantaneously upon restoration of proper voltage (90%) on the normal source.
- f. The transfer switch will be equipped with a microprocessor based control panel. The control panel will perform the operational and display functions of the transfer switch. The display functions of the control panel will include ATS position and source availability.
- g. The front panel display will include indicators for timing functions, capability to bypass the TD on transfer or retransfer, an ATS test switch and afford on-board diagnostic capability.
- h. The control panel will be provided with calibrated pots (accessible only by first opening the lockable cabinet door) to set time delays, voltage and frequency sensors. Designs which make use of DIP switches to render such adjustments are not acceptable. The ATS will be capable of being adjusted while the controls are energized and the unit in automatic mode. Designs which force a "programming mode" or require the controls be de-energized during adjustment are unacceptable.
- i. The control panel will be opto-isolated from its inputs to reduce susceptibility to electrical noise and provided with the following inherent control functions and capabilities:
  - i. An LED display for continuous monitoring of the ATS functions.
  - ii. Built-in diagnostic display.
  - iii. Capability to support external communication and network interface through an optional RS 485 port.
  - iv. Mechanical test switch to simulate a normal source failure.
  - v. Time delay to override momentary normal source failure prior to

06000-43

engine start. Field programmable 0-10 minutes (continuously adjustable via a calibrated potentiometer factory set at 3 minutes).

- vi. Time delay on retransfer to normal source, continuously adjustable 0-30 minutes, factory set at 15 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls will automatically bypass the time delay and immediately retransfer to the normal position.
- vii. Time delay on transfer to emergency, continuously adjustable 0-15 minute, factory set at 1 minute.
- viii. An in-phase monitor will be provided. The monitor will compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero crossing point to minimize switching transients.
- ix. An interval-type automatic clock exerciser will be incorporated within the microprocessor.
- x. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer.

#### 4. Construction and Performance

- a) The automatic transfer switch will be of double throw construction operated by a reliable electrical mechanism momentarily energized. There will be a direct mechanical coupling to facilitate transfer in 6 cycles or less.
- b) The normal and emergency contacts will be mechanically interlocked such that failure of any coil or disarrangement of any part will not permit a neutral position.
- c) For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole will be provided. This additional pole will isolate the normal and emergency neutrals. The neutral pole will have the same withstand and operational ratings as the other poles and will be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.
- d) The contact structure will consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts will be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

06000-44

e) The transfer switch manufacturer will submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings will be as follows:

- |  |                             |
|--|-----------------------------|
| a) Any molded case breaker: <u>Size (Amps)</u>       | c)                          |
| b) Up to 200   | d) <u>(RMS Symmetrical)</u> |
| e) 201-260   | f) 35,000                   |
| g) 261-400   | h) 35,000                   |
| i) 401-1200  | j) 50,000                   |
| k) 1201-4000   | l) 100,000                  |
|  | m)                          |
| m) Specific coordinated breakers: <u>Size (Amps)</u> | o) <u>(RMS</u>              |
| p) Up to 150   | q) 30,000                   |
| r) 151-260   | s) 42,000                   |
| t) 261-400   | u) 50,000                   |
| v) 401-800   | w) 65,000                   |
| x) 801-1200  | y) 85,000                   |
| z) 1201-4000   | aa) 100,000                 |
|  | cc)                         |
| bb) Current limiting fuse: <u>Size (Amps)</u>        | dd) <u>(RMS</u>             |
| ee) Up to 4000                                       | ff) 200,000                 |

i. \*All values 480 volt, RMS symmetrical, less than 20% power factor.

- f) A dielectric test at the conclusion of the withstand and closing tests will be performed.
- g) The automatic transfer switch manufacturer will certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at 0.50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- h) All relays will be continuous duty industrial type with wiping contacts. Customer interface contacts will be rated 10 amperes minimum. Coils, fuses, relays, timers and accessories will be readily front accessible. The control panel and power section will be interconnected with a harness and keyed disconnect plugs for maintenance.
- i) Main and arcing contacts will be visible without major disassembly to facilitate inspection and maintenance.

- j) A manual handle will be provided for maintenance purposes with the switch de-energized. An operator disconnect switch will be provided to defeat automatic operation during maintenance, inspection, or manual operation.
- k) The switch will be mounted in a NEMA 3R enclosure unless otherwise indicated on the plans.
- l) Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch will not be acceptable.

## **06040 ODOR CONTROL AND CHEMICAL FACILITIES**

1. Odor control measures will be evaluated for all possible sources of odor related to wastewater pumping systems. Source locations to be analyzed will include, but not be limited to, the wetwell at the pump station, the force main discharge location, and force main air release valves. Odor control measures to be analyzed will include, but not be limited to, oxidizing agent added to the wastewater, odor masking agents added to the air, activated carbon treatment, biofilter treatment, and wet scrubber treatment. Final determination of appropriate odor control measures will be made by the City of Roxboro.
2. Solutions that include chemical feed must consider the feasibility of chemical delivery to the site, provide appropriate chemical storage facilities including secondary containment, and must incorporate chemical feed systems as listed in the City of Roxboro Approved Manufacturers List.
3. Odor control facilities not located on the pump station site (air release valves and discharge points, for instance) will be constructed in underground vaults outside of the roadway or if necessary to be above ground, will be housed inside a structure. Appropriate consideration will be given to changing media or supplying chemical at the remote locations, as well as the safety of the maintenance staff while servicing the systems.

## **06050 INSPECTIONS, TESTING, AND TRAINING**

### **A. INSPECTIONS**

1. All materials and equipment used in the construction of the wastewater pumping system must be verified for compliance with the specifications (or other approval granted by the City) by the City prior to installation. Non-conforming materials or equipment will be immediately removed from the

job site.

2. Compliance with plans and specifications will be verified on a regular basis by the Inspector.

## **B. TESTING**

### 1. General

- a) The Contractor will furnish all materials, labor, and equipment to perform all testing. Water for testing purposes may be obtained from the City of Roxboro at no cost.
- b) All water or wastewater used during testing of the pump station, force main, or any of the systems described in this section, must be returned to the City of Roxboro sanitary sewer system after proper coordination with the City of Roxboro.
- c) Before the operational tests are conducted, the required copies of the Operation and Maintenance Manuals will be delivered to the City of Roxboro.
- d) The City of Roxboro reserves the right to require further testing, as necessary, to assure that all components and infrastructure are performing in accordance with the manufacturer recommendations and City of Roxboro Specifications. All testing, repairs and/or readjustments, and necessary re-testing, will be at no additional cost to the City of Roxboro.
- e) All on-site testing and/or installation verification will be performed in the presence of the Inspector or other representative authorized by the City of Roxboro.
- f) All testing, installation verification, and training, will be performed in the presence of, or by, an experienced, competent, and authorized manufacturers representative.
- g) Factory testing will consist of testing all operating functions of the equipment under varying operating conditions to assure that it will perform as specified. Any specific testing that may be required is discussed under the individual equipment items below. Results of factory testing will be presented to the City of Roxboro prior to delivery of the equipment.
- h) Installation Verification will consist of a visit to the site by a manufacturer's representative to inspect, check, adjust if necessary, and approve the equipment installation. The manufacturer's representative will certify that the equipment has been properly installed and lubricated, is in accurate alignment, and is free from any undue stress imposed by connecting

pipings or anchor bolts. Any specific verification requirements are discussed under the individual equipment items below. Results of the installation verification will be presented to the City of Roxboro prior to start-up of the equipment.

- i) On-Site Testing will consist of all manual and automatic operating functions under various operating conditions, including full load conditions. The equipment will also be tested under adverse or emergency conditions. All alarms and remote signals will also be tested. Any specific testing that may be required is discussed under the individual equipment items below. Results of the on-site testing will be presented to the City of Roxboro prior to final acceptance of the project.
- j) All functions and systems of the pump station, even those not specifically listed below, will be tested to ensure proper operation under normal and emergency situations.
- k) All defective equipment or malfunctioning systems will be replaced or corrected, and the full system placed in a fully operational condition to the satisfaction of the Inspector.
- l) Results of all factory testing, installation certifications, and on-site operational testing will be provided to the City of Roxboro in the final construction documents as described in the Submittals portion of this specification section.

## 2. Pump Testing

- a) Each pump will be tested at the factory for capacity, power requirements, and efficiency at specified rated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports will conform to the requirements and recommendations of the Hydraulic Institute Standards. Acceptance testing will be Level A, with no minus tolerance or margin allowed. The test result report will include data and test information as stipulated in the Hydraulic Institute Standards, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves will include head, bhp (brake kW), pump efficiency, and shop test NPSH available, plotted against capacity. The curves will be easily read and plotted to scales consistent with performance requirements. All test points will be clearly shown.
- b) All pumps will receive installation verification.
- c) On-site testing will be performed to the maximum extent possible (flow availability could limit the range of testing conditions).

### 3. Grinder Testing

- a) Each grinder unit will be factory tested.
- b) Each grinder unit will receive installation verification.
- c) Each grinder unit will receive on-site testing.

### 4. Generator Testing

- a) Each engine generator set will be fully assembled with its control panel and factory tested to demonstrate that the equipment conforms to specified requirements for load capacity. The tests will consist of repeated starts and stops operation under a load bank at specified capacity for a minimum of 4 continuous hours, and tests to demonstrate that each safety shutdown device is working properly.
- b) Each engine generator set will receive installation verification.
- c) Each engine-generator set will receive on-site testing to demonstrate that the equipment conforms to specified requirements for load capacity, and starting duty. The complete system (engine, generator, control panel, and automatic transfer switch) will be field tested together by the manufacturer or manufacturer's representative as a complete system to assure compatibility. A resistive load bank with temporary connections will be provided to complete the field testing. Each unit will be mechanically checked for proper operation. Each alarm and safety shutdown will be checked by artificially simulating an alarm condition. The testing will consist of repeated starts and stops, a "cold start", normal operation under full load conditions at the specified power rating for a minimum of four continuous hours, and a one step rated load pickup test in accordance with NFPA 110. The following items will be measured, recorded, and submitted in a field test report: outdoor ambient temperature, barometric pressure, kW output, engine speed (RPM), engine jacket water temperature, engine oil pressure, start time, completion time. Test reports will verify that the specified tests have been performed and will state results.

### 5. Automatic Transfer Switch Testing

- a) Each automatic transfer switch will receive field verification.
- b) Each automatic transfer switch will receive on-site testing in conjunction with the engine generator. At a minimum, the main power supply from the commercial power grid will be cut and the switch will automatically properly transfer the power feed to the standby generator.

## 6. Control System Testing

- a) All electrical, instrumentation, control, and telemetry systems will receive on-site testing to ensure complete operation of all systems. At a minimum the testing will include the following:
  - i. Pump automatic control and operation
  - ii. Level-sensing equipment operation
  - iii. Alarm and telemetry system automatic operation
  - iv. Backup power generation automatic control and operation

## 7. Structure Testing

- a) Wetwells and other wastewater containing structures at the pump station will be inspected and tested for watertightness. Structures will be thoroughly cleared of dirt, mud, gravel and other foreign debris prior to testing.
- b) The watertightness test will be performed in accordance with ACI 350.1R "Testing Reinforced Concrete Structures for Watertightness". If the structure is a small diameter precast manhole, a vacuum test in accordance with ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by Negative Test Pressure (Vacuum) Test" may be used in lieu of the hydrostatic test.
- c) Watertightness testing will not commence until the structure is fully assembled and backfilled.
- d) Any structure that fails to meet the requirements of the watertightness test will be inspected, made watertight, and retested until the structure passes.

## **C. OPERATOR TRAINING**

- 1. Suppliers of major equipment packages will provide training to City of Roxboro staff as to the proper operation and maintenance of their equipment.
- 2. Training will be performed by an experienced, competent, and authorized manufacturers representative.
- 3. Training will be at no additional cost to the City of Roxboro.
- 4. Training will be provided for, but not limited to, the equipment listed in the table below. The training times presented below for Operation Training and Maintenance Training are the minimum required. Complicated systems can require more than the minimum requirements.

Equipment System	Operation Training (hours)	Maintenance Training (hours)
Pumps and Pump Control Systems	4	4
Grinder System	2	2
Engine Generator and Automatic Transfer Switch	2	4
Chemical on/or Odor Control Systems	2	2
Alarm Dialer/ SCADA/Telemetry	1	1

5. Operational training will include, but not be limited to, the following procedures or information: normal startup of the unit, normal shutdown of the unit, emergency shutdown of the unit, normal operation of the unit (typical temperature, pressures, signals, rpm, etc., for gages and instruments which are displayed on the panel), a presentation of all operational features (alternative run modes, bypasses, other features not typically used in day-to-day operation, etc.), presentation of all alarm signals, etc.
  
6. Maintenance training will include, but not be limited to, the following procedures or information: standard lubrication procedures and schedules, removal and replacement of equipment, disassembly and re-assembly, replacement of wear parts or common replacement parts, standard troubleshooting procedures, etc.
  
7. Simplified operation instructions will be submitted for review in accordance with the submittals section of this specification. When the review is complete, the instruction sheets will be printed on heavy paper or cardboard stock and laminated with clear plastic. Two copies of the laminated instructions will be furnished with the unit. One copy will be located or displayed at the control panel for the unit. The reserve copy will be delivered to the City of Roxboro. The instructions specified here are in addition to the required operation and maintenance manuals.

END OF SECTION 06000

SECTION 07000  
MISCELLANEOUS MATERIALS FOR UTILITIES

TABLE OF CONTENTS

07010	MISCELLANEOUS MATERIALS
	A. Water
	B. Coarse Aggregate
	C. Sand
	D. Aggregate Base Course
	E. Cement
	F. Concrete
	G. Non-Shrink Grout
	H. Cement Bonding Agent
	I. Anchor Adhesive
	J. Sealants
	K. Portland Cement Mortar
	L. Brick
	M. Steel for Reinforcement
	N. Formwork
	O. Bituminous Concrete Binder Base Course
	P. Tack Coat
	Q. Bituminous Concrete Surface Course
	R. Steel Encasement Pipes
	S. Erosion Control Blankets
	T. Turf Reinforcement Matting
	U. Rip-Rap
	V. Filter Fabric Under Rip-Rap
	W. Pedestrian Fencing
	X. Geotextile Fabric for Trench Stabilization
	Y. Select Backfill
	Z. Topsoil
	AA. Silt Fence Fabric
	BB. Stormwater Inlets
	CC. Miscellaneous Iron and Steel
	DD. Brass Piping

## **07010 MISCELLANEOUS MATERIALS**

### **A. WATER**

1. Water used for mixing concrete or mortar will be clean and free from any deleterious substances such as acids, alkalis, and organic matter.

### **B. COARSE AGGREGATE**

1. Coarse aggregate will consist of sound, hard, crushed stone conforming to the requirements of ASTM C-33. Stone will be crushed to the sizes required for the various classes of concrete, bedding and grading.

### **C. SAND**

1. All sand used as fine aggregate in concrete will be clean and sharp natural sand conforming to ASMT Specification C-33, latest revision. Sand will be free from loam, clay, or vegetable matter and graded to insure workability and water tightness when mixed with other ingredients.

### **D. AGGREGATE BASE COURSE**

1. Aggregate base material will comply with the requirements of Section 520 and Section 1010 of the North Carolina Department of Transportation Standard Specifications For Roads and Structures dated January 2012 as amended. Aggregate used will be Type B. Base material will be placed in layers and each layer thoroughly compacted prior to placing the next. Only after all base material has been placed and thoroughly compacted and conditioned will the surface course be placed if base has been installed for asphalt paving. Aggregate base course will be installed to the thickness required per N.C.D.O.T. Standard Specifications after rolling or compacting. Paving or the replacement of asphalt will not be allowed if the stone base has any noticeable "pumping". Corrective actions to address or correct any "pumping" of the base will be determined by the City of Roxboro and performed by the Contractor.

### **E. CEMENT**

1. All cement used for this project will meet ASTM Specification for Portland Cement, C-150. Type IA or Type IIA for air-entrained concrete may be used for Projects.

