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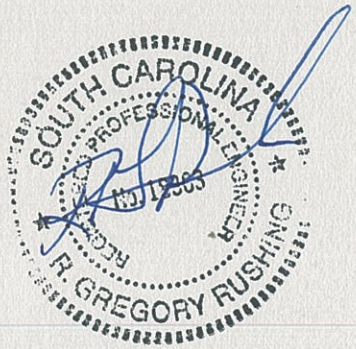
STANDARD SANITARY SEWER SPECIFICATIONS for the TOWN OF FORT MILL, SOUTH CAROLINA

FORT MILL
South Carolina



October 11, 2016

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Sewers and Appurtenances

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Sewers and Appurtenances

S-I GRAVITY SEWER SYSTEMS

S-I.1. GENERAL

1.1 DESIGN STANDARDS

Gravity sewers/collection systems must be eight inch (8") diameter or larger and shall be designed to conform to, or exceed, the requirements set forth in SCDHEC R.61-67.300[1]. Whenever the requirements of this document conflict with SCDHEC R.61-67.300, the higher standard shall prevail.

1.2 LOCATION

In general, all sewer mains shall be installed in dedicated public streets. The sewer shall be located such that the manhole locations are not within the wheel path of the street. If it is not possible or feasible for such an installation to be made in a dedicated street or the depth of the sewer would make maintenance of the sewer difficult it is the Town's policy to require a 30 feet wide (minimum) utility easement. The sewer main shall generally be centered within the easement. Excessive sewer depths shall not be used in order to serve areas outside the natural surface drainage area. The slope of the sewer should generally parallel the slope of the street or finished grade as much as possible so that excessive depths are minimized. Construction of sewers at depths greater than 15 feet will require specific approval of the Town. Additional easement width shall be provided if the pipe size or depth of cover so dictate. All easements must be shown on the plans and on the final recorded plat as a 30 feet wide utility easements dedicated to the Town of Fort Mill.

No storm water detention facilities may be located over any sanitary sewer existing or proposed.

[1] Standard for Wastewater Facility Construction: R.61-67 of South Carolina, May 22, 2015 (or most recent revision)

1.3 SEPERATION OF SEWER AND WATER

1) Sewer lines and manholes shall be located a minimum of 100 feet from a public water supply well and shall be located at least 20 feet from any other potable well as defined in SCDHEC Regulation 61-71.

2) There shall be no physical connections between a water supply system and a sewer or other sewer related appurtenance which may permit the passage of sewage or polluted water into a potable supply. No potable water line may pass through or come into contact with any part of a sewer manhole.

3) Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main (measured edge to edge). In cases where local conditions or barriers prevent the 10 foot horizontal separation, a deviation may be allowed, provided the sewer main is in a separate trench and the bottom of the potable water main is at least 18 inches above the top of the sewer. Ductile iron pipe will also be required for sewer and water mains when these clearances are not maintained.

4) When a sewer main crosses a potable water main, a minimum vertical separation of 18 inches must be provided between the outside of the potable water main and the outside of the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where the new sewer line crosses the potable water main, one full length of ductile iron pipe shall be used for both the sewer line and potable water main so that the joints of each line are as far as possible from the point of crossing.

5) Where it is impossible to obtain the distances specified herein, an alternative design that meets the criteria outlined in this paragraph may be considered. No deviation from the distances specified in this section will be approved by the Town unless first approved by SCDHEC.

    a) Maximize the distance between the sewer line and the potable water main and the joints of each;

    b) Use pipe material which meet the requirements as specified in SCDHEC Regulation 61-58.4(D)(1) for the sewer line, and

    c) Allow enough distance to make repairs to one of the lines without damaging the other.

1.4 MINIMUM DISTANCE FROM UTILITIES OTHER THAN WATER MAINS

1) The minimum horizontal separation between a sanitary sewer and other underground utilities shall not be less than 5-feet measured from the outside of the pipe.
2) Additional separation may be required by the Town for deeper sewers and shall consider the relative depth of the adjacent utilities and the stability of the soil conditions and backfill materials to provide space for repair and alterations of the sewer.
3) All utility crossings must be shown in profile. A minimum vertical separation of 18-inches is required for storm sewers and 12-inches for all other utilities measured outside to outside. Include method of backfilling and support between the pipes/utilities that will provide adequate structural support for the sewer.
4) Sewers shall be laid at least 10-feet horizontally from any existing or proposed storm sewer. The distance shall be measured edge-to-edge.

1.5 PIPE QUALITY

Latitude in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces; be first quality, be free from cracks, blisters, and other imperfections, and be true to theoretical shapes and forms throughout each length. Pipe shall be subject to inspection by the Town's inspector or engineer at the pipe plant, trench, and other points of delivery for the purpose of culling and rejecting pipe, independent of laboratory tests, which does not conform to the requirements of this section. Pipe that does not conform will be so marked by the Town's inspector or engineer, and shall not be used in the work. On-the-job repairing of rejected pipe will not be permitted.

The pipe manufacturer shall submit evidence, if required by the Town, of having consistently produced pipe and joints of the quality specified herein, and which have exhibited satisfactory performance results in service over a period of not fewer than five years. The pipe manufacturer and the pipe manufacturing process shall be subject to approval by the Town's inspector or engineer.

1.6 MATERIALS HANDLING

The Contractor shall unload, haul, distribute and store pipe and related materials as outlined in the following paragraphs.

1.6.a. Unloading

Equipment and facilities for unloading, hauling, distributing and storing materials shall be furnished by the Contractor and shall at all times be available for use in unloading materials.

1.6.b. Handling

Pipe, fittings and other material shall be carefully handled so as to prevent breaking and/or damage. Pipe may be unloaded individually by hand but shall not be unloaded by rolling or dropping off of trucks or cars. Preferred unloading is in units using mechanical equipment, such as forklifts, cherry pickers or front end loaders with forks. If fork lift equipment is not available, units may be unloaded with use of spreader bar on top and nylon strips or cables (cushioned with rubber hose sleeve) looped under the unit.

1.6.c. Distributing

Materials shall be distributed and placed so as to least interfere with traffic. No street or roadway may be closed without first obtaining permission of the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets, and roadways upon which material is distributed. No distributed materials shall be placed in drainage ditches.

1.6.d. Storage

1) All pipe fittings and other materials which cannot be distributed along the route of the work shall be stored for subsequent use when needed. The Contractor shall make his own arrangements for the use of storage areas.
2) Ductile iron pipe must be stock-piled on level ground. Timbers must be placed under the pipe for a base and to prevent dirt and debris from washing into the pipe.
3) PVC pipe must be stockpiled on level ground. If pipe is unloaded individually by hand, timbers must be used under the pipe for a base, spaced the same as factory load, with stop blocks nailed at either end. Stockpile must be built up the same manner as it was stocked for shipment, transferring dunnage and chock blocks from load to stockpile. Individual lengths of pipe shall not be stacked in piles any higher than five feet (5’).
4) If pipe is unloaded in units, the units must be placed on level ground and shall not be stacked more than two (2) units high. Units must be protected by dunnage in the same way they were protected while loaded on the truck or car.

The dunnage must support the weight of all units so that pipe lengths do not carry the weight of the unit loaded above.

5) If PVC pipe is to be stored outside and exposed to sunlight for a number of months, the pipe must be protected from ultraviolet light (UV) by covering with canvas or other opaque material. The cover shall be loose enough to allow for air circulation around the pipe to prevent heat build-up. The use of clear plastic sheets will not be permitted.

1.7 ORDER OF WORK

The Town reserves the right to require certain line segments to be constructed before others and to accept and use portions of the work when it is considered to be in the public's interest to do so.

1.8 INSPECTION

All work done and material furnished shall be subject to inspection by the Town's authorized representative. Improper work shall be reconstructed and materials which do not conform to the requirements of this section shall be removed from the work upon notice being received from the Town of the rejection of those materials. The Town shall have the right to mark rejected materials and/or the Contractor shall segregate said materials to distinguish them as such.

1.9 ORGANIZATION OF WORK

1) The Contractor shall so organize his work that back-filling and cleanup shall closely follow pipe laying operations and manhole construction.
2) In general, not more than one block of a street or roadway shall be closed for construction at any one time. Before proceeding with trenching operations in a succeeding block, the proceeding section shall be back-filled, cleanup completed, and the street opened to traffic.
3) For work outside the streets and roadways, back-filling, and windrowing, in accordance with the provisions of "General Back-filling" paragraph shall be performed in such manner that not more than five hundred (500') feet of trench shall remain open at any one time.
4) Failure on the part of the Contractor to comply with the above provisions in a reasonable manner shall be sufficient cause to order a temporary shut-down of further trenching and pipe laying operations until the provisions have been met.

1.10 ACCEPTANCE OF WORK

Sewer lines and appurtenances will not be considered ready for acceptance until all provisions of the specifications have been complied with, until all tests have been satisfactorily completed, and until inspection of the work has been made.

1.10.a. Construction Plans As-builts

All entities who construct any public sewer line to be maintained by the Town of Fort Mill must submit an "as-built" set of construction drawings for approval as a part of the Town's acceptance process. The As-built drawings shall clearly and legibly show any changes or variations from the approved drawings and record actual construction including:

1) Measured station number and horizontal and vertical locations of manholes and other appurtenances, referenced to a minimum of two permanent aboveground features of the Work.
2) Measured locations of internal utilities and appurtenances concealed in construction, referenced to a minimum of two permanent aboveground features of the Work.
3) Provide survey of horizontal coordinates for each manhole and ground elevation, top elevation and invert elevations for each manhole. Survey to be tied to state plane coordinates.
4) Reference all bores from the center of the roadway to the beginning and end of the casing. Depths of bury must also be provided.
5) Field changes of dimension and detail.
6) Details not on original Construction drawings.

1.10.b. GIS Shapefile As-builts

GIS shapefiles with applicable attributes for As-built drawings must be submitted for approval as a part of the Town's acceptance process. GIS data of sewer assets submitted in shapefile (.shp) format shall meet the following requirements:

1) Shapefile formatting shall be delivered on sub-foot accuracy and in NAD_1983_StatePlane_South_Carolina_FIPS_3900_Feet_Intl coordinate system.
2) Required GIS data features, if applicable:
    a. Fittings (force mains)
        i. Attributes:

a. Type: Cap, Cross, Tee, Bend (with degree), Sleeve, Reducer, Plug, etc.
b. Material: PVC, DI, etc.
c. Restrained: Yes / No
d. Installation Date: MM/DD/YYYY

b. Valves (force mains)
   i. Point Feature
   ii. Attributes:
      a. Valve ID: Identifier per as-built
      b. Type: plug, etc.
      c. Diameter
      d. Position: Open / Closed Open
      e. Installation Date: MM/DD/YYYY

c. Lift Station (if applicable)
   i. Point Feature
   ii. Attributes:
      a. Type: dry-pit, submersible, etc.
      b. Capacity: gpm
      c. Wet Well Diameter
      d. Installation Date: MM/DD/YYYY

d. Grease Trap (if applicable)
   i. Point Feature
   ii. Attributes:
      a. Installation date: MM/DD/YYYY

e. Wastewater (force mains and gravity sewers) Mains
   i. Type: i.e. gravity, force, etc.
   ii. Flow Direction
   iii. Diameter
   iv. Material: PVC, Ductile Iron, etc.
   v. Length between fitting(s), manhole(s), valve(s), material change(s), and any other notable features.
   vi. Invert elevation: in feet
   vii. RIM elevation: in feet

viii. Lined: yes/no
  a. If yes, note the Lining Material and Lining Method used.
ix. Tracer wire: yes/no

f. Service Lines (if applicable)
  i. Diameter
  ii. Material

g. Easements (if applicable)
  i. Polygon Feature
  ii. Attributes: Easement Type: Utility, Water, Drainage, etc.
  iii. Duration: Temporary or Permanent

The As-built drawings shall be submitted to the Town in paper (blue line copy and mylar copy), electronic format (CD-ROM) in AutoCAD DWG format and electronic format (.shp) in GIS shapefile format, prior to final acceptance. Additional requirements for sewer as-built drawings may be found on line at www.fortmillsc.org.

1.11 WARRANTY

For a period of at least one year after final acceptance of the Project by the Town of Fort Mill, the Contractor and/or Developer shall warrant the fitness and soundness of all work done and materials and equipment put in place. Neither the partial or the entire occupancy of the premises by the Town of Fort Mill shall constitute an acceptance of work that is not done in accordance with the approved development plans, or relieve the Contractor and/or Developer of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor and/or Developer shall guarantee the equipment to be free from defects in workmanship, design, and material for a period of one year from final acceptance and shall replace without charge any part or parts of any equipment defective or showing undue wear in that time. The Contractor and/or Developer shall remedy any defects in the work and pay for any damage to other work resulting therefrom, which shall appear within the warranty period. The Town will give notice of observed defects with reasonable promptness. All work performed under warranty shall include all materials, parts, labor, and any additional costs necessary to perform the work and shall be done at no expense to the Town of Fort Mill.

S-I.2. MATERIALS

2.1 POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS

1) Polyvinyl Chloride (PVC) sewer pipe shall be bell and spigot pipe, shall be supplied in standard laying lengths of 14 ft. and/or 20 ft. and shall have minimum wall thickness conforming to ASTM D 3034 under the classification for SDR 26 pipe, as amended to date.
2) PVC pipe may be utilized for sewers up to and including 15" nominal diameter. All other sewer pipe shall be ductile iron pipe.
3) PVC sewer pipe shall be installed with a minimum of 3-feet of cover and a maximum of 20-feet of cover. When the cover is more than 20-feet, ductile iron pipe must be used.
4) Polyvinyl chloride (PVC) sewer pipe fittings shall be supplied by the pipe manufacturer and shall be bell and spigot or bell and plain end and shall conform to ASTM D 3034, as amended to date.
5) PVC pipe shall be marked at intervals of 5 ft. or less with the following information: manufacturer's name or trademark, plan code, date of manufacture, nominal pipe size, PVC cell classification, the legend "Type PSM SDR 26 PVC Sewer Pipe" and ASTM designation D 3034. Fittings shall be marked with the following information: manufacturer's name or trademark, nominal size, designations PVC and PSM and ASTM designation D 3034. All markings shall remain legible during normal handling, storage and installation.
6) PVC pipe used for sewer lines shall be green in color.
7) The Contractor shall furnish a written statement from the manufacturer that all pipe and fittings furnished have been sampled, tested and inspected in accordance with ASTM D 3034, as amended to date. Each certification so furnished shall be signed by an authorized agent of the manufacturer.
8) The pipe shall be made and joined with an integral bell, bell-and-spigot rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Gaskets shall conform to ASTM F 477, as amended to date. Joints shall meet the requirements specified in ASTMD 3212, as amended to date.

9) New service branch connection for PVC pipe shall consist of molded “T” or “Y” branch fittings with all gasketed connections. Taps will not be permitted. Cemented mitered connections without socket reinforcement shall not be used.

2.2 DUCTILE IRON PIPE AND FITTINGS

The Contractor shall furnish iron pipe and fittings for gravity sewer construction (and force mains, ***See S-III,1.1.c***) as follows:

1) Pipe shall be centrifugally cast and shall conform to ANSI Specification A21.51 (AWWA C151) as amended to date, with mechanical or push-on joints and laying lengths of at least 18 ft. with minimum Pressure Class 250 wall thickness or as required by the installation conditions (i.e., depth of cover, etc.). The pressure class of pipe required shall be determined by trench depth, type of bedding, and trench width in accordance with **Table S-1**, below for pipe with **flexible linings**. Submit pipe laying schedule for review by the Town indicating the location of each pressure class of pipe and the respective trench type used for ALL the pipe on the project. Trench type and pipe class shall not change between manholes.

Table S-1: Rated Working Pressure and Maximum Depth of Cover for Ductile Iron Pipe with Flexible Linings

Pipe Size (inches)	Pressure Class	Type 2 Trench	Type 4 Trench	Type 5 Trench
8	350	20’	34’	50’
10	350	15’	28’	45’
12	350	15’	28’	44’
14	250 300 350	11’* 13’ 14’	23’ 26’ 27’	41’ 43’ 44’
16	250 300 350	11’* 13’ 15’	24’ 26’ 28’	41’ 43’ 45’
18	250 300 350	10’* 13’ 15’	23’ 26’ 28’	40’ 43’ 45’
20	250 300 350	10’ 13’ 15’	23’ 26’ 28’	40’ 43’ 44’
24	250 300 350	11’ 13’ 15’	23’ 26’ 28’	41’ 43’ 45’
30	250 300 350	11’ 12’ 15’	23’ 25’ 28’	40’ 42’ 44’

* Minimum allowable depth of cover is 3 ft.

2) Fittings shall be cast from ductile iron and shall conform to ANSI Specifications A 21.53 (AWWA C-153) or ANSI/AWWA A21.10/C-110 as amended to date. All fittings shall have standard mechanical joints. Fittings for pipe sizes through 24 inch shall be Pressure Class 350 and for fittings above 24-inch through 48-inch shall be Pressure Class 250.

3) **All** ductile iron pipe and fittings shall be epoxy-lined pipe and fittings. Epoxy lining shall be Protecto 401 Ceramic Epoxy or approved equal. The Protecto 401 Ceramic Epoxy Lining System shall be furnished in accordance with ASTM B 117, ASTM G 95, and ASTM D 714. All pipe and fittings shall be holiday tested at 2,500 volts (minimum) and shall be tested to insure a lining thickness of 40 mils (nominal DFT) minimum.

4) Weights of pipe and fittings shall conform strictly to the requirements of ANSI specifications. The class designations for the various classes of pipe and fittings shall be cast on fittings in raised numerals, and cast or stamped on the outside of

each joint of pipe. Weights shall be plainly and conspicuously painted in white on the outside of each joint of pipe and each fitting after the exterior coating has hardened.

5) The manufacturer of iron pipe and fittings shall furnish both the engineer and the owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI specification for each.

2.3 CONCRETE PIPE

Unless otherwise approved by the Town, all sewer pipe shall be ductile iron or PVC. Reinforced concrete sewer pipe may be considered for gravity sewers on a case by case basis.

2.4 STEEL PIPE CASING

The Contractor shall furnish steel pipe casing and related materials as follows:

1) All existing improved roads, railroad and highway crossings shall be cased in steel pipe with a nominal diameter of the carrier pipe plus 6 inches. Casing shall be new and unused pipe. The steel plate shall also meet the chemical requirements of ASTM A-36. Casing pipe shall be plain, uncoated steel, having a yield strength of not less than 36,000 psi, and manufactured in conformance with the following specifications:
   AWWA C201 “Fabricated Elect. Welded Steel Water Pipe”
   AWWA C202 “Mill-Type Steel Water Pipe”
   ASTM A53 “Welded and Seamless Steel Pipe”

2) Casing installation shall be coordinated with the Town and shall meet the requirements of the SCDOT and/or the railroad. Pipe used for casing shall be of wall thickness to accommodate the required forces to be exerted on the casing when jacking and to meet the anticipated service conditions and loads that will be imposed on the casing.

2.5 PORTLAND CEMENT CONCRETE

Concrete shall be composed of cement, fly ash (if required), admixtures (if required), fine aggregate, coarse aggregate, and water proportioned and mixed to produce a plastic workable mix, and shall be suitable for the specific conditions of placement. Concrete shall be classified as "A", "B", and "C"; shall have normal setting characteristics (unless the use of high early strength cement is approved by the Engineer); shall be used in the locations identified herein;

and shall have 28-day compressive strengths not less than those listed below, except that concrete containing high early strength cement shall have 7-day compressive strengths not less than those listed below.

1) Class "A" Concrete: Class "A" concrete shall have a compressive strength of not less than 4,000 psi, and shall be used for reinforced concrete work, and for unreinforced footings not thicker than 8-inches.
2) Class "B" Concrete: Class "B" concrete shall have a compressive strength of not less than 2,500 psi, and shall be used for blocking, gravity type walls, and unreinforced footings and slabs thicker than 8-inches.
3) Class "C" Concrete: Class "C" concrete shall have a compressive strength of not less than 1,500 psi, and shall be used for concrete sub-foundations, pipe encasement, and concrete backfill where required.
4) Ready mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.6 PRECAST CONCRETE MANHOLES

2.6.a. General

Precast concrete manholes shall consist of precast reinforced concrete riser sections, eccentric top section and a base section conforming to typical details shown on Drawing **SD-08**. Precast manhole sections shall be manufactured in accordance with ASTM C 478, as amended to date, and these specifications. Concrete shall have a minimum compressive strength of 4,000 psi when tested in accordance with ASTM C 39, as amended to date. Steel reinforcement shall be as specified in ASTM C 478, as amended to date. Wall and bottom section shall have a minimum thickness of five inches (5”). Precast concrete manholes shall be designed for a minimum HS20 loading and the soil load equivalent to the depth of the manhole. Absorption shall not exceed 9% when determined in accordance with ASTM C497, as amended to date.

2.6.b. Base Sections

1) Base sections for precast concrete manholes shall have a bottom poured monolithically with the walls.

2) Base sections shall be furnished with inside diameters of 4, 5, and 6 feet as required with inside diameters sized to provide structurally sound bases at all pipe deflections.

3) Base sections shall be furnished with a minimum height of 24 inches for pipes having a diameter of 8, 10, 12 inches and a minimum height of 36 inches for pipes having a diameter of 15 or 16 inches, and a minimum height of 60 inches for pipe having a diameter of 30 inches.

4) The openings in the base section for the accommodation of the pipe shall be cast to closely conform to job conditions and shall provide a minimum clearance of three inches (3") between the inside bottom of the base and outside bottom of the pipe barrel. Inverts, which are poured monolithically, will not require the required "sump".

2.6.c. Riser Sections

1) The riser sections shall be furnished in a minimum of sixteen inch (16") increments and shall be four ft. (4') in diameter with (a) tongue and groove joint to be sealed with approved butyl rubber or bitumastic material similar to "E-Z Stik" as manufactured by Concrete Supply Company, or (b) O-ring gasket type joint conforming to ASTM C 443, as amended to date.

2) The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an approved epoxy to give a smooth surface free of any honeycomb.

3) The external perimeter of all joints between precast components shall also be sealed with a polyethylene backed flat butyl rubber sheet measuring a minimum of 1/16-inch thick and six-inches 6" wide. When applied the rubber sheet shall be held securely in place so that it is not disturbed during installation or backfill.

4) Transition sections, which convert bases that are larger than 4 feet in diameter to 4 foot in diameter risers, shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the section.

2.6.d. Alteration to Manholes

No manholes shall be altered by the Contractor.