## **F. CONCRETE**

1. Concrete work will conform to all requirements of the American Concrete Institute, ACI Standard 301, Specification for Structural Concrete for Buildings. Hot weather and cold weather concreting and curing will conform to all requirements of ACI Standards 305 and 306.
2. All concrete for blocking of fittings, hydrants, concrete plugs, etc., or for pads around valve box covers will be Class "B" concrete.
3. All concrete drive entrances, sidewalk, reinforced concrete, and curb and gutter will be poured using Class "A" concrete. One-half inch preformed expansion joint material will be installed where new concrete butts against old concrete.
4. Class A concrete will have a 28 day compressive strength of not less than 4,000 pounds per square inch, a maximum water/cement ratio of 5.5 gallons per bag (0.51 on weight basis) for air-entrained concrete, and a slump between 2 and 5 inches. All Class A concrete will be air-entrained, having 5%, plus or minus 1% total air content by volume. Coarse aggregate will be 1-inch stone which will pass a 1-1/2 inch screen or 3/4 - inch stone which will pass a 1 inch screen.
5. Class B concrete will have a 28-day compressive strength of not less than 3,000 pounds per square inch, a maximum water/cement ratio of 5.55 gallons bag (0.51 on weight basis) for air-entrained concrete, and a slump between 2 and 5 inches. All Class B concrete will be air-entrained with requirements similar to those for Class A concrete.
6. A design mix made by an independent laboratory, approved by the City of Roxboro, for each Class of concrete, will be submitted to the City of Roxboro for approval prior to the pouring of any concrete.

## **G. NON-SHRINK GROUT**

1. Non-shrink grout will be a cementitious grout with a 2-stage shrinkage compensating mechanism that controls shrinkage in both the plastic and hardened states. All non-shrink grout used for Projects will be non-metallic and contain no chloride.
2. All non-shrink grout will be structural, with a minimum compressive strength of 6,200 P.S.I. when applied in a flowable state. Bond strength will be a minimum of 1,900 P.S.I. when applied in a flowable state.
3. The non-shrink grout used will be compatible for use with "pea-size" gravel aggregate for deep applications greater than 2 inches.

4. All non-shrink grout will meet Corps of Engineers' Specifications CRD C-621 and ASTM C-1107, Grade C.
5. All non-shrink grout used on Projects will be mixed and applied according to the Manufacturers' Recommendations. Non-shrink grout will be placed only after existing substrates have been coated with a bonding agent.

#### **H. CEMENT BONDING AGENT**

1. Where concrete repairs are required, or fresh concrete butts directly against old concrete, the surface of hardened concrete will be coated with a bonding agent prior to the placement of fresh, plastic concrete or non-shrink grout. The bonding agent will be a 2-component solvent-free, moisture-tolerant, epoxy-modified, cementitious product. The bonding agent will conform to ASTM C-882 and ASTM C-109 with a minimum bond strength of 2600 P.S.I. and a compressive strength of 8500 P.S.I. at 28 days. The bonding agent will be mixed and applied according to the manufacturers' recommendations.

#### **I. ANCHOR ADHESIVE**

1. Where required by construction, all reinforcement or grouting for bolts, pins, dowels etc... will be secured to hardened concrete by the use of a 2-component, 100% solids, high-modulus, high-strength, structural epoxy that conforms with ASTM C-881 Standards and AASHTO M-235 Specifications. Anchor adhesive will be installed as a smooth non-sag paste that provides minimum bond strength of 2000 P.S.I. for a 3-3/8 inch embedment. The use of anchor adhesives will be according to the manufacturers' recommendations.

#### **J. SEALANTS**

1. All sealants used on Projects unless approved otherwise will be low modulus, 100 percent silicone rubber for exterior use. Sealants will be non-flowable that will not slump, sag or run-off. The silicone rubber sealant used will be durable and flexible. Sealants will be applied in strict accordance with manufacturers' instructions and recommendations. Silicone sealants will be used primarily to seal small metal openings, junction boxes, concrete openings where approved by the City of Roxboro. Silicone sealant used will have a UL label.

**K. PORTLAND CEMENT MORTAR**

1. All cement mortar used on projects will be Type M, with a compressive strength of 2,000 psi minimum at 28 days. Maximum air volume will be 16 percent. The mortar cement used will contain Portland Cement, hydrated lime, plasticizing admixtures, and/or hydraulic hydrated lime. Portland Cement Mortar will be used for the laying of masonry units.

**L. BRICK**

1. All brick used on projects will be hard, tough, sound clay or shale brick, of first class quality, thoroughly vitrified and especially suitable to the class of work for which it is to be used. The brick will meet the requirements of ASTM Specifications C-62. Grade SW and FBS of ASTM C-216 for clay brick. All brick masonry will have modular face dimensions of 3-5/8" x 2-1/4" x 7-5/8". Mortar joints will be 3/8" thick. Concrete brick or 4" solid concrete blocks conforming to NCDOT Standards may be used in lieu of brick masonry after prior approval has been granted by the City of Roxboro.

**M. STEEL FOR REINFORCEMENT**

1. All reinforced steel will meet the requirements of ASTM Specification A-615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Grade 60. All steel will be free from rust, scale or other coatings that would reduce or destroy the bond with poured concrete.

**N. FORMWORK**

1. All forms will be clean, smooth, and tight with all angles, interior and exterior, mitered to prevent leaving sharp angles in the finished concrete. Forms will be carefully constructed, true to line and grade, and thoroughly braced so as to maintain such line and grade when concrete is placed. Formwork is not required for the paving of below-ground concrete blocking provided the shape of earth excavation meets required dimensions and the walls and bottoms of excavation are free of loose earth material.
2. The design and engineering of the formwork, as well as its construction, will be the responsibility of the Contractor.

**O. BITUMINOUS CONCRETE BINDER BASE COURSE**

1. Bituminous base courses will comply with Section 610, Asphalt Concrete Plant Pavements and Section 1020, Asphalt Materials – Type I 19.0B of the North Carolina Department of Transportation Standard Specifications for Roads and Structures dated January 2012 as amended. Binder Base course will be installed to a thickness required per N.C.D.O.T. Standard Specifications after rolling and proper compaction.

**P. TACK COAT**

1. Surfaces to be paved will be thoroughly cleaned by brooming or other methods and will be completely dry before the tack coat is applied. Tack coat will consist of an asphalt cement of the same grade as used in the bituminous concrete mixture to be used for the surfacing and will be uniformly applied at the rate of .06 to .12 gallons per square yard. After tack coat has been applied, drives will be barricaded to prevent damage by traffic. The tack coat will comply with Section 605 of the North Carolina Department of Transportation Standard Specifications For Roads and Structures, dated January 2012 as amended.

**Q. BITUMINOUS CONCRETE SURFACE COURSE**

1. Materials used in the construction of the bituminous concrete surface course will comply with Section 610, Asphalt Concrete Plant Mix Pavements – Type S9.5B of the North Carolina Department of Transportation Standard Specifications For Roads and Structures dated January 2012 as amended. Surface course type and thickness will be as required per N.C.D.O.T. Standard Specifications after rolling and proper compaction.

**R. STEEL ENCASUREMENT PIPES**

1. Steel encasement pipes will be installed at all bore locations. Steel encasement pipes for road bores will be installed at the diameter and wall thickness required by N.C.D.O.T. Standard Specifications but under no circumstance will the thickness of any steel encasement pipe be less than 0.250 inches. The encasement pipes will be made of carbon steel conforming to ASTM A-139, Grade B. Encasement pipes will have a minimum yield strength of 35,000 psi. Encasement pipes may be welded or seamless. Steel encasement pipe will be manufactured in conformance with the standards of AWWA C-202.
2. Steel encasement pipes will be coated with bituminous asphalt with an internal and external application. The bituminous coating will meet ANSI-A-21.4 and AWWA C-104.
3. Joints, coatings and the method of installation will be in conformance with the requirements of the Department of Transportation Standard Specifications For Roads and Structures dated January 2012 as amended.

## **S. EROSION CONTROL BLANKETS**

1. All disturbed ditches where indicated on the Drawings or as directed by the City of Roxboro will be lined with a 100% agricultural straw matrix stitch bonded with degradable thread between two standard photodegradable polypropylene nettings. Rolls will cover a minimum of 6.67 feet in width, 108 feet in length with a plus or minus 40-pound weight. Blankets will have a minimum permissible shear stress of 1.75 P.S.F.

## **T. TURF REINFORCEMENT MATTING**

1. All disturbed ditches with a shear stress greater than 1/75 P.S.F. will be lined with a turf reinforcement matting. Matting will be 70% straw, 30% coconut fiber connected into a permanent three-dimensional matrix. A top and bottom matting will be heavy-duty UV stabilized polypropylene weighing approximately 5 lbs/1000 FT<sup>2</sup>. The middle matting will be heavy-duty UV stabilized polypropylene weighing approximately 24 lbs/1000 FT<sup>2</sup>. The turf matting will provide a shear resistance of 10 P.S.F. Matting will be 6.50 feet wide.

## **U. RIP-RAP**

1. All rip-rap used on Projects will comply with NCDOT Standard, Section 1042-Rip-Rap Materials. All rip-rap used will be plain and installed as directed by the Engineer.
2. Class B rip-rap will have a size range between 5 and 12 inches with a mid-range size of 8 inches.
3. For all rip-rap required by the City of Roxboro, not more than five (5) percent of the material furnished can be less than the minimum size specified nor more than 10 percent of the material can exceed the maximum size specified.

## **V. FILTER FABRIC UNDER RIP-RAP**

1. Filter fabric will be installed under all newly installed rip-rap. The filter fabric will comply with NCDOT Standard, Section 1056-Engineering Fabrics, Type 2. Fabric will have a minimum tensile strength of 200 lbs. with openings between 0.6 mm maximum and 0.115 mm minimum. Fabric will be suitable for use under all grades / types of rip-rap required for Projects. Fabric will have a minimum roll width of 36 inches.

## **W. PEDESTRIAN FENCING**

1. All pedestrian fencing will be a high density polyethylene with a minimum tensile strength of 370 pounds per foot. The nominal mesh opening will be 4 inches by 1-3/4 inches. Pedestrian fencing will be colored orange.
2. Pedestrian fencing will be installed using 5 foot tall steel posts spaced a maximum of 10 feet on-center. Steel posts will be hot rolled steel in a studded T shape weighing a minimum of 1.33 pounds per foot. Posts will be painted with a weather resistant baked green enamel. Posts will meet the requirements of ASTM 702.
3. Pedestrian fencing will be installed around individual trees or tree save areas as directed by the City of Roxboro.

## **X. GEOTEXTILE FABRIC FOR TRENCH STABILIZATION**

1. Geotextile fabric will be used where directed by the City of Roxboro during trenching operations to separate stone bedding from earth backfill. Fabric will be used primarily where trenching cuts across pavement. Fabric will be installed according to manufacturers' recommendations and will extend a minimum of five (5) feet past the outside edge of any pavement.
2. Geotextile fabric used in this application will be non-woven with a grab tensile strength of 270 pounds according to ASTM D-4632 and a puncture strength of 155 pounds according to ASTM D-4833. The non-woven geotextile fabric will be permeable, allowing a flow rate of 80 gallons / minute / ft<sup>2</sup> according to ASTM D-4491. Fabric will have a minimum roll width of six (6) feet. Minimum fabric weight will be 10 ounces per square yard.

## **Y. SELECT BACKFILL**

1. All select backfill will comply with NCDOT Standards, Section 1016, Class I Material. Materials which contains roots, rootmats, stumps, or other unsatisfactory material will not be acceptable.

## **Z. TOPSOIL**

1. All topsoil delivered to the site will comply with ASTM D-5268, with a pH range between 5.5 and 7. Topsoil will have a minimum of 5 percent organic material, be free of stones, sticks and other extraneous materials one inch or larger in any dimension.

## **AA. SILT FENCE FABRIC**

1. Silt fencing will be installed where required by the City of Roxboro. Silt fencing will comply with NCDOT Standard, Section 1056-Engineering Fabrics, Type 3. Fabric will have a minimum tensile strength of 100 lbs. with openings between 0.850 mm maximum and 0.300 mm minimum. Fabric will have minimum roll width of 36 inches.

## **BB. STORMWATER INLETS**

1. All stormwater inlet boxes will be precast with minimum dimensions 48 inches by 48 inches. Boxes will be structurally designed by the manufacturer for the depth shown on the Drawings and the size and number of pipes entering and leaving the box. Structural design will meet minimum H-20 loading requirements. The inlet boxes will be constructed of concrete with a compressive strength not less than 4,000 psi at 28 days with solid walls and top not less than six (6) inches thick. Reinforcement steel will be Grade 60, complying with ASTM Standard A-615. All precast concrete inlet boxes installed on Projects will be NCDOT approved.
2. Inlet boxes will be constructed with a maximum of one (1) joint which will be for the top. Joint will be sealed with butyl rubber that meets or exceeds the requirements of Federal Specifications (GSA-FSS) SS-S-00 210A.
3. Frames and grates required at all stormwater inlet boxes will be heavy-duty, rated for traffic, constructed of cast iron conforming to ASTM A 48 Class 35. Tensile strength will be a minimum of 35,000 psi. Frame minimum weight will be 135 pounds. Grating minimum weight will be 130 pounds. Minimum inlet open area for grate will be 275 square inches.
4. Frames will be cast with a minimum of four anchor bolt holes in the flange to secure the frame to the top of the precast inlet box. Anchor bolts, nuts and washers will be stainless steel tamp-ins after frame has been set to the box. Minimum bolt diameter will be 5/8 inch.

## **CC. MISCELLANEOUS IRON AND STEEL**

1. All miscellaneous iron and steel, such as rods, bolts, nuts, washers, etc. used on Projects not otherwise specified or shown on the Drawings will be 316 stainless steel.

## **DD. BRASS PIPING**

1. All brass piping will be standard, seamless, red brass. All brass piping will conform to ANSI-H 27.1 and ASTM Standard B-43.

SECTION 10000  
RECORD DRAWING CHECKLIST

TABLE OF CONTENTS

10010	RECORD DRAWING INFORMATION
10020	DATA
10030	GENERAL INFORMATION
10040	STORM DRAINAGE
10050	WATER SYSTEM
10060	SANITARY SEWER SYSTEM
10070	FORCE MAINS
10080	PUMP STATIONS

## SECTION 10000 RECORD DRAWING CHECKLIST

All entities who construct public infrastructure will submit to the City of Roxboro a certified set of record drawings and a CD with files of each sheet, signed and sealed by the NCPE and/or NCPLS, as a part of the City's acceptance process. Record drawings must be submitted and approved prior to acceptance of the improvements or issuance of a certificate of occupancy. Plan sheets will be 24" X 36". Three copies of final record drawings are required. Mylars are required.

The following check list must be attached to each set of record drawings submitted for approval. Each blank must be initialed by the applicant as being included on the record drawings or marked N/A if not applicable to the project. All applicable information listed below must be included on all record drawings.