2.6.e. Repaired and Patched Sections

Repaired and patched sections will not be acceptable unless each individual section so repaired or patched shall first have been inspected and approved by the engineer for repair and

patching at the manhole plant. Repairs to and patching of O-ring grooves and shoulders will not be permitted.

2.6.f. Testing and Qualifications

The manholes shall be manufactured and supplied by a precast manufacturer that complies with the following requirements:

1) All precast manhole components shall be manufactured, supplied and warranted by a single manufacturer.
2) Precast components on the project must be manufactured in a plant certified in the National Precast Concrete Associations (NPCA) plant certification program.
3) The manhole supplier must be the manhole manufacturer.
4) The precast manufacturer must have a minimum of five years' experience in the design and production of the specified precast components and must also have produced a minimum of five projects with the given pipe size

2.6.g. Manhole Brick

Manholes shall be constructed of pre-cast concrete only. Raising ring and cover assemblies up to grade may be accomplished with brick, using a maximum of two (2) courses of brick. Brick may be used in the construction of manhole inverts only. Brick shall only be constructed of concrete.

S-I.3. INSTALLATION

3.1 EROSION CONTROL

Siltation and soil erosion shall be controlled by the Contractor using permanent erosion control measures, temporary erosion control measures and supplemental measures such as, mulches and quick growing grasses, slope drains and other pollution control devices as necessary. All projects which will involve land-disturbing activities are required to comply with the requirements of the Town of Fort Mill and the South Carolina Department of Health and Environmental Control and all permits must be secured before any construction begins. Additional information regarding the Town of Fort Mill's erosion control requirements can be obtained at www.fortmillsc.org.

All materials shall be first class quality and approved by the Town of Fort Mill and the South Carolina Department of Health and Environmental Control. Erosion and pollution control

may include temporary construction work outside the right of way, where necessary, as a result of construction operations, such as haul roads and equipment storage sites.

3.1.a. Erosion and Sedimentation Control During Construction

During construction, protective structures and measures shall be implemented and maintained by the Contractor to minimize erosion and sedimentation as a result of the work being performed. All disturbed areas along the pipeline shall be grassed as soon as possible after, backfilling operations have been completed. Under no circumstance will land disturbance of more than 14 days be allowed prior to permanent stabilization.

3.1.b. Limit of Progress

The area of excavation shall be limited commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such pollution control measures current in accordance with an accepted schedule. Should seasonal limitations make such coordination unrealistic, special erosion control measures shall be taken immediately to the extent feasible and justified.

3.1.c. Permanent Erosion and Sedimentation Control

Permanent structures and measures shall be provided as required and shall be constructed and maintained by the Contractor for the term of the project.

3.1.d. Construction in Rivers, Streams and Impoundments

Construction operations in rivers, streams and impoundments shall be restricted to those areas which must be entered for the construction of temporary or permanent structures. As soon as conditions permit, rivers, streams and impoundments shall be promptly cleared of all falsework, piling which are to be removed, debris, and other obstructions placed therein or caused by the construction operations. Frequent fording of live streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings are necessary. Mechanized equipment shall not be operated in live streams except as may be required to construct channel changes and temporary or permanent structures, and to remove temporary structures.

3.2 CLEARING

The Contractor shall perform all clearing necessary for installation of the complete work. Clearing shall consist of removing all trees, stumps, roots, brush, and debris in the way of the work. All materials cleared and grubbed in accordance with this Specification and shall become

the property of the Contractor and unless otherwise approved shall be removed from the site and legally disposed of in accordance with all applicable regulations. Disposal of timber and other combustible materials by burning shall not be permitted.

Trees and shrubs designated to be left in place, and those outside of construction limits, shall not be damaged. Trees and shrubs that are damaged which are not scheduled to be removed shall be replaced by the Contractor with plantings of similar species and maturity at no additional cost to the Owner.

3.3 TRENCH WORK

Reference Drawings: **SD-01** – **SD-02**

3.3.a. Terminology

The trench is divided into five specific areas:

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

3.3.b. Trenchwork Materials

1) Foundation Materials: The bottom of the trench shall provide a foundation to support the pipe and its specified bedding. If the trench bottom does not provide firm, stable footing and the material at the bottom of the trench will not adequately support the pipe, the Contractor shall over excavate the trench bottom and fill with crushed stone as outlined in specified in ***S-1.3.3.e – Trench Stabilization***.
2) Bedding and Haunching Materials: Unless specified otherwise, bedding and haunching materials for PVC pipe shall be crushed stone and shall be select earth material or crushed stone for ductile iron pipe. Where crushed stone has been utilized for trench foundation, the same material shall be used for bedding

and haunching regardless of pipe type. Crushed stone shall conform to the latest revision of ASTM C 33, as amended to date, graduation #67 (ASTM #67) varying in sizes 1/4" through 3/4" and select earth materials for bedding and haunching shall be as specified for initial backfill. See Drawing **SD-01** and **SD-02.**

3) Initial Backfill: Initial backfill material shall be select earth materials or crushed stone as specified for bedding and haunching materials. Select backfill materials shall consist of finely divided earth, stone, dust, sand, crushed stone, or other approved material carefully placed about the pipe in uniform succeeding layers not exceeding six (6) inches in thickness. Each layer shall be uniformly placed and tamped with proper hand tools in a manner which will not disturb or injure the pipe. Backfilling shall be carried on simultaneously on both sides of the pipe in a manner which will prevent injurious side pressures from occurring. If suitable select materials are not available from trench excavation, the Contractor will be required to obtain them elsewhere. Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench. Suitable materials shall be clean and free of rock larger than 2-inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes and other unsuitable materials. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this Section.

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

5) Select Backfill: Select backfill shall be materials which meet the requirements as specified for bedding, haunching, initial backfill or final backfill materials, including compaction requirements.

6) Concrete: Concrete for bedding, haunching, initial backfill or encasement shall be Class "C" as defined in ***S-I.2.5 Portland Cement Concrete***.

7) Flowable Fill: Flowable fills, where required for trench backfill, shall meet the requirements of South Carolina Department of Transportation "Standard Specifications for Highway Construction".

8) Granular Material: Granular material, where required for trench backfill, shall be sand, river sand, crushed stone or aggregate, pond screenings, crusher run, recycled concrete, or other angular material. Granular material shall meet gradation requirements for Size No. 57 or finer.

3.3.c. Excavation

1) All excavation of every description and of whatever substance encountered shall be performed to the depth shown or specified, or both, for all sewers, manholes, piers, conduit, and other appurtenances. Excavation shall be accomplished by open cut, unless otherwise directed. No tunneling shall be done.

2) Topsoil and grass shall be stripped a minimum of 6-inches over the trench excavation site and the topsoil stockpiled separately for replacement over the finished grading areas.

3) The top portion of the trench may be excavated to any width within the construction easement or right-of-way that will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Sheeting and shoring may be necessary to accomplish this.

4) Where rock is encountered in trenches, excavation to remove boulders and stones shall provide a minimum of 6-inches clearance between the rock and any part of the pipe or manhole.

5) The sides of all trenches shall be vertical, as much as possible, to a minimum of one foot above the top of the pipe. The top portion of the sewer pipe trenches may have sloping or vertical sides to widths which will not cause damage to adjoining structures, roadways, pavements, utilities, and private property. For untimbered trenches and trenches held by stay bracing only, the width of the lower portion of the trench to a height of two feet (2') above the top of the pipe shall not exceed the trench widths specified in ***S-I.3.3.f – Trench Widths***. Where skeleton and solid sheeting is used, trench width may be increased to

dimensions approved by the Town, but shall be not greater than that necessary to clear the walers when lowering pipes into the trench.

6) Where trench excavation may damage adjoining poles, roadways, utilities and private property, the Contractor shall install suitable sheeting for their protection. Such orders shall in no way relieve the contractor from his responsibility of protection of the facilities, nor shall the lack of those orders relieve the contractor from that responsibility. If trenches are excavated to widths in excess of the above limitations, or collapse because of insufficient bracing and sheeting, the contractor will be required to use special methods of constructing pipe foundations and backfilling as specified herein.

7) Trench excavation shall not advance more than five hundred (500) feet ahead of pipe laying.

8) Excavation in excess of depth required for proper bedding shall be corrected by using crushed stone conforming to the latest revision of ASTM C 33, as amended to date, graduation #67 varying in sizes 1/4" through 3/4", to bring trench bottom to grade as directed by the Engineer. Bell holes shall be excavated in a manner, which will relieve pipe bells of all load, but holes shall be small enough to insure that support is provided throughout the length of the pipe barrel.

9) Excavation in excess of the depths required for catch basins, manholes, and related structures shall be corrected by placing a sub-foundation of Class "C" concrete or crushed stone.

10) Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the next higher Type of bedding and haunching for the full trench width as actually cut. The excessive trench width may be due to unstable trench walls, inadequate or improperly placed bracing and sheeting which caused sloughing, accidental over-excavation, intentional over-excavation necessitated by the size of the Contractor's tamping and compaction equipment, intentional over-excavation due to the size of the Contractor's excavation equipment, or other reasons beyond the control of the Engineer or the Utility.

11) The trenches shall be excavated to the required depth or elevation that allow for the placement of the pipe and bedding to the dimensions shown on Drawings **SD-01** or **SD-02**.

12) Solid rock, ledge rock, boulders, and large stones shall be removed to provide a clearance of not less than six inches (6") in every horizontal direction from all parts of pipe, fittings, and other appurtenances.

13) Where rock is encountered at grade in trenches, the trench shall be excavated not less than six inches (6") below the bottom of the pipe bell. Trenches undercut for rock shall be refilled with crushed stone conforming to the latest revision of ASTM S33, as amended to date, graduation #67 (ASTM #67) varying in sizes 1/4" through 3/4", thoroughly tamped in-place. Excavated rock shall be removed from the site. Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe.

14) Suitable excavated materials shall be placed adjacent to the work to be used for backfilling as required. Topsoil shall be carefully separated and lastly placed in its original location.

15) Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements

3.3.d. Dewatering Trenches

1) All excavation shall be dewatered properly before laying pipe. Where running sand is encountered, dewatering shall be done by well pointing whenever possible.

2) Where soil conditions are not favorable for use of well points, french drains of graded stone shall be constructed to suitably located pumps and the water removed by bailing and pumping. The excavation shall be dewatered continuously to maintain a water level two feet below the bottom of the trench.

3) Drainage in the vicinity of excavation shall be controlled so the ground surface is properly pitched to prevent water running into the excavation. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavations.

4) Where the utility crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented. Provision shall be made for the satisfactory disposal of

surface water to prevent damage to public or private property. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.

5) When pumping from sumps does not lower the water level two feet below the trench bottom, dewatering shall be accomplished through use of a well-point system. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing, 6 to 10-inches in diameter, shall be jetted into the ground, followed by the installation of the well point, filling casing with sand and withdrawing the casing

3.3.e. Trench Stabilization

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

2) If, after dewatering as specified above, the trench bottom is spongy, or if the trench bottom does not provide firm, stable footing and the material at the bottom of the trench will still not adequately support the pipe, the trench will be determined to be unsuitable and the Town shall then order trench stabilization by directing the Contractor to over excavate trench bottom and fill with crushed stone.

3) The Contractor shall undercut the ditch and backfill with crushed stone conforming to the latest revision of ASTM C 33, as amended to date, graduation Size No. 67. The stone shall be brought to grade and compacted.

4) Where the replacement of unsuitable material with crushed stone does not provide an adequate trench foundation, the trench bottom shall be excavated to a depth of at least two feet below the specified trench bottom. Stabilization fabric shall be placed in the bottom of the trench and the fabric shall be supported along the trench walls until the trench stabilization, bedding, haunching and pipe have been placed at the proper grade. The ends of the filter fabric shall be overlapped above the pipe.

5) Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 90 percent of the maximum dry density, unless shown or specified otherwise.

3.3.f. Trench Widths

Trench widths for installation of ductile iron pipe shall be in accordance with AWWA C 600-05 as amended to date. Trenches may be of extra widths to permit the placement of timber support, sheeting, bracing and alternatives when approved by the Town. The top portion of pipe trenches may have sloping or vertical sides to widths which will not cause damage to adjoining structures. All excavation shall be executed in accordance with OSHA standards. The width of the lower portion of the trench to a height of two feet (2') above the top of the pipe shall not exceed the trench widths specified in the standards cited. Where skeleton and solid sheeting is used, trench width may be increased to dimensions approved by the Town, but shall be not greater than that necessary to clear the walers when lowering pipes into the trench.

Trench widths for PVC pipe shall be as specified herein and shall be sufficient to provide adequate room for placement of haunching material. The clear width of the trench at the top of the pipe should not exceed the pipe diameter plus 24 inches. If this width is exceeded or the pipe is installed in a compacted embankment, pipe embedment shall be compacted to the trench walls.

3.3.g. Sheeting, Bracing and Shoring

Sheeting, bracing and shoring shall be performed in any of the following instances:

1) Where sloping of the trench walls do not adequately protect persons within the trench from slides or cave-ins.
2) In caving ground.
3) In wet, saturated, flowing or otherwise unstable materials. The sides of all trenches and excavations shall be adequately sheeted, braced and shored.
4) Where necessary to prevent damage to adjoining buildings, structures, roadways, pavement, utilities, trees or private properties which are required to remain.
5) Where necessary to maintain the top of the trench within the available construction easement or right-of-way.
6) In all cases, excavation protection shall strictly conform to the requirements of the Occupational Safety and Health Act of 1970, as amended.
7) Timber: Timber for shoring, sheeting, or bracing shall be sound and free of large or loose knots and in good, serviceable condition. Size and spacing shall be in accordance with OSHA regulations.

8) Steel Sheeting and Sheet Piling: Steel sheet piling shall be the continuous interlock type. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and live loads. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times. The Contractor shall provide closure and sealing between sheet piling and existing facilities.

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

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

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

3.3.h. Trench Rock Excavation

1) Definition of Trench Rock: Any material that cannot be excavated with conventional excavating equipment, and is removed by drilling and blasting, and occupies an original volume of at least one cubic yard.

2) Blast Monitoring: Exhaust other practical means of excavating prior to utilizing blasting as a means of excavation. Provide licensed, experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all buildings and structures from the effects of the blast. Repair any resulting damage. The Contractor shall employ an

independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

3) Removal of Rock: Dispose of rock off site that is surplus or not suitable for use as rip rap.

4) The Contractor shall employ an independent, qualified specialty sub-contractor, approved by the Town, to monitor the blasting by use of a seismograph, identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

5) The Contractor shall notify the Town prior to any blasting. Additionally, the Contractor shall notify the Town and local fire department before any charge is set.

3.4 BEDDING AND HAUNCHING

Reference Drawing: **SD-01**

3.4.a. General

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

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

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

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

3.4.b. Bedding and Haunching PVC Pipe

1) PVC pipe shall be laid as specified using the following classes of bedding required for the various type soils and conditions encountered. Bedding for PVC pipe shall be in accordance with ASTM D 2321, as amended to date, the manufacturers recommendations and these Specifications.
2) Bedding Material: Class I materials (angular ¼ to ¾ inches graded stone test revision of ASTM C33-Gradation #67 or #57) shall be used for bedding and haunching in all conditions. Class II, III, IV and V materials will not be permitted for bedding and haunching under any condition.
3) Depth of Bedding: Trench shall be undercut to allow for a minimum of six inches (6") of bedding material. Bell holes shall be excavated in the bedding material to allow for unobstructed assembly of the joint, but care shall be taken to assure that bell hole is no larger than necessary to accomplish proper joint assembly. After joint assembly, Class I bedding material shall be placed under and up to the springline of the pipe (i.e. outside diameter/2) for the entire length of pipe and compacted. Compaction to the springline of the pipe shall be of the same material used in the bedding. Selected backfill shall then be carried to a point twelve inches (12") above the top of pipe, using hand tools for tamping. Puddling will not be allowed as a method of compaction. The remaining backfill shall be as specified in "Selected Backfill" and "General Backfill" paragraphs of these specifications. Pipe shall have at least thirty six inches (36") of cover before wheel loading and at least forty eight inches (48") of cover before using heavy duty tamping equipment such as a hydrohammer.

3.4.c. Bedding and Haunching of Ductile Iron Pipe

Ductile iron pipe for gravity sewers and force mains shall be laid as specified using the following type of bedding required for the depth of cover for the various sizes of pipe to be

installed. Backfill shall be as specified in the "Selected Backfilling" and "General Backfilling" paragraphs, and as detailed on the Contract Drawings.

1) Bedding Types: The Contractor shall refer to the Drawing **SD-01** for allowable bedding types to be used.
2) Cover: Maximum depth of cover for ductile iron pipe of the various classes and sizes to be installed shall be in accordance with ANSI/AWWA C 151/A21.51-91. Bedding types 2, 4, and 5 shown on the details shall be assumed equal to bedding Types 2, 4, and 5 detailed in ANSI/AWWA C151/A21.51-91 for purposes of determining the maximum depth of cover.

3.4.d. Paving and Driveway Cuts and Repairs

Pavement cuts for sewer and force main installation in existing roadways and across driveways shall be made and repaired in accordance with SCDOT "A Policy for Accommodating Utilities on Highway Rights-Of-Way", August 2005 (or most recent revision)

3.5 CREEK AND WET WEATHER DITCH CROSSINGS

Reference Drawing: **SD-04**

Proposed sanitary sewers paralleling a creek shall be designed to a proper depth such that all creek crossings and lateral connections will be below the stream bed elevation unless otherwise approved by the Town. Sewers crossings streams/ditches should be designed to cross the stream as nearly perpendicular to the stream flow as possible. Gravity sewers shall be protected from erosion by concrete encasement around the pipe. Please refer to **SD-04 – Stream Crossing Detail**. Sewers shall be installed with the top of the encasement a minimum of two-feet below the deepest part of the bottom of the stream bed or ditch.

3.6 LAYING GRAVITY SEWER PIPE

3.6.a. General

All sewer pipe shall be laid upgrade, spigots shall point downgrade. The pipe shall be laid in the trench so that, after the sewer is completed, the invert surface shall conform accurately to the grades and alignment. The interior of all pipes shall be carefully cleaned of all dirt and superfluous material of every description, as pipe laying proceeds. Defective joints discovered after laying shall be repaired and made tight. Defective pipe shall be removed and proper replacement made. All sewer pipe shall be laid on a bed of crushed stone which is to extend to flow line of pipe.

3.6.b. Pipe Grades

Manholes shall be installed at the end of each line, at all changes in grade, size, or alignment, and at the intersection of all piping. The maximum distances between manholes and the minimum slopes per pipe size are listed in the following table:

Table S-1(A): Acceptable Distance and Slope between Manholes

Size of Sewer (inches)	Distance Between Manholes (feet)	Minimum Slope
8”	400	0.40
10”	400	0.28
12”	400	0.22
15	400	0.15
18	500	0.12
21	500	0.10
24	500	0.08
30	500	0.058

In general, grades greater than those shown above are desirable.

3.6.c. Defective Pipe

If any pipe is discovered to be defective after having been laid, it shall be removed and replaced with sound material at the expense of the Contractor. PVC pipe shall be installed in accordance with ASTM D2321 (as amended to date) and the specifications herein. In the event of a conflict between ASTM D2321 and these specifications, the requirements of these specifications shall govern.

3.6.d. Field Cutting

Field cut pipe to be joined shall be square cut using a hacksaw, handsaw or power saw with a steel blade or abrasive disc. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. A factory-finished beveled end shall be used as a guide for proper bevel angel, and depth of bevel plus the distance to the insertion reference mark. The end may be beveled using a pipe beveling tool or a wood rasp that will cut the correct taper. A portable sander or abrasive disc may be used to bevel the pipe end. Any sharp edges on the leading edge of the bevel must be rounded off with a pocketknife or a file.

3.6.e. Assembly of Gasketed Joint

1) General: The assembly of the gasketed joint shall be performed as recommended by the pipe manufacturer. In all cases, the gasket, the bell, especially the groove area and the spigot area shall be cleaned with a rag, brush

or paper towel to remove any dirt or foreign material before the assembling. The gasket, pipe spigot bevel, gasket groove, and sealing surfaces shall be inspected for damage or deformation. Only gaskets which are designed for and supplied with the pipe shall be used. They shall be inserted as recommended by the manufacturer. Lubricant used shall be supplied by the pipe manufacturer and shall be applied as specified by the pipe manufacturer.

2) Lubrication: Proper lubrication and good alignment of the pipe is essential for ease of assembly. The spigot shall be aligned to the bell and insert into the bell until it contacts the gasket uniformly.

3) Joining: The pipe shall be pushed into place, not swung or "stabbed" into the bell. The spigot end of the pipe should be marked by the manufacturer to indicate the proper depth of insertion. If undue resistance to insertion of the pipe end is encountered or the reference mark does not position properly, the joint shall be disassembled and the position of the gasket checked. If it is twisted or pushed out of its seat ("fish-mouthed"), the Contractor shall inspect components, repair or replace damaged items, clean the components, and repeat the assembly steps. Both pipe lengths must have concentric alignment. If the gasket was not out of position, the Contractor shall verify proper location of the reference mark. The reference mark shall be relocated if it is out of position.

3.6.f. PVC Pipe with Elastomeric Joints

1) General: Proper implements tools and equipment shall be used for placement of the pipe in the trench to prevent damage. Under no circumstances may the pipe be dropped into the trench. In subfreezing temperatures, caution shall be exercised in handling pipe to prevent impact damage. All pipe shall be carefully examined for cracks, nicks, gouges, severe scratches, voids, inclusions and other defects before laying.

2) Deflection Testing: The maximum deflection in the installed PVC pipeline shall not exceed 5% of the pipe's original internal diameter. Deflection testing will be required using either a "GO-NO-GO" mandrel. The Town Inspector shall randomly select portions of the project to be deflection tested. Such portions shall consist of not less than 5% of the total reaches (reach being length of pipe between two manholes) in the project (excluding house leads). Where deflection is found to be in excess of 5% of the original pipe diameter, the Contractor shall

excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be re-tested for deflection. However, after the initial testing should the deflected pipe fail to return to the original size (inside diameter), the line shall be replaced. In the event that deflection occurs beyond the 5% limit in any section of 5% or more of the reaches tested, the entire system shall be tested.

3.6.g. Ductile Iron Pipe with Mechanical or Push-on Joints

1) General: Proper and suitable tools and equipment shall be used for the safe and convenient handling and laying of ductile iron pipe. Care shall be taken to prevent damage to the exterior coating and interior cement lining. All pipe shall be carefully examined for cracks and other defects before laying. If any pipe or fitting is discovered to be defective after having been laid, it shall be removed and replaced with sound material at the expense of the Contractor. Whenever pipe is required to be cut, the cutting shall be done by skilled workmen using an abrasive wheel cutter. Use of a cold chisel or oxyacetylene torch will not be permitted.