### 10010 RECORD DRAWING INFORMATION

Project Name: \_\_\_\_\_  
TOC Plan #: \_\_\_\_\_  
Submitted by: \_\_\_\_\_  
Sealing Engineer: \_\_\_\_\_  
NCPE Lic. No.: \_\_\_\_\_  
Phone #: \_\_\_\_\_  
Transmittal Date: \_\_\_\_\_

### 10020 DATA

Pg #  
\_\_\_\_ A. Acreage in total tract  
\_\_\_\_ B. Average lot size  
\_\_\_\_ C. Total number of lots  
\_\_\_\_ D. Total number of stop signs  
\_\_\_\_ E. Total linear footage of infrastructure chart  
      \_\_\_\_ Streets (List individually in lengths: Public, Private or Fire Lane)  
      \_\_\_\_ Water mains (Identify size and length)  
      \_\_\_\_ Sewer mains (Identify size and length)  
      \_\_\_\_ Number of valves (For each size)  
      \_\_\_\_ Number of fire hydrants  
      \_\_\_\_ Number of manholes  
      \_\_\_\_ Other (Any additional appurtenances)

## 10030 GENERAL INFORMATION

Pg #

- \_\_\_ \_\_\_ A. Copy of recorded plat indicating easements (including sight distance easements) and right of way
- \_\_\_ \_\_\_ B. Boundary of tract by courses and distance with references
- \_\_\_ \_\_\_ C. Tie to N.C. grid coordinate system
- \_\_\_ \_\_\_ D. 500 scale vicinity map
- \_\_\_ \_\_\_ E. Scale of drawings and bar scale
- \_\_\_ \_\_\_ F. North arrow
- \_\_\_ \_\_\_ G. Location of benchmark with M.S.L. elevations
- \_\_\_ \_\_\_ H. Seal and signature of North Carolina registered P.E. or P.L.S. responsible for record drawings on each sheet
- \_\_\_ \_\_\_ I. All easements identified and dimensioned. Include legal reference (deed, BOM, page #)
- \_\_\_ \_\_\_ J. Statement designating drawings are "Record Drawing" on each sheet

## 10040 STORM DRAINAGE

Pg #

- \_\_\_ \_\_\_ A. Outline of 100 year flood plain
- \_\_\_ \_\_\_ B. Pipe material
- \_\_\_ \_\_\_ C. Structure invert and top elevations, outlets to survey grade using state plane coordinates in x, y and z and signed by a PLS.
- \_\_\_ \_\_\_ D. Pipe size
- \_\_\_ \_\_\_ E. Pipe slope and distance
- \_\_\_ \_\_\_ F. Size of riprap dissipation pad
- \_\_\_ \_\_\_ G. Statement of stormwater velocity at all outlets
- \_\_\_ \_\_\_ H. Show permanent stormwater best management practice and provide calculations on separate work sheets
- \_\_\_ \_\_\_ I. A separate, recorded easement dedication plat for utility extensions outside right of way
- \_\_\_ \_\_\_ J. Provide City of Roxboro Hydraulic Grade Line (H.G.L.) Calculations and profile on separate work sheets

## 10050 WATER SYSTEM

- Pg #
- \_\_\_ \_\_\_ A. Pipe material labeled
  - \_\_\_ \_\_\_ B. Pipe size labeled
  - \_\_\_ \_\_\_ C. Separation from sanitary, storm sewer and gas line shown on plans
  - \_\_\_ \_\_\_ D. Locations with distance references (permanent points/fixed structure) (2 each per appurtenance) or survey grade using state plane coordinates in x, y and z and signed by a PLS.
    - \_\_\_ Valves
    - \_\_\_ Fittings
    - \_\_\_ Fire hydrants
    - \_\_\_ Blow-offs
    - \_\_\_ Meters
    - \_\_\_ Air release valves
  - \_\_\_ \_\_\_ E. Certification by N.C.P.E. of construction in accordance with the water extension permits
    - \_\_\_ Certification on the plans
    - \_\_\_ A separate certification sheet will be provided
  - \_\_\_ \_\_\_ F. A separate, recorded easement dedication plat for utility extensions outside right of way
  - \_\_\_ \_\_\_ G. Plan and Profile
  - \_\_\_ \_\_\_ H. Calculations as required on separate work sheets

## 10060 SANITARY SEWER SYSTEM

- Pg #
- \_\_\_ \_\_\_ A. Pipe material labeled
  - \_\_\_ \_\_\_ B. Pipe size labeled
  - \_\_\_ \_\_\_ C. Manhole top elevations
  - \_\_\_ \_\_\_ D. Invert in and out elevations
  - \_\_\_ \_\_\_ E. Pipe slope
  - \_\_\_ \_\_\_ F. Separation from storm sewer, water line, reclaim water and gas line
  - \_\_\_ \_\_\_ G. Locations with distance references (permanent points/fixed structure) (2 each per appurtenance) or survey grade using state plane coordinates in x, y and z and signed by a PLS.
    - \_\_\_ Clean outs
    - \_\_\_ Manholes
  - \_\_\_ \_\_\_ H. Horizontal control (angles at manholes)
  - \_\_\_ \_\_\_ I. 100-year flood plain elevation
  - \_\_\_ \_\_\_ J. Certification by N.C.P.E. of Construction in accordance with sanitary sewer extension permits
    - \_\_\_ Certification on the plans
    - \_\_\_ A separate certification sheet will be provided
  - \_\_\_ \_\_\_ K. A separate, recorded easement dedication form for utility extensions outside right of way
  - \_\_\_ \_\_\_ L. Plan and profile
  - \_\_\_ \_\_\_ M. Calculations as required on separate work sheets

## 10070 FORCE MAINS

Pg #

- \_\_\_ \_\_\_ A. Pipe material labeled
- \_\_\_ \_\_\_ B. Pipe size labeled
- \_\_\_ \_\_\_ C. Separation from potable water, sanitary sewer, reclaimed water, storm sewer and gas line shown on plans
- \_\_\_ \_\_\_ D. Locations with distance references (permanent points/fixed structure) (2 each per appurtenance) or survey grade using state plane coordinates in x, y and z and signed by a PLS.
  - \_\_\_ Valves
  - \_\_\_ Location of Marker Balls
  - \_\_\_ Meters
  - \_\_\_ Blow-offs
  - \_\_\_ Air release valves
- \_\_\_ \_\_\_ E. Certification by N.C.P.E. of construction in accordance with the force main permits
  - \_\_\_ Certification on the plans
  - \_\_\_ A separate certification sheet will be provided
- \_\_\_ \_\_\_ F. A separate, recorded easement dedication plat for utility extensions outside right of way
- \_\_\_ \_\_\_ G. Plan and Profile
- \_\_\_ \_\_\_ H. Calculations as required on separate work sheets

## 10080 PUMP STATIONS

Pg #

- \_\_\_ \_\_\_ A. Site Plan and Design Drawings
- \_\_\_ \_\_\_ B. Pump Station Design Capacity
- \_\_\_ \_\_\_ C. Pump Type and Manufacture
- \_\_\_ \_\_\_ D. Manhole / Wet Well top elevations
- \_\_\_ \_\_\_ E. Invert in and out elevations
- \_\_\_ \_\_\_ F. Locations with distance references (permanent points/fixed structure) (2 each per appurtenance) or survey grade using state plane coordinates in x, y and z and signed by a PLS.
- \_\_\_ \_\_\_ G. Calculations as required on separate work sheets
- \_\_\_ \_\_\_ H. Certification by N.C.P.E. of construction in accordance with the pump station permits
  - \_\_\_ Certification on the plans
  - \_\_\_ A separate certification sheet will be provided

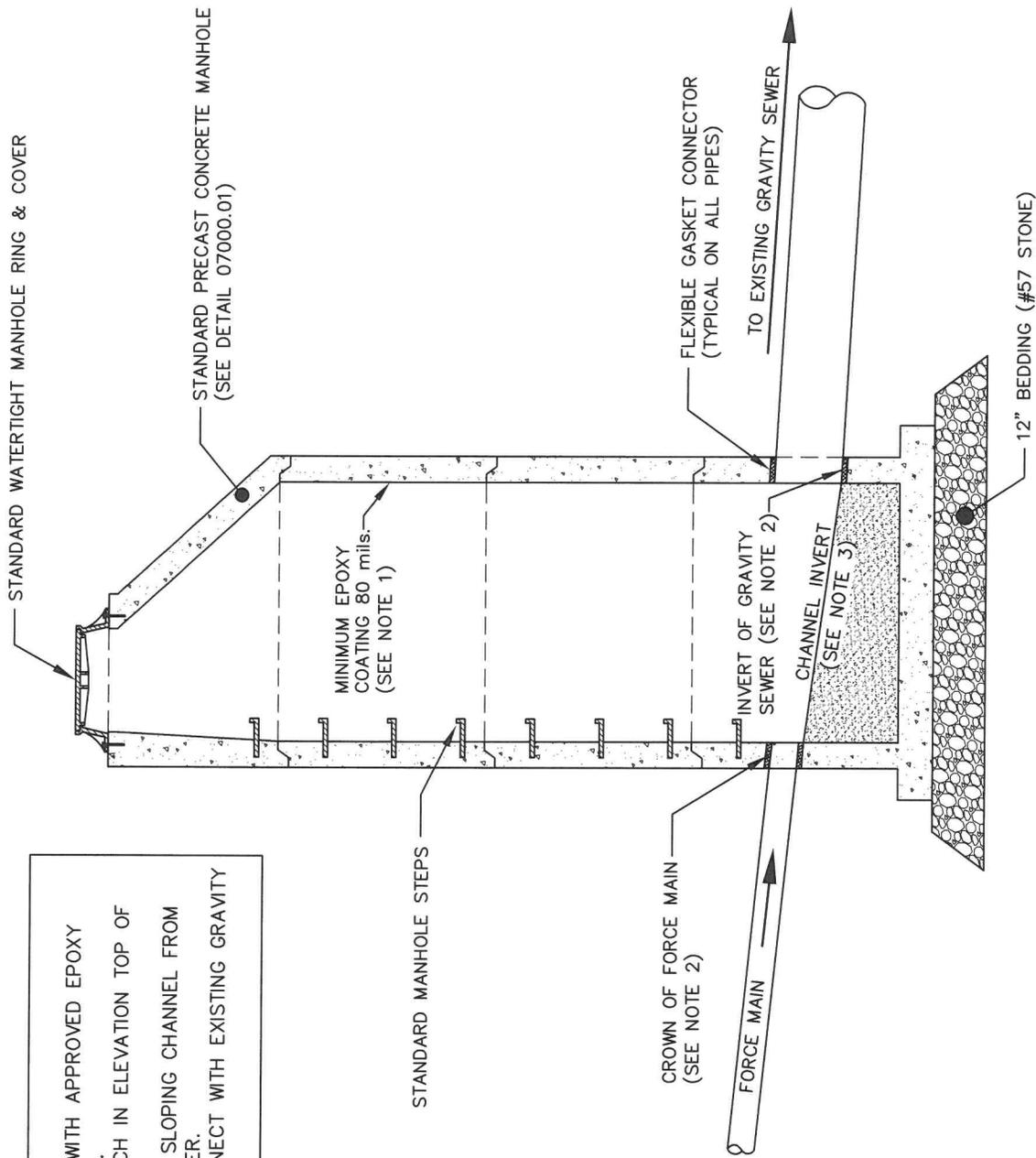
CITY OF ROXBORO USE ONLY

-----

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_  
Approved: \_\_\_\_\_ Returned: \_\_\_\_\_

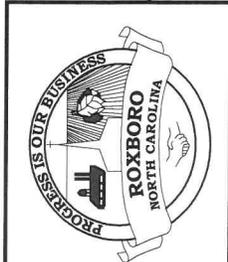
# DETAILED DRAWINGS

- NOTES:**
1. COAT INTERIOR OF MANHOLE WITH APPROVED EPOXY COATING AT MINIMUM 80-mils.
  2. TOP OF FORCE MAIN TO MATCH IN ELEVATION TOP OF GRAVITY SEWER.
  3. PROVIDE SMOOTH DOWNWARD SLOPING CHANNEL FROM FORCE MAIN TO GRAVITY SEWER.
  4. FORCE MAIN SHALL NOT CONNECT WITH EXISTING GRAVITY SEWER MANHOLES.

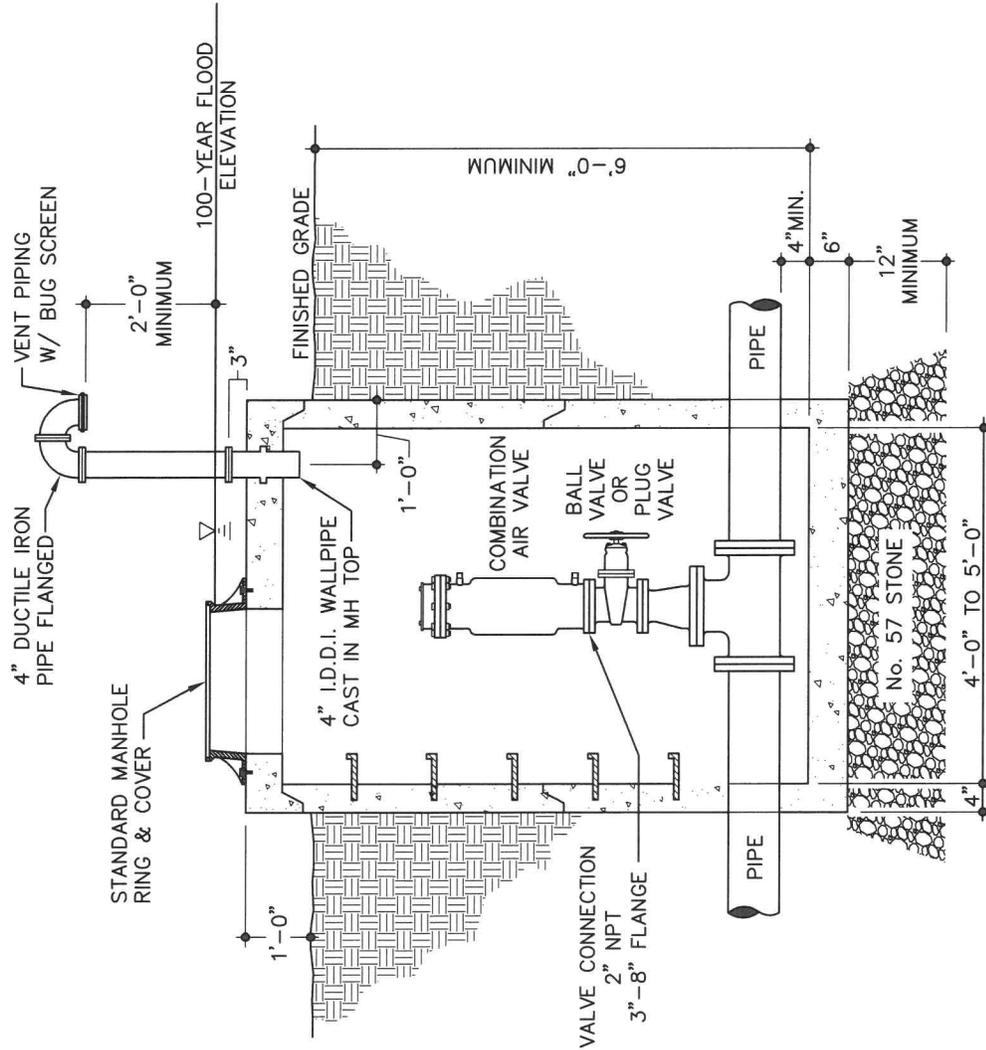


**FORCE MAIN DISCHARGE MANHOLE, TYPE 1  
UPWARD SLOPING FORCE MAIN**

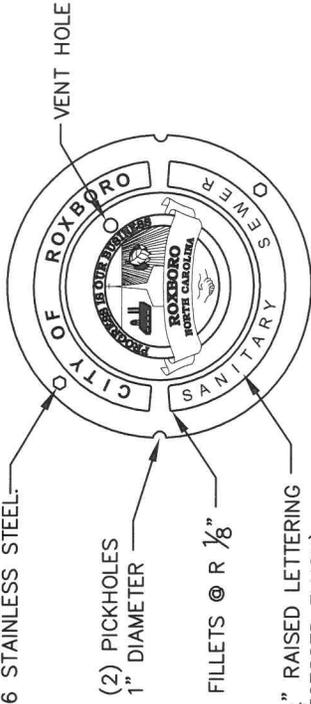
DETAIL No.  
04000.01  
SHEET 1 OF 1



EFFECTIVE:



(2) 1/2" x 1 3/4" HEX HEAD, STAINLESS STEEL BOLTS AND WASHERS AT 180° COUNTERSUNK. BOLTS & WASHERS TO BE TYPE 316 STAINLESS STEEL.

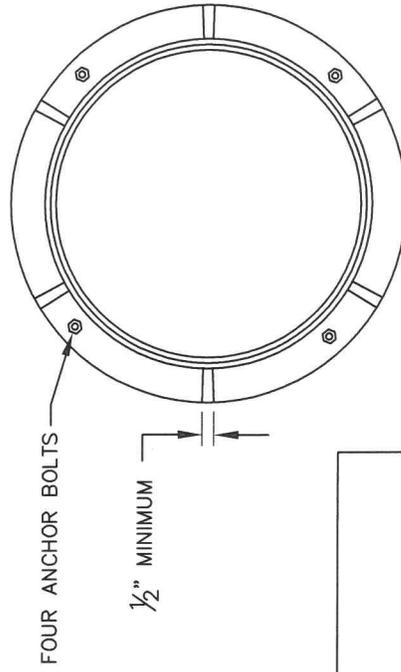


**COVER TOP VIEW**

**RING & COVER SPECIFICATIONS:**

1. CLASS 35 GREY IRON.
2. COMPLIES WITH ASTM A48 CL35B.
3. ALL LETTERING SHALL BE CLEAN, CRISP, AND CLEARLY LEGIBLE.
4. DOMESTICALLY MADE AND MANUFACTURED IN THE USA.