2) Mechanical Joints: Mechanical joints shall be made in accordance with pipe manufacturer's directions. Sockets and spigots shall be washed with soapy water before slipping and gland and gasket over the spigot end of the pipe. The spigot shall be inserted into the socket full depth, then backed off ¼ inch to provide clearance for expansion. The gasket shall be brushed with soapy water and shall be pushed into position making sure that it is evenly seated in the socket. The gland shall then be moved into position for compressing the gasket. All bolts and nuts shall be made "finger-tight". For joints made in trenches, the bolts shall be tightened to a uniform permanent tightness, using a torque wrench for tightening. Bolts shall be tightened alternately 180 degrees apart.

3) Push-On Joints: The groove and bell socket shall be thoroughly cleaned and lubricated before the gasket is inserted. Before inserting the gasket, it shall be thoroughly lubricated and manufacturer's instructions shall be followed for proper facing and seating of gasket. After the gasket is in place and just prior to joint assembly, a generous coating of lubricant shall be applied to the exposed gasket surface. The lubricant used shall be lubricant supplied by the pipe manufacturer. The plain end shall be inspected and any sharp edges which might damage the

gasket shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly. Prior to inserting the plain end of the pipe into bell socket, lubricant shall be applied to the beveled nose of the pipe. Small pipe may be pushed home with a long bar but large pipe may require additional power such as a jack, lever or back-hoe. A timber header shall be used between the bell and bar or other power to avoid damage to the pipe. During assembly of the pipe, the joint must be kept straight while pushing. Pipe may be deflected if desired but only after the assembly is completed.

4) Mechanical Joint or Push-on Joint Pipe on Piers: Mechanical or Push-on Joint Pipe may be used on piers in gravity sewer lines. Pipe shall be laid with ¼ inch clearance in each joint to provide for expansion. Jointing of pipe shall be as described above. On mechanical joint pipe, the bolts shall be tightened alternately 180 degrees apart, but left "finger-tight" until the sewage is diverted into the sewers; then bolts shall be further tightened a sufficient amount which will prevent leakage of the joint, but which will not prevent axial movement which may occur because of temperature stresses.

3.7 HOUSE SERVICE LINES

Reference Drawing: **SD-07**

3.7.a. Size and Location

On all sewer lines, 4-inch service lines shall be provided at all buildings and dwellings and at such other locations as directed by the Town.

Service lines shall extend from the main sewer in the street to the property lines as shown on Drawing **SD-07**. Service lines and associated appurtenances may not be located in driveways or other inaccessible areas which restrict maintenance by the Town.

3.7.b. Service Lateral Risers

Service laterals from the main sewer shall exit at an angle no greater than 45 degrees from the horizontal. Where trench depths are twelve (12) feet or more that vertical risers are required, service lines shall be installed in a rigid sleeve supported by concrete as shown on Drawing **SD-07**. Vertical risers should utilize a single length of pipe for the riser section, whenever possible. Transitions from horizontal to vertical shall be smooth and well supported. Bends shall be used to connect the riser to the house service lines.

3.7.c. Stoppers, Caps and Plugs

All house service connections shall be closed with factory manufactured pipe stopper of such design and secured in such a manner as to not leak under a maximum hydrostatic head of ten feet (10') or five (5) psi air pressure. The pipe stopper shall be able to be removed without special tools, excessive force or breakage of the pipe bell.

3.7.d. House Service Branches

1) In general, house service branches shall incline upward at approximately 45 degrees above a horizontal line normal to the direction of flow in the street main. Service lines shall be laid on a straight line and have a minimum grade of 1/4-in per foot from the sewer or riser to the property line, and in no event shall service lines be less than three and one-half feet (3-½') deep to invert of the pipe at the property line. Laterals extending to the house inside the property line shall be a minimum of two feet (2'-0") deep. Laterals having less than two feet of cover must be ductile iron.
2) Service lines shall be backfilled and compacted with natural earth materials, free of rocks, clods and debris. No backfill shall be placed until the work has been inspected and approved by the Town.
3) A minimum of one clean-out shall be installed in each sewer service lateral as shown on Drawing **SD-07**. Clean-outs shall be required every seventy-five feet (75') in the service lateral.
4) A backflow check valve shall be installed in the sewer lateral to prevent reversal of flow from the sewer main during high water. The backflow valve shall be installed with an access cover at grade and shall have a clean-out installed immediately downstream in the lateral.
5) When required, two (2) 45-degree bends shall be used to connect the service branch to the house service line. Standard 90-degree bends shall not be used. Pipe service branches, together with bend(s), shall be placed on a compacted bed of crushed stone in such a manner as to be self-supporting and to relieve the strain on branches and bends.
6) Service connections to all new sewer mains shall be made to a wye and shall be water tight and not protrude into the sewer. All materials used to make the service connections shall be compatible with each other and with the pipe materials to be joined.

7) Connections of a new service lateral to an existing sanitary sewer shall be accomplished with a flexible PVC compression fit service connection as manufactured by Fernco. The connection shall be designed to join with the type of pipe to be connected, shall be corrosion proof and shall provide a water tight connection. Openings into the sewer shall be machine tapped and shall not damage the pipe and when complete shall provide a smooth opening that is free to pass solids and other materials that could create a blockage.

8) During the placement of new concrete curb, utility markings shall be embossed into the top of the curb for all sanitary sewer laterals and all manholes. The marking shall be 2-inch tall letters and be "SS" for a sanitary sewer lateral and "MH" for a sanitary sewer manhole. The stamp shall be placed into the concrete before it sets up. The letters shall be located perpendicular from the utility feature that is being marked.

3.8 PLACING PRECAST CONCRETE MANHOLES

Reference Drawings: **SD-06, SD-08 – SD-10**

Precast concrete manholes shall be placed or constructed where shown. Manholes shall be 4, 5 and 6 feet in diameter as determined from the schedule of pipe size and line deflection, or as shown. See Drawing **SD-08** for schedule. The top of manholes outside of roads, streets, and highways shall be built to grades twenty-four inches (24") above the ground surface unless otherwise shown on the drawings. In manicured yards and parks, the top of manholes shall be built to grades three inches (3") above the ground surface. Manholes in roads and rights-of-way, etc. shall be built to grade.

3.8.a. Bedding

Precast concrete manholes shall be bedded on not less than six inches (6") of compacted crushed stone at Contractor's expense. The crushed stone shall extend not less than six inches (6") outside the walls of the manhole, and shall be compacted under entire length of pipe within manhole excavation.

3.8.b. Connection of Pipe to Manhole

Connection of pipe to manhole shall be made with a flexible joint system. The joint system shall be a neoprene or synthetic rubber boot or sleeve, either cast or core drilled in the wall of manhole. The boot or sleeve shall be clamped and seated to the pipe with a stainless steel band. The boot or sleeve system shall be "LOCK JOINT FLEXIBLE MANHOLE SLEEVE"

as manufactured by Interpace Corporation, Parispany, New Jersey or “KOR-N-SEAL” as manufactured by National Pollution Control System, Inc., Nashua, New Hampshire, or equal. The opening between the pipe and the manhole shall have a minimum clearance of one inch (1”) and shall be filled from the inside of the manhole with a non-shrink grout.

3.8.c. Adjustment

The top of the concentric top section shall have a minimum wall thickness of eight inches (8”) to accommodate brick courses for height adjustment. A maximum of two (2) brick courses will be allowed for adjustment of manhole to required grade.

3.8.d. Manhole Inverts

Manhole inverts shall be carefully constructed with cement grout, Class “B” concrete, cement mortar brickwork, or fabricated at the time of casting; special care shall be taken to lay the channel and adjacent pipes to grade. Cement mortar shall be made of one (1) part cement and two (2) parts clean sharp sand. Channels shall be properly formed, rounded, and trowelled smooth. The connections of the sewer with the wall and channel of the manhole shall be tight and smooth. See Drawing **SD-09**.

3.8.e. Manhole Frames and Covers

Manhole frames and covers shall be as detailed and shown on Drawing **SD-06** and shall include setting to finished grade as required and grouting in place. Manhole frames outside of paved areas shall be securely anchored in place to the manhole with not less than four (4) stainless steel anchor bolts, as provided by the manufacturer. The complete width of the frame between the frame and the concrete manhole shall be sealed with a bitumastic sealant material to provide a positive watertight seal between the manhole and the frame. The frames and covers shall be heavy duty suitable for highway traffic loads and able to sustain a proof load of 25,000 pounds. Frames and covers shall be as manufactured by U.S. Foundry & Manufacturing Corporation or equal.

3.8.f. Manhole Steps

Manhole steps shall conform to the details shown on Drawing **SD-09**. Steps for precast concrete manholes shall be installed along a vertical centerline, on approximately 14” to 16” centers.

3.8.g. Drop Connections

Drop connections will be required, where called for on the drawings, or as determined by the dimensions shown in “Drop Manhole Schedule”, shown on Drawing **SD-10**. Drop pipe shall be not smaller than 8 inches. Generally, drop pipe shall be one size smaller than the sewer which they serve. Openings in walls of precast concrete manholes for drop connections shall not be made at joints. Drop connection fittings and riser pipe shall be encased in brick and mortar or formed Class “C” concrete. Drop connections for precast concrete manholes shall conform with typical details as shown on Drawing **SD-10**. Drop connections shall be carefully backfilled to prevent dangerous side pressures. A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert shall be filleted to prevent solids deposition.

Drop connections shall be completed with an outside drop but where safety considerations or working space prevent the construction of an outside drop connection, the Town may consider the installation of an inside drop connection. Inside drop connections shall be secured to the interior wall of the manhole and provide access for cleaning.

3.8.h. Future Sewer Connections

Where shown, a twelve inch (12”) long pipe stub for future sewers, of such size as may be designated, shall be laid to proper grade and alignment and plugged with a factory plug with same type joint as used on the sewer pipe.

3.8.i. Connection To Existing Manholes

At locations where new sewers are shown to be connected to existing manholes, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. The work shall consist of coring an appropriate size hole in the manhole wall, inserting the new pipe to the elevation shown, and using an appropriate flexible manhole boot to seal the pipe in place. High early strength cement shall be used for mortar in constructing and remodeling the manhole invert in order that proper channels may be formed in manhole bottoms with a minimum interruption of service to the existing sewer. By-passing raw wastewater directly or indirectly into a stream or onto the ground is strictly prohibited and punishable under South Carolina state law.

3.8.j. Connection To Existing Sewers

At location where new sewers are shown to be connected to existing sewers at a new manhole, the Contractor shall first expose the existing sewer and install a supporting timber beam with suitable straps around the pipe so as to bridge the excavation for the new manhole. The manhole shall then be constructed complete with invert and frame and cover. Under special conditions the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. Actual physical connection of the sewers may be made at a later date, as directed.

3.9 CLEANING AND TESTING

3.9.a. General

Before acceptance of any sewer or systems of sewers, ALL lines shall be cleaned and tested in accordance with these specifications.

Prior to issuance of the SCDHEC operating permits no valve shall be opened to the Town of Fort Mill's system without direct supervision of Town personnel. Plugs must be installed on manholes not operational and removed only under supervision of Town personnel. Pump stations shall not be started without review of the wetwell to ensure no silt/sand will be drawn into the pump assembly.

3.9.b. Cleaning

Where any obstruction is met, the Contractors will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be clean before final inspection.

3.9.c. Leakage Tests

All manholes in wet areas and other areas directed by the Town shall be tested by the vacuum method as provided in 1) below. All tangents of all sewer lines, including house service lines, shall be tested for leakage. Low-pressure air test shall be the primary method for testing pipe diameters 24 inches or less. Sewers larger than 24 inches in diameter should be tested using one or a combination of the methods as provided in 2) or 3). The use of low pressure air test for pipe larger than 24 inches will be evaluated on a case by case basis. All tests shall be conducted in the presence of the Town's inspector, the Town's engineer or his representative, before being placed into service.

1) Manhole Vacuum Testing: All incoming and outgoing sewer and service lines shall be plugged, the plugs restrained and the vacuum tester head placed on the

manhole frame and sealed. A vacuum of 10 inches Hg shall be drawn on the manhole and the time measured for the vacuum to drop to 9 inches Hg. This time shall not be less than 40, 50, or 60 seconds per manhole with diameters of 48, 60, and 72 inches respectively. For manholes deeper than 20 feet, the test times shall be increased by 2 seconds per foot of additional manhole depth.

2) Infiltration Test: Where natural ground water levels stand a minimum of two feet (2') above the top of the pipe, the amount of leakage may be determined from measurements made at the lower end of the sewer section under test. The water surface elevation shall be established during construction and verified by the Town's inspector. Sewers above the test section shall be closed before testing by the installation of suitable watertight bulkheads. The length of the test section shall be determined by the Town's inspector or engineer. The average of six readings at five-minute intervals will be used to determine the rate of infiltration for any one test section. The rate of infiltration of ground water into any test section of sewer, including manholes, shall not exceed 25 gallons per day per inch diameter per mile of pipe or according to the following values given per foot of sewer:

Table S-2: Acceptable Infiltration Rates per Sewer Size

Size of Sewer (inches)	Gallons Per 24 Hours Per Foot of Sewer
8"	0.038
10"	0.047
12"	0.057
15"	0.071
16"	0.076
18"	0.086
20"	0.095
24"	0.114
30"	0.143

3) Exfiltration Test: Where natural ground water levels do not stand two feet (2') above the top of the pipe, an exfiltration test shall be conducted on each section of sewer. The test shall be performed up to an average maximum hydrostatic head of ten feet (10'). The test shall be conducted in the following manner. The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into each bulkhead at the top of the sewer pipe shall be a 2-inch pipe nipple with an elbow. At the upper end of the test section a riser pipe

shall be installed. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a tight valve, until all air is exhausted and until water overflows the riser pipe at the upper end. Water may be introduced into the pipe twenty-four (24) hours prior to the test period to allow complete saturation. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water. During the test period, which shall extend over a period of thirty (30) minutes, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the thirty (30) minute test period shall no exceed that shown for infiltration in the table above.

4) Low-Pressure Air Test: The Contractor shall conduct a low-pressure air test on each section of sewer after completion and before acceptance. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 ft or less) using Air-Lock balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached and the pressure allowed to stabilize (approximately 2 to 5 minutes), the pressure may be reduced to 3.5 psi before starting the tests. If a 1.0 psi drop does not occur within the minimum test time, then the line will be deemed to have passed the test. If the pressure drops more than 1.0 psi during the test time, the line section is presumed to require the necessary repairs and retesting. Minimum test time for various pipe sizes for PVC pipe is given in **Table S-3**, which is based on ASTM F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

Minimum test times for various diameter ductile iron pipe is given in **Table S-4**, which is based on ASTM C924

Table S-3: Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of PVC Pipe Indicated for Q=0.0015 CFM/SF

Pipe Dia., inches	Min. Time min:sec	Length for min. Time, ft.	Time for Longer Length, sec.	100 ft.	200 ft.	300 ft.	400 ft.
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:42
8	7:34	298	1.520 L	7:34	7:34	7:36	10:08
10	9:26	239	2.374 L	9:26	9:26	11:52	15:49
12	11:20	199	3.418 L	11:20	11:24	17:05	22:47
15	14:10	159	5.342 L	14:10	17:48	26:42	35:36

(Adapted from ASTM F1417)

For more efficient testing of long test sections of PVC pipe and/or sections of larger diameter pipes, a timed pressure drop of 0.5 psig may be used in lieu of the 1.0 psig time pressure drop, upon approval by the Town's inspector. If a 0.5 psig pressure drop is used, the appropriate required times shall be exactly half as long as those values outlined in **Table S-3**, as shown in **Table S-3A**.

Table S-3A: Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size and Length of PVC Pipe Indicated for Q=0.0015 CFM/SF

Pipe Dia., inches	Min. Time min:sec	Length for min. Time, ft.	Time for Longer Length, sec.	100 ft.	200 ft.	300 ft.	400 ft.
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:51
8	3:47	298	0.760 L	3:47	3:47	3:48	5:04
10	4:43	239	1.187 L	4:43	4:43	5:56	7:54
12	5:40	199	1.709 L	5:40	5:42	8:33	11:24
15	7:05	159	2.671 L	7:05	8:54	13:21	17:48

(Adapted from ASTM F1417)

Table S-4: Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Ductile Iron Pipe

Size of Sewer (inches)	T (time) minutes/100 ft.
6"	0.7
8"	1.2
10"	1.5
12"	1.8
15"	2.1
18"	2.4
21"	3.0
24"	3.8
30"	4.8

(Adapted from ASTM C924)

Note: Due to safety concerns, air testing of pipes greater than 24" diameter is not recommended.

Required test equipment includes Air-Lock balls, braces, air hose, air source, timer, rotometer as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi 4½-inch diameter pressure gauge with gradations in 0.05 psi and accuracy of ±2%. The Contractor shall keep records of all tests made. A copy of such records will be given to the Town's inspector or engineer. Such records shall include date, line number and stations, operator and such other pertinent information as required by the Town's inspector or engineer. The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

5) Repairs: All visible leaks shall be repaired regardless of whether infiltration, exfiltration or air test is within allowable limits. No sewer will be accepted until leakage tests demonstrate compliance with one of the above leakage test methods.

S-II SEWAGE PUMPING STATIONS

Reference Drawings: **SD-11** – **SD-17**

S-II.1. SITE REQUIREMENTS

1.1 MINIMUM SITE DIMENSIONS AND SLOPE

1) The minimum dimensions for the pump station site shall be 80 feet by 80 feet, which includes a 30 feet minimum distance from the fence to any adjoining property. The outer most 15 feet of the perimeter of the site (i.e., adjacent to the property line) may not be disturbed. For smaller capacity pump stations, the Town may consider a reduction in the site dimensions provided adequate clearance is provided between all structures and equipment and the fencing to allow access for the completion of routine maintenance.

2) The site shall be level within 6 inches within the fence line. Earth slopes around the pump station created by “fill” that are steeper than 3 to 1 must be stabilized with a soil stabilization mat in addition to permanent grassing.

3) Pump Stations and force mains shall be located a minimum of 100 feet from a public water supply well and shall be located at least 20 feet from any other potable well as defined in SCDHEC Regulation 61-71.

1.2 ENTRANCE DRIVE

1) The pumping station shall be situated so as to provide access by maintenance vehicles during all weather conditions.

2) A paved entrance drive on a dedicated easement shall be provided from the main road to the pump station gate. The drive slope shall not be greater than 8% at any point. A smooth vertical transition from the driveway to the frontage road and adequate sight distance is required. Where posted speed on the frontage road is equal to or greater than 35 MPH, a deceleration and acceleration lane along the frontage road may be required at the pump station entrance.

3) If the entrance drive is over 50 feet in length and/or the frontage road is a main road outside the development, a paved turn-around with a minimum 15-foot radius will be required.

1.3 SECURITY AND SIGNAGE

Security fencing with a locking vehicle gate at the entrance drive shall be provided as shown on the Drawing **SD-13**. A reflective aluminum sign displaying the pump station identification and emergency telephone number shall be provided and affixed to the entrance gate as shown on Drawing **SD-16**. Locking hatches and covers shall be provided. An intrusion alarm may be required and shall be determined on a case-by-case basis.

1.4 FLOOD ELEVATION

Wastewater pumping station structures and related electrical and mechanical equipment shall be protected from flooding and physical damage by a 100-year flood event.

1.5 WATER SUPPLY

A potable water supply line with a freeze proof standard hose bibb shall be provided at the pump station and connected to a water meter supplied by the Town. An approved RPZ backflow preventer, at least ¾-inch size shall be installed to protect the water supply from accidental contamination. The backflow preventer shall be installed in an insulated enclosure

with heater. The enclosure shall be Flip Top – Hot Box or equal. A post-type non-freeze yard hydrant shall be provided an installed inside the pump station fence line as shown on Drawing **SD-11** and detailed on Drawing **SD-15**.

1.6 AESTHETICS

For some sites selected for pump station location, the Town may require special fencing, vegetative ground cover, and/or specific plants including trees and shrubs to mitigate the aesthetic impact of the facility. The costs for visual screening and installation shall be borne by the Contractor.

1.7 WARRANTY

Except for the warranty requirements for submersible pumps, refer to ***S-1.1.11 Gravity Sewers, Warranty, page S-6*** for warranty requirements for pump stations.

1.8 ODOR CONTROL

Where deemed necessary by the Town, odor control equipment shall be required at the pump station and/or at the force main discharge manhole to minimize, contain or treat odorous compounds. An evaluation of the upstream collection system, wet well and discharge system, which addresses the potential for the generation of odorous compounds shall be submitted with the information required in ***S-II.2.2 SUBMITTALS.*** The Town will review the requirement for odor control equipment on a case-by-case basis and will monitor odors at the station and at the point of discharge during the one-year warranty period. If objectionable odors are observed during this period, provisions to minimize, contain or treat odors shall be provided at no cost to the Owner. Where required, the odor control equipment shall be as outlined in ***S-II.2.9 VENTILATION AND ODOR CONTROL.***

S-II.2. DESIGN CRITERIA

2.1 GENERAL

1) Pump stations shall be sized to serve the proposed development and all future phases that may be tributary to it. In order to avoid the proliferation of small pumping stations, each development will be analyzed by the Town in regard to the potential for serving future development upstream. If such potential exists, the pump station and force main shall be sized according to the Town's engineering recommendation for pumping capacity and total dynamic head.

2) The basis of design for the pump station, including gallons per capita per day, population or population equivalent, average daily flow, peak hourly flow, total dynamic head, NPSH calculations, static head, system curve, wet-well volume, cycle time, pump station friction losses, force main friction losses, buoyancy calculations, force main diameter and length, pump efficiency, brake horsepower, power input to electric drive motor and overall efficiency of the pumping unit for the various conditions under which the units are to operated and any other pertinent information requested by the Town shall be supplied for review.
3) Adequate provision to effectively protect maintenance personnel from hazards shall be made including equipment for confined space entry in accordance with OSHA and other regulatory agency requirements.
4) In any pump station design, a minimum of two pumps shall be provided. Where only two pumps are provided, they shall be of the same size. The pumps shall have capacity such that the facility shall be capable of pumping the design peak hourly flow with any unit out of service.
5) The station capacity shall be based on peak hourly flow and shall be adequate to maintain a minimum velocity of 2 feet per second in the force main.
6) Pumps shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge openings shall be at least 4 inches in diameter, except for grinder pumps.
7) Each pump shall have an individual intake. Wet-well and intake design shall avoid turbulence near the intake and to prevent vortex.
8) The pumps shall be placed to operate under positive suction head during normal operating conditions.