MINIMUM WEIGHTS	
RING	180
COVER	120
TOTAL	300



**RING TOP VIEW**

**NOTES:**

- 1) TEE FITTING AND ISOLATION VALVE TO BE SAME SIZE AS AIR VALVE.
- 2) ALL PIPING AND FITTINGS, IN THE MANHOLE, SHALL BE PROTECTO 401 LINED OR FBE COATED.
- 3) MANHOLE INTERIOR SHALL BE COATED WITH 100-mils OF AN APPROVED EPOXY COATING.
- 4) MANHOLE STEPS SHALL BE PLACED 16" ON CENTER AS SHOWN BY DETAIL 03000.02.



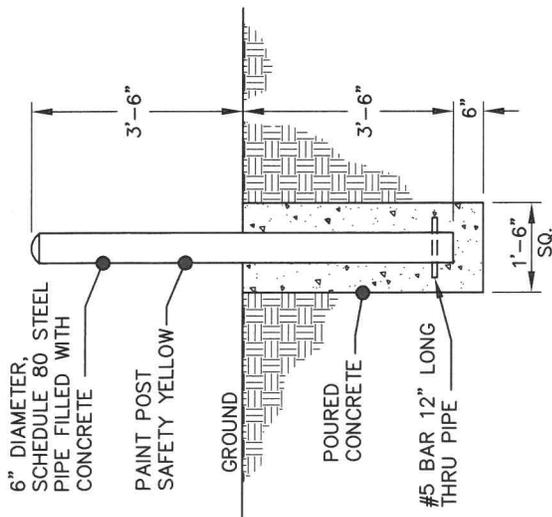
EFFECTIVE:

**STANDARD COMBINATION AIR VALVE MANHOLE  
(FOR FORCE MAINS)**

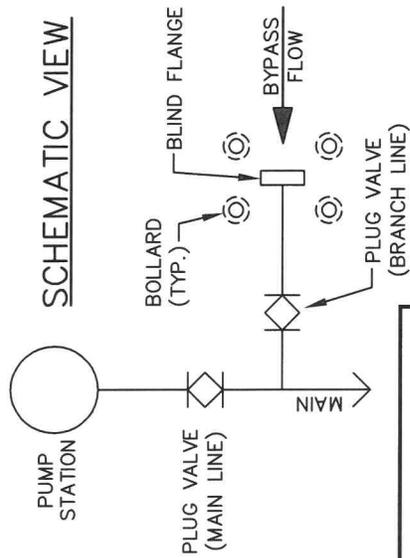
DETAIL No.

04000.02

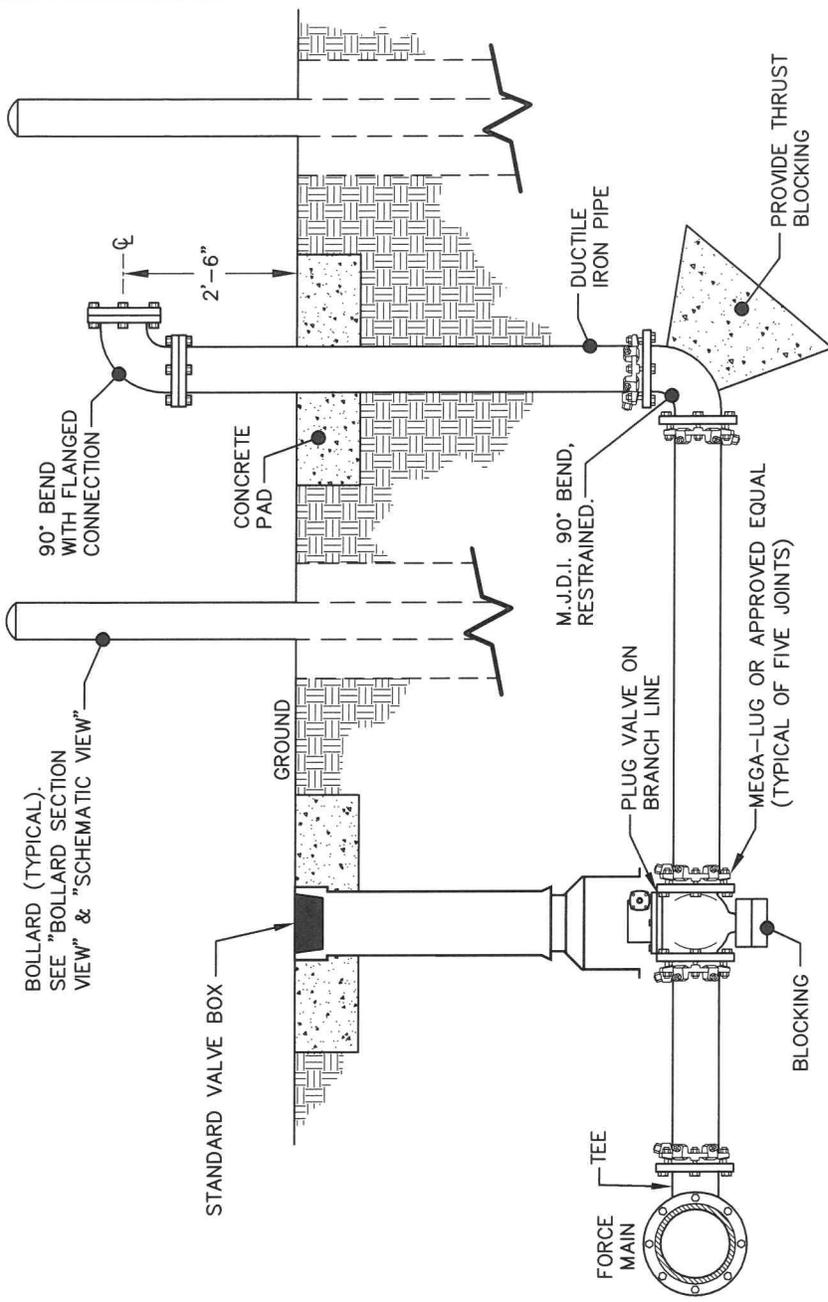
SHEET 1 OF 1



**BOLLARD SECTION VIEW**



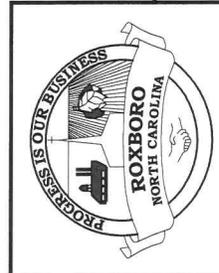
**SCHEMATIC VIEW**



**BYPASS PUMPING CONNECTION SECTION VIEW**

**NOTES:**

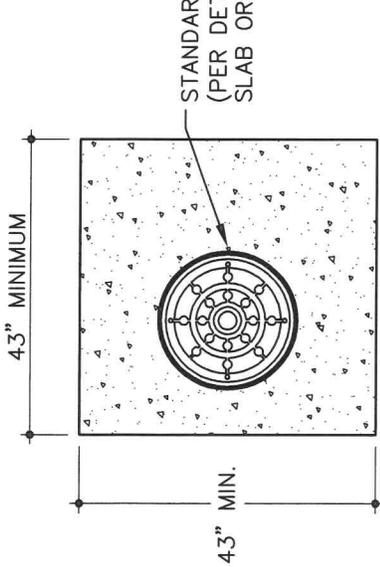
- 1) THE BYPASS CONNECTION SHALL BE LOCATED WITHIN 50-FT OF THE PUMP STATION VALVE VAULT. THE CONNECTION SHALL BE SURROUNDED BY BOLLARDS AND LABELED "FOR EMERGENCY BYPASS PUMPING ONLY".
- 2) ALL PIPING WITHIN THE BYPASS ASSEMBLY SHALL BE INTERIOR COATED WITH PROTECTO 401.
- 3) ALL BURIED PIPES, VALVES, AND FITTINGS SHALL BE RESTRAINED WITH WEDGE ACTION RETAINER GLANDS AND BLOCKING AS SHOWN.
- 4) ALL PIPING FOR THE BYPASS CONNECTION SHALL BE SIZED BY THE ENGINEER OF RECORD.



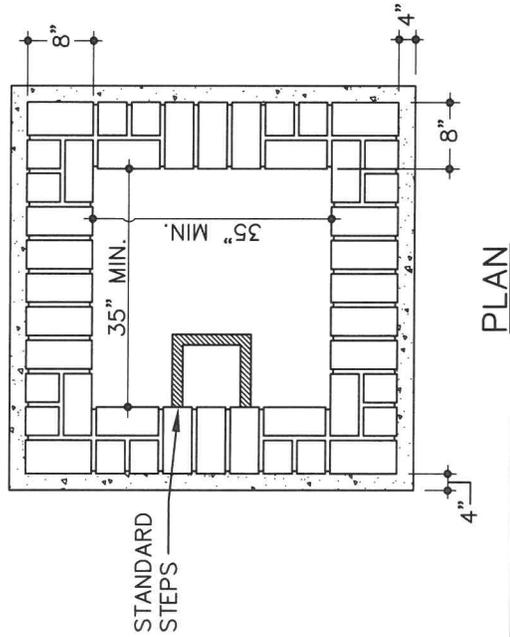
EFFECTIVE:

**TYPICAL PUMP STATION BYPASS CONNECTION TO FORCE MAIN**

DETAIL No.  
04000.05  
SHEET 1 OF 1



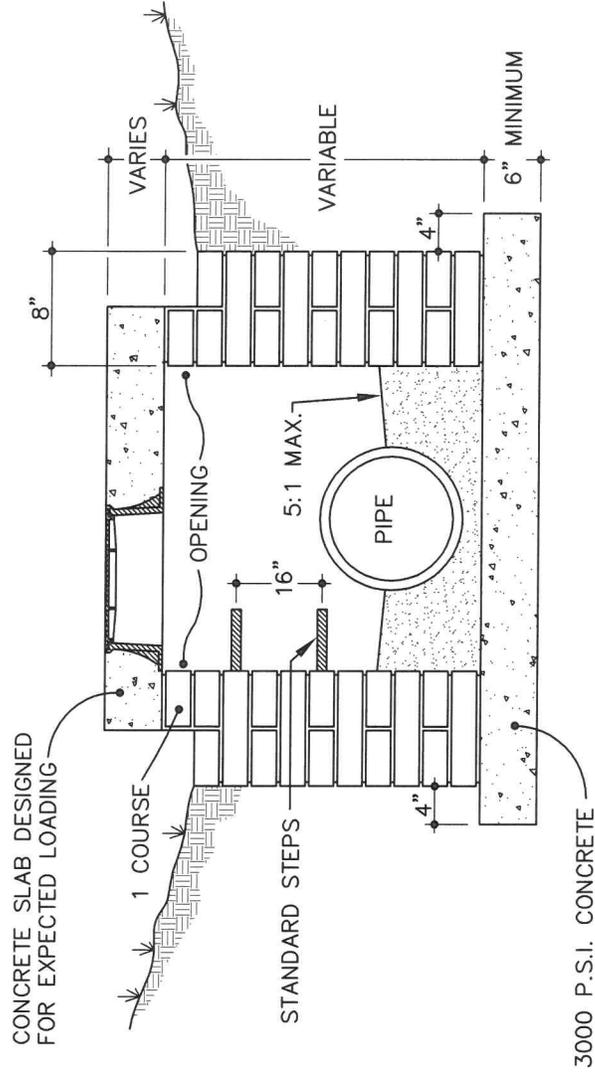
**CONCRETE SLAB**



**PLAN**

**NOTES:**

1. EITHER SOLID BRICK, SOLID BLOCK, OR PRECAST CONCRETE MAY BE USED.
2. STANDARD STEPS REQUIRED, 16 INCHES ON CENTER, WHERE DEPTH EXCEEDS 3 FEET.
3. USE MINIMUM 3000 P.S.I. CONCRETE MIX.
4. INSIDE DIMENSION FOR 24 INCH PIPE AND GREATER USE PIPE DIAMETER PLUS 12 INCHES.
5. WHERE DEPTH EXCEEDS 3 FEET, MANHOLE RING AND COVER TO BE LOCATED OVER STEPS.
6. LETTERING FOR MANHOLE COVER PER DETAIL 04000.03.



**SECTION**

**STANDARD YARD INLET WITH CONCRETE SLAB**

DETAIL No.

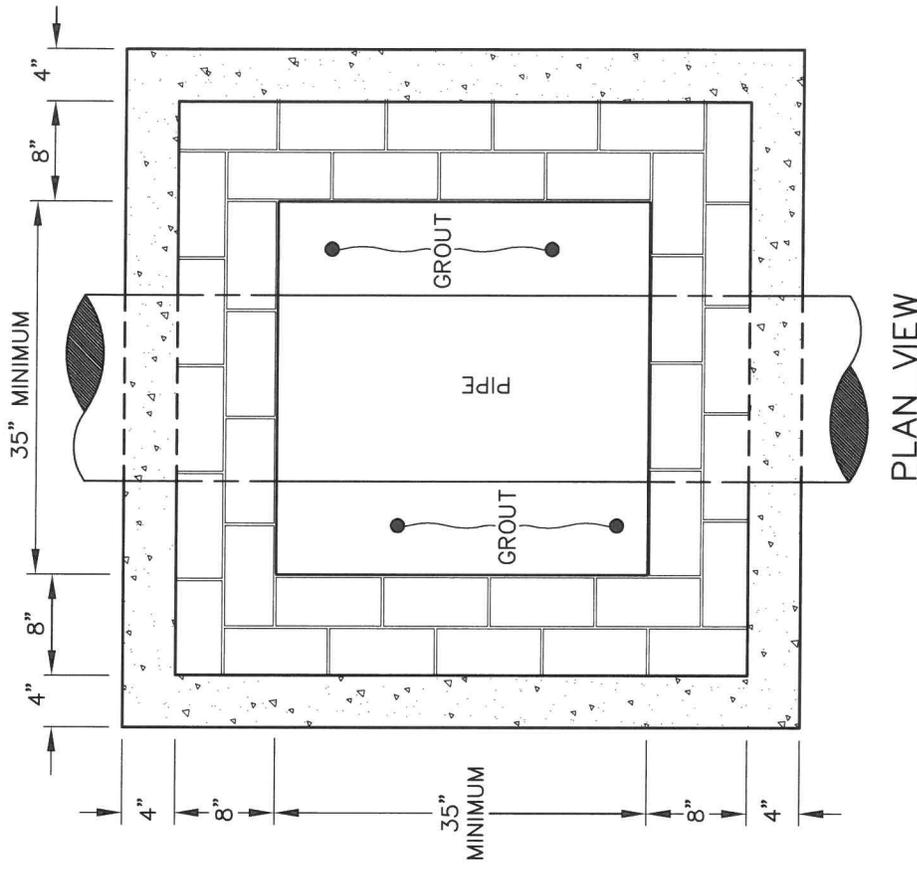
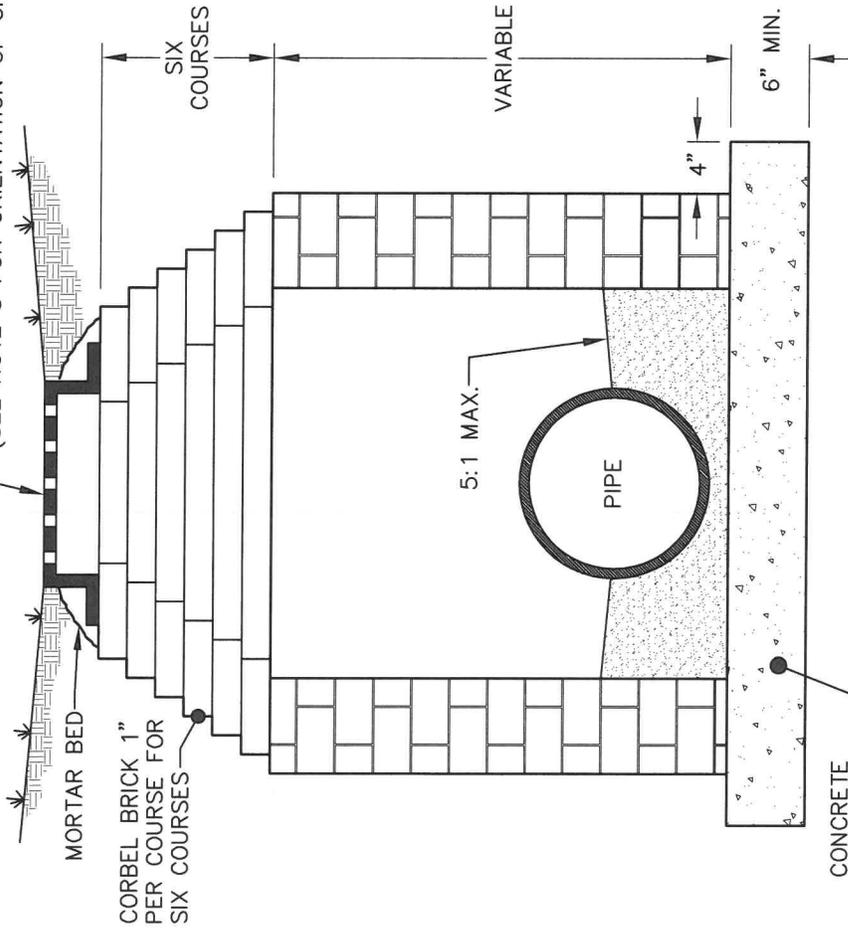
05000.01

SHEET 1 OF 1



EFFECTIVE:

NCDOT STANDARD 2' x 2' GRATE  
(SEE NOTE 5 FOR ORIENTATION OF GRATE)

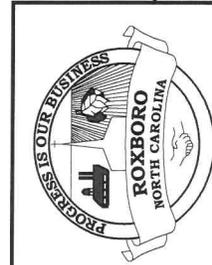


SECTION VIEW

PLAN VIEW

NOTES:

1. EITHER SOLID BRICK, SOLID BLOCK, OR PRECAST CONCRETE MAY BE USED.
2. FOR 24 INCH R.C.P. AND LARGER USE PIPE DIAMETER PLUS 12 INCHES FOR MINIMUM INSIDE DIMENSION.
3. GRATED INLETS SHALL NOT BE USED WITHIN TRAVEL AREAS.
4. STANDARD STEPS REQUIRED @ 16 INCHES O.C. WHERE DEPTH EXCEEDS 3 FEET.
5. WHERE STEPS ARE REQUIRED, USE OF PRECAST CONCRETE SLAB SHALL BE USED AS TOP AND GRATE POSITIONED OVER STEPS.
6. YARD INLETS DEEPER THAN 10 FEET SHALL REQUIRE DOUBLE WALLS.



EFFECTIVE:

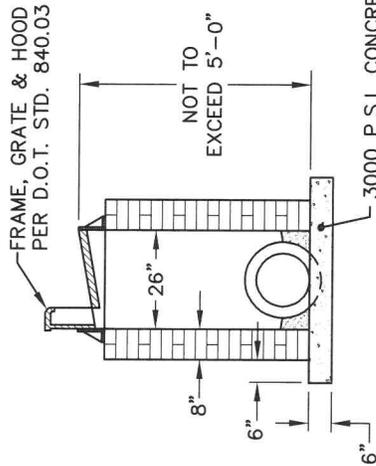
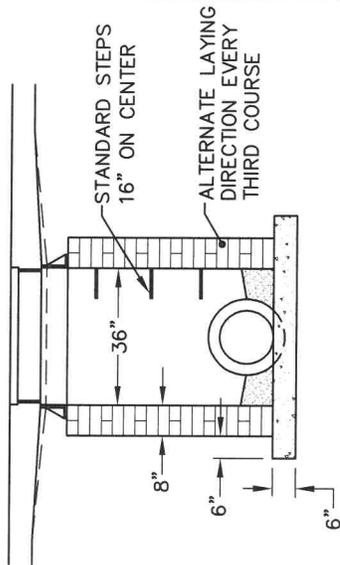
STANDARD YARD INLET WITH GRATE AND FRAME

DETAIL No.

05000.02  
SHEET 1 OF 1

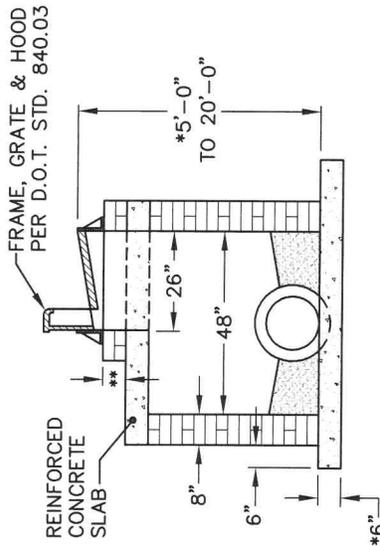
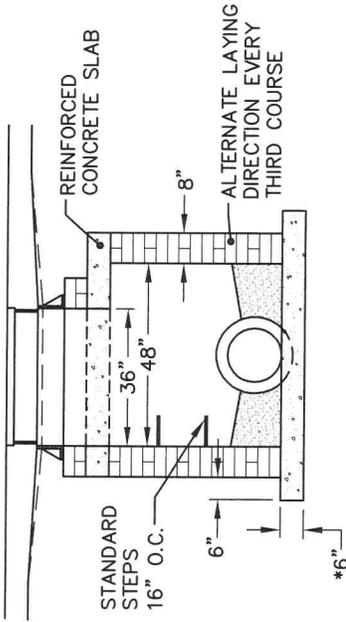
**SHALLOW TYPE**

(5 FEET OR LESS IN DEPTH)

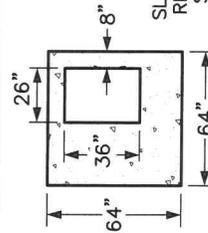


**INTERMEDIATE TYPE (4'X4')**

(5 FEET TO 20 FEET IN DEPTH)



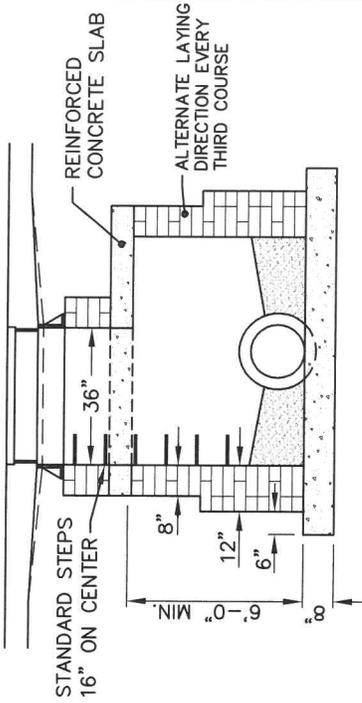
**SLAB DETAIL**



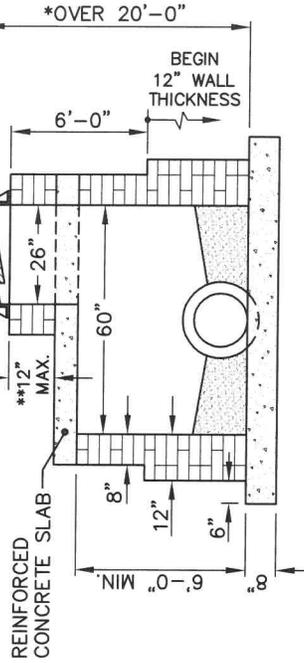
SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

**DEEP TYPE (5'X5')**

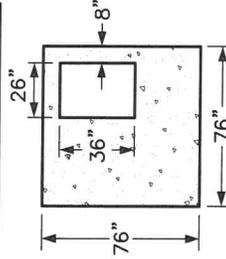
(OVER 20 FEET IN DEPTH)



FRAME, GRATE & HOOD PER D.O.T. STD. 840.03



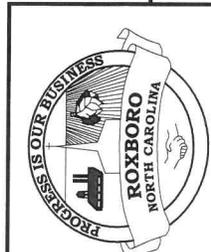
**SLAB DETAIL**



SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

\* OVER 8' IN DEPTH, 12" WALL THICKNESS TO 6' FROM TOP OF WALL, AND 8" BOTTOM SLAB SHALL BE USED.

\*\* BRICK MAY BE USED TO ADJUST FRAME, GRATE & HOOD TO SURFACE ELEVATION A MAXIMUM OF 12 INCHES.



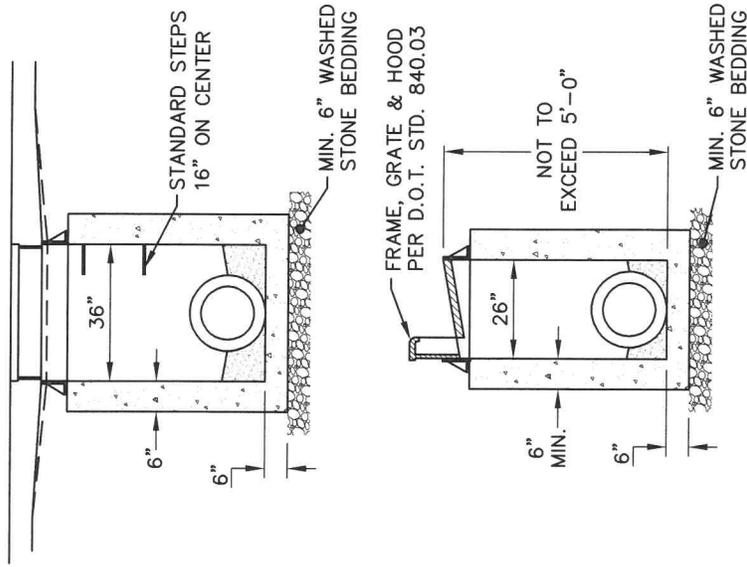
EFFECTIVE:

**STANDARD CONCRETE BLOCK OR BRICK CATCH BASIN**

DETAIL No. 05000.03  
SHEET 1 OF 2

### SHALLOW TYPE

(5 FEET OR LESS IN DEPTH)



#### NOTES:

1. CONCRETE SHALL BE 4000 P.S.I. MINIMUM FOR ALL PRECAST CONCRETE CATCH BASINS.
2. PRECAST CONCRETE STRUCTURES MAY ONLY BE INSTALLED TO DEPTHS CERTIFIED AS ACCEPTABLE BY THE MANUFACTURER.
3. "WAFFLE" BOXES ARE ACCEPTABLE FOR SHALLOW TYPE CATCH BASINS.

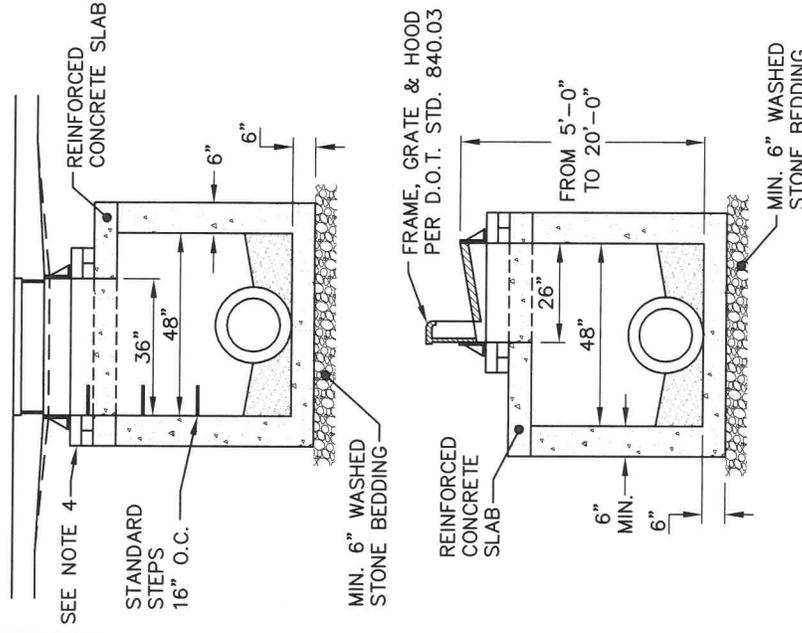
4. BRICK MAY BE USED TO ADJUST FRAME, GRATE & HOOD TO SURFACE ELEVATION A MAXIMUM OF 12 INCHES.



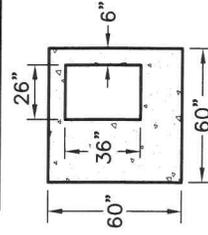
EFFECTIVE:

### INTERMEDIATE TYPE (4'X4')

(5 FEET TO 20 FEET IN DEPTH)



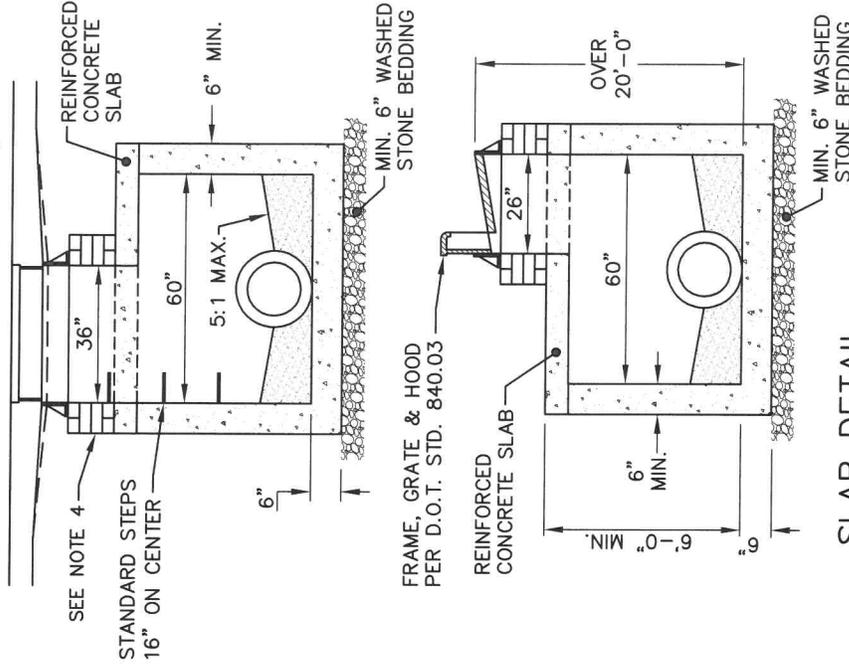
#### SLAB DETAIL



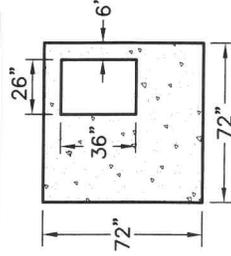
SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

### DEEP TYPE (5'X5')

(OVER 20 FEET IN DEPTH)



#### SLAB DETAIL



SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

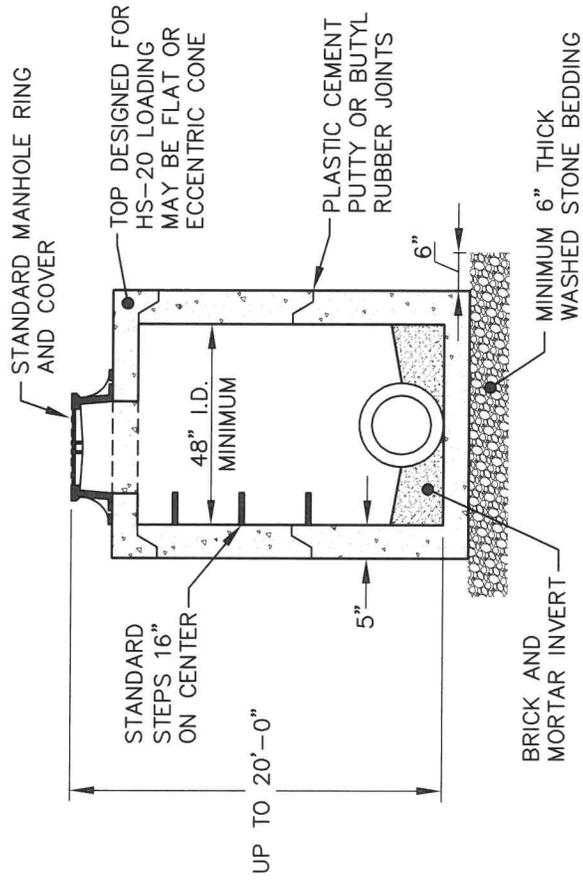
DETAIL No.