2.2 SUBMITTALS

1) A minimum of two (2) copies of all submittals, as required herein, shall be submitted for the Town's approval prior to construction of a pump station.
2) The Contractor shall submit pump curves for the units which (s)he proposes to supply showing Total Dynamic Head, NPSH, pump efficiency, brake horsepower, power input to electric drive motor and overall efficiency of the pumping unit for the various conditions under which the units are to operate, together with descriptive data and specifications describing in detail the construction of the complete units.

3) Contractor shall provide cut-sheets, specifications and other manufacturer's literature for proposed pumps, valves, telemetry, standby generator sets, odor control/ventilation equipment and other specialty items that may be supplied as part of the pump station installation. All equipment selections shall be subject to the approval of the Town.

2.3 CONFIGURATION

Wastewater pumping stations shall utilize centrifugal, solids handling pumps of the submersible (pumps installed in the wet-well) configuration.

Air ejector-type stations or other designs are not acceptable.

2.4 PUMP STATION SUPPLIER

For the purpose of standardization, the pump station equipment, including pumps, controls, and pump hoisting mechanism shall be provided by Xylem (Flygt). Other reputable manufacturers must be pre-approved by the Town prior to submittal, and have at least ten years experience in the design and manufacture of pumps and controls for the pumping of raw wastewater. Pump replacement parts and repair services shall be available from local suppliers and/or equipment representatives.

2.5 WET-WELL SIZE, CONFIGURATION AND STORAGE VOLUME

1) The effective volume of the wet-well shall be based on design average flow and a filling time not to exceed 30 minutes. The pump cycle time shall be selected to prevent excessive cycling of the pumps and shall be limited to one start per ten minutes unless otherwise recommended by the pump manufacturer. The size of the wet-well shall be as recommended by the pump supplier and shall be approved by the Town.
2) For submersible stations using typical pre-cast concrete manhole components, the minimum inside wet-well diameter shall be five (5) feet.
3) Wet-wells shall be covered and not open at the top.
4) Wet-wells shall be filleted at the bottom corners to discourage sediment build-up.
5) Only one inlet pipe shall be allowed into the wet-well. If two or more gravity sewer lines drain to the pump station, they shall be joined at a separate manhole outside the wet-well.
6) Storage shall be provided above the high-level alarm equal to one (1) hour at design flow. Storage volume is calculated to be that volume between the high-

level alarm and the lowest point of overflow (including basement elevations regardless of backflow valves in service lines). Said storage may consist of any combination of line capacity, manhole capacity, and wet-well volume. No corrugated metal pipe may be utilized for storage.

2.6 BUOYANCY

Where high groundwater conditions are anticipated, buoyancy of the wastewater pumping station structures shall be considered and, if necessary, adequate provisions shall be made for protection.

2.7 CORROSION PROTECTION

1) Materials shall be selected that are appropriate under conditions of exposure to hydrogen sulfide and other corrosive gases, greases, oils and other constituents frequently present in wastewater. Contact between dissimilar metals shall be avoided. Provisions shall be made to minimize galvanic action.
2) Manholes used for pump station wet wells and the manhole at the force main discharge shall be coated with a monolithic, high-build, solvent free, epoxy coating to prevent corrosion of the concrete from hydrogen sulfide gas and bacteriological attack typical to municipal sanitary sewer systems. Surface preparation and coating application shall be in strict accordance with the manufacturer's recommendations. The coatings shall be Raven 405 – Ultra High Build Epoxy Coating system or equal. The coatings shall be uniformly applied to a minimum thickness of 125 mils or greater.

2.8 SUBMERSIBLE PUMPING STATION REQUIREMENTS

In addition to other requirements set forth herein, submersible type pump stations shall adhere to the following design criteria:

1) Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle and shall meet the requirements of the National Electrical Code for such units.
2) An effective method to detect shaft seal failure and potential seal failure shall be provided.
3) Submersible pumps shall be readily removable and replaceable without dewatering the wet-well or disconnecting any piping in the wet-well. Hatch doors

shall be sized by the pump supplier to allow adequate clearance to easily remove the pumps.

4) Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet-well. Terminals and connectors shall be protected from corrosion by location outside the wet-well or through use of watertight seals.

5) The pump control panel shall be located outside the wet-well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electric Code, to prevent the atmosphere of the wet-well from gaining access to the control panel. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal. The control panel enclosure shall be UL listed and it shall meet the requirements of NEMA 3R or 4X.

6) The pump control panel shall be supplied by the pump manufacturer and fabricated by a current UL 508A listed industrial control panel manufacturer and UL labeled.

7) The pump motor cords shall be designed for flexibility and serviceability under conditions of extra hard usage and shall meet the requirements of the National Electrical Code standards for flexible cords in wastewater pump stations. Ground fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent the entry of moisture into the cable, shall be provided with strain relief appurtenances, and shall be designed to facilitate field connecting. Only copper wire shall be used in the electrical system of the pump station.

8) Valves required under ***S-II.2.10 VALVES, VALVE VAULTS, ACCESSORIES & BY-PASS REQUIREMENTS*** shall be located in a separate valve pit. Provisions shall be made to remove or drain accumulated water from the valve pit. The valve pit may be dewatered to the wet-well through a drain line with a gas and watertight check/flap valve. Valve vaults shall be precast concrete as shown on Drawing **SD-12**. All valve vaults shall have a lockable aluminum hatch, as manufactured by BilCo, or equal. The hatch shall be sized to allow safe entry by maintenance personnel and easy removal of the valves.

2.9 VENTILATION AND ODOR CONTROL

Adequate ventilation and odor control shall be provided for all pump station wet-wells as follows:

1) Wet-wells shall have provisions for air displacement to the atmosphere using four-inch (minimum) diameter vent pipe with an insect screen, unless mechanical ventilation is required.
2) Dry air scrubbers, if required, shall be a Syneco Systems Peacemaker series, or equal, subject to approval by the Town. Odor control systems shall be sized based on the manufacturer's recommendations for the specific application.
3) Odor control systems shall be provided with a one year supply of odor control media and/or chemicals.

2.10 VALVES, VALVE VAULTS, ACCESSORIES & BY-PASS REQUIREMENTS

2.10.a. General

1) Suitable shutoff and check valves shall be placed on the discharge line of each pump. The check valve shall be located between the shutoff valve and the pump. Check valves shall be suitable for raw sewage and shall be placed on the horizontal portion of the discharge piping. Valves shall be capable of withstanding normal pressure and water hammer.
2) Both shut-off and check valves shall be installed in a concrete valve vault as shown in Drawing **SD-12**. Valves shall not be installed in the wet well.
3) Valves and piping within the valve vault shall have standard ANSI flanges.
4) Valves and piping within the valve vault shall be thoroughly cleaned of all dirt, rust scale, etc. and shall be field coated with two coats of an epoxy coating system suitable for harsh environments. Each coat shall be applied to a dry film thickness of 4 to 6 mils. The factory applied primer shall be compatible with the field applied coatings.

2.10.b. Valve Vault

1) A pre-cast concrete valve vault shall be provided as shown in Drawing **SD-12**, adequately sized to house both discharge plug valves, check valves and the discharge pressure gauges, as specified herein.

2) The concrete valve vault may be circular or rectangular as appropriate for the size requirements of the valves to be housed therein. The valve vault shall have a solid concrete bottom, either monolithically cast or poured in place separately.
3) The concrete base shall be supported by a minimum of 6” layer of compacted crushed stone.
4) The valve vault shall be piped to drain back to the pump station wet well with a 2” schedule 80 PVC pipe sloped ¼-inch per foot. The drain line shall have a backflow check valve to prevent raw sewage in the wet well from backing into the valve vault during high water levels. The check valve shall be constructed of Buna-N and shall be a 2” TideFLex Type TF-2, Series 35, or equal.
5) The interior floor of the valve vault shall be grouted ¼” per foot to slope to the drain pipe inlet.
6) The drain pipe penetration into the wet well shall be cored and the drain pipe secured and sealed in the wet well wall with a SS link seal.

2.10.c. Plug Valves

1) Plug valves and accessories shall be in accordance with the applicable ASTM and or ANSI/AWWA specifications, as amended to date, and shall be manufactured by DeZurik, Pratt, Clow, Val-Matic or equal as approved by the Town. Plug valves shall be rated for a normal working pressure of 150 psi or greater.
2) Plug valves shall be of the eccentric, non-lubricated resilient seat type, designed for sewage at 150 psi normal working pressure and shall have mechanical joint or flanged ends. Drilling for flanged ends shall be in accordance with ANSI B17.1 Class 125. The interior design shall allow straight through flow with maximum flow capacity and minimum pressure drop.
3) The valve body shall be semi-steel conforming to ASTM A126, Class B.
4) Seats shall be corrosion resistant, welded nickel.
5) Eccentric plugs shall rotate 90-degrees from open to close and as it does, shall move a raised eccentric seat. In the open position, the segmented plug shall be shall be completely out of the flow path. As the plug closes, it shall move toward the seat without scraping the seat or body walls to minimize binding and wear. In the closed position, the plug shall make contact with the seat and make a tight, leak-free shut off.

6) Upper and lower plug stem bushings shall be of stainless steel and permanently lubricated. All valves shall have a bolted bonnet for maximum strength, packing adjustment and disassembly. Stems shall have multiple packing rings to seal stem shaft and provide easy packing adjustment and/or replacement without valve disassembly.

7) Valves shall be installed according to directional flow arrows cast into the body and/or as per manufacturer's instructions.

2.10.d. Swing Check Valves

1) Swing check valves shall be constructed with heavy cast iron or cast steel body with a bronze or stainless steel seat ring, a non-corrosive shaft for attachment of weight and lever, and complete non-corrosive cushion chamber. Swing check shall be manufactured by Golden-Anderson, APCO or equal and shall be rated for a normal working pressure of 150 psi or greater.

2) Valves shall absolutely prevent the return of water, oil or gas back through the valve when the inlet pressure decreases below the delivery pressure. The valve must be tight seating, and must operate without hammer or shock.

3) The check valve body shall be cast iron or cast steel per AWWA C508 having integral (not wafer) flanges. A flow directional arrow shall be cast into the body to indicate correct installation direction.

4) The seat ring shall be stainless steel and must be renewable and shall be securely held in place by a threaded joint.

5) The valve disc shall be of cast iron or cast steel and shall be suspended from a non-corrosive shaft which will pass through a stuffing box or seal chamber on both sides of the valve body and be connected to the cushion chamber on the outside of the valve.

6) The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any hammering action. The cushioning shall be by air, and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements. The air cushion chamber shall be constructed of corrosion-resistant material and the piston shall be totally enclosed within the cylinder and not open at one end. The bottom cylinder head shall be swivel mounted and not rigid to follow the change of

angular force as the lever rises or lowers to open or close the check valve. The inlet and discharge of the cushioning air shall occur through two separate, distinct and appropriately sized openings. The inlet and exhaust of the air shall NOT occur through a single orifice

2.10.e. Pressure Gauges

1) Pressure gauges shall be mounted on each discharge line in the valve vault as shown in Drawing **SD-12**. Mechanical pressure gauges shall be Type S, 2-1/2 inch as manufactured by Helicoid Division of Acco Industries or equal meeting ANSI B40.1 - Grade B with ± 2% or better.
2) Gauge pressure range shall be selected to read normal operating (discharge) pressure near the middle of the gauge, but not exceed the full-scale range of the gauge at pump shut-off pressure.
3) Gauges shall read across a 270° dial.
4) All pressure gauges shall be isolated from the process fluid with a dual diaphragm seal. The seal shall be Type 100H as manufactured by Helicoid Division of Acco Industries, or equal. Diaphragm seals shall be completely field serviceable. Diaphragms shall be 316 stainless steel. Instrument top side housing shall be steel and process side housing shall be 316 stainless steel. O-ring material shall be Buna-N.
5) A 1/4 inch flushing connection shall be provided. Diaphragm seals shall have a stainless steel nameplate identifying the materials of construction and the maximum pressure rating. Diaphragm seals shall be selected for the pressure rating of the gauge for which it is intended to protect. Gauge cocks shall be union type made of polished brass with 1/4” connections and able to withstand pressures to 300 psi.

2.10.f. Pump Bypass Provision

1) A special provision for pump station by-pass operation using a portable pump may be required on a case-by-case basis, for smaller pump stations and/or when emergency generators are not required.
2) Such provision shall include a station by-pass tap on the force main as shown on Drawing **SD-17**. Valves shall be as specified herein with standard ANSI flanges.

S-II.3. ELECTRICAL AND INSTRUMENTATION REQUIREMENTS

3.1 ELECTRICAL

3.1.a. General

1) Devices and materials shall be listed and/or labeled by Underwriters' Laboratories, Inc., wherever standards have been established by that agency. Where Underwriters' Laboratories listing is not available for equipment, certified test reports shall be submitted of adequately equipped, recognized, independent testing laboratory, approved by the local inspecting authority, indicating that equipment is in conformance with local code requirements or any other applicable requirements.
2) In lieu of independent test reports, written approval of equipment by local electrical inspecting authority will be acceptable.
3) Equipment, devices and material shall be clearly marked with name or trademark of manufacturer and rating in volts and amperes and other pertinent information on a nameplate.
4) Electrical systems and components in raw wastewater wet-wells or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class I Group D, Division1 locations and be provided with intrinsically safe control circuitry. The control panel must be mounted and installed outside of the hazardous environment as outlined in NFPA 70 and NFPA 820.
5) Complete wiring diagrams shall be furnished covering all electrical circuits, controls and subsystems.

3.1.b. Power Requirements

1) All pump motors shall utilize three phase (277/480 volt) power, and shall be type NEMA B.
2) Three phase power systems shall have phase monitor relays on each power leg to prevent operation during loss of phase or low voltage. Surge protection shall also be provided to protect the MCC as well as the pump motors.
3) A typical riser diagram is shown in Drawing **SD-14** and should be used as a guide for the pump station electrical system layout.

3.1.c. Special Requirements for Environmental Conditions

1) Equipment located in the wet-well shall be suitable for use under corrosive conditions. Flexible cables shall be provided with watertight seals and separate strain relief. Conduit/cables shall be sealed at the wet-well and at the control panel to prevent corrosive gases from entering the electrical control system. Splicing of cables inside the wet-well will not be permitted.
2) A fused disconnect switch shall be located above ground for the main power feed and if exposed to weather, shall meet the requirements of weatherproof equipment NEMA 3R or NEMA 4X. Lighting and surge protection shall be provided.

3.1.d. Surge Suppression

1) The surge suppressor shall be U.L. listed and labeled under UL1449 and UL1283. A surge suppressor shall be provided at the power service entrance. The surge suppressor shall have voltage characteristics to match the power service.
2) The surge suppressor shall be in NEMA-4X enclosure and shall provide line to line, line to neutral, line to ground and neutral to ground protection modes as applicable for the power service.
3) The surge suppressor shall be provided with an integral disconnect separate from the main breaker. Minimum surge current rating shall be 100KA per mode, 200KA per phase per NEMA LS-1. The surge suppression system shall be duty cycle tested to survive 20KV, 10KA, IEEE C62.41 category surge current with less than 5% degradation of clamping voltage. The surge suppressor shall have minimum repetitive surge capacity of 2500 impulses per mode and 5000 impulses per phase. Status indicating lights and form ‘C’ dry alarm contacts shall be provided.

3.1.e. Panels, Enclosures and Connections

1) Enclosures for motor starters, relays, instruments and controls shall be NEMA 3R or 4X, Stainless Steel. All enclosures mounted outdoors shall have a device for securing with padlock and key.
2) A 115-volt power receptacle to facilitate maintenance shall be provided inside the control panel where the control panel is located outdoors.

3) All outdoor cabinets and panels shall be secured to stainless steel or aluminum mounting posts set in a concrete base and protected from sun/heat by an electrical panel shelter. A typical shelter is shown in Drawing **SD-11A**. Stainless steel Uni-strut may be used to secure panels to posts. All fasteners shall be corrosion resistant, stainless steel or aluminum. No galvanized or carbon steel supports will be allowed.

3.1.f. Grounding

1) Minimum requirements for grounding shall be National Electrical Code. Locknut connections to cabinets, pull boxes and junction boxes shall be wrench-tight, with locknut projections driven into the opposing metal surface.
2) No ground connection shall be made except as required by the National Electrical Code or as specified herein. The pump station housing steel shall be bonded to the made electrode grounding system.

3.2 PROVISION FOR STANDBY POWER

1) Provision shall be made for emergency operation of all wastewater pumping stations.
2) A dedicated stand-by generator shall be provided for pump stations of sufficient kW capacity to fully power the pump station during a power outage. The generator set shall be self-starting and be furnished with an automatic transfer switch to automatically transfer the pump station load to the generator and back to normal power when normal power is restored.
3) The stand-by generator shall be powered by a diesel engine, of a type and shall be as manufactured by Caterpillar, Cummins or other manufacturer acceptable to the Town. The diesel fuel tank for the generator shall be an above-ground type, with double wall containment, integral with the skid mount or separate. If separate it shall be a Convault or equal. Storage capacity sufficient to power the generator set for a minimum of 8 hours at full load shall be provided. Fuel lines from the storage tank to the generator set shall be double wall or otherwise enclosed within a containment vessel to prevent leakage of fuel onto or into the ground. Provision for containment of fuel, oil and grease leakage and spills shall be made for the diesel engine generator set.
4) Gasoline engine driven generators shall not be acceptable.

5) The generating unit size shall be adequate to provide power for pump motor starting current and for lighting, ventilation and other auxiliary equipment necessary for safety and proper operation of the lift station.
6) If mounted outdoors, the generator shall be furnished with a durable outdoor weather protective enclosure to shield the equipment from the elements. The enclosure shall be equipped with doors and access panels to access controls and accessories for service and maintenance of the unit. The enclosure shall provide noise level attenuation of 75 dBa at 7 meters at 100 percent rated load.
7) The generator engine shall be protected from damage from freezing temperatures and shall have pre-heaters for cold weather starting.
8) The generator engine shall be supplied with a heavy-duty battery and permanently wired battery charging unit.
9) The generator set shall be furnished with proper gauges for monitoring engine temperature and oil pressure, and generator output voltage and amperage with a line selector switch for each phase/line. A non-re-settable elapsed time meter shall be supplied to record cumulative generator run time.
10) The operation of only one pump during periods of auxiliary power supply must be justified. Such justification may be made on the basis of the design peak hourly flows relative to single pump capacity, anticipated length of power outage, and storage capacity.
11) Special sequencing controls shall be provided to start pump motors unless the generating equipment has capacity to start all pumps simultaneously with auxiliary equipment operating.
12) Protective equipment shall be capable of shutting down the engine and activating an alarm on site and as provided in ***S-II.3.4 TELEMETRY***.
13) The engine shall be located above grade with adequate ventilation of fuel vapors and exhaust gases. Emergency equipment shall be protected from damage at the restoration of regular electrical power.
14) All emergency equipment shall be provided with instructions (in English) indicating the need for regular starting and running of such units at full loads. Provisions shall be made for automatic and manual start-up and load transfer. Provisions shall be made to allow the engine to start and stabilize at operating speed before assuming the load.

15) Manufacture and type of standby generator shall be subject to approval by the Town prior to installation.

3.3 CONTROLS

1) The pumping station shall be furnished with an automatic pump control system which utilizes a Xylem (Flygt) - “Multitrode” 10-point level probe (aka level transmitter) and free hanging back-up floats to activate start/stop of pumps and alarms according to wet-well level. Pumps shall be called to start and stop automatically based on the wet-well level settings.
2) The backup floats shall be located as not to be unduly affected by turbulent flows entering the wet-well or by the turbulent suction of the pumps. The Multitrode shall be mounted in a turbulent area of the wet-well. The Multitrode shall be installed according to the manufacturer’s installation instructions and include the manufacturer’s supplied mounting bracket with polyurethane squeegee pad for probe cleaning.
3) A minimum of five level settings will be selected on the 10-point level probe to operate the control system for the following operations:

    Lead Pump ON
    Lag Pump ON
    All Pumps OFF
    High Level Alarm
    Low Level Alarm

4) Two floats shall be installed in the pump station wet-well to act as a back-up control system (high level/low level) to the Multitrode. The high level float shall start the lead pump when the float is activated and after a field adjustable period of time (0 to 10 seconds), the lag pump shall start after the float is activated. One float shall be installed as a low level float to stop both pumps. When the high level float is activated the high level alarm shall also be activated. The floats shall be suspended in the wetwell and secured/attached to a stainless steel float bracket to be provided by the pump supplier.
5) The pump supplier shall provide a pump controller that shall be Multitrode MultiSmart or approved equal. The pump controller shall monitor and control two pumps and three alarms and be capable of discriminating between four different fault conditions. The pump controller should be provided with the necessary

keypads, indication, leveling sensing, programming, time delays, fault monitoring and communication to meet the requirements of the Town's utility specifications. The pump controller shall be intrinsically safe.

6) A non-re-settable elapsed time hour meter for each pump shall be mounted in the control panel to record each pump's total run time.
7) Provision for automatic pump alternation shall be included.
8) Each pump shall be controlled through a three position switch for "HAND," "OFF" and "AUTOMATIC" operation. When switched to the "HAND" position, the respective pump starter shall engage calling the pump to "RUN" regardless of the status of the automatic level control.
9) Each circuit breaker, disconnect switch, motor starter, control switch, panel lamp or other devices shall have an identifying nameplate affixed, such as "PUMP #1", "RUN", "HAND-OFF-AUTOMATIC". Nameplates shall be laminated plastic, white engraved letters on black background. Letters shall normally be 1/4" high. Embossed taped strips are not acceptable.
10) Outdoor control panels shall be mounted in false front cabinets, with all indicator lamps and control switches concealed within the outer cabinet.
11) Local station alarm systems shall be provided for all pumping stations. The alarm system shall be activated in cases of power failure, high wet-well level, sump pump failure (dry well pumps stations), pump failure, unauthorized entry, or any cause of pump station malfunction. Pumping station alarms shall be telemetered as described in ***S-II.3.4 TELEMETRY***. The local station alarm system shall include a flashing amber or red light mounted outdoors and an audible 95 dB alarm to indicate during any of the alarm conditions. Audible alarm shall be silenced manually with a momentary contact switch mounted on the station panel.

3.4 TELEMETRY

A telemetering system shall be provided for all pumping stations consisting of an advanced auto-dialer using wireless communication through digital cellular data networks to an automated central control center. The equipment and installation shall have the following characteristics and features:

3.4.a. Device Manufacturer and Model

The telemetry equipment shall consist of one (1) Mission Model 110 RTU, with supervised power supply and battery back-up, installed and tested as described herein. Provide one (1) Mission tipping bucket rain gauge for measuring and reporting rainfall events with each RTU.

3.4.b. Inputs:

1) Eight (8) general purpose, supervised, dry contact inputs
2) Two (2) analog, 10 bit (4-20 mA or 0 – 5 volt, jumper selectable)
3) One (1) electronic key reader to log activity, enable service mode.
4) Two (2) pulse counter for flow meters or rainfall tipping buckets.
5) Three (3) output relays' status telemetered without using above channels.
6) Three (3) internal status (AC-voltage, battery voltage, and signal strength) are transmitted.

3.4.c. Monitoring Points

DI-1 Pump 1 status (closed contact from MCC when pump is running).
DI-2 Pump 2 Status (closed contact from MCC when pump is running).
DI-3 Pump 1 fail or pump fail (pump fail, seal fail and over-temp).
DI-4 Pump 2 fail or pump fail (pump fail, seal fail and over-temp).
DI-5 Wet-well high alarm (from float switch mounted in wet-well).
DI-6 Transfer switch (closed contact from the transfer switch when utility power is off).
DI-7 Generator status (closed contact from the generator when generator is running).
DI-8 Generator alarm (closed contact from the generator when in alarm).
Pulse 1 (for tipping bucket rain gauge)

3.5 GUARANTEES AND TESTS

1) The installation shall be entirely free from improper grounds, short circuits, or other defects. All tests shall be made in the presence of the Town's inspector or engineer. The Contractor shall furnish assistance in performing these tests as required by the Town.
2) All protective equipment shall be operated to show it is in proper operating condition. All control systems shall be checked for correct operation before acceptance by the Town.

3) The Contractor shall provide the Town with a written 5-year pro-rated warranty on all submersible pumps and a 1-year (100%) warranty on all other mechanical and electrical equipment.

S-II.4. FINAL SUBMITTALS AND DOCUMENTATION

Three (3) sets (minimum) of the following documents shall be provided to the Town upon final acceptance of the pumping station:

1) As-built drawings, to scale, of the pump station including, but not limited to: site plan (with topography, showing flood plain, top of slab and structure elevations, and all above-ground structures and features), pump station details with plan and section views, electrical diagrams, control schematics, and any other drawings that might be necessary to cover the particular installation. The drawings shall be submitted to the Town in paper (blue line copy and mylar copy) and electronic format (CD-ROM) in AutoCad DWG format, prior to final acceptance. Additional requirements for as-built drawings may be found on line at www.fortmillsc.org.

2) Operation and maintenance (O&M) manuals for the pumps, motors, controls, telemetering equipment and stand-by generator (if supplied). O&M manuals shall include clearly written standard operating procedures, emergency procedures, maintenance schedules, equipment diagrams, trouble-shooting and repair procedures, required tool list, part numbers, recommended spare parts lists and available suppliers' contact information.

S-III FORCE MAINS

Reference Drawings: **SD-18** – **SD-20C**

1.1 PIPE MATERIAL AND QUALITY

1.1.a. General

Piping for force mains shall be minimum Class 250 epoxy lined ductile iron pipe or PVC C900 DR-18 PC 235 pipe. Ductile iron pipe may only be used for force mains larger than 12-inch diameter. Higher rated pressure class pipe may be required to accommodate system requirements or may be required by the Town on a case-by-case basis.

Detection wire shall be installed along the length of PVC force mains (not required if D.I.P. is used). It shall be THHN 12 gauge (minimum) solid copper wire, and shall form a single

electrical conductor along the length of the pipe. Each splice shall be made with copper split bolt wire connectors and completely wrapped in electrical tape. Wire shall be wrapped around valve boxes, air release valves and should accessible for direct connection of locating equipment to the wire. If the connections or wire is broken during installation of the pipe, the Contractor will be required to excavate and make the repairs. Metallic detection tape shall not be acceptable

All force mains over cross-drains, water lines, sewers, roadways which are open cut, at stream crossings, and anywhere else specifically requested by the Town shall be pressure Class 350 epoxy lined D.I.P.

See also ***S-I.1.5 Gravity Sewers, General, Pipe Quality, page S-3***

1.1.b. PVC Pipe and Fittings

Polyvinyl chloride (PVC) plastic pipe supplied for force main installations shall meet the requirements of AWWA C900 Standards and shall bear the approval of the National Sanitation Foundation (NSF). Pipe shall be in accordance with the applicable ASTM and/or ANSI/AWWA Specifications, as amended to date, and the following requirements:

1) Pipe shall be supplied in 20 ft. nominal laying lengths.
2) The pipe shall include an integral bell with factory-installed gaskets meeting the requirements of ASTM F-477 and the gasketed joints shall meet the requirements of ASTM D-3139.
3) Meet the approval of the American Water Works Association, meet the minimum standards of AWWA C900 DR-18 PC 235 PVC pipe.
4) Be marked at intervals of not more than five feet with the above mentioned ratings.
5) PVC pipe used for force mains shall be green in color.
6) Fittings for PVC pipe shall be mechanical joint epoxy lined ductile iron fittings conforming to ANSI/AWWA A21.53/C-153 or ANSI/AWWA A21.10/C-110, with the joint meeting the requirements of ANSI/AWWA A21.11/C-111. Ductile iron fittings shall have a working pressure of 350 psi.
7) PVC pipe force main design and installation should generally follow the guidelines presented in the publication, *UNI-TR-6-97, PVC Force Main Design*, by the Uni-Bell PVC Pipe Association, the applicable provisions of AWWA C605 and the manufacturer's written instructions.

1.1.c. Ductile Iron Pipe and Fittings

Refer to ***S-I.2.2 Gravity Sewers, Materials, Ductile Iron Pipe and Fittings, page S-8.***

1.2 MATERIALS HANDLING

Refer to ***S-I.1.6 Gravity Sewers, General, Materials Handling, page S-3.***

1.3 ORDER OF WORK

Refer to ***S-I.1.7 Gravity Sewers, General, Order of Work, page S-5.***

1.4 INSPECTION

Refer to ***S-I.1.8 Gravity Sewers, General, Inspection, page S-5.***

1.5 ORGANIZATION OF WORK

Refer to ***S-I.1.9 Gravity Sewers, General, Organization of Work, page S-5.***

1.6 ACCEPTANCE OF WORK

Refer to ***S-I, 1.10 Gravity Sewers, General, Acceptance of Work, page S-6.***

1.7 WARRANTY

Refer to ***S-I.1.11 Gravity Sewers, General, Warranty, page S-6.***

1.8 STEEL PIPE CASING

Refer to ***S-I.2.4 Gravity Sewers, Materials, Steel Pipe Casing, page S-10.***

1.9 PORTLAND CEMENT CONCRETE

Refer to ***S-I.2.5 Gravity Sewers, Materials, Portland Cement Concrete, page S-10.***

1.10 VALVES

Where required, valves for force main construction (i.e., underground valves) shall be plug valves and shall be as specified in section ***S-II.2.10.c, Sewage Pumping Stations, Design Criteria, Plug Valves, page S-46*** except valves shall be supplied with mechanical joint ends and all 4-inch and larger underground valves shall be gear operated.

1.11 AIR AND VACUUM RELIEF VALVE

Automatic air relief valves shall be placed at high points in the force main to prevent air locking. Additional air and/or air-vacuum relief valves may be necessary on long force mains. The force main configuration and head conditions shall be evaluated as to the need for and placement of vacuum relief valves. **Table S-5**, below is from the reference cited in S-III.1.1

above and should be followed for air-vacuum release valve requirements. Proper sizing of air-vacuum valves should follow manufacturer's guidelines.

Table S-5, Locating and Utilizing Air-Vacuum Valves

Condition	Recommendation
Peaks	Combination air valves
Increasing down-grade	Combination air valves
Decreasing up-grade	Combination air valves
Long ascents	Air & vacuum valves, ¼ to ½ mile intervals
Long descents	Combination air valves, ¼ to ½ mile intervals
Long horizontal	Avoid if possible; otherwise install combination valves every ¼ to ½ mile.

1) Air/vacuum valves shall be Crispin Universal Series or APCO Series 401 and designed specifically for service in sewage force mains, having an internal design that prevents solids and debris from fouling the valve seating mechanism.
2) Internal metal parts shall be of high quality stainless steel and/or other corrosion resistant materials for maximum durability.
3) Seating seals shall be of Buna-N for working pressures greater than 4-5 psig. For installations where lower system pressures may be encountered, a soft seating material may be required to prevent leakage.
4) The valve body shall be fitted with flushing and drain ports to allow cleaning of the valve without removal from the force main.
5) A shut-off valve shall be installed between the air release valve and the force main. The shut-off shall be either a plug valve or ball valve and of the same pipe diameter as the air release valve.
6) The air/vacuum relief valve(s) shall be installed in a manhole per Drawing **SD-18**.

1.12 TERMINATION

Force mains shall enter the gravity sewer system at a point not more than 2 feet above the flow line of the receiving manhole and terminate in an upward- facing 90-degree bend and shall be called out on the submittal drawings. See Drawing **SD-19**. Odor control equipment may be required at this location, see ***S-II.1.8 ODOR CONTROL***.

1.13 PIPE AND DESIGN PRESSURE

1) At design pumping rates, a cleansing velocity of at least 2 feet per second shall be maintained.

2) Force mains shall be at least 4 inches in diameter, except for force mains that follow grinder pumps.
3) Pipe and joints shall be equal to water main strength material suitable for design conditions as described herein. The force main, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. Surge protection chambers should be evaluated.
4) A horizontal separation of at least 10 feet must be maintained between the force mains and any existing or proposed parallel water main (measured edge to edge).
5) When force mains cross water mains, a minimum vertical separation of 18 inches must be provided between the two pipes (measured edge to edge), and the water main must cross over the sewer force main. At crossing, one full length of force main pipe must be located so that both joints are as far from the water main as possible.
6) Sewage force mains within subdivisions shall be located on the south side of east-west streets, and on the east side of north-south streets, (opposite from water mains) unless otherwise agreed to by the Town.
7) Where it is not possible or feasible for force mains to be installed in a dedicated public street right of way, it is the Town's policy to require a 20 feet wide (minimum) utility easement. The force main shall generally be centered within the easement. All easements must be shown on the plans and on the final recorded plat as 20 foot utility easements dedicated to the Town of Fort Mill. In general, easements dedicated to the Town will be entered by the Town personnel for maintenance purposes only. Non-permanent structures, such as fences, shrubs, and small trees, which will not impact access or maintenance of the force main shall be allowed within force main easements.
8) Force mains shall have a minimum cover of four (4) feet to the top of the pipe.

1.14 DESIGN FRICTION LOSSES

Friction losses through force mains shall be based on the Hazen and Williams formula or other acceptable methods. For cement-lined ductile iron, a Hazen and Williams "C" value of 120 should be used. For PVC force mains, a higher "C" value not to exceed 150 may be allowed for design.

1.15 INSTALLATION OF FORCE MAIN PIPING

1.15.a. Erosion Control

Refer to ***S-1.3.1, page S-13***

1.15.b. Clearing

Refer to ***S-1.3.2, page S-14***

1.15.c. Trench Work

Refer to ***S-1.3.3, pages S-15 – S-23*** and Drawing **SD-01 and** Drawing **SD-02.**

1.15.d. Bedding and Haunching

Refer to ***S-1.3.4, pages S-23 – S-25***.

1.15.e. Paving and Driveway Cuts and Repairs

Refer to ***S-1.3.4.d, pages S-25.***

1.15.f. Blocking and Thrust Restraint

Concrete blocking shall be installed for all force mains according to details shown on Drawings **SD-20A and SD-20C**. All pressure pipe shall either be blocked or installed with restrained joints. Restrained joint pipe and fittings shall be ductile iron meeting the requirements for ductile iron pipe and ductile iron fittings specified elsewhere and shall:

1) Restrained joint pipe having a diameter of 4-inch to 18-inch may be restrained using US Pipe Field Lok Gaskets, American Fast Grip Gaskets or approved equal. Restrained joint pipe having a diameter of 20-inch to 36-inch shall be Flex Ring by American Cast Iron Pipe Company, TR. Flex by US Pipe, or approved equal.

2) Mechanical joint restraint device shall have a working pressure of at least 250 p.s.i. with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc.,

1.15.g. Leakage & Pressure Test

All new force mains shall be pressure tested before acceptance of work by the owner. The Contractor shall notify the Town at least 48 hour prior to testing of any part of the system and shall provide all necessary supplies, equipment, labor, and apparatus for conduction of the tests. A Town inspector MUST be present during pressure test.

Ductile iron and PVC pressure lines shall be cleaned, filled with water, air completely exhausted and a leakage test made. The Contractor shall furnish a test pump, and means for

accurate measurement of water introduced into a line during testing, and shall furnish and install corporation stops in the line as required for blowing lines free from air and at the test pump location. No corporation stops will be allowed in copper lines, or PVC lines.

The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure tests, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material. Test pressure shall be 150 psi or 1.5 times the maximum working pressure of the pipe, whichever is higher, as measured at the lowest point of elevation of the section of line being tested.

Piping shall be filled with water, air completely exhausted and a leakage test made. Pressure testing shall be performed in accordance with the requirements of AWWA C600 for ductile iron pipe and AWWA C605 for PVC pipe. Leakage shall be determined from the following formula, which is based on AWWA C600 and AWWA C605.

(In Inch Pound Units.)

$L=(NxDxP^{1/2})/K$

L= Allowable leakage in gallons per hour

N= Length of pipe tested, in feet (ductile iron pipe); or, number of joints (PVC pipe).

D= Nominal diameter of the pipe in inches

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

K = 133,200 for ductile iron pipe and 7,400 for PVC pipe.

Table S-6, Leakage Allowance (Ductile Iron)
(Gallons per hour per 1,000 feet of pipe)

Pipe Diameter	Pressure 150 PSI	Pressure 200 PSI	Pressure 250 PSI
6”	0.55	0.64	0.71
8”	0.74	0.85	0.95
10”	0.92	1.06	1.19
12”	1.10	1.27	1.42

Table S-7, Leakage Allowance (PVC)
(Gallons per hour per 50 pipe joints or 1,000 feet of pipe)

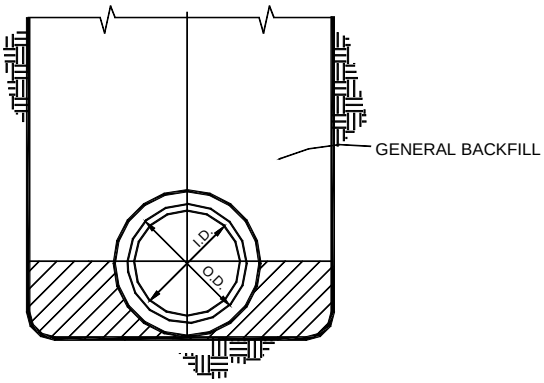
Pipe Diameter	Pressure 150 PSI	Pressure 200 PSI	Pressure 250 PSI
6”	0.50	0.57	0.64
8”	0.66	0.76	0.85
10”	0.83	0.96	1.07
12”	0.99	1.15	1.28

Minimum test period shall be twenty-four (24) hours to test blocking and/or restrained joints plus two- (2) hour's leakage test; Contractor shall maintain the 24-hour test pressure ± 5 psi for 24 hours. However, if in the opinion of the Town, additional testing is required, the testing period will be extended.

Any cracked or broken pipe shall be removed and replaced with sound pieces. Joints, which leak, shall be carefully remade. Remade joints and replaced material shall be re-tested under the same conditions of operation. If joints or materials are then found to be defective, they shall be remade and replaced until the line passes the required test.

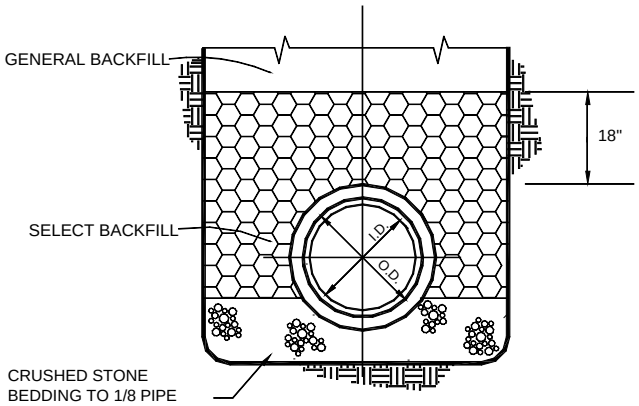
All tests shall be performed before any part of the system is connected to the tested portion of system, and all results shall be witnessed by a representative from the Town.

S-IV DRAWINGS



TYPE 2

FLAT-BOTTOM TRENCH WITH GENERAL BACKFILL
UNDERCUT TRENCH @ BELLS



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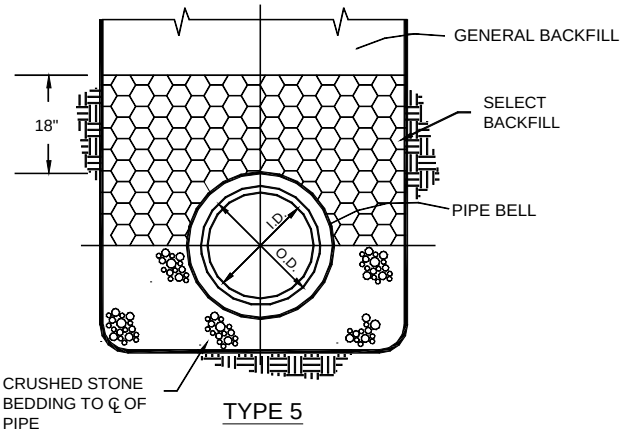
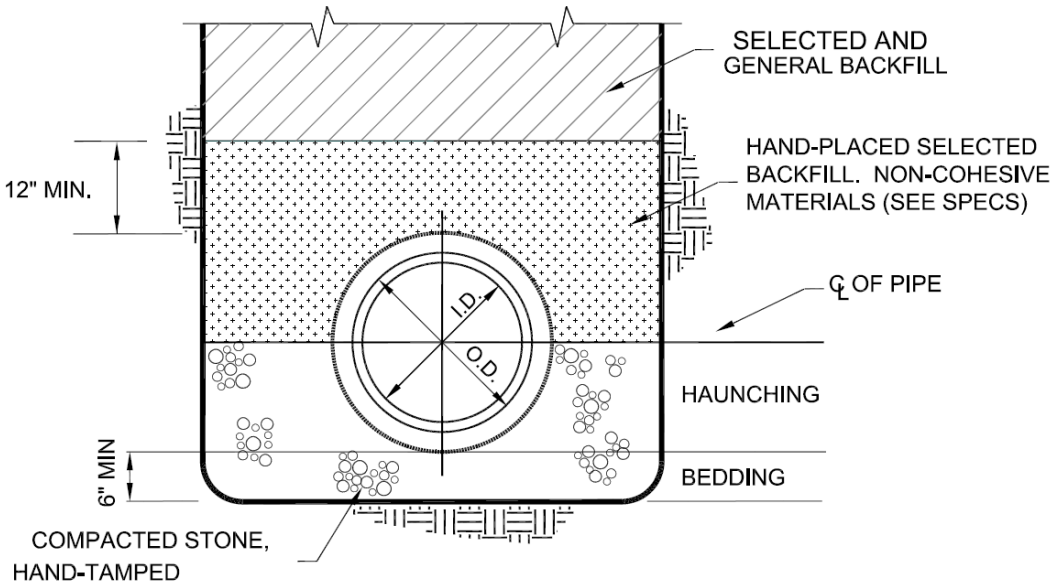


TYPE 5

NOTE:
TYPE 1 AND TYPE 3 ARE NOT FOR USE IN CONSTRUCTION.

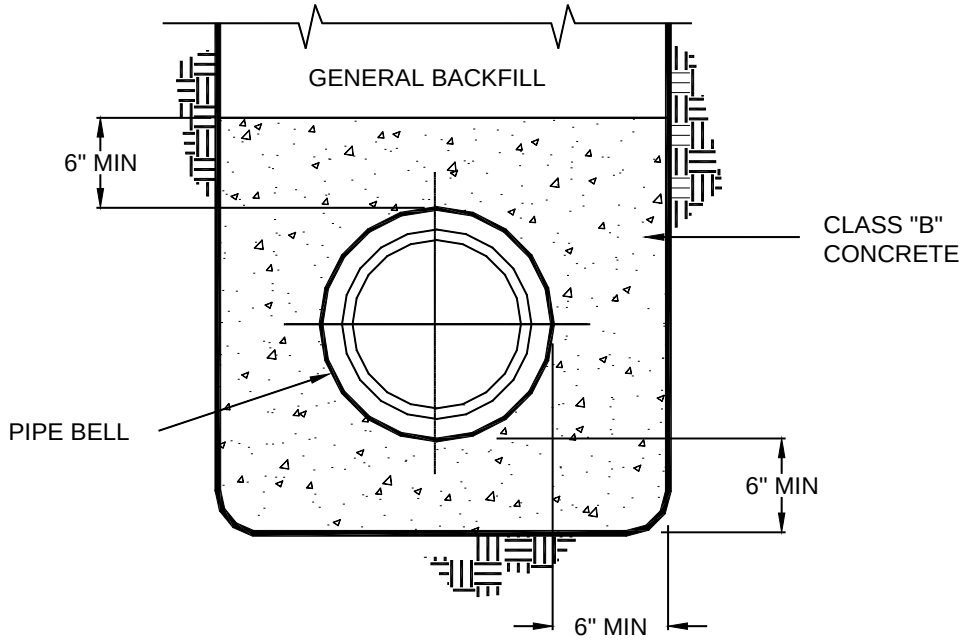
SD-01, BEDDING DETAILS FOR USE WITH DUCTILE IRON PIPE, N.T.S



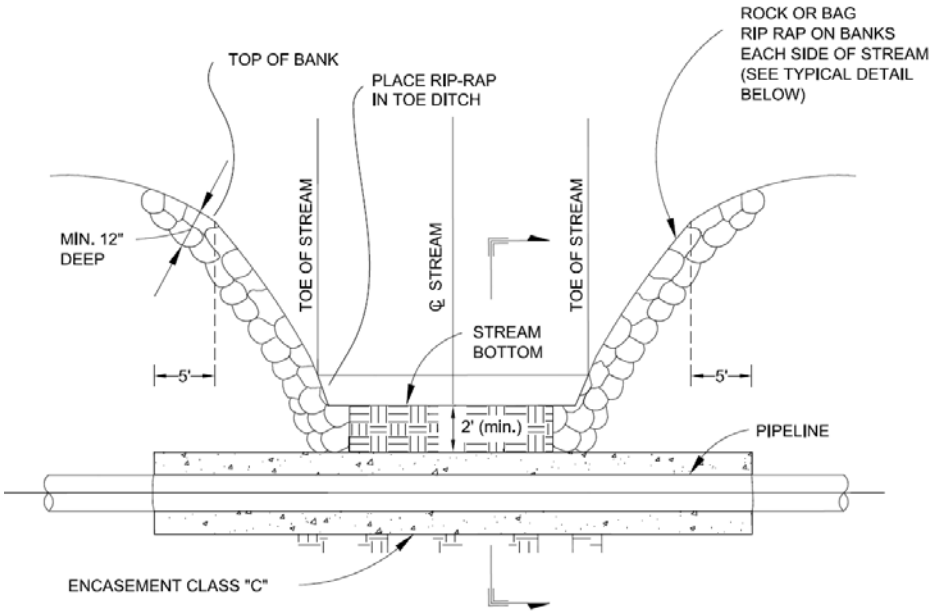
NOTE:
CRUSHED STONE BEDDING SHALL BE ANGULAR 1/4 TO 3/4 INCHES GRADED STONE. LATEST REVISION OF ASTM C33-GRADATION SIZE NO. 57.