05000.03  
SHEET 2 OF 2

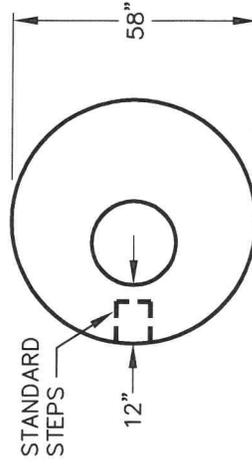
## STANDARD PRECAST CONCRETE CATCH BASIN

STANDARD TYPE

(UP TO 20 FEET IN DEPTH)

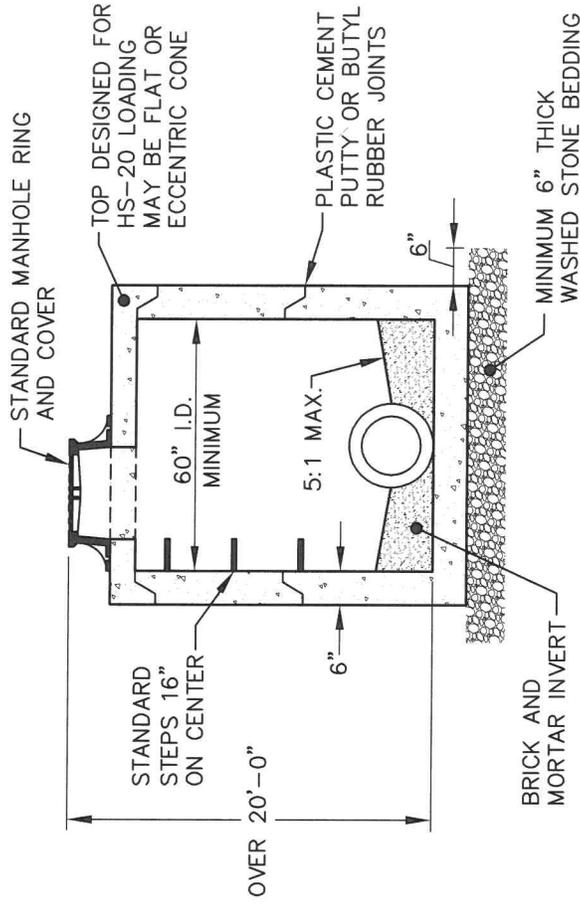


FLAT TOP DETAIL

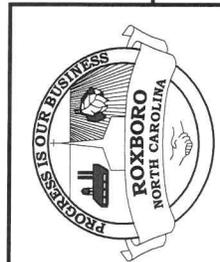
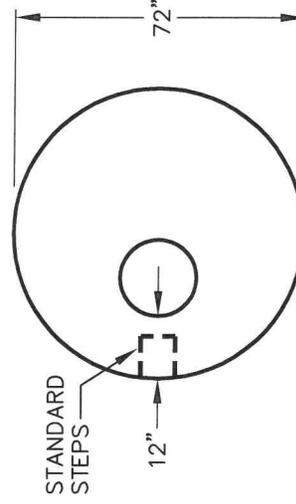


DEEP TYPE

(OVER 20 FEET IN DEPTH)



FLAT TOP DETAIL



EFFECTIVE:

STANDARD PRECAST CONCRETE MANHOLE JUNCTION BOX

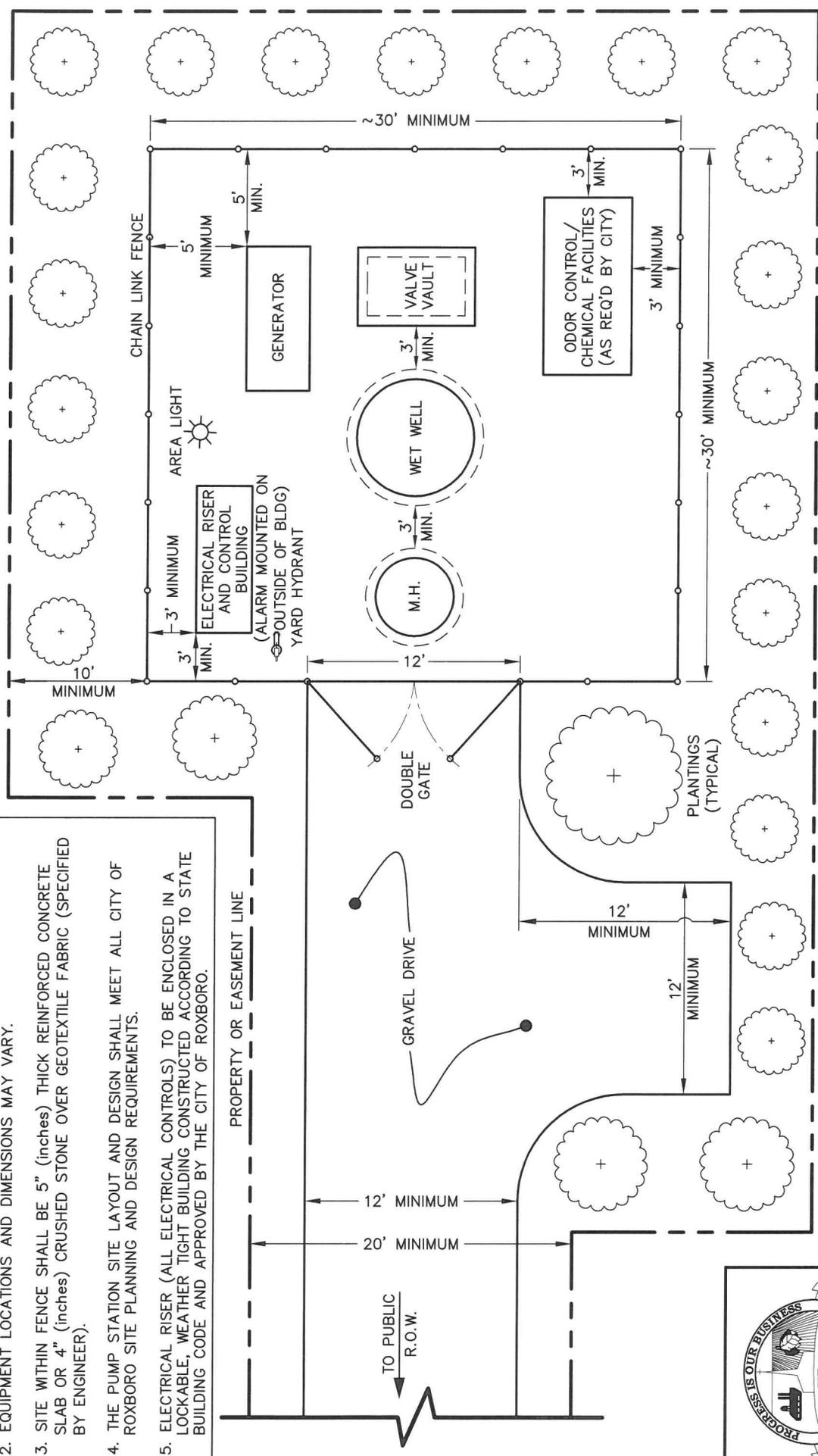
DETAIL No.

05000.05

SHEET 1 OF 1

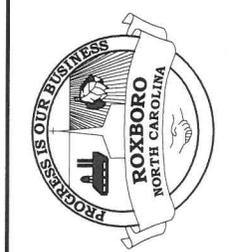
**NOTES:**

1. PUMP STATION PROPERTY OR EASEMENT SHALL BE 50' x 50' (ft.) MINIMUM.
2. EQUIPMENT LOCATIONS AND DIMENSIONS MAY VARY.
3. SITE WITHIN FENCE SHALL BE 5" (inches) THICK REINFORCED CONCRETE SLAB OR 4" (inches) CRUSHED STONE OVER GEOTEXTILE FABRIC (SPECIFIED BY ENGINEER).
4. THE PUMP STATION SITE LAYOUT AND DESIGN SHALL MEET ALL CITY OF ROXBORO SITE PLANNING AND DESIGN REQUIREMENTS.
5. ELECTRICAL RISER (ALL ELECTRICAL CONTROLS) TO BE ENCLOSED IN A LOCKABLE, WEATHER TIGHT BUILDING CONSTRUCTED ACCORDING TO STATE BUILDING CODE AND APPROVED BY THE CITY OF ROXBORO.

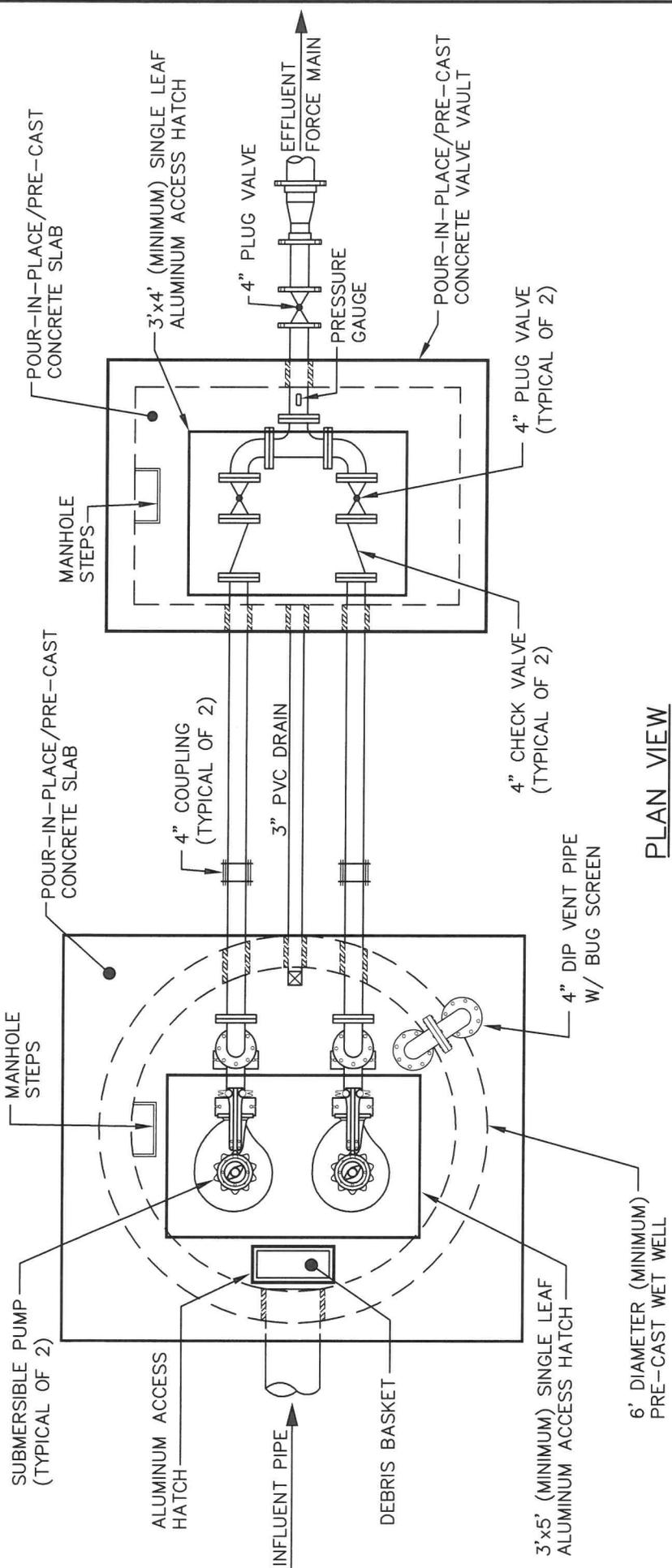


DETAIL No.  
06000.01  
SHEET 1 OF 1

**PUMP STATION SITE LAYOUT**



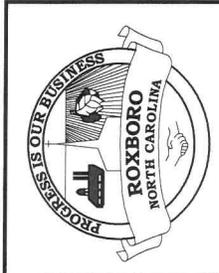
EFFECTIVE:



PLAN VIEW

- NOTES:**
1. PUMP STATIONS SHALL MEET ALL STATE MINIMUM DESIGN REQUIREMENTS AND BE APPROVED BY THE ENGINEER.
  2. WET WELLS SHALL BE EPOXY COATED.
  3. ALL PIPE AND VALVE SIZES DISPLAYED ARE MINIMUM SIZES, AND THE ACTUAL SIZES WILL BE DETERMINED BY THE HYDRAULIC DESIGN OF A PROFESSIONAL ENGINEER.

SEE SHEET 2 OF 2 FOR PROFILE VIEW



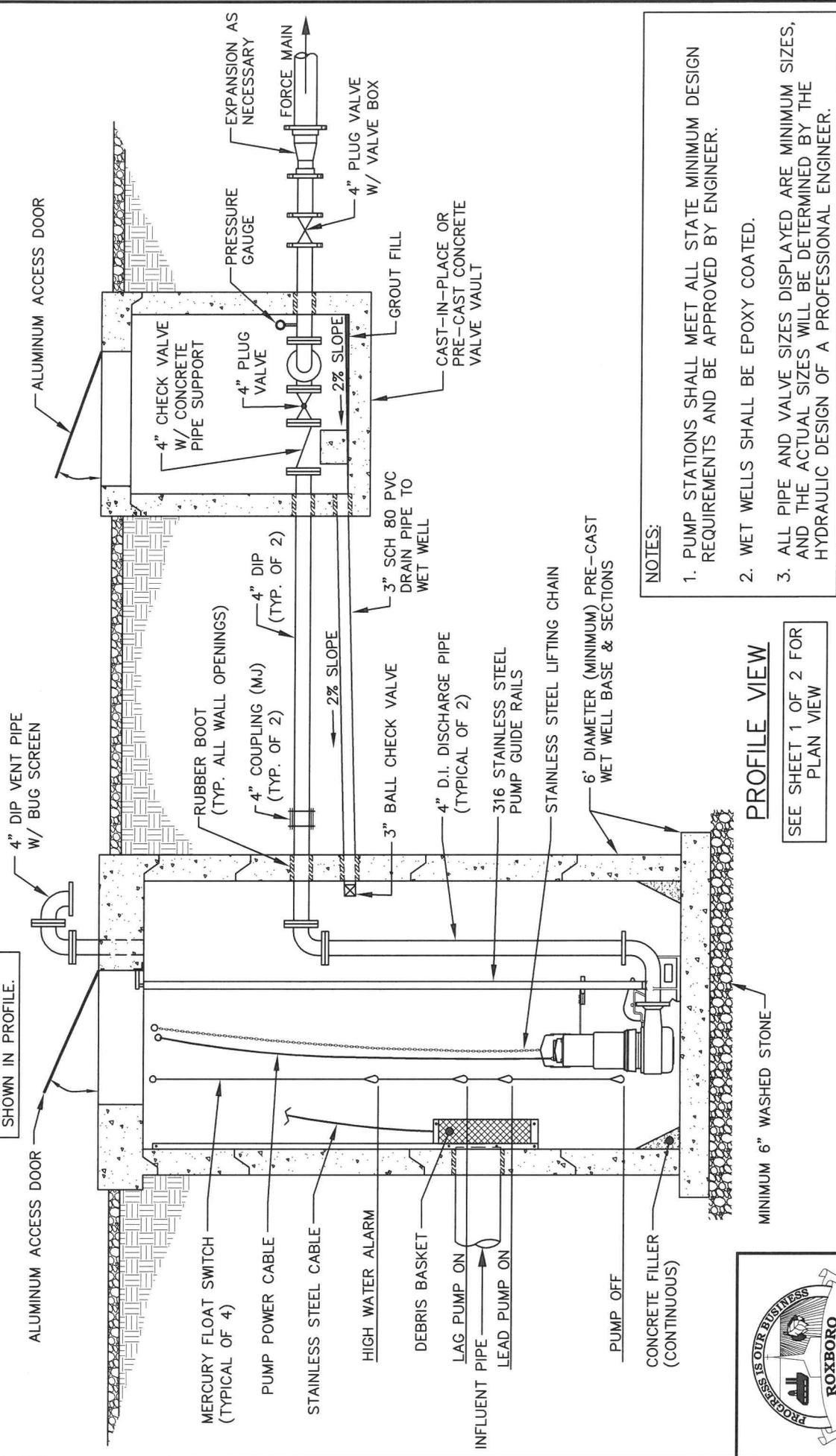
EFFECTIVE:

# WET WELL AND VALVE VAULT

DETAIL No.

06000.02  
SHEET 1 OF 2

NOTE:  
MANHOLE STEPS NOT  
SHOWN IN PROFILE.



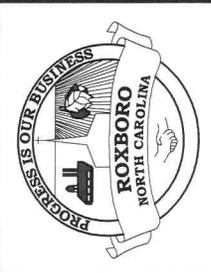
**PROFILE VIEW**

SEE SHEET 1 OF 2 FOR  
PLAN VIEW

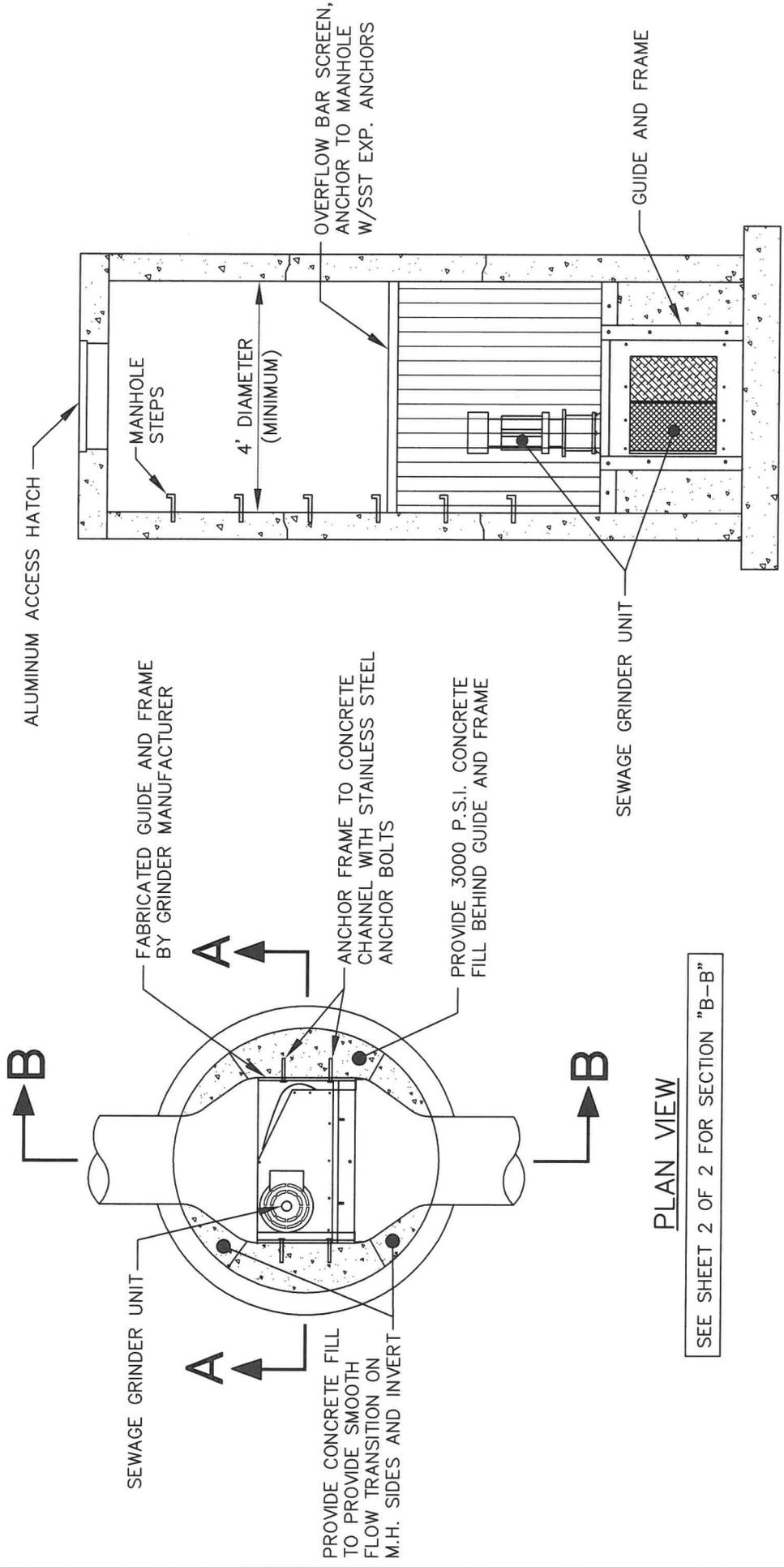
- NOTES:**
1. PUMP STATIONS SHALL MEET ALL STATE MINIMUM DESIGN REQUIREMENTS AND BE APPROVED BY ENGINEER.
  2. WET WELLS SHALL BE EPOXY COATED.
  3. ALL PIPE AND VALVE SIZES DISPLAYED ARE MINIMUM SIZES, AND THE ACTUAL SIZES WILL BE DETERMINED BY THE HYDRAULIC DESIGN OF A PROFESSIONAL ENGINEER.

DETAIL No.  
06000.02  
SHEET 2 OF 2

**WET WELL AND VALVE VAULT**



EFFECTIVE:



- NOTES:
1. THERE SHALL ONLY BE A SINGLE INFLUENT LINE INTO THE GRINDER MANHOLE.
  2. GRINDER MANHOLES SHALL BE EPOXY COATED.



EFFECTIVE:

SEWAGE GRINDER UNIT (MANHOLE INSTALLATION)

DETAIL No.  
06000.03  
SHEET 1 OF 2

QUICK-COUPLE HYDRAULIC HOSE CONNECTIONS.  
LOCATE ABOVE STRAIN RELIEF. (TYPICAL OF 2)

CONDUIT TO HYDRAULIC POWER UNIT

STAINLESS STEEL STRAIN RELIEF FOR HYDRAULIC  
HOSE, KELLUM GRIP, OR EQUAL.  
MOUNT TO HATCH FRAME. (TYPICAL OF 2)

ALUMINUM ACCESS HATCH

PRECAST MANHOLE WITH STEPS

OVERFLOW BAR SCREEN

INFLUENT PIPE

EFFLUENT PIPE

SEWAGE GRINDER

**SECTION "B-B"**

SEE SHEET 1 OF 2 FOR PLAN VIEW



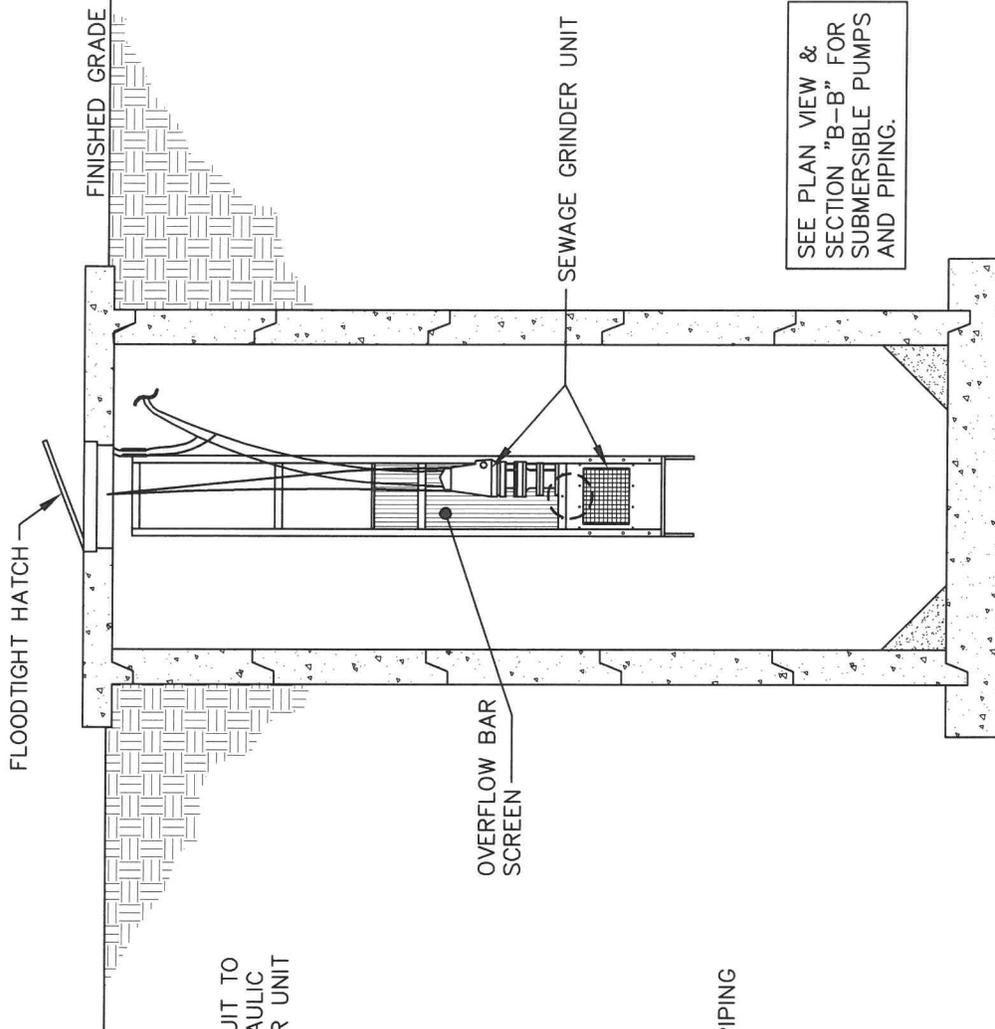
EFFECTIVE:

**SEWAGE GRINDER UNIT (MANHOLE INSTALLATION)**

DETAIL No.

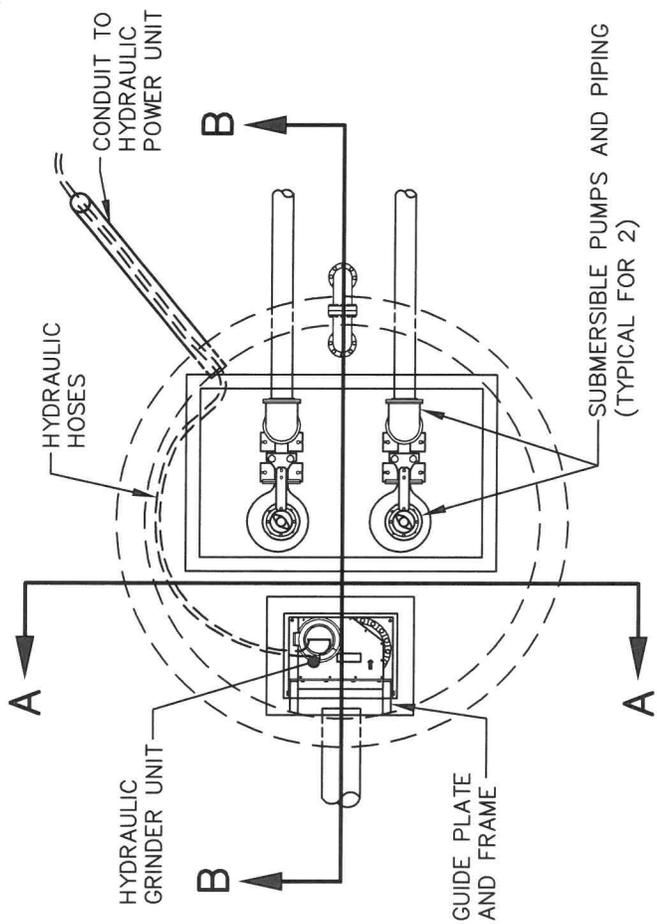
06000.03

SHEET 2 OF 2



SEE PLAN VIEW &  
SECTION "B-B" FOR  
SUBMERSIBLE PUMPS  
AND PIPING.

SECTION "A-A"

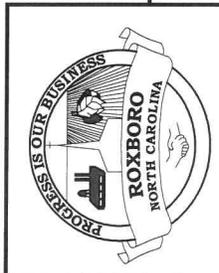


PLAN VIEW

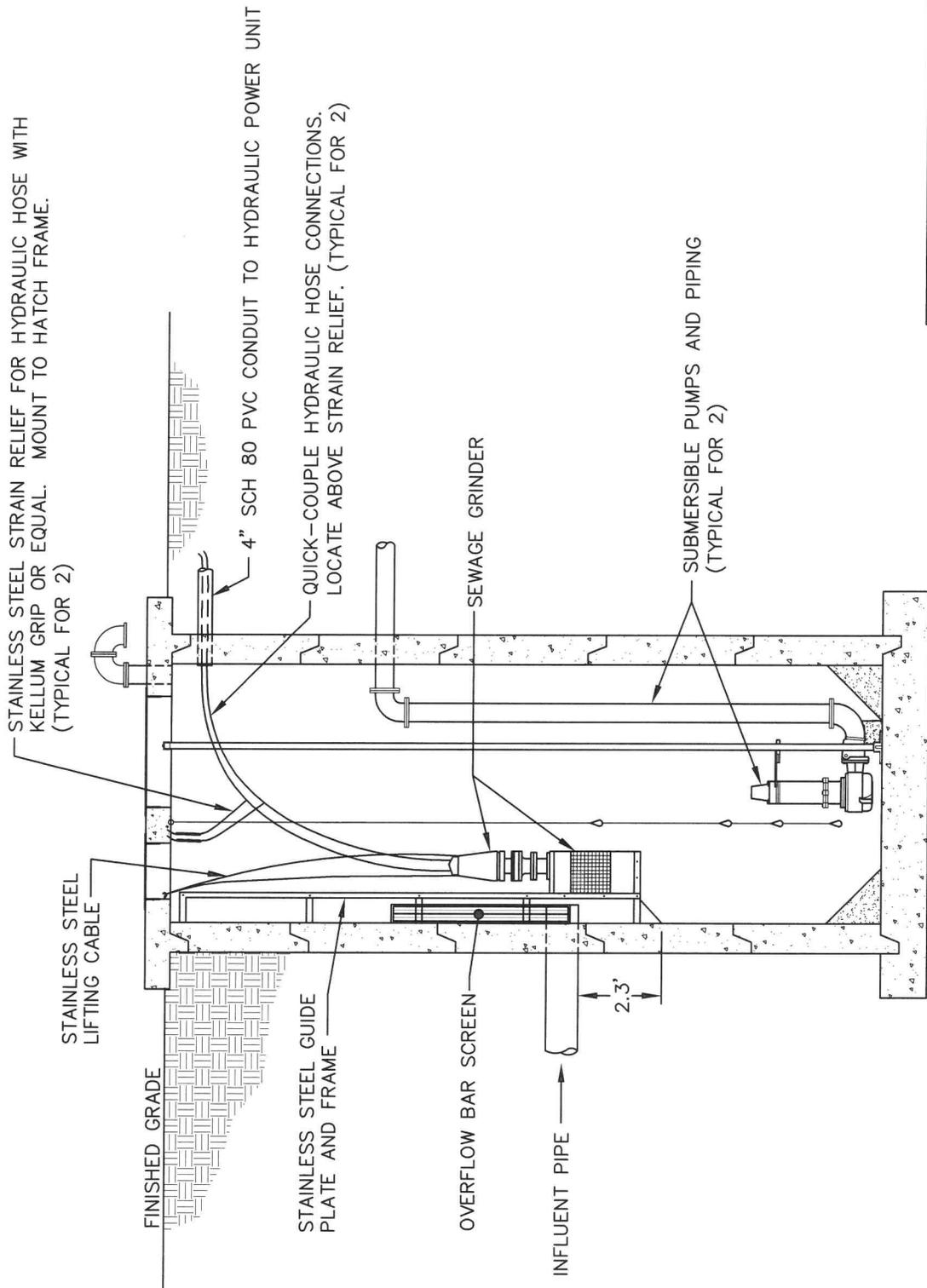
SEE SHEET 2 OF 2 FOR  
SECTION "B-B"

DETAIL No.  
06000.04  
SHEET 1 OF 2

SEWAGE GRINDER UNIT (WET WELL INSTALLATION)



EFFECTIVE:



SEE SHEET 1 OF 2 FOR PLAN VIEW AND SECTION "A-A"