SD-02, PVC PIPE BEDDING DETAIL (6" – 15"), N.T.S.

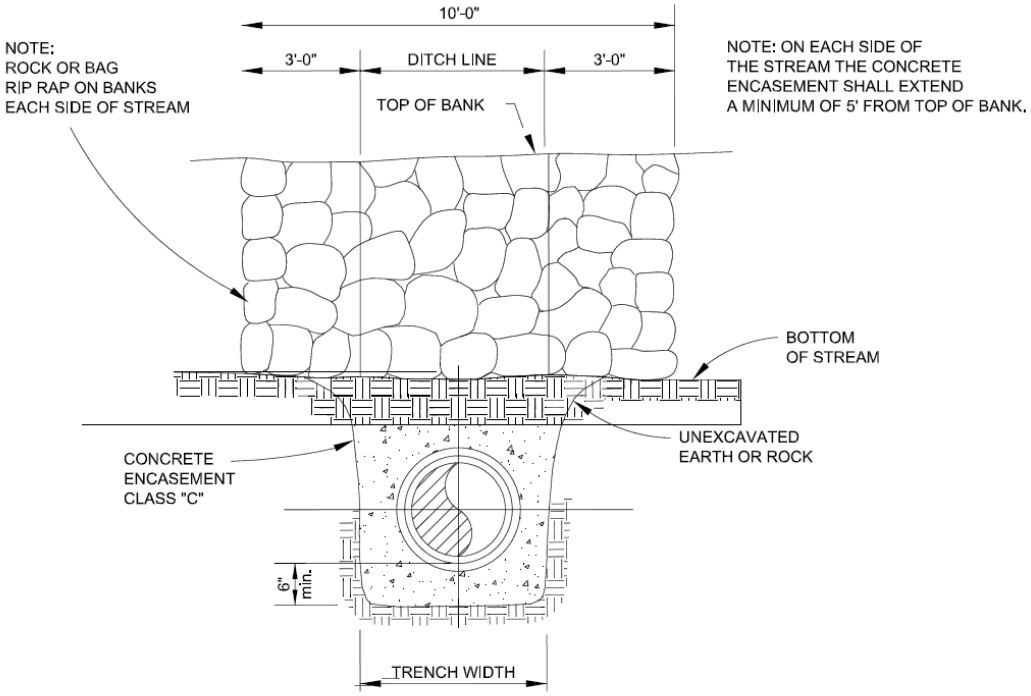
NOTE: Applicable to both earth and rock trenches, compacted stone bedding shall be 95% - 100% passing on 1-2 sieve, 95% - 100% retained on No.4 sieve.



SD-03, CONCRETE ENCASEMENT, N.T.S.

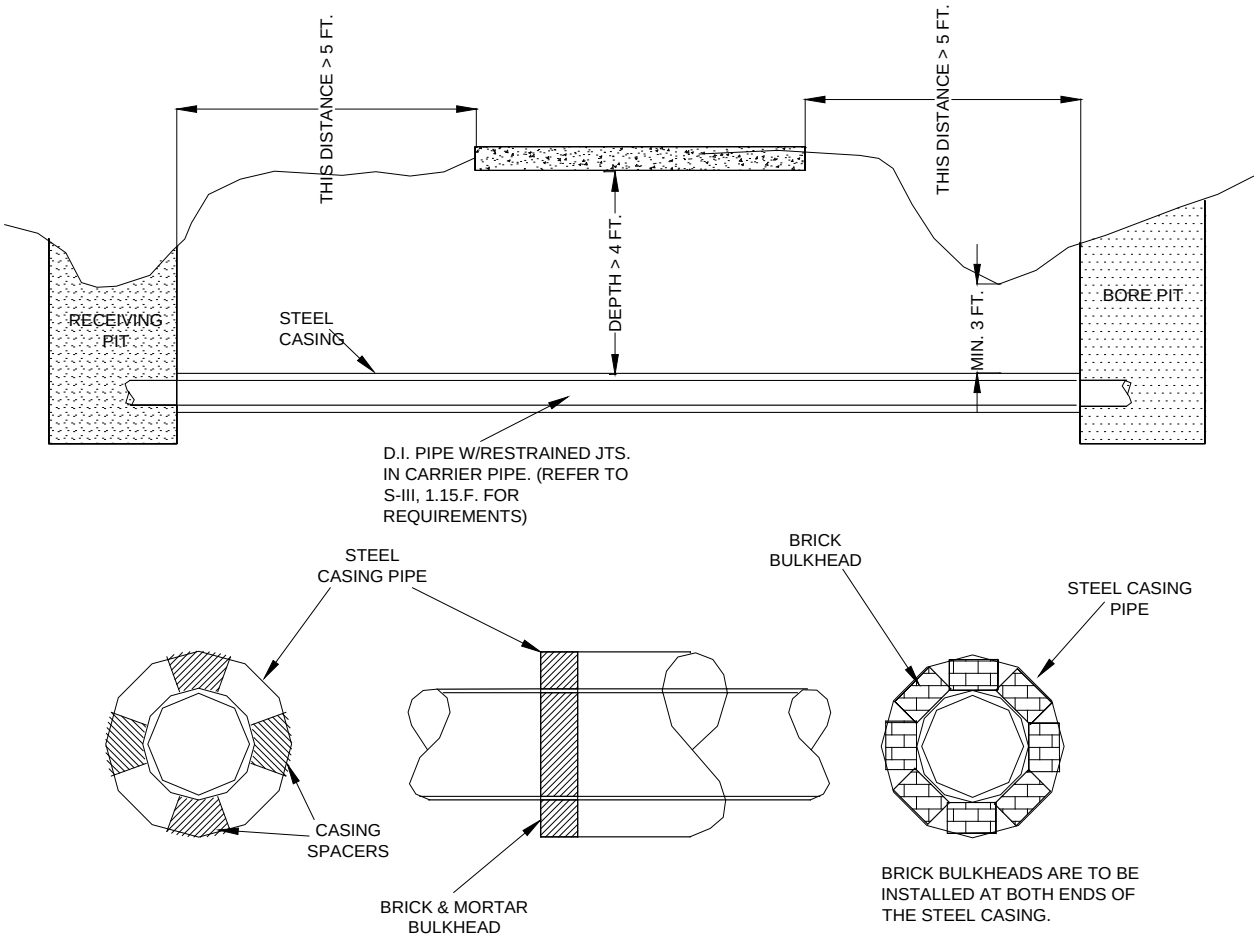


TYPICAL DETAIL FOR RIP RAP
ON BANKS OF STREAM
N.T.S



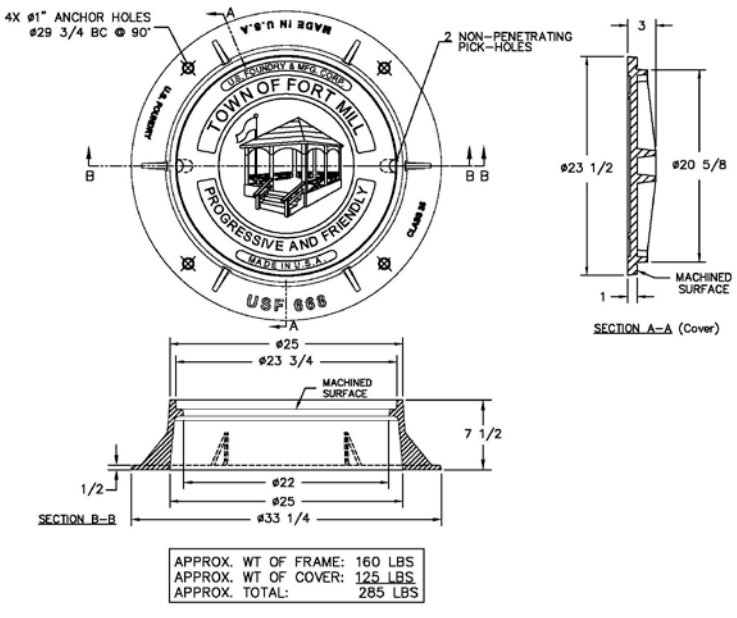
TYPICAL STREAM CROSSING DETAIL
N.T.S

SD-04, RIP-RAP & STREAM CROSSING DETAIL, N.T.S



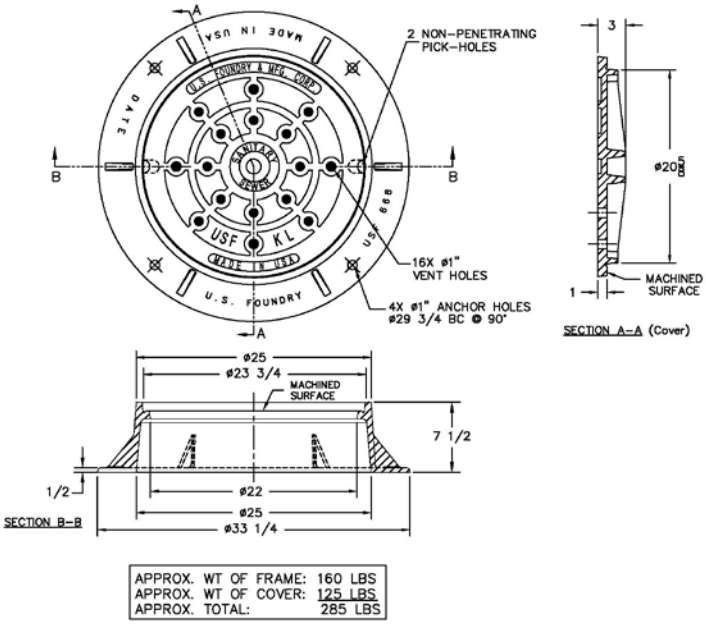
CASING SPACERS SHALL BE FLANGED, BOLT-ON STYLE WITH A TWO-SECTION STAINLESS STEEL SHELL LINED WITH A PVC LINER, MINIMUM 0.09-INCH THICK ALSO HAVING A HARDNESS OF 85-90 DUROMETER. RUNNERS SHALL BE ATTACHED TO STAINLESS STEEL RISERS WHICH SHALL BE PROPERLY WELDED TO THE SHELL. THE HEIGHT OF THE RUNNERS AND RISERS SHALL BE MANUFACTURED SUCH THAT THE PIPE DOES NOT FLOAT WITHIN THE CASING. CASING SPACERS SHALL BE CASCADE WATERWORKS MANUFACTURING COMPANY OR EQUAL.

SD-05, STEEL PIPE CASING DETAIL, N.T.S.



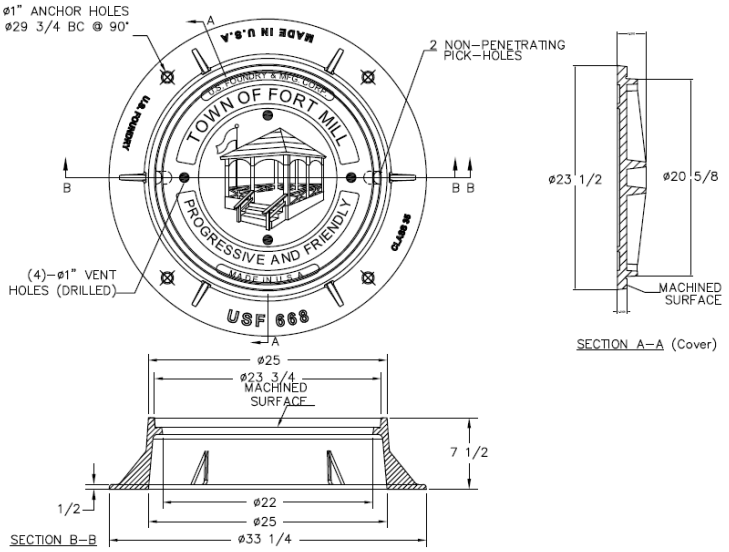
APPROX. WT OF FRAME: 160 LBS
APPROX. WT OF COVER: 125 LBS
APPROX. TOTAL: 285 LBS

TYPICAL PLAIN C.I. MANHOLE FRAME & COVER
US FOUNDARY & MFG. CORP.
MODEL USF 668 RING & USF NJ COVER BWT
N.T.S.



APPROX. WT OF FRAME: 160 LBS
APPROX. WT OF COVER: 125 LBS
APPROX. TOTAL: 285 LBS

TYPICAL VENTED C.I. MANHOLE FRAME & COVER
US FOUNDARY & MFG. CORP.
MODEL USF 668-KL RING & COVER
N.T.S.



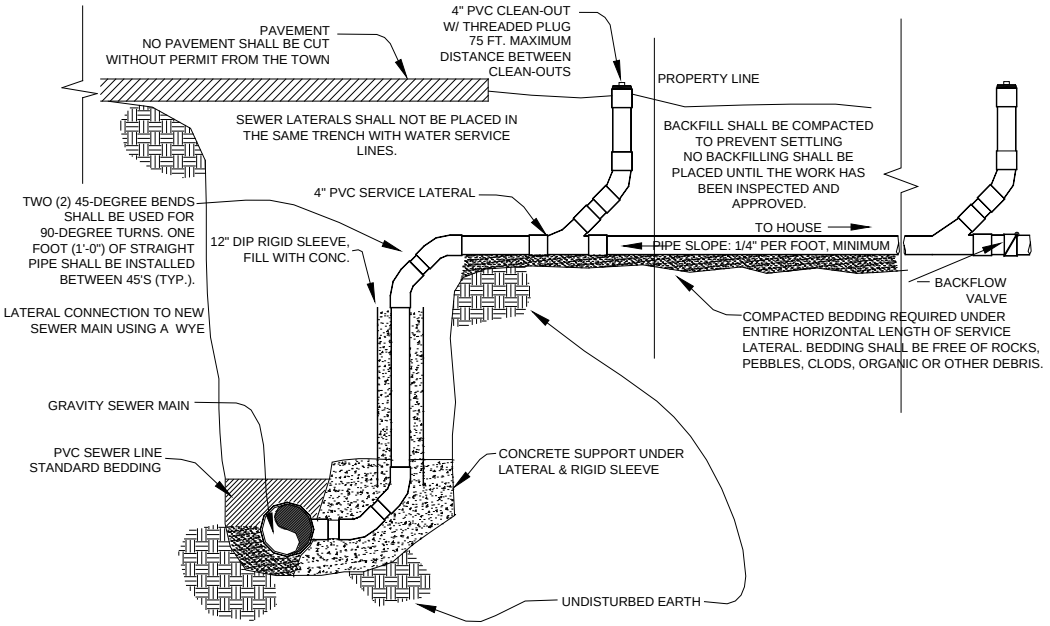
APPROX. WT OF FRAME: 160 LB
APPROX. WT OF COVER: 125 LB
APPROX. TOTAL: 285 LB

NOTE:

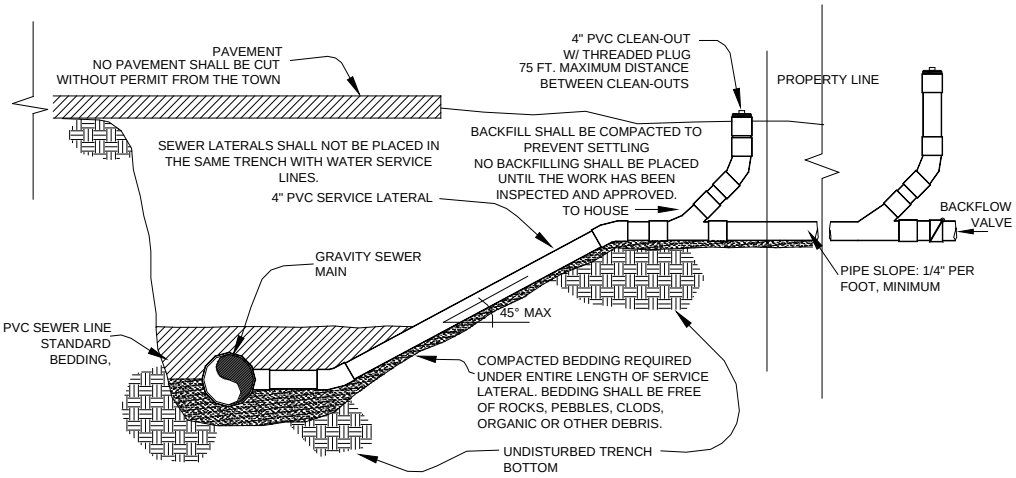
SECURE MANHOLE FRAME FOR ALL MANHOLES OUTSIDE OF PAVED AREAS WITH 4 - SS ANCHORS (TYPICAL ALL TYPES OF F&Cs).

TYPICAL VENTED C.I. MANHOLE FRAME & COVER
U.S. FOUNDARY & MFG. CORP.
MODEL USF 668 RING & USF NJ COVER
N.T.S

SD-06, C.I. MANHOLE FRAME & COVER DETAIL, N.T.S

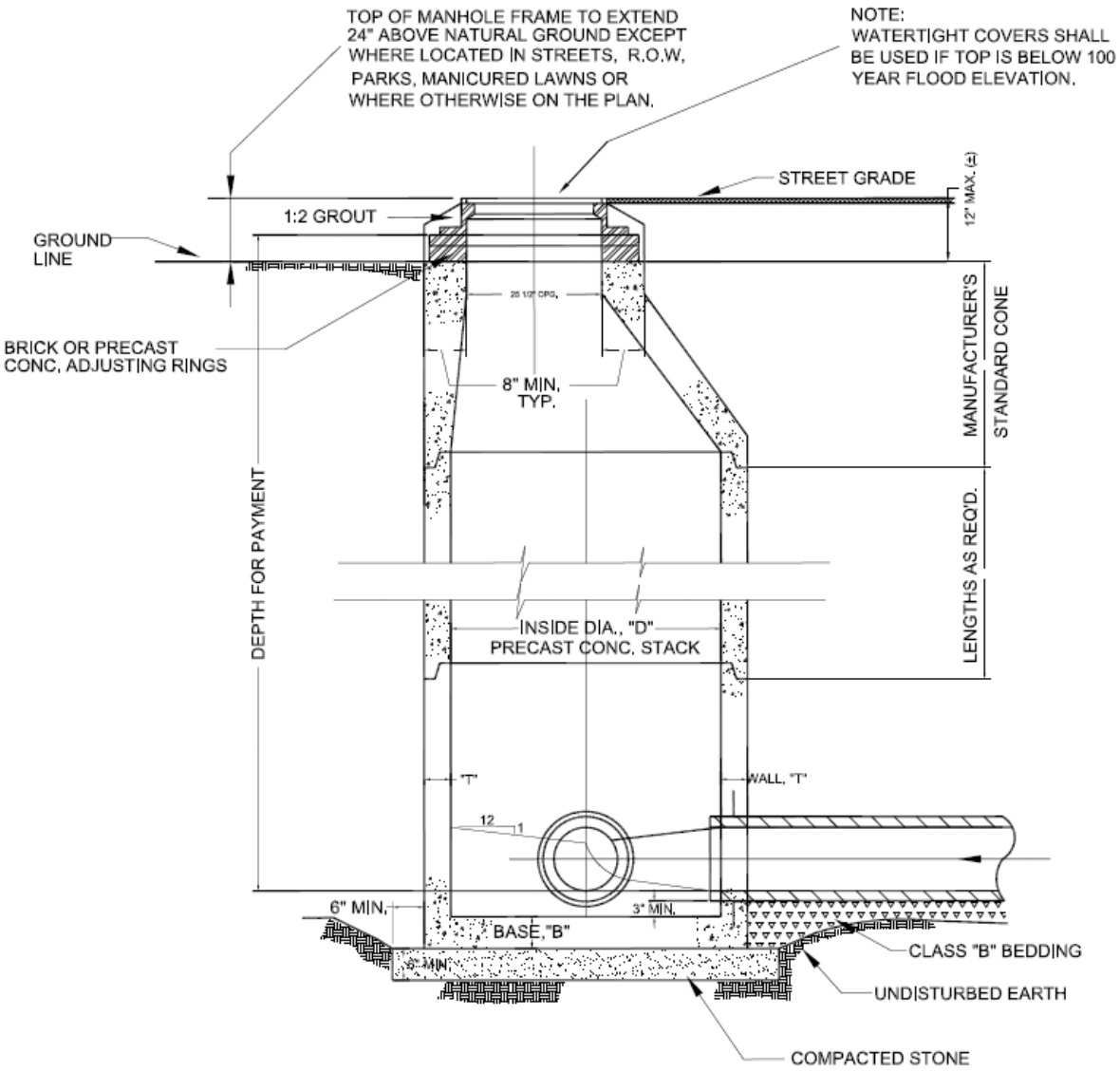


TYPICAL DETAILS OF VERTICAL RISER
N.T.S.



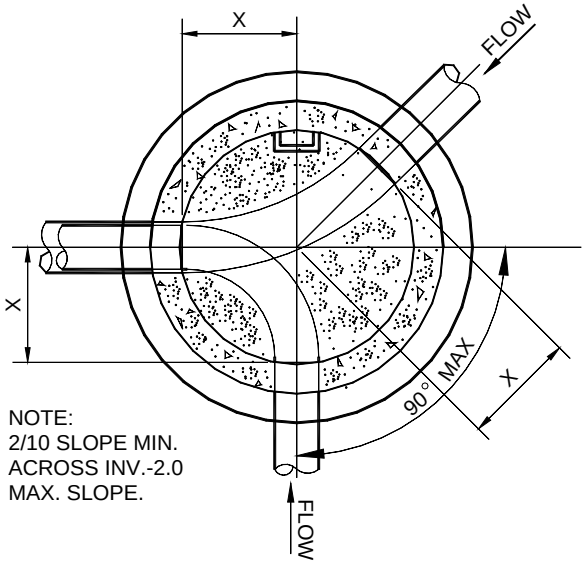
TYPICAL DETAILS OF SANITARY HOUSE SERVICE LINE

SD-07, SANITARY HOUSE SERVICE LINE – TYPICAL FOR DEEP CUTS, N.T.S.



DIAMETER, "D"	WALL, "T"	BASE, "B"
48–INCHES	5–INCHES	6-INCHES
60–INCHES	6-INCHES	8–INCHES
72–INCHES	7-INCHES	8–INCHES

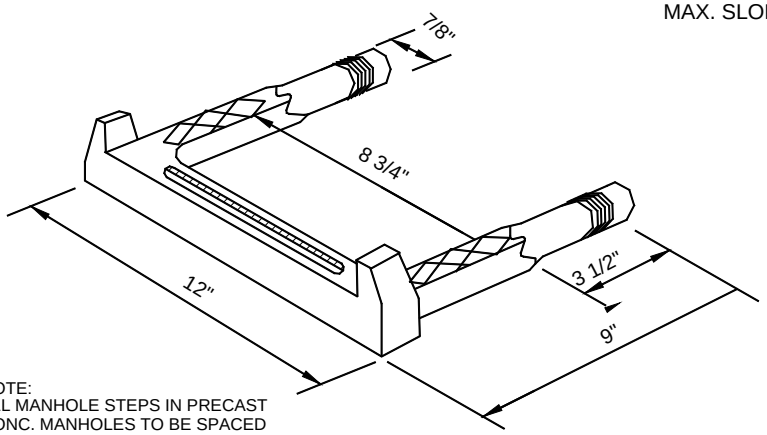
SD-08, PRECAST CONCRETE MANHOLE, SECTION DETAIL, N.T.S.



NOTE:
2/10 SLOPE MIN.
ACROSS INV.-2.0
MAX. SLOPE.

TYPICAL INVERT PLAN

(ALL SIZES)
N.T.S.



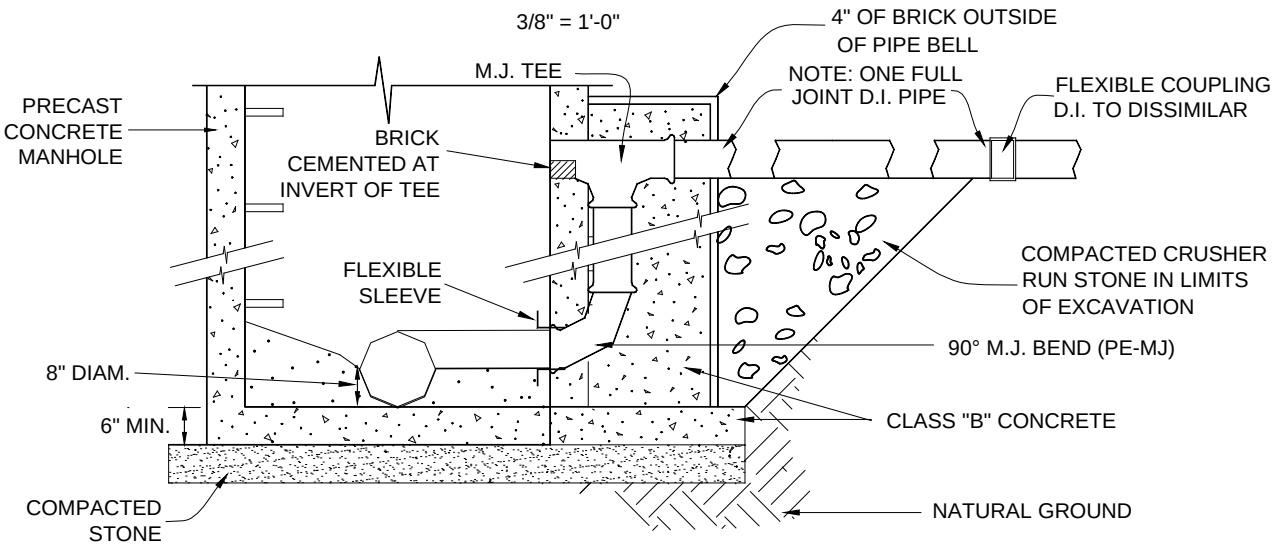
NOTE:
ALL MANHOLE STEPS IN PRECAST CONC. MANHOLES TO BE SPACED 14" TO 16" C.C. STEPS SHALL HAVE GRADE 60 3/8" DEFORMED STEEL REINFORCING ROD CENTER

POLYPROPYLENE PLASTIC
MANHOLE STEP DETAIL

FOR PRECAST CONC. M.H.
N.T.S.

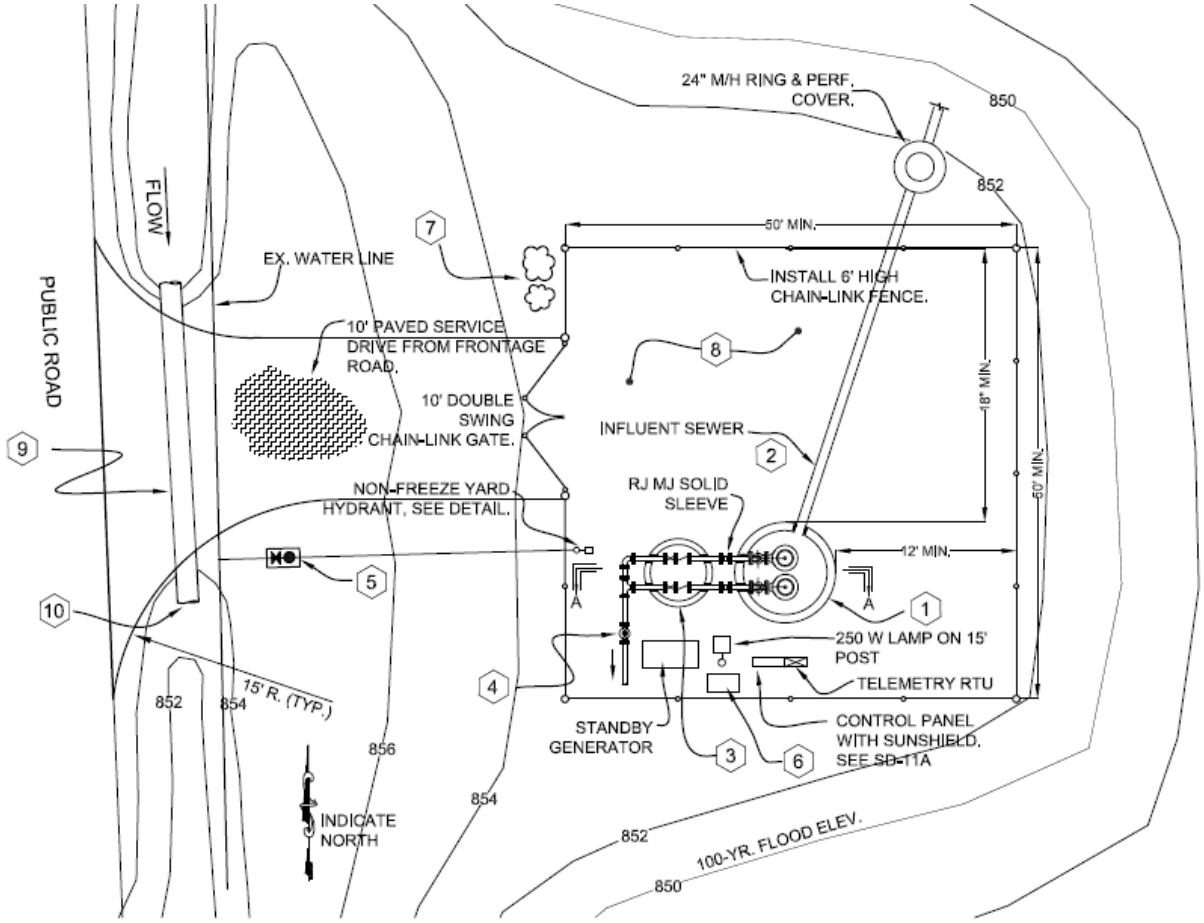
GOVERNING DIMENSIONS FOR CIRCULAR MANHOLES			
PIPE SIZE	DEFLECTION	M.H. DIA.	"X"
8" & 15"	0° 90°	4' 0"	1'-10"
18"	0° 60°	4' 0"	1'-8"
18"	60° 90°	5' 0"	2'-3"
21" & 24"	0° 60°	5' 0"	2'-2"
30"	0° 45°	5' 0"	1'-11"
21" & 24"	60° 90°	6' 0"	2'-8"
30"	45° 90°	6' 0"	2'-6"
36"	0° 60°	6' 0"	2'-5"
30" & 36"	60° 90°	7' 0"	3'-0"

SD-09, TYPICAL MANHOLE INVERT PLAN & MISC. DETAILS, N.T.S.



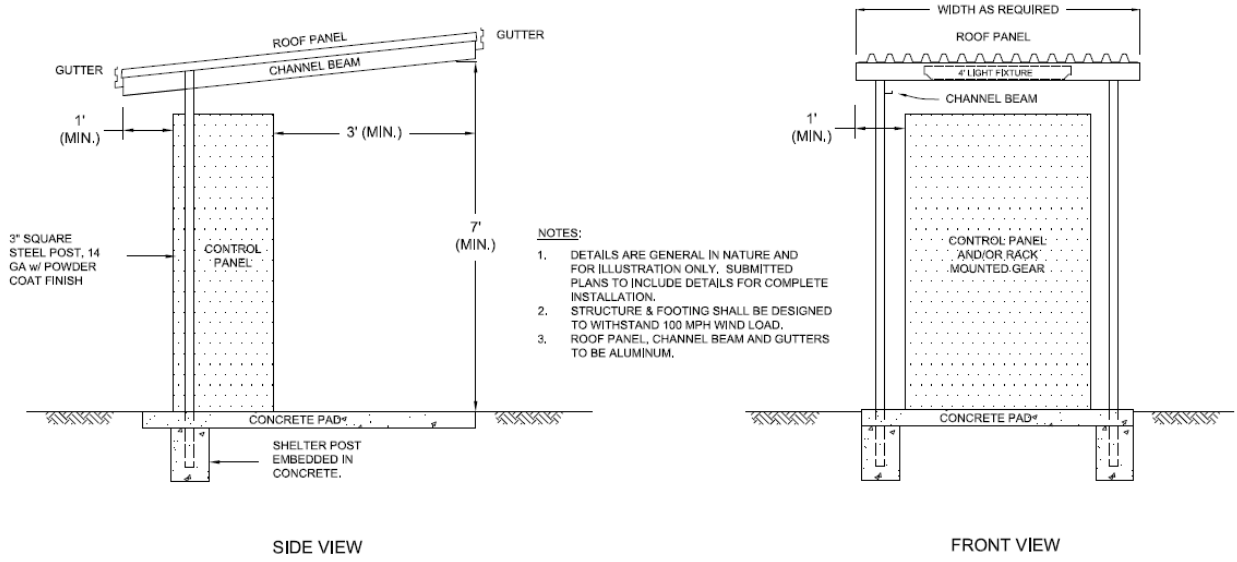
SCHEDULE FOR DROP CONNECTIONS DIM "A"		
PIPE SIZE	DROP SIZE	MIN. DROP
6"	6"	24"
8"	8"	24"
10"	8"	24"
12"	10"	35"
15"	12"	37"
18"	15"	39"
24"	21"	43"

SD-10, TYPICAL DROP MANHOLE SECTION & DETAILS, N.T.S.

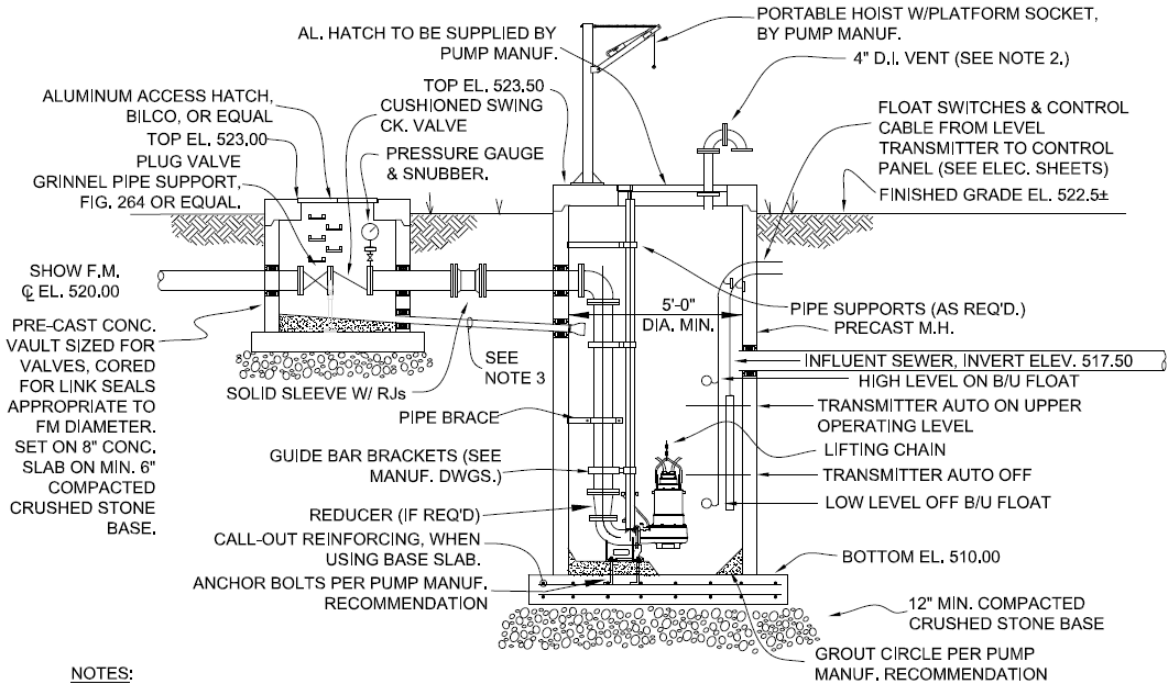


1. PRE-CAST CONC. MANHOLE USED FOR SUBMERIBLE PUMP STATION. USE SS LINK SEALS TO SECURE INLET PIPE & DISCHARGE PIPES IN MANHOLE WALL.
2. INDICATE INFLUENT LINE SIZE, MATERIAL, INVERT ELEVATION, SLOPE & POSITION ON SITE PLAN.
3. PUMP DISCHARGE VALVE VAULT. USE SS LINK SEALS TO SECURE PIPES IN VAULT WALLS. INSTALL RJ MJ SOLID SLEEVE IN LINE BETWEEN MANHOLE & VALVE VAULT.
4. CONNECTION TO FORCE MAIN FOR EMERGENCY BY-PASS PUMP (WHEN REQUIRED BY TOWN).
5. TAP EX. WATER LINE, INSTALL 3/4" WATER METER W/BACKFLOW PREVENTER IN HOT BOX, INSTALL SCHEDULE 80 PVC WATER LINE TO LIFT STATION. INSTALL 3/4" WATER LINE FOR DISTANCES LESS THAN 100' & 1" WATER FOR DISTANCES 100' OR MORE.
6. POWER COMPANY PAD-MOUNTED TRANSFORMER. IF O/H POWER LINES, FEEDER TO PUMP STATION FROM POWER POLE SHOULD BE VIA UNDERGROUND.
7. ON OUTSIDE PERIMETER OF FENCE, PLANT EUNIMOUS, LEYLAND CYPRESS OR OTHER EVERGREEN VEGETATION APPROVED BY THE TOWN (TYP. 6' - 8' MIN. HT. AT MATURITY)
8. AREA INSIDE FENCE LINE: 1.) STRIP VEGETATION FROM AREA. 2.) TAMP SOIL. 3.) INSTALL GEOTEXTILE UNDERLINER FOR WEED BARRIER. 4.) INSTALL 6" OF COMPACTED CRUSHED STONE FOR PARKING/WORK AREA.
9. GRADE FOR PROPER TRANSITION TO EXISTING ROADWAY
10. INSTALL STORM DRAIN PIPE IN TYPE 5 TRENCH UNDER DRIVE. GRADE DITCH AT INLET TO MATCH INVERT

SD-11, TYPICAL SUBMERSIBLE PUMP STATION SITE PLAN, N.T.S

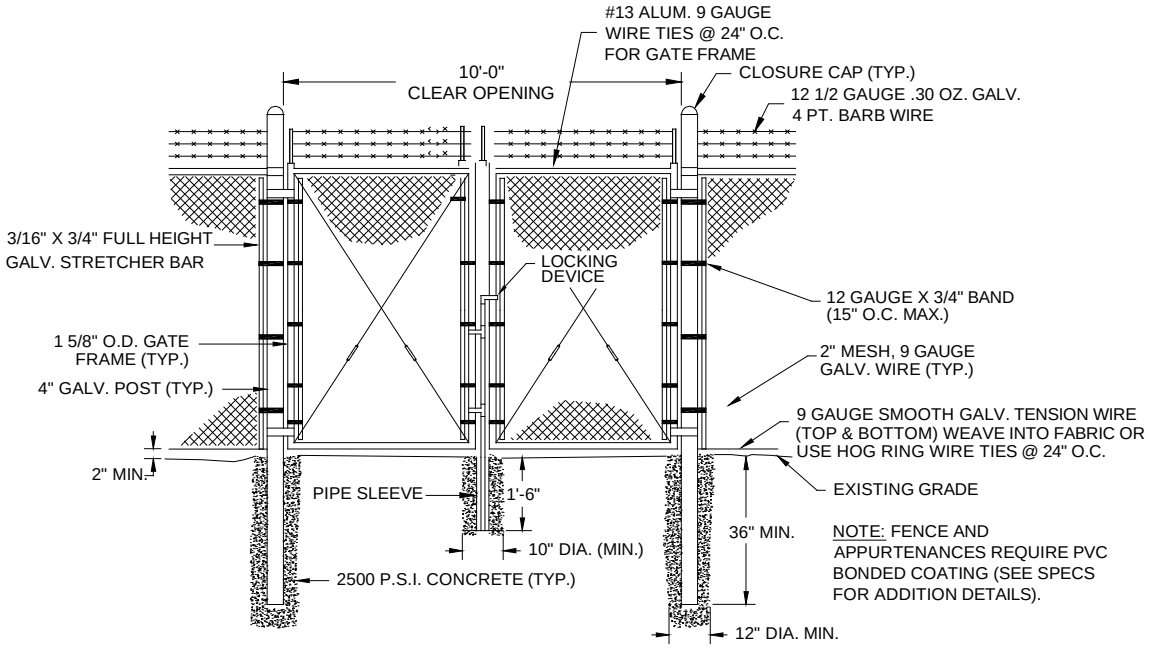


SD-11A, TYPICAL CONTROL/ELECTRICAL PANEL SHELTER, N.T.S.

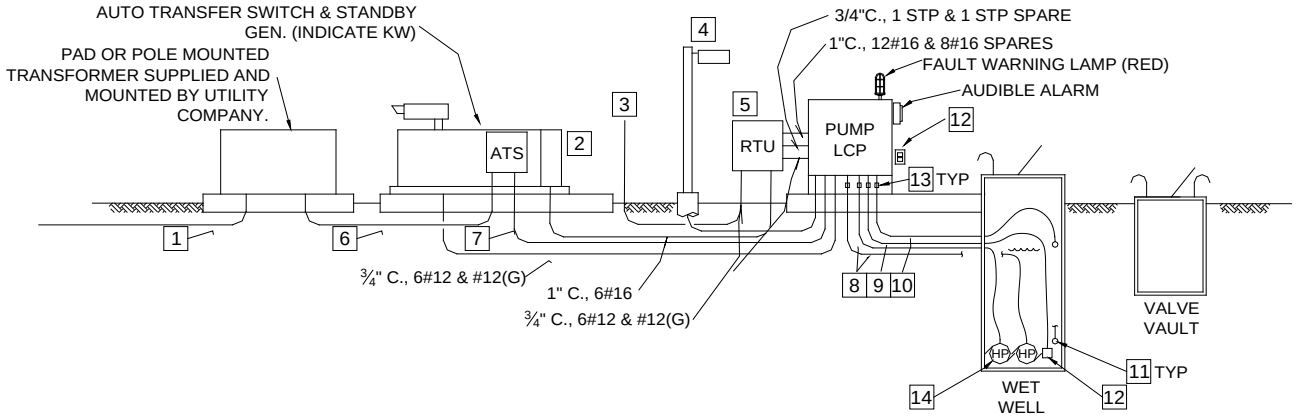


NOTES:
1. ELEVATIONS SHOWN ARE FOR ILLUSTRATION ONLY; USE ACTUAL ELEVATIONS WHEN SUBMITTING PLANS.
2. SINGLE VENT PIPE CONNECTED TO ODOR CONTROL SCRUBBER FOR PASSIVE SYSTEM. FOR MECHANICAL (FORCED AIR) SYSTEM, AIR SHALL BE FORCED INTO THE WET WELL WITH THE ODOR CONTROL SYSTEM CONNECTED TO THE EXHAUST PIPE. FAN AND SCRUBBER CAPACITY SHALL BE AS DETERMINED BY SCRUBBER MANUFACTURER. INLET AIR VENTS MUST HAVE SS INSECT SCREENS.
3. VALVE VAULT SHALL BE DRAINED BACK TO THE WET WELL. INSTALL 2" SCH. 80 PVC PIPE, SLOPE $\frac{1}{4}$ INCH PER FOOT, INSTALL ELASTOMER CHECK VALVE (TIDEFLEX TF-2, SERIES 35) ON WET WELL END OF PIPE. GROUT FLOOR OF VALVE VAULT TO SLOPE TO DRAIN. SEAL PIPE WITH SS LINK SEALS.

SD-12, TYPICAL SUBMERSIBLE PUMP STATION SECTION A-A, N.T.S.



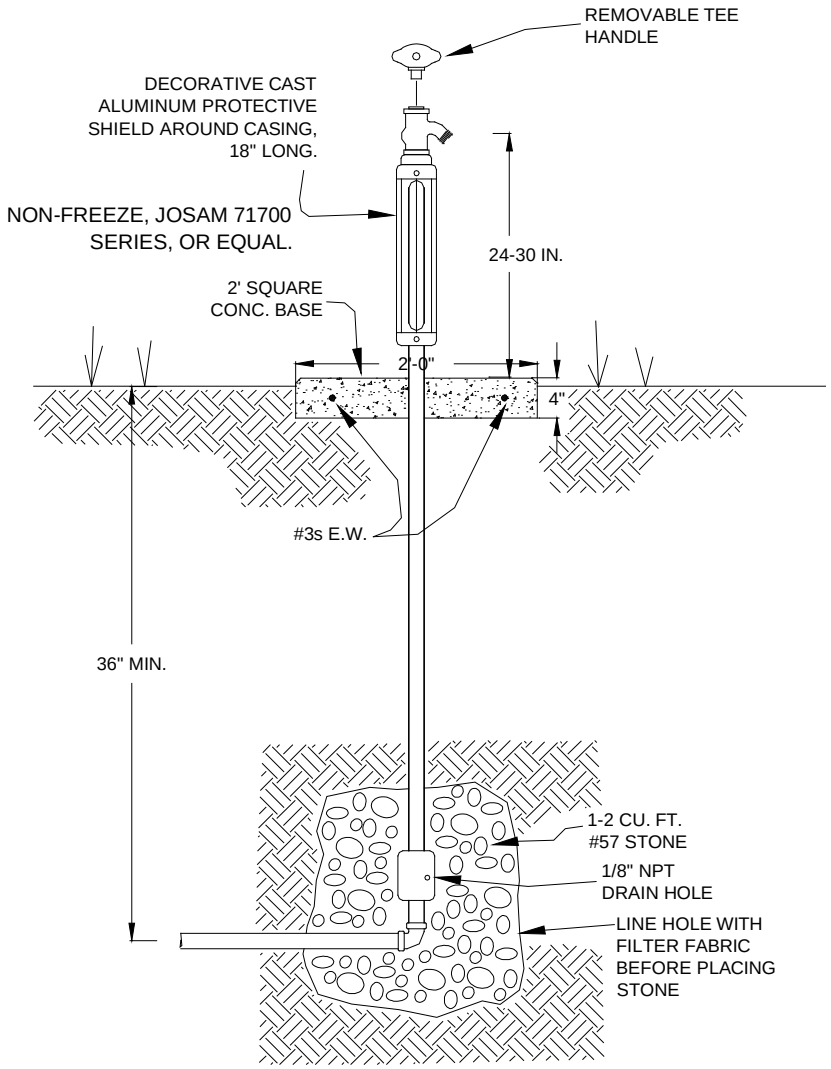
SD-13, DOUBLE-SWING GATE & FENCE DETAIL, N.T.S.



KEYED NOTES: (APPLIES TO THIS SHEET ONLY)

1. 480V, 3 PHASE, 3W SERVICE PROVIDED BY UTILITY CO. COORDINATE LOCATION AND INSTALLATION WITH POWER COMPANY.
2. ACTUAL LOCATION OF GENERATOR TO BE SHOWN ON PLAN DRAWING. GENERATOR SHALL BE POWERED BY DIESEL.
3. RTU AND TELEMETRY FROM STATION, COORDINATE WITH RTU SUPPLIER, TOWN AND CELLULAR COMPANY.
4. FURNISH AND INSTALL POLE MOUNTED LIGHTING FIXTURE EQUAL TO RUUD MODEL AC1425-M, 16" SQUARE, 250W METAL HALIDE FIXTURE ON 15' CREOSOTE WOOD POLE.
5. ALL SUPPORTS AND HARDWARE TO BE STAINLESS STEEL OR ALUMINUM. PLACE RTU ENCLOSURE AS CLOSE AS POSSIBLE TO THE PUMP CONTROL PANEL.
6. INDICATE CONDUIT SIZE, NO. & SIZE OF CONDUCTORS (e.g., 3" C., 4#1/0) FROM TRANSFORMER TO 'NORMAL' LINE OF POWER TRANSFER SWITCH.
7. INDICATE CONDUIT SIZE, NO. & SIZE OF CONDUCTORS FROM LOAD SIDE OF POWER TRANSFER SWITCH TO LINE SIDE OF PUMP CONTROL PANEL MAIN.
8. PVC COATED GALV. RIGID STEEL CONDUIT WITH SUBMERSIBLE PUMP CABLES (INDICATE CONDUIT SIZE). COORDINATE SIZE AND QUANTITY OF SUBMERSIBLE CABLES WITH PUMP MANUFACTURER PRIOR TO INSTALLING CONDUIT.
9. PVC COATED GALV. RIGID STEEL CONDUIT WITH LEVEL TRANSMITTER SUBMERSIBLE CABLES (INDICATE CONDUIT SIZE).
10. PVC COATED GALV. RIGID STEEL CONDUIT WITH LEVEL SWITCH SUBMERSIBLE CABLES (INDICATE CONDUIT SIZE).
11. FLOAT LEVEL SWITCHES FURNISHED WITH EQUIPMENT.
12. LEVEL TRANSMITTER FURNISHED WITH EQUIPMENT.
13. SEAL-OFF FITTINGS. FILL WITH GE OR DOW SILICON AFTER CONDUCTORS ARE INSTALLED.
14. INDICATE PUMP HORSEPOWER (HP) BEING PROVIDED.

SD-14, RISER DIAGRAM, N.T.S.

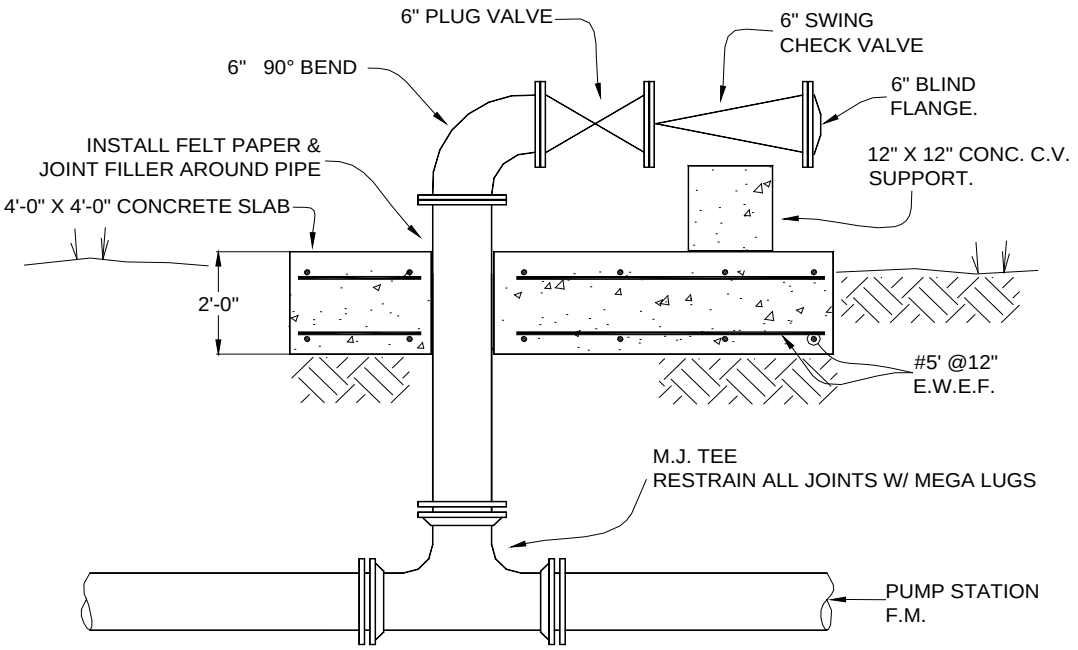


SD-15, POST-TYPE NON-FREEZE YARD HYDRANT, N.T.S

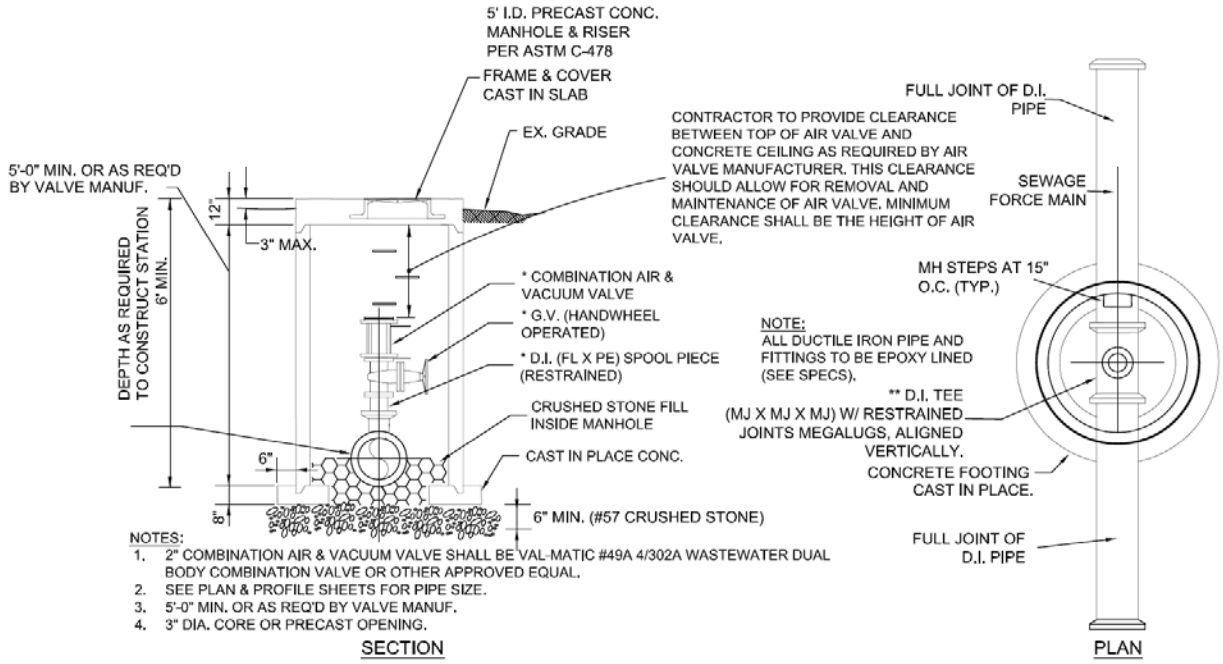
Town of Fort Mill
Water Pollution Control Facility
No. 22
NO TRESPASSING
AUTHORIZED PERSONEL ONLY
In case of Emergency, Call (803) XXX-XXX

Sign is to be 16 ga. aluminum, worded as shown, except use facility number and emergency telephone number provided by Town of Fort Mill.
Sign is to be fastened to entrance gate at eye-level.

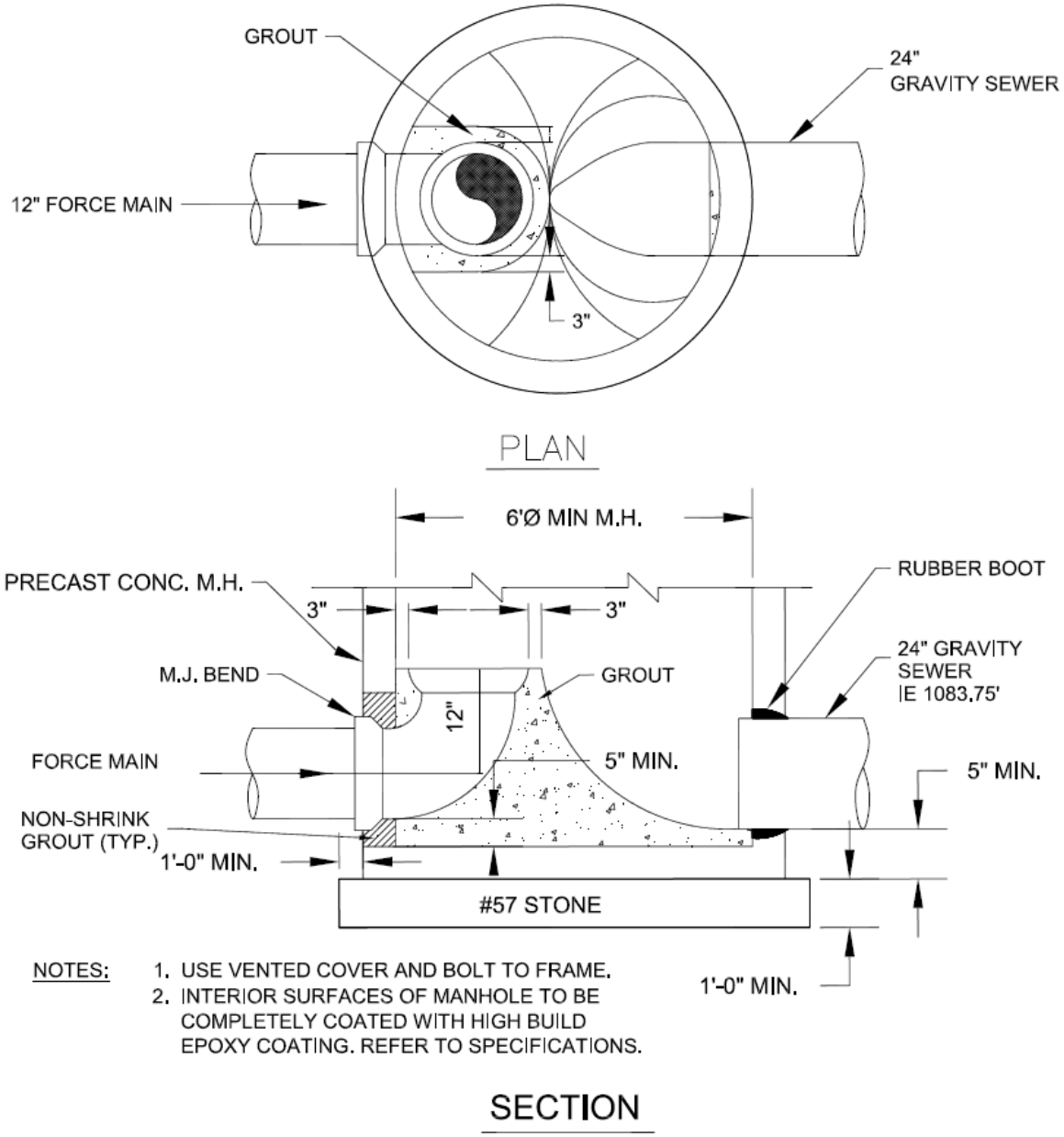
SD-16, PUMP STATION SIGN, N.T.S



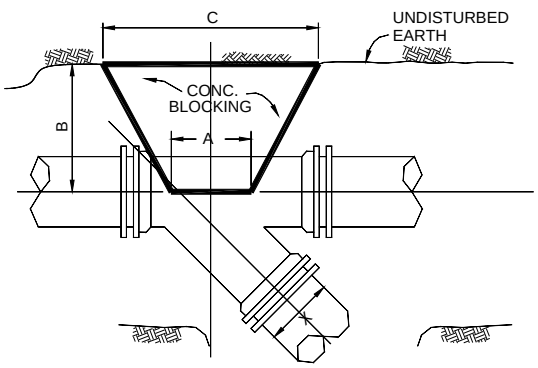
SD-17, EMERGENCY PUMP STATION BY-PASS CONNECTION, N.T.S



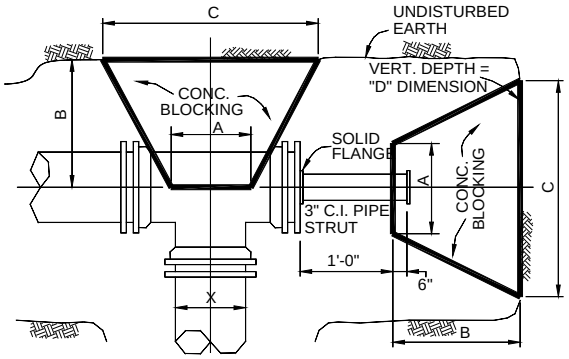
SD-18, SEWER FORCE MAIN AIR RELEASE VALVE INSTALLATION, N.T.S



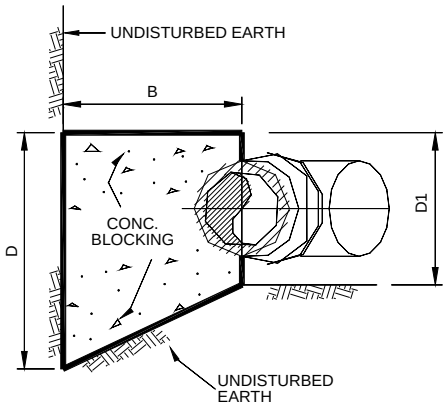
SD-19, SEWER FORCE MAIN DISCHARGE DETAIL, N.T.S



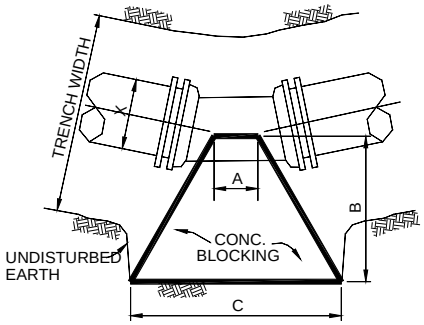
WYES



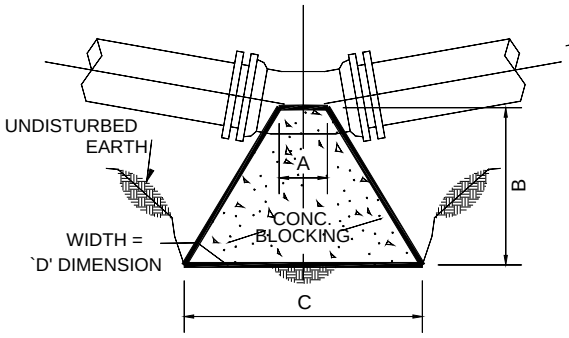
TEES



SECTION

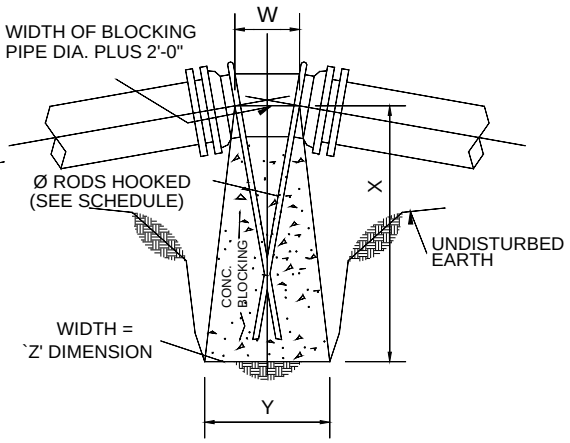


BENDS



VERTICAL UP BENDS

N.T.S.



VERTICAL DOWN BENDS

N.T.S.

SD-20A, CONCRETE BLOCKING DETAILS, N.T.S.

CONC. BLOCKING DIMENSIONS FOR FORCE MAINS					
X	A	B	C	D	D1
TEES - 12" RUN					
12"	1'-6"	2'-6"	3'-0"	3'-0"	2'-0"
10"	1'-2"	1'-6"	2'-8"	2'-6"	2'-0"
8"	1'-0"	1'-6"	2'-6"	2'-0"	1'-0"
6" or less	10"	1'-6"	2'-4"	1'-0"	1'-0"
TEES - 10" RUN					
10"	1'-2"	1'-10"	3'-0"	2'-4"	1'-8"
8"	1'-0"	1'-6"	2'-6"	1'-8"	1'-8"
6" or less	10"	1'-6"	2'-4"	1'-0"	1'-0"
TEES - 8" RUN					
8"	1'-0"	1'-6"	2'-6"	1'-8"	1'-8"
6" or less	10"	1'-6"	2'-4"	1'-0"	1'-0"
TEES - 6" RUN					
6"	10"	1'-6"	2'-4"	1'-0"	1'-0"
90° BENDS					
12"	1'-2"	2'-10"	4'-0"	3'-0"	2'-0"
10"	1'-0"	2'-0"	3'-0"	2'-10"	1'-10"
8"	10"	1'-8"	2'-6"	2'-4"	1'-8"
6" or less	8"	1'-4"	2'-0"	1'-6"	1'-0"
45° BENDS					
12"	8"	2'-8"	3'-4"	2'-0"	2'-0"
10"	6"	2'-0"	2'-6"	1'-10"	1'-10"
8"	6"	1'-4"	1'-10"	1'-8'	1'-8"
6" or less	6"	1'-4"	1'-10"	1'-0"	1'-0"
22 1/2° BENDS					
12"	8"	1'-6"	1'-8"	2'-0"	2'-0"
10"	6"	1'-4"	1'-4"	1'-10"	1'-10"
8"	6"	1'-4"	1'-0"	1'-8"	1'-8"
6" or less	6"	1'-0"	1'-0"	1'-0"	1'-0"
11 1/4° BENDS					
12"	8"	1'-6"	2'-0"	1'-0"	1'-0"
10"	6"	1'-4"	1'-4"	1'-0"	1'-0"
8"	6"	1'-4"	1'-0"	1'-0"	1'-0"
6" or less	6"	1'-0"	1'-0"	1'-0"	1'-0"

PRESSURE: 150 (MAX.) SOIL: 2000 P.S.F.

NOTE: LARGER BLOCKING REQUIRED AT HIGHER PRESSURE.
PLUG - SAME AS TEE EXCEPT THAT THE LARGER SIZE IN UNEQUAL RUNS SHALL BE USED.

SD-20B, CONCRETE BLOCKING DIMENSIONS

PRESSURE: 150 P.S.I.					
45° BEND					
PIPE DIA.	W	X	Y	Z	ØROD DIA.
30"	1'-5"	13'-0"	13'-0"	13'-0"	2"
24"	1'-3"	11'-3"	11'-3"	11'-3"	1 1/2"
20"	1'-1"	10'-0"	10'-0"	10'-0"	1 1/2"
16"	12"	8'-6"	8'-6"	8'-6"	1"
12"	10"	7'-2"	7'-2"	7'-2"	1"
10"	8"	6'-3"	6'-3"	6'-3"	3/4"
8"	6"	5'-6"	5'-6"	5'-6"	3/4"
6"	4"	4'-6"	4'-6"	4'-6"	3/4"
22 1/2° BEND					
PIPE DIA.	W	X	Y	Z	ØROD DIA.
30"	2'-0"	11'-0"	11'-0"	11'-0"	1 1/2"
24"	1'-8"	8'-10"	8'-10"	8'-10"	1 1/2"
20"	1'-5"	7'-10"	7'-10"	7'-10"	1 1/2"
16"	1'-4"	7'-0"	7'-0"	7'-0"	1"
12"	1'-3"	5'-9"	5'-9"	5'-9"	1"
10"	12"	5'-0"	5'-0"	5'-0"	3/4"
8"	10"	4'-4"	4'-4"	4'-4"	3/4"
6"	8"	3'-8"	3'-8"	3'-8"	3/4"

SD-20C, DOWN BEND CONCRETE BLOCKING DIMENSIONS – 150 PSI

NOTE: FOR HIGHER PRESSURE THAN SHOWN, PROVIDE ENGINEERING DESIGN FOR LARGER SIZE BLOCKING REQUIRED