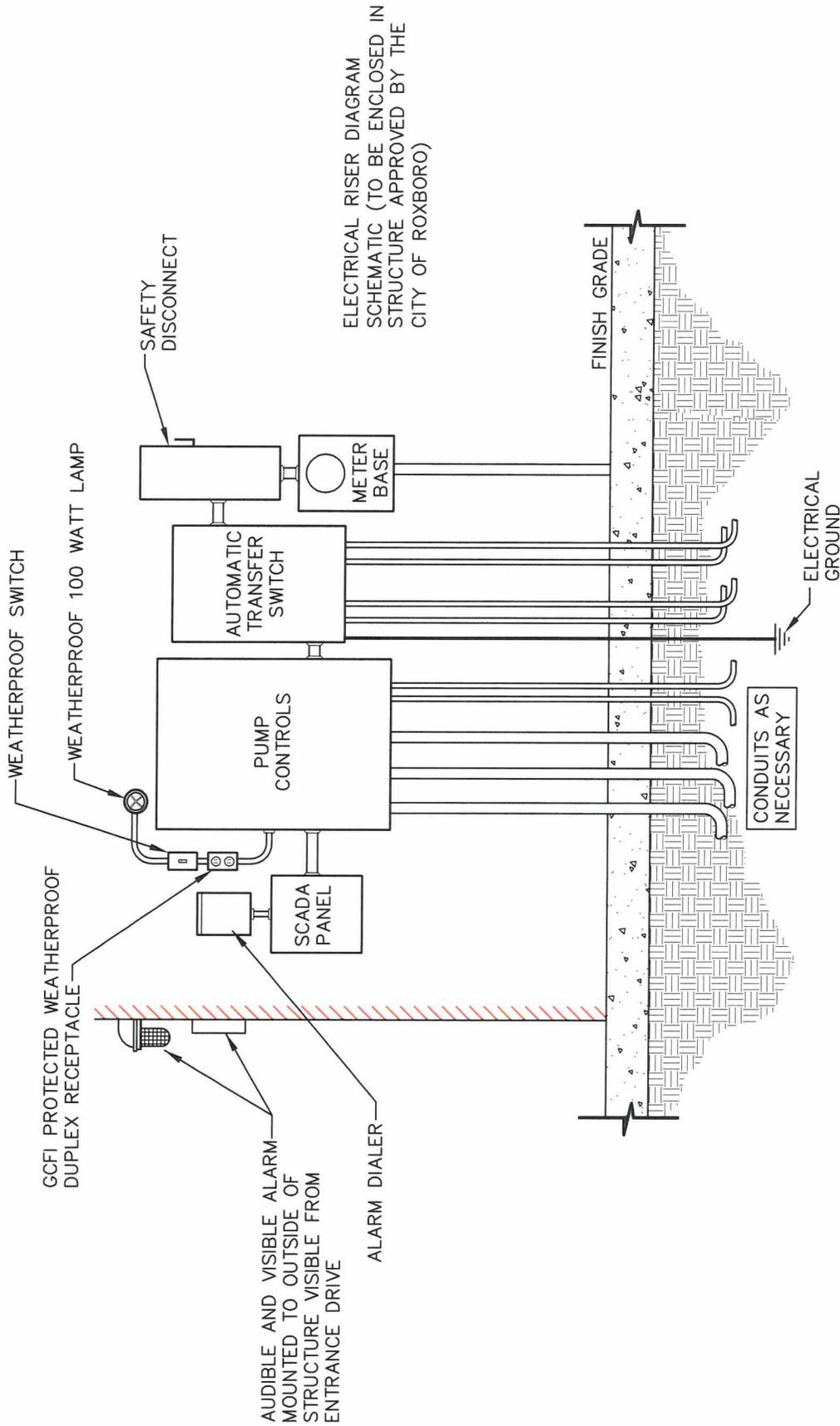
SECTION "B-B"

SEWAGE GRINDER UNIT (WET WELL INSTALLATION)

DETAIL No.  
06000.04  
SHEET 2 OF 2



EFFECTIVE:



NOTE:  
ALL ELECTRICAL SYSTEMS SHALL MEET OR EXCEED NEC REQUIREMENTS.

## ELECTRICAL RISER DIAGRAM

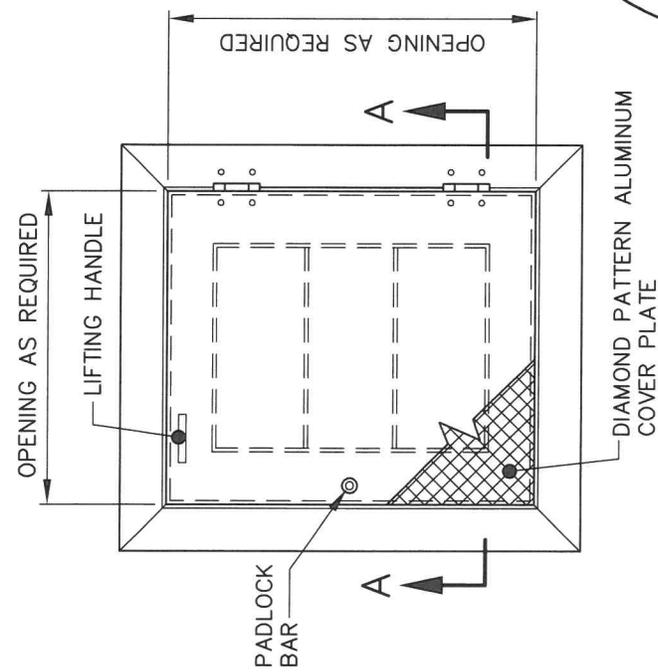
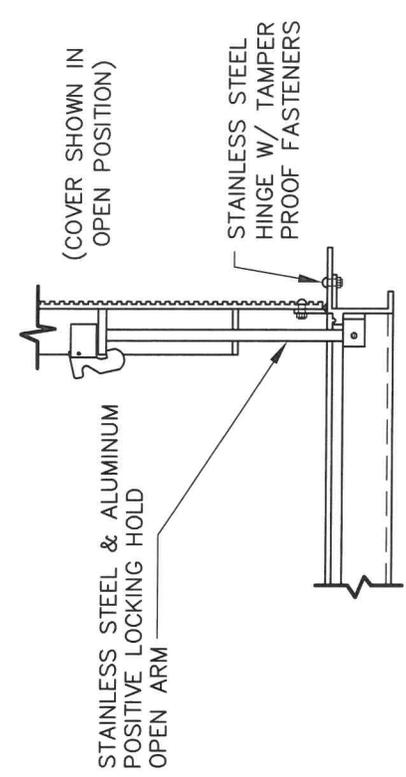
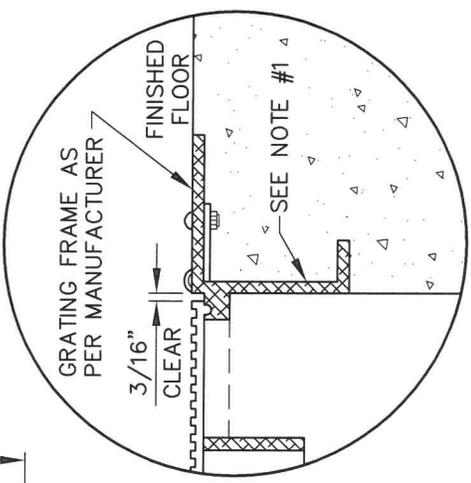
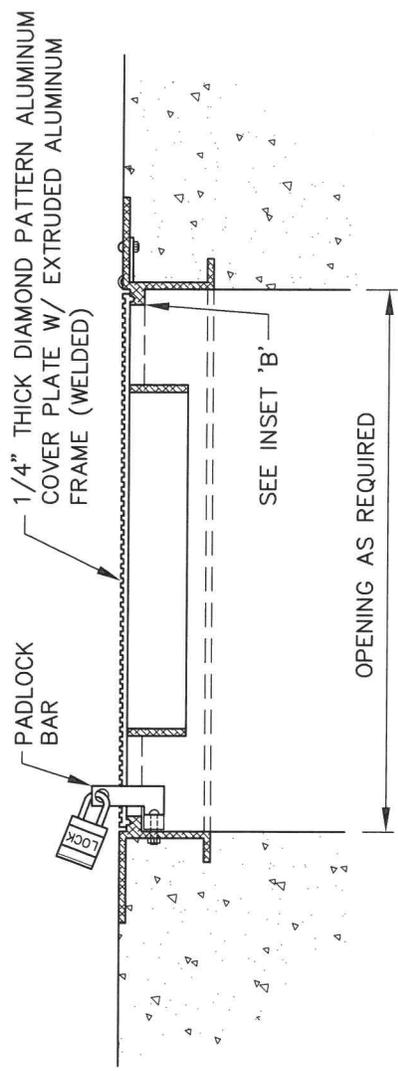
DETAIL No.

06000.05

SHEET 1 OF 1



EFFECTIVE:



NOTES:

1. ALL ALUMINUM SURFACES IN CONTACT WITH CONCRETE OR GROUT SHALL BE COATED WITH BITUMINOUS MATERIAL FOR PROTECTION.
2. HATCHES SHALL BE SINGLE OR DOUBLE HATCH DEPENDING ON OPENING SIZE AND MANUFACTURER'S RECOMMENDATIONS.

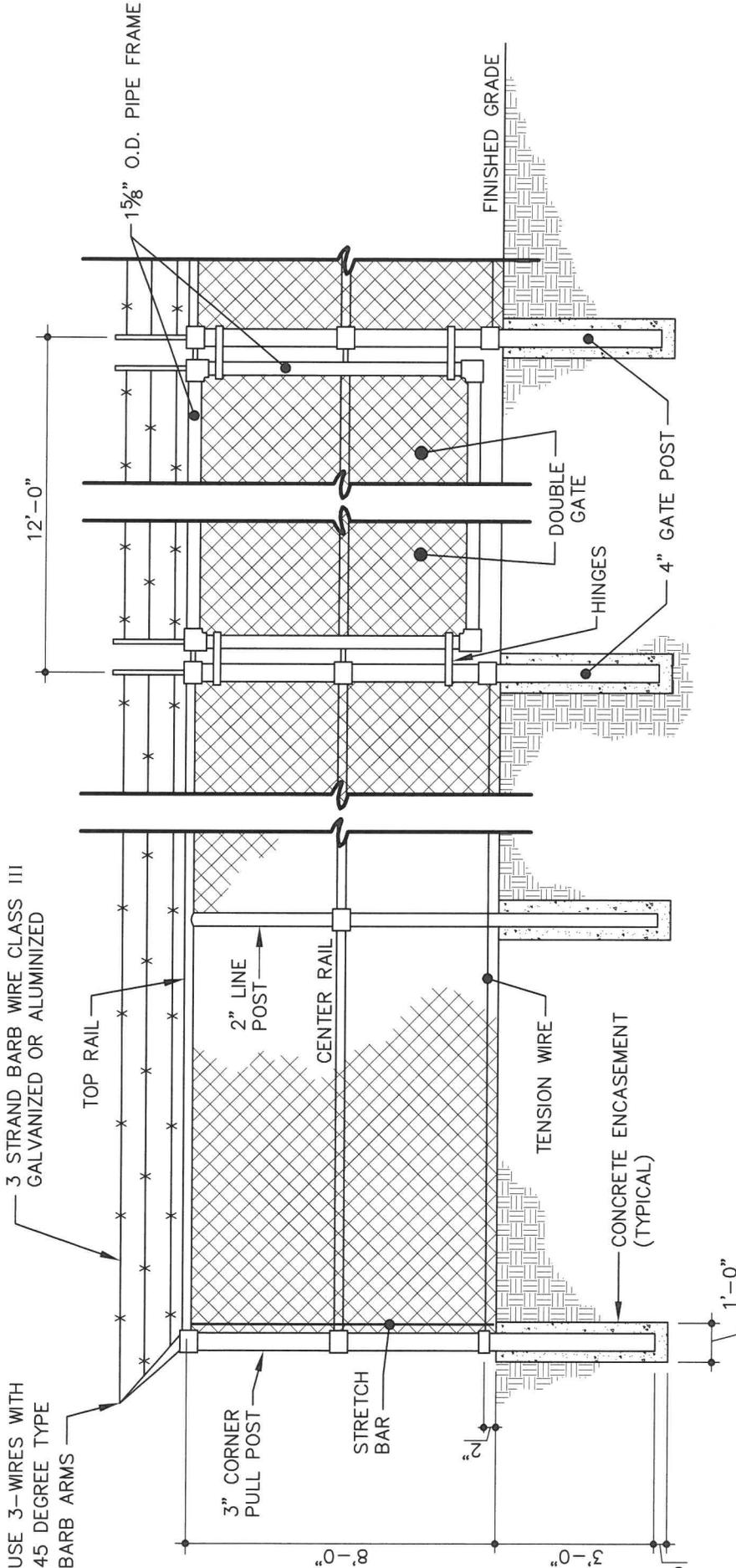
PROGRESS IS OUR BUSINESS

ROXBORO NORTH CAROLINA

EFFECTIVE:

DETAIL No.  
06000.06  
SHEET 1 OF 1

ALUMINUM ACCESS HATCH



- NOTES:**
1. DOUBLE GATE SHALL HAVE A LOCKING MECHANISM, DROP ROD, AND TRUSS ROD.
  2. ALL FENCE COMPONENT MATERIALS SHALL BE EITHER HOT DIPPED GALVANIZED STEEL OR IRON. FENCE FABRIC SHALL BE ALUMINUM COATED.
  3. ALL FENCING SHALL BE PROVIDED WITH A BLACK VINYL COATED POLYESTER PRIVACY SCREEN ACROSS THE ENTIRE SURFACE AREA OF THE FENCE INCLUDING GATES.
  4. ALL CHAIN LINK FENCING AND POSTS SHALL BE VINYL COATED WITH BLACK UV RESISTANT VINYL.



## CHAIN LINK FENCE & GATE

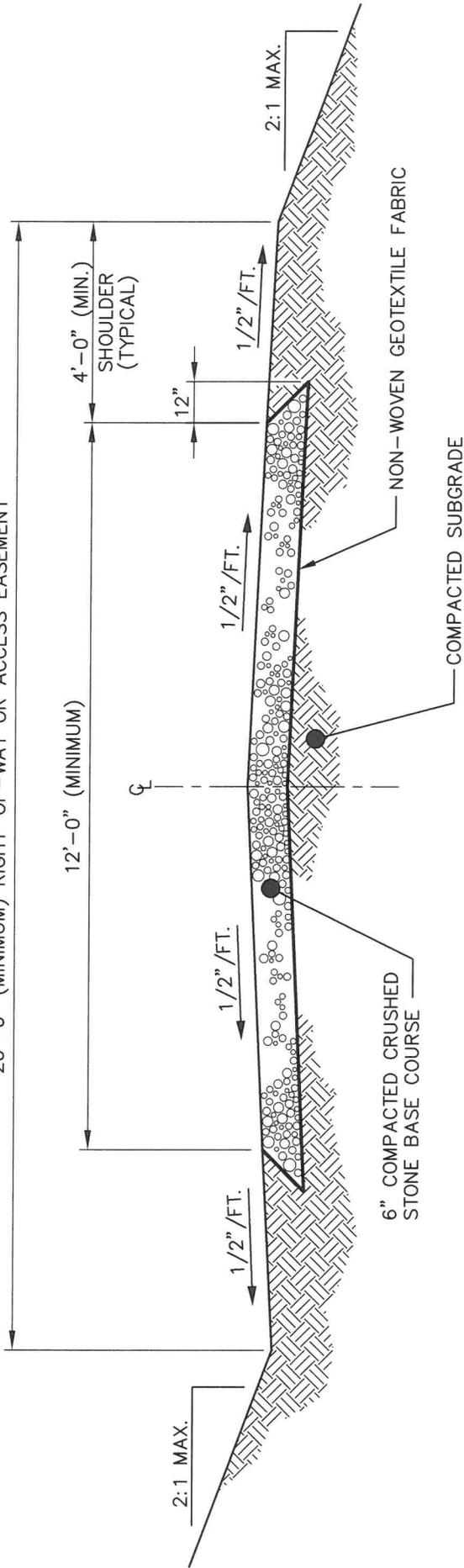
DETAIL No.

06000.07

SHEET 1 OF 1

EFFECTIVE:

20'-0" (MINIMUM) RIGHT-OF-WAY OR ACCESS EASEMENT

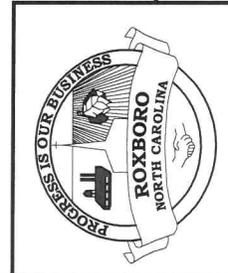


DETAIL No.

06000.08

SHEET 1 OF 1

### PUMP STATION ACCESS ROAD



EFFECTIVE: