



DEVELOPER'S SPECIFICATIONS

Covering

Sanitary Sewerage Facilities

for

Guilford Township Authority

Guilford Township

Franklin County, Pennsylvania

October 2022

INTRODUCTION

These STANDARD CONSTRUCTION AND MATERIAL SPECIFICATIONS (Specifications) set forth the minimum technical requirements for the design and construction of sanitary sewer facilities which are intended to become a part of the Guilford Township Authority's (Authority) wastewater collection and conveyance system (System). The Specifications are typically used by engineers and contractors working for developers who intend to construct extensions to Authority's existing System.

These Specifications are in addition to Authority's Rates, Rules and Regulations (Regulations) which contain the general administrative requirements and also some technical requirements for extensions to the System. The emphasis in these Specifications is on the design and installation of collection and conveyance pipeline facilities. In the event of any conflict between the Regulations and these Specifications the Regulations shall prevail. While these Specifications also contain minimum requirements and guidance on pump stations, the design of those and certain other facilities will be reviewed and regulated on a case-by-case basis. These Specifications cannot cover every possible facility design and installation scenario, therefore the Authority reserves the unqualified right to modify or establish additional requirements to insure the integrity, operational viability, and life span of the facilities to be constructed.

All construction plans must be reviewed and approved by the Authority prior to the commencement of any construction.

All Construction Drawings must contain the following Notes:

SANITARY SEWER NOTES

1. All sewer line construction shall be performed in accordance with the Guilford Township Authority Standard Sewer Specifications.
2. Approval of this subdivision/land development plan by the Guilford Township Authority does not, in any way, guarantee or reserve capacity within the Authority's wastewater collection and conveyance system to serve the lots and/or plans so approved.
3. It is the lot owner's responsibility to determine whether or not a sewage grinder pump is required for the discharge of wastewater into the sanitary sewer system. Should a grinder pump system be required, the property owner must purchase the Environment One current design D-Series simplex grinder pump as specified by the Guilford Township Authority. Property owners may contact the Guilford Township Authority Manager for assistance in acquiring the specified grinder pump system.

Definitions

Developer - An individual, partnership, corporation or other legal entity intending to develop a tract of land for residential or other purposes which tract is proposed to be served by wastewater facilities of the Guilford Township Authority.

Authority - the Guilford Township Authority, Franklin County, PA acting directly through its Board or through any agent, officer or employee duly authorized to act on its behalf.

Drawings or Plans- Collectively, all of the drawings or plans for the subdivision, or land development project approved by the municipality in which the project is located or in the alternative those drawings or plans approved by the Authority with respect to the proposed wastewater facilities. This term shall include any supplementary drawings or plans issued by the Developer and approved by the Authority to provide clarification or additional details for the proposed facilities.

Engineer - the person or firm duly employed by the Authority to provide engineering services in its behalf. Such person or firm may provide construction observation and resident project representative services for the Authority in connection with the development project. The services may be performed by the Engineer directly or through its duly authorized agents, officers, or employees. At the Authority's sole discretion it may act in the role of the Engineer as the term is used throughout these Specifications.

Contractor - the person or firm engaged by the Developer to construct the proposed wastewater facilities as shown on the Drawings or Plans or otherwise as part of the development project. The term includes the Contractor's agents, officers, and employees.

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SECTION 01 00 00 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Developer shall provide all labor, materials, equipment and services and perform all operations required for complete installation of all items and work in these Specifications and as indicated on the Drawings. Drawings shall be considered construction drawings approved by the Authority or its Engineer. No changes can be made to the approved drawings without the authorization of the Authority or its Engineer.

1.2 REFERENCED STANDARDS AND SPECIFICATIONS

- A. Standards and other publications referenced in these Specifications shall be of the issues in effect at time of construction of the project facilities.
- B. References are made to the Pennsylvania Department of Transportation specifications. Unless otherwise noted, the State specifications referred to are the Department of Transportation Publication 408 Specifications, as Amended. Reference in the State Specifications to 'State', 'Chief Engineer', or 'Department' shall be interpreted as the ENGINEER as herein defined. When particular articles or sections are referred to, all paragraphs other than those relating to measurement and payment shall apply.

1.3 WORK CONDITIONS

- A. Construct the work in stages to provide for public convenience.
 - 1. Do not close off public use of facilities until completion of one stage of construction will provide alternative usage.
- B. Conduct construction operations to ensure the least inconvenience to the general public.
- C. Take measures to control traffic when working on or near public roads and streets.
 - 1. Employ traffic control measures in accordance with Pennsylvania Department of Transportation Publication No. 213, "Work Zone Traffic Control".
- D. Restore existing paving outside the limits of the work that is damaged by the Developer's operations, to its original condition at the expense of the Developer.
- E. Continuously keep rights-of-way, storage areas, streets, roads, highways and adjacent properties free from accumulations of waste materials, excess excavation, rubbish and windblown debris resulting from construction operations.

F. Protection of Existing Utilities and Structures:

1. Notify Pennsylvania One Call by dialing 811 at least 3 working days in advance of intent to excavate, do demolition work or use explosives and give the location of the job site. Mark area to be excavated with white paint. Renew notification every 10 days.
2. Advise each person in physical control of powered equipment or explosives used in excavation or demolition work of the type and location of utility lines at the job site, the Utility Company assistance to expect, and procedures to follow to prevent damage.
3. Immediately report to the Utility Company and to the Authority and its Engineer any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of affected premises of any emergency created or discovered.
4. Allow free access to the site to Utility Company personnel at all times for purposes of maintenance, repair and inspection.
5. Notify County Control, all school districts affected, Franklin County EMA and Guilford Township if any interference with the normal flow of traffic will be caused by this work.
6. Developer must obtain a Road Occupancy Permit from Guilford Township if the work affects a Township road.

1.4 PENNDOT HIGHWAY OCCUPANCY PERMIT AND BONDS

- A. The Developer's attention is directed to Chapter 459, Occupancy of Highways by Utilities under Title 67 Transportation of the Pennsylvania Code. The Developer will pay the cost of the highway occupancy permit and the costs of inspection as required by PENNDOT. The Developer must complete the highway occupancy permit application and return the required number of copies to the Authority for signing. The Authority will typically be designated as the permittee. The Developer shall pay all other costs in connection with the highway occupancy permit or permits, including but not limited to all costs for special insurances and bonds and state inspectors.
- B. Bonds for construction to be performed in PennDOT right-of-ways will be held in force for the required maintenance period of two (2) years. This two (2) year period shall begin from the date of PennDOT's final inspection of the restoration

1.5 PERMITS

- A. The Developer will secure and pay the cost for the Department of Environmental Protection Water Quality Management permit, if applicable.
- B. The Developer shall secure and pay for all other permits required to comply with Federal, State, and local ordinances and regulations.
- C. The Developer shall obtain and pay for a Guilford Township Road Occupancy Permit when working on Township Roads.

PART 2 - PRODUCT (NOT USED)

PART 3 - EXECUTION

3.1 PROCEDURE

- A. Confer and verify with other contractors and Utility Companies as to locations and extent of their work, to the end that interferences and deletions between trades are prevented.

3.2 DEVELOPER'S USE OF PREMISES

- A. Confine construction equipment, the storage of materials and equipment, and operations of workmen to within the permanent and temporary rights-of-way.
- B. Pipeline materials may be stored appropriately along the route of the work provided such stored materials do not unduly restrict public use or infringe on private property.
- C. Assume full responsibility for materials stored on site.
- D. Transport materials remaining at the completion of the project to an acceptable storage area.

3.3 SEWER AND WATER MAIN SEPARATION

A. Horizontal Separation:

- 1. Sewers, including manholes, should be separated at least 10 feet, horizontally, from any existing or proposed water mains. Should local conditions prevent a lateral separation of 10 feet, a sewer may be closer than 10 feet to a water main if:
 - a. it is laid in a separate trench; or if
 - b. it is laid in the same trench with the water main located at one side of a bench of undisturbed earth; and if
 - c. the elevation of the top (crown) of the sewer is at least 18 inches below the bottom of the bottom (invert) of the water main.

B. Vertical Separation:

- 1. Whenever sewers cross under water mains, the top of the sewer shall be at least 18 inches below the bottom of the water main.
- 2. When the elevation of the sewer cannot be varied to provide the required 18" vertical separation, relocate the water main, for a distance of 10 feet extending on each side of the sewer, with one full length of water main centered over the sewer so that both joints will be as far from the sewer as possible. Water main should be constructed of AWWA slip-on or mechanical joint ductile iron pipe.
- 3. Sewers shall be constructed of AWWA mechanical joint cast iron pipe for any portion within 10 feet of the water main with the sewer joints equidistant from the water main and as far as possible from the water main joints. Both sewer and water main services shall be pressure tested to assure watertightness prior to backfilling. Where a water main crosses under a sewer, provide adequate structural support for the sewer to prevent damage to the water main.

- C. A minimum of 12 inches of separation is required both horizontally and vertically between sewer mains and all other utilities (i.e. storm sewer, gas lines, etc.). Where it is not possible to achieve this 12 inches of separation minimum, the Developer must receive approval from the Authority.
- D. Special Conditions: Where it is impossible to obtain proper horizontal and vertical separation as specified, construct the pipelines as specified above and, in addition, encase the sewer line with minimum 6" cement concrete or flowable fill for 10 feet on either side of the water main.

3.4 SOIL EROSION AND SEDIMENTATION CONTROL PLAN

- A. The Developer is required to provide soil erosion and sedimentation control measures as indicated in the Soil Erosion and Sedimentation Control Plan from the Franklin County Conservation District which will be completed as necessitated by the nature or extent of the work. The Developer is responsible for obtaining approval of the Erosion and Sediment Control Plan including any associated costs. Approval must be obtained prior to starting work.

3.5 FIELD INSPECTION

- A. Field inspection will be required and provided by the Authority or its Engineer. Inspection will also include witnessing of testing. The Authority's Inspector shall have the authority to halt construction if, in his opinion, construction is not being done according to specifications. The approved design may not be altered without written approval of the Authority and/or its Engineer. A final inspection of all facilities is required before acceptance of flow or dedication of the facilities to the Authority. Any inspection costs incurred by the Authority will be the responsibility of the Developer.

3.6 SAFETY

- A. The Developer is responsible for compliance with all laws, codes, and regulations relating to safety provisions at the construction site. The Authority and its representatives will not be responsible for the safety of construction personnel, persons visiting the site, or the general public nor will it be responsible for the enforcement of any laws, codes, or regulations relating to safety. Enforcement of safety regulations will be the responsibility of the appropriate agency.

3.7 SEWER SYSTEM DESIGN

- A. Generally sewer system extensions shall be designed as gravity mains. The Authority may entertain a request from the Developer to allow use of a low pressure sewage system in certain limited circumstances. Any approval to use such a system shall be in the Authority's sole discretion.

3.8 REPLACEMENT OF EXISTING LATERALS

- A. Replacement of existing laterals shall be in accordance with the Authority's Rules and Regulations for sewer service.

3.9 CONNECTION OF FORCE MAIN TO GRAVITY SEWERS

- A. When connecting force mains to new or existing gravity sewers, the first three manholes downstream must be lined per Section 33 39 16, unless otherwise approved by the Authority.

3.10 INSIDE MANHOLE DROPS

- A. Inside manhole drops will be allowed only under limited special circumstances in the Authority's sole discretion.

3.11 SEWAGE PUMPING STATIONS

- A. Justification requirements for a pump station, which are contained in the Authority's Rules and Regulations, must be met before a station may be designed and constructed.
- B. The design of sewage pumping stations will vary considerably depending upon the area to be served and other site specific circumstances. Design guidelines and minimum acceptable material and construction specifications are set forth in paragraph C. below and in Appendix-II.
- C. Design of pumping stations will be in accordance with the Authority's and the Authority's Engineer's recommendations. The Authority will determine the type of station to be designed prior to the Developer's engineer commencing design of the station.

END OF SECTION 01 00 00

SECTION 03 30 53 - CONCRETE FOR UTILITY CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
1. Cast-in-place Cement Concrete Construction
 2. Reaction and Support Blocking
 3. Cradles and Encasement
- B. Related Work specified elsewhere:
1. Section 31 23 16 - Trenching, Backfilling & Compacting
 2. Section 32 12 16.10 - Paving Restoration
 3. Section 33 30 10 - Manholes
- C. Applicable Standard Details:
1. 03-01 Concrete Cradle and Encasement Details
 2. 03-03 Thrust Block for Bends, Tees, Caps
 3. 03-04 Thrust Block for Vertical Bends
 4. 33-02 Sloped Riser Lateral Detail
 5. 33-03 Vertical Riser Lateral Detail
 6. 33-23 Type A Drop Manhole Detail, PVC Pipe
 7. 33-24 Type B Drop Manhole Detail, PVC Pipe

1.2 REFERENCES

- A. Pennsylvania Department of Transportation (PennDOT): Publication 408 Specifications.
- B. All materials used in the PennDOT Road right-of-way must be from a certified PennDOT supplier.
- C. American Society for Testing and Materials (ASTM):
1. ASTM A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
 2. ASTM C31 Methods of Making and Curing Concrete Test Specimens in the Field
 3. ASTM C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
 4. ASTM C42 Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 5. ASTM C94 Ready Mixed Concrete
 6. ASTM C143 Test Method for Slump of Portland Cement Concrete
 7. ASTM C172 Method of Sampling Fresh Concrete
 8. ASTM C173 Test Method for Air Content of Freshly Mixed Concrete - Volumetric Method
 9. ASTM C231 Test Method for Air Content of Freshly Mixed Concrete - Pressure Method

1.3 SUBMITTALS

- A. Submit certification from the concrete producer attesting that the cement concrete conforms to the State Specifications for the class of concrete being used.
- B. Submit certified results of compressive strength tests performed by an independent testing laboratory.
- C. Submit detailed shop drawings of reinforcing steel.

PART 2 - PRODUCTS

2.1 CEMENT CONCRETE

- A. Ready-mixed, conforming to Section 704, cement concrete, Pub. 408 Specifications.
- B. Requirements for State approved batch plants, design computations and plant inspection shall not apply; the acceptability of concrete will be based on conformance with the Cement Concrete Criteria specified below and the results of the specified tests.
- C. Cement Concrete Criteria:
 - 1. Class A:
 - a. 28-day compressive strength: 3300 psi
 - b. Slump: 1 to 3 inches
 - 2. Class C:
 - a. 28-day compressive strength: 2000 psi
 - b. Slump: 2 to 6 inches
 - 3. High Early Strength:
 - a. 3-day compressive strength: 3000 psi
 - b. Slump: 1 to 3 inches
 - 4. Cement Factor and Maximum Water-Cement Ratio conforming to Table A, Section 704.1(b), Pub. 408 Specifications.

2.2 REINFORCEMENT STEEL

- A. Reinforcement Bars:
 - 1. New billet-steel bars conforming to ASTM A615.
 - 2. Deformed, Grade 60.
- B. Steel Wire Fabric: Conforming to Section 709.3, Pub. 408 Specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with applicable paragraphs of Section 1001, Pub. 408 Specifications for construction requirements including formwork, curing, protection and finishing of cement concrete.
- B. Excavate and shape trench bottoms and sides to accommodate thrust block forms, encasement, manhole bases, inlets and vaults.
- C. Support pipe, valves and fittings at the required elevation with brick or concrete block. Do not use earth, rock, wood, or organic material as supports.
- D. Proper grade markers or stakes shall be used by Developer to establish grades for ramps, platforms, sidewalks, slopes to drains and inlets.

3.2 CONSTRUCTION

- A. Construct cast-in-place vaults, inlets, endwalls, curbs, sidewalks and miscellaneous reinforced structures of Class A concrete; Class A concrete shall be central-plant-mixed.
- B. Construct reaction and support blocking, cradles, encasements, and miscellaneous mass concrete of Class C concrete; Class C concrete may be from a mobile cement concrete plant or truck-mixed.
- C. Concrete Curbs:
 - 1. Construct of Class A concrete with air entrainment, where indicated on Drawings; use expansion material between curbs and sidewalks and at control joints.
 - 2. Curbs shall include one construction joint every 10' and one expansion joint every 30'.
 - 3. Concrete curbs shall be installed according to local Government requirements.
- D. Construct reinforced and plain cement concrete roadway pavements and base courses of High Early Strength concrete; High Early Strength concrete shall be central-plant-mixed.
- E. Provide spacers, chairs, bolsters, ties and other devices for properly placing, spacing, supporting and fastening reinforcement in place.
- F. Place concrete utilizing all possible care to prevent displacement of pipe or fittings; return displaced pipe or fittings to line and grade immediately.
- G. Insure tie rods, nuts, bolts and flanges are free and clear of concrete.
- H. Do not backfill structures until concrete has achieved its initial set, forms are removed, and concrete work is inspected by the Authority's Engineer.
- I. Perform backfilling and compaction as specified in Section 31 23 17 - Trenching, Backfilling and Compacting.

3.3 FINISHING

- A. Integral Finishes: Obtain finishes on concrete slabs without applying separate topping coat, as follows.
 - 1. Broom Finish: Draw stiff broom over previously floated finish, to obtain non-slip finish, on exterior sidewalks, ramps, stairs, pads and similar locations.

3.4 FIELD TESTS OF CONCRETE DURING CONSTRUCTION

- A. Perform compressive strength tests, slump tests, and air content tests for each 50 cubic yards of each class of structural concrete placed, or fraction thereof. Testing is not required for non-structural applications such as sidewalks and other such uses.
- B. Retain an independent testing laboratory to test cylinders.
- C. Keep a slump cone and an air meter in close proximity to all concrete placements.
- D. Sample concrete in accordance with ASTM C172.
- E. Determine slump in accordance with ASTM C143.
- F. Determine air content in accordance with ASTM C231 or ASTM C173 as applicable.
- G. Test Cylinders:
 - 1. Cast at least 5 cylindrical test specimens for each batch.
 - 2. Test two cylinders at 7 days; test two cylinders at 28 days.
 - 3. Hold the remaining cylinder in reserve for testing in the event that any of the other cylinders are damaged prior to testing.
 - 4. Prepare and cure test cylinders in accordance with ASTM C31.
 - 5. Determine concrete compressive strength in accordance with ASTM C39.
 - 6. Compute and evaluate in accordance with ASTM C94.
- H. If test cylinders fail to meet compressive strength requirements, the Authority may require additional core tests in accordance with ASTM C42 at the expense of the Developer.

END OF SECTION 03 30 53

SECTION 03 40 00 - PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Pump Stations

B. Related Work Specified Elsewhere:

1. Section 31 20 00 - Earthwork

1.2 QUALITY ASSURANCE

A. Design Criteria:

1. Watertight precast reinforced air-entrained concrete structures designed to ASTM C890 A-16 live loading and installation conditions, and manufactured to conform to ASTM C913.
2. Minimum 28-day Compressive Strength: 5,000 psi
3. Honeycombed or retempered concrete will not be acceptable.

B. Reference Standards:

1. American Society for Testing and Materials (ASTM):
 - a. A185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - b. A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - c. C33 Specifications for Concrete Aggregate
 - d. C150 Specification for Portland Cement
 - e. C260 Specification for Air-Entraining Admixtures for Concrete
 - f. C858 Underground Precast Concrete Utility Structures
 - g. C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
 - h. C891 Practice for Installation of Underground Precast Concrete Utility Structures
 - i. C913 Specifications for Precast Concrete Water and Wastewater Structures.
 - j. C990 Specifications for Joints for concrete Pipe, Manholes, and Precast box Sections Using Preformed Flexible Joints Sealants

C. The precast concrete structures shall have sufficient weight to counteract the buoyancy uplift from ground water that is at a level equal to the top of the structures with a factor of safety of 1.5. Provide calculations demonstrating this requirement is being met. The Developer shall add additional weight as needed by installing a poured-in-place anchoring collar that is structurally anchored to the precast structure via screwed in dowel rods.

1.3 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Submit detailed shop drawings to the Authority for approval prior to fabrication.
 - 2. Include details of reinforcing steel, joint design, concrete mix design, and loading calculations.
- B. Submit certification from the precast structures manufacturer attesting that the structures meet or exceed Specifications.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport and handle precast concrete units with equipment designed to protect the units from damage.
- B. Do not place units in position which will cause overstress, warp or twist.
- C. Separate stacked members with battens across the full width of each bearing point.
- D. Stack so that lifting devices are accessible and undamaged, and identification marks are discernible.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C150, Type II
- B. Coarse Aggregates: ASTM C33; Graded 1" to No. 4 Sieve.
- C. Sand: ASTM C33; 2.35 fineness modulus
- D. Water: Potable; clean and free of injurious amounts of acids, alkalis, salts, organic materials, or other substances that may be incompatible with concrete or steel.
- E. Air-Entraining Admixtures: ASTM C260
- F. Reinforcing Steel:
 - 1. Deformed Bars: ASTM A615, Grade 40
 - 2. Welded Wire Fabric: ASTM A185
- G. Joint Sealant:
 - 1. ASTM C990

2.2 MIXES

- A. Design concrete mix to produce the required concrete strength, air-entrainment, watertight properties, and loading requirements.

2.3 FABRICATION AND MANUFACTURE

- A. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the Drawings, and to the specified design criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Unless otherwise specified herein below, the precast units shall be installed in accordance with ASTM C891.
- B. Install precast concrete units to the elevation and location indicated on the Drawings.
- C. Install required pipe connections, valves, baffles and other appurtenances as indicated on the Drawings.

3.2 BACKFILLING STRUCTURES

- A. Do not backfill precast concrete structures until after examination and approval of the Authority.
- B. Backfill structures in accordance with Section 31 20 00 - Earthwork.

END OF SECTION 03 40 00

SECTION 31 20 00 - EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:

1. Excavation and Backfill for Structures
2. Dewatering
3. Sheet piling and Shoring
4. Site Grading

B. Related Work Specified Elsewhere:

1. Section 31 23 17 - Trenching, Backfilling & Compacting

1.2 QUALITY ASSURANCE

A. Testing Agency:

1. A qualified independent testing agency or agencies will be under Contract and paid for by the Developer and approved by the Authority during construction of this project on a periodic basis for observation of earthwork activities and performance of in-place soil testing and laboratory testing of soil materials.

B. Developer's Failure to Meet Contract Requirements:

1. The Authority reserves the right to reject any items which do not meet the requirements of the plans and specifications and will require the Developer to replace these items and bear all expenses in connection with such replacements.
2. The Developer shall pay all costs incurred in providing additional testing and/or analysis (including engineering fees) required because of deficient test results or construction not in compliance with these requirements.

C. Referenced Standards:

1. American Society for Testing and Materials (ASTM):
 - a. C33 Standard Specification for Concrete Aggregates
 - b. D698 Test for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - c. D1556 Test for Density and Unit Weight of Soil in Place by the Sand Cone Method
 - d. D2922 Test for Density of Soil and Soil Aggregate in Place by Nuclear Methods
 - e. D5080 Test for Rapid Determination of Percent Compaction
2. Pennsylvania Department of Transportation (PennDOT): Publication 408 Specifications, as amended

D. All materials used in the PennDOT Road right-of-way must be from a certified PennDOT supplier.

1.3 JOB CONDITIONS

- A. Department of Environmental Protection Bureau of Land Recycling and Waste Management - Clean Fill Policy:
1. See Department of Environmental Protection Bureau of Land Recycling and Waste Management Document No. 258-2182-773.
 2. Imported Fill: The Contractor will perform environmental due diligence to determine whether imported fill is clean or regulated as specified in DEP Clean Fill Policy. The Contractor will manage the fill following the guidelines of the policy including the furnishing of any certifications, testing or permits that may be required.
 3. Exported Fill: The Contractor will perform environmental due diligence and testing to determine that the excavated material scheduled to be spoiled off site qualifies as clean fill under DEP Clean Fill Policy. Should materials be uncovered that are suspected of being other than clean fill, the Contractor will immediately notify the Owner. If evidence of release of regulated substance is found, material shall be disposed of as regulated fill.
- B. The locations shown for utility facilities are approximate. Proceed with caution in the areas of utility facilities and expose them by hand or other excavation methods such as hydroexcavating and acceptable to the utility owner.
- C. Erect sheeting, shoring, and bracing as necessary for protection of persons, improvements, and excavations, when trench is five or more feet deep.
- D. Furnish and maintain barricades, signs and markings for excavated areas.
- E. Select and install a system of dewatering to accomplish groundwater control in excavations.
- F. Preserve, protect and maintain operable existing drainage ways, drains and sewers.

1.4 SUBMITTALS

- A. Certificates:
1. Submit a Certificate of Compliance, together with supporting data, from the materials supplier attesting that the composition analysis of backfill materials meets specification requirements.
 2. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.
 3. Submit certified density testing results from the soils testing laboratory.
- B. Qualification Data:
1. Submit evidence of qualifications for the testing agency.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

- A. On site or imported natural soils as approved by Authority.

- B. Load bearing fill is defined as earth fill or rock fill required for bearing loads imposed by structures or pavement subject to motor traffic and all earth materials necessary to raise the grade from an existing elevation or prepared foundation elevation to the finished elevation in a designated fill area which cannot tolerate settlement. All load bearing fill and backfill shall be compacted to 95% of the standard proctor maximum dry density as determined by ASTM D698.
- C. Nonbearing fill shall be free of roots, rock larger than 4" in size and building debris, capable of minimum compaction of 90% standard proctor density at optimum moisture content established for the soil material by ASTM D698.

2.2 MATERIALS FOR BACKFILLING, LOAD BEARING FILLS OR EMBANKMENTS

- A. Well-graded soil aggregate mixture, consisting of inorganic on-site cut soils with rock fragments less than 4 inches nominal diameter and less than 20% by weight of the mass, less than 30% of particles finer than No. 200 sieve, liquid limits less than 50, and plasticity indices greater than 10. Alternatively, PennDOT 2RC and No. 2A coarse aggregate would be acceptable.
- B. Total content of gravel or rock fragments larger than 1/2" shall not exceed 20% by weight of the mass.
- C. Backfill shall not contain topsoil, organic matter, debris, cinders, or frozen material.

2.3 SELECT STONE FILL

- A. Compacted stone under slabs.
- B. Stone shall be a coarse aggregate material and shall comply with AASHTO #57(PennDOT 2B), Section 703.2 (C) of Publication 408 Specifications.

2.4 SELECT GRANULAR MATERIAL

- A. Compacted in areas of overexcavation in load bearing areas.
- B. Crushed stone or gravel aggregate conforming to Select Granular Material (PennDOT 2RC), Section 703.3, Publication 408 Specifications.

2.5 PERVIOUS MATERIAL

- A. Natural clean, free-draining sand or gravel conforming to the requirements of ASTM C33 except:
 - 1. Materials passing a No. 100 sieve not to exceed 8%.
 - 2. Materials not passing a No. 200 sieve not to exceed 5%.

2.6 SOURCE OF MATERIALS

- A. Use materials for fill only if they meet the requirements specified herein. If sufficient material meeting these requirements is not available from required excavation, obtain requisite material from other sources.

- B. Use only material which has been approved as to quality, location of source and zone of placement in the fill.
- C. The Authority has the right to reject material at the job site by visual inspection, pending sampling and testing.

2.7 EARTHWORK EQUIPMENT

- A. The Developer shall submit a list of the compaction equipment to be utilized on the project and the recommendations of the equipment manufacturer as to the maximum lift thickness which can be placed and the method of compaction to be used with this equipment to achieve the required compaction.
- B. Lift Thickness Limitations:
 - 1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer's recommendations.
 - 2. However, if the equipment manufacturer's lift thickness recommendation is followed and the specified density is not obtained, the Developer shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.

PART 3 - EXECUTION

3.1 PREPARATION AND LAYOUT

- A. Establish and identify required lines, levels, contours and datum.
- B. Maintain bench marks, monuments and other reference points.
- C. Protect trees, shrubs, lawns and other features remaining as portion of final landscaping.

3.2 ROUGH GRADING

- A. Rough grade to uniform contours; form foundations for embankments and load bearing fills.
- B. Construct the finished subgrade to vary not more than 1" above or below the elevation shown.
- C. Rough grade to prevent ponding of water in any area; install temporary swales if necessary to improve surface drainage.
- D. Complete embankment slopes to vary not more than 6" from the slope line shown.
- E. In saturated areas indicating sponginess and instability during earth moving operations shall be excavated and prepared to receive acceptable fill materials as specified; material excavated due to unsuitability shall be removed from site.
- F. Excavated subsoil materials to be used for fill materials shall be approved by Authority; materials rejected by Authority shall be removed from the site.

3.3 FOUNDATION PREPARATION OF NEW LOAD BEARING AREAS

- A. A load bearing area is defined as an area supporting loads of a structure or pavement area subject to motor traffic.
- B. After excavating to foundation subgrade elevation, the independent testing agency shall perform soil bearing tests, under the direction of the Authority's Engineer, to confirm bearing capacity of the subgrade meets or exceeds the minimum safe bearing capacity. If the subgrade does not meet the minimum safe bearing capacity, the Authority's Engineer will review and provide direction for change in the work.
- C. Proofrolling should be performed by a piece of heavy, rubber-tired equipment such as a loaded tri-axle dump truck. The piece of equipment used for proofrolling should weigh at least 70,000 pounds, and should be operated with tire pressures of at least 60 pounds per square inch (psi). The proofrolling equipment should traverse the subgrade at 2 to 3 miles per hour (the pace of a slow walk), making at least one pass in each direction. Proofrolling should be observed by an experienced construction inspector who can evaluate the suitability of the subgrade soils and direct the removal and replacement of any unsuitable soils; all soft spots or irregularities within the natural soil, disclosed as the proof-rolling progresses, shall be excavated to sound material and then backfilled or leveled to grade as hereinafter specified; Authority shall be so advised by Developer that additional excavation is necessary to achieve satisfactory proof-rolling. Suitable backfill to replace unacceptable soil in load bearing areas shall be compacted select granular material.
- D. If rock is exposed at design footing grades, the rock shall be over-cut one foot and replaced with select stone fill. No additional payment will be made for this work.

3.4 SHORING, SHEETING AND BRACING

- A. Install shoring, sheeting and bracing to comply with Federal, State and local code requirements. Responsibility for the safety of the work, personnel and structures rests solely with the Developer.
- B. Carry the bottom of the support system to depth below the main excavation, adequate to prevent ground movement.
- C. Follow the excavation closely with sheeting and shoring placement.
- D. Perform excavation for the installation of sheeting carefully to minimize the formation of voids.
- E. If unstable material is encountered during excavation, take measures to contain it in place and prevent ground displacement.
- F. Have sufficient quantity of material on hand at all times for sheeting, shoring, bracing and other operations for the protection of the work and for use in case of accident or emergency.
- G. Leave sheeting and shoring in place as long as possible, compatible with the placing and compacting of backfill.

3.5 EXCAVATION - GENERAL

- A. Excavate to the neat lines or setback lines for mixed face conditions and grades indicated on the Drawings.
- B. Excavate in sequence and stages which will not subject permanent or temporary structures, installations, or surfaces to unstable conditions.

- C. Excavate as required to provide sufficient working space to permit placing, inspection, and completion of the structures.
- D. Shape excavations accurately to the cross-sections and grades indicated.
- E. Support the sides of excavations as specified or required.
- F. Keep excavations free from water.
- G. Fill all openings and fractures in the excavation bottom and sides with cement grout to preclude potential development of soil piping and pinholes. Obtain Authority's written approval of the foundation excavation before placing any foundation stone bedding or construction concrete.
- H. The Developer's failure to maintain dewatering operations for structure excavations shall not be a basis for payment for removal and replacement of unsuitable materials.

3.6 BLASTING

- A. Blasting will be permitted except in areas where the proximity of structures, underground facilities, or public safety precludes the use of explosives. Nothing in this Section shall relieve the Developer of his responsibilities for damages, nor shall it result in any responsibility to the Authority.
- B. Blasting work shall be supervised by licensed and experienced personnel and performed in conformance with applicable Federal, State and local codes.

3.7 BACKFILLING STRUCTURES

- A. Do not commence backfilling around any structure until such structure has been examined and approved by the Authority. Unexamined structures will be re-excavated so proper inspection can take place.
- B. Do not place backfill until the requirements for concrete curing and waterproofing have been complied with and, if required, test cylinders for the particular structure indicate that the concrete has attained the compressive strength specified.
- C. When backfilling against structures and where applicable, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures. Place material in uniform increments over fill area.
- D. Protect structures from damage by construction activity, equipment, and vehicles. Repair or replace damaged structures to the satisfaction of the Owner.

3.8 DISPOSAL OF EXCAVATED MATERIAL

- A. Surplus excavated materials shall become the property of the Developer and be removed from the project site.

3.9 EMBANKMENT AND FILLS

- A. Do not place fill on any part of the embankment foundation until such areas have been examined and approved.
- B. Do not place fill on frozen surface.
- C. Place embankment fill in layers of uniform thickness for entire width so that each layer can be uniformly compacted.
- D. Avoid accumulation of large pieces of material at one location; fill voids and interstices with fine materials.
- E. Compact embankment materials of fills within 5 feet of structures using lightweight compactors; do not overstress the structures.
- F. Construct the finished subgrade to vary not more than 1/2" above or 1" below the elevation shown; complete embankment slopes to vary not more than 6" from the slope line shown.
- G. Place fill material over the fill areas and spread in loose horizontal layers, not exceeding equipment manufacturer's recommended uncompacted thickness; cobble size rock fragments may be placed in the lower three feet in areas where the fill is greater than eight feet; all rock shall have interstices filled with smaller rock sizes; work fill material in a direction parallel to the long axis of the fill section unless otherwise approved by the Authority; the gradation and distribution of fill material shall be such that the area will be free from lenses, pockets, and layers of material differing substantially in texture or gradation from surrounding material; after spreading, harrow fill material if necessary to break up large pieces and blend materials.
- H. Where compacted fill is to be placed on a slope, bench the slope in horizontal and vertical faces of such width and depth as to provide adequate keying of the fill into the slope; in places where the movement of large equipment is restricted, place fill material in maximum 4" layers and compact with smaller vibratory rollers or power tampers; take particular care to thoroughly compact in areas where fill is placed against exposed bedrock.

3.10 DENSITY TESTING:

- A. Under the direction of the Authority, the Developer's testing agency shall conduct density tests at locations as follows during backfilling operations:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one (1) test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one (1) test for each 100 feet or less of wall length, but no fewer than 2 tests.
- B. Determine density by ASTM D1556 or ASTM D2922.

3.11 MOISTURE CONTROL

- A. Control moisture content of fill materials to + 2% of the optimum moisture content as determined by ASTM D698; material that is too wet may be spread and scarified on the fill surface and permitted to dry, until the moisture content is within specified limits; when fill material is too dry, sprinkle each layer of the fill and work moisture into the material until a uniform distribution within the specified limits is obtained; if, in the opinion of the Authority, the top surface of a partial fill section becomes too dry to permit a suitable bond, scarify loosen the dried surface, dampen the loosened material and compact the moistened material.

- B. Keep the top plane of load bearing fill areas under construction sloped for drainage; when rain or inclement weather is expected, flat roll the top of embankment to seal it.

3.12 SURFACE DRAINAGE

- A. Intercept and divert surface drainage away from the excavation by the use of dikes, curb walls, ditches, pipes, sumps or other means.
- B. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water.
- C. Remove the surface drainage system when no longer required.
- D. Remove debris and restore the site or sites to original condition.

3.13 DRAINAGE AND DEWATERING OF EXCAVATED AREAS

- A. Provide and maintain ditches to collect surface water and seepage which may enter the excavations and divert.
- B. Install a dewatering system to keep excavations dry and free of water.
- C. Maintain water level below subgrade until concrete work or backfill, or both, have been completed to offset uplift pressures.
- D. Dispose of precipitation and subsurface water clear of the work. Provide necessary sediment and erosion control requirements.
- E. During dewatering operations, water discharged to a watercourse must be clear and free of silt, mud and other deleterious materials. Construct and maintain settling ponds to prevent stream degradation. Comply with the requirements for dewatering or discharging to a watercourse as required by Federal, State or local codes.
- F. Backfill drainage ditches, sumps, and settling basins when no longer required with granular material or other material as approved by the Authority.

3.14 FINISHING

- A. On completion of the work, clean ditches and channels and finish the site in a neat and presentable condition. Slope areas to provide positive drainage.

END OF SECTION 31 20 00

SECTION 31 23 17 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:

1. Trench excavation, backfill and compaction
2. Support of excavation
3. Pipe bedding requirements
4. Control of excavated material
5. Restoration of unpaved surfaces

B. Related Work Specified Elsewhere:

1. Section 31 20 00 - Earthwork
2. Section 33 05 23 - Boring and Jacking
3. Section 33 31 13 - Sanitary Sewer Pipe

C. Applicable Standard Details:

1. 03-01 Concrete Cradle and Encasement Details
2. 03-02 Concrete Anchors for Steeply Sloped Pipe
3. 03-03 Thrust Block for Bends, Tees, and Caps
4. 03-04 Thrust Block for Vertical Bends
5. 31-01 Pipe Trench Detail
6. 31-02 Pipe Bedding Details
7. 31-04 Vertical Water Main Clearance
8. 31-05 Stream Crossing Detail
9. 31-06 Clay Dike Detail
10. 32-01 Trench Repaving Detail

1.2 QUALITY ASSURANCE

A. Testing Agency: Density testing shall be performed by an independent soils testing laboratory engaged and paid for by the Developer and approved by the Authority's Representative.

B. Referenced Standards:

1. Pennsylvania Department of Transportation (PENNDOT):
 - a. Regulations Governing Occupancy of Highways by Utilities (67 PA Code, Chapter 459)
 - b. Publication 408 Specifications
 - c. Pennsylvania Test Method, PTM 106
 - d. Pennsylvania Test Method, PTM 402
 - e. Publication 213, Work Zone Traffic Control

2. American Society for Testing and Materials (ASTM):
 - a. D698 Test for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - b. D1556 Test for Density and Unit Weight of Soil in Place by the Sand Cone Method
 - c. D2922 Test for Density of Soil and Soil Aggregate in Place by Nuclear Methods

C. All materials used in the PennDOT Road right-of-way must be from a certified PennDOT supplier.

D. Density Testing:

1. Conduct a minimum of two (2) density tests per manhole section or pipeline. Conduct one (1) test in the lower half of the trench and one (1) test in the upper half of the trench at locations as directed by the Authority's Engineer during backfilling operations. If any test fails, the Developer shall take remedial steps to correct the compaction and rerun the test until compliance with the density requirements are shown. A density test that fails does not count toward the number of tests to be taken. The cost of the initial test and any required retesting is the responsibility of the Developer.
2. Determine density by ASTM D1556 or ASTM D2922.

1.3 SUBMITTALS

A. Certificates:

1. Submit, prior to delivery of the material to the job site, a Statement of Compliance from the materials supplier, together with supporting data, attesting that the composition analysis of pipe bedding and select material stone backfill materials meets specification requirements. Should a change in source of materials be made during construction, submit a new Statement of Compliance from the new source for approval before the material is delivered to the job site.
2. Submit certified density testing results from the soils testing laboratory.
 - a. Compaction testing equipment must have a current calibration certificate.

B. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.

C. Agreements with Property Owners: Prior to storing or disposing of excavated materials on private property, submit a copy of the written agreement with the property owner.

1.4 JOB CONDITIONS

A. Control of Traffic: Employ traffic control measures in accordance with Pennsylvania Department of Transportation Publication 213, "Work Zone Traffic Control".

B. Protection of Existing Utilities and Structures:

1. Take all precautions and utilize all facilities required to protect existing utilities and structures. In compliance with Act 121 of the General Assembly of Pennsylvania, PA One Call System and Common Grounds Alliance Best practices Manual, advise in advance of intent to excavate, do demolition work or use explosives and give the location of the job site. Request cooperative steps of the Utility and suggestions for procedures to avoid damage to its lines.

2. Advise each person in physical control of powered equipment or explosives used in excavation or demolition work of the type and location of utility lines at the job site, the Utility assistance to expect, and procedures to follow to prevent damage.
 3. Immediately report to the Utility and the Authority and the Authority's Engineer any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of premises of any emergency created or discovered.
 4. Allow free access to Utility personnel at all times for purposes of maintenance, repair and inspection.
- C. Department of Environmental Protection Bureau of Land Recycling and Waste Management - Clean Fill Policy:
1. See Department of Environmental Protection Bureau of Land Recycling and Waste Management Document No. 258-2182-773.
 2. Imported Fill: The Developer will perform environmental due diligence to determine whether imported fill is clean or regulated as specified in DEP Clean Fill Policy. The Developer will manage the fill following the guidelines of the policy including the furnishing of any certifications, testing or permits that may be required.
 3. Exported Fill: The Developer will perform environmental due diligence and testing to determine that the excavated material scheduled to be spoiled off site qualifies as clean fill under DEP Clean Fill Policy. Should materials be uncovered that are suspected of being other than clean fill, the Developer will immediately notify the Authority. If evidence of release of regulated substance is found, material shall be disposed of as regulated fill.

PART 2 - PRODUCTS

2.1 PIPE BEDDING MATERIAL

- A. Type IV Pipe Bedding Material: Crushed stone or gravel aggregate conforming to AASHTO No. 8 (PennDOT 1B) as specified in Section 703.2, Publication 408 Specifications, as shown in Standard Detail 31-02.

2.2 BACKFILL MATERIAL

- A. Select Granular Material Backfill: Crushed stone or gravel aggregate conforming to Select Granular Material (PennDOT 2 RC), Section 703.3, Publication 408/2011 Specifications.

- B. Suitable Backfill Material (All Roads and Highways):

1. From top of pipe bedding material to subgrade elevation:
 - a. Select Material Stone Backfill as specified in paragraph 2.2.A. or
 - b. Flowable backfill as specified in Section 220, Publication 408 Specifications.
2. See Standard Detail 31-01 for pipe trench detail.

- C. Suitable Backfill Material (Other than Roads and Highways):

1. From top of pipe bedding material to 24" over top of pipe:

- a. Material excavated from the trench if free of stones larger than 4" in size and free of wet, frozen, or organic materials.
- 2. From 24" above pipe to subgrade elevation:
 - a. Material excavated from the trench if free of stones larger than 8" in size and free of wet, frozen, or organic materials.
- 3. See Standard Detail 31-01 for pipe trench detail.
- D. Unsuitable Backfill Material: Where the Authority's Engineer deems backfill material to be unsuitable and rejects all or part thereof due to conditions prevailing at the time of construction, remove the unsuitable material and replace with select material stone backfill as specified in paragraph 2.02.A or suitable foreign backfill material.

2.3 CLAY DIKE MATERIAL

- A. Clay dike material conforming to the following:

- 1. Percent passing the #200 sieve - 70%
- 2. Unified Soil Classification - Soils CL & CH
- 3. Plastic Index - >10

2.4 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

- A. Tape shall consist of a minimum 5-mil (0.005") overall thickness, with no less than a 35 gauge (0.00035") solid aluminum foil core. The foil must be visible from BOTH sides. The layers shall be laminated together with the extrusion lamination process, not adhesives. Further, there shall be NO inks or printing extending to the edges of the tape. The adhesive will NOT contain any dilutants, pigments or contaminants and is specially formulated to resist degradation by elements normally encountered in the soil. All printing shall be encased to avoid ink rub-off.
- B. Test Data:

<u>Property</u>	<u>Method</u>	<u>Value</u>
Thickness	ASTM D2103	5.0 mils
Tensile strength	ASTM D 882	25 lbs./inch (5500 psi)
Elongation	ASTM D 882-88	<50% at break
Printability	ASTM D2578	>50 dynes/cm ²
Flexibility	ASTM D 671-81	Pliable hand
Inks	Mfg. specs.	Heat set Mylex
Message repeat	Mfg. specs.	Every 20"
Foil	Mfg. specs.	Dead soft/annealed
Top Layer	Mfg. specs.	Virgin PET
Bottom layer	Mfg. specs.	Virgin LDPE
Adhesives	Mfg. specs.	>30%, solid 1.5#/R
Bond strength	Boiling H ² O @ 100°C	5 hours w/o peel
Colors	APWA code	See below

C. Color Code shall be as follows:

1. Safety Red: Electric power, distribution and transmission and municipal electric systems.
2. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous materials, product and steam.
3. Safety Alert Orange: Telephone and telegraph systems, police and fire communications, and cable television.
4. Safety Precaution Blue: Water systems and slurry pipelines.
5. Safety Green: Sanitary and storm sewer systems.
6. Safety Brown: Force mains, reclaimed water lines and effluent reuse lines.
7. Alert Purple: Reclaimed non-potable water lines.

PART 3 - EXECUTION

3.1 MAINTENANCE AND PROTECTION OF TRAFFIC

- A. Coordinate the work to ensure the least inconvenience to traffic and maintain traffic in one or more unobstructed lanes unless closing the street is authorized.
- B. Maintain access to all streets and private drives.
- C. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform with construction operations and to keep traffic flowing with minimum restrictions.
- D. Comply with State and local codes, permits and regulations.

3.2 CUTTING PAVED SURFACES

- A. Where excavation includes breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the centerline of the trench. Cut offsets at right angles to the centerline of the trench. Saw cut concrete surfaces; saw cut other hard surfaces or make straight cuts with jackhammer. No paving shall be broken except that which has been previously cut.
- B. Protect edges of cut pavement during excavation to prevent raveling or breaking; square edges prior to pavement replacement.

3.3 BLASTING

- A. Blasting will be permitted except in areas where the proximity of structures, underground facilities, or public safety precludes the use of explosives. Nothing in this section shall relieve the Developer of his responsibilities for damages, nor shall it result in any responsibility to the Authority or the Authority's Engineer.
- B. Blasting work shall be supervised by licensed and experienced personnel and performed in conformance with applicable Federal, State and local codes.

3.4 TRENCH EXCAVATION

-
- A. Topsoil Stripping and Stockpiling: Strip topsoil encountered during trench excavation to its full depth and stockpile for reuse.
- B. Depth of Excavation:
1. Gravity Pipelines:
 - a. Excavate trenches to the depth and grade shown on the profile drawings for the invert of the pipe plus 6 inches for placement of pipe bedding material.
 - b. Excavation for laterals shall provide a straight uniform grade from the main pipeline or riser stack to the elevation at the right-of-way line, plus 6 inches for placement of pipe bedding material. The minimum slope of laterals shall be $\frac{1}{4}$ " per foot for 4" pipe, or $\frac{1}{8}$ " per foot for 6" pipe for their entire length except that laterals shall connect to the sewer main by means of a 1/8 bend. See Section 33 31 13, Sanitary Sewer Pipe.
 2. Pressure Pipelines:
 - a. Excavate trenches to the minimum depth necessary to place required pipe bedding material and to provide 4' from the top of the pipe to the finish ground elevation, except where specific depths are otherwise indicated on the Drawings.
 - b. Where unsuitable bearing material is encountered in the trench bottom, continue excavation until the unsuitable material is removed, solid bearing is obtained or can be established, or concrete cradle can be placed. If no concrete cradle is to be installed, refill the trench to required pipeline grade with pipe bedding material.
 - c. Where the Developer, by error or intent, excavates beyond the minimum required depth, backfill the trench to the required pipeline grade with pipe bedding material.
- C. Width of Excavation:
1. Excavate trenches, including laterals, to a width necessary for placing and jointing the pipe and for placing and compacting bedding and backfill around the pipe.
 2. Shape trench walls completely vertical from trench bottom to at least 24" above the top of the pipe.
 3. For pressure pipeline fittings, excavate trenches to a width that will permit placement of concrete thrust blocks. Provide earth surfaces for thrust blocks that are perpendicular to the direction of thrust and are free of loose or soft material.
 4. Where rock is encountered in the sides of the trench, remove the rock to provide a minimum clearance between the pipe and rock of 6".
- D. Length of Open Trench: Do not advance trenching operations more than 400' ahead of completed pipeline. Trenches may not remain open during non-working hours. All pipe ends and clean outs must be securely capped or plugged at the end of each day. Duct tape will not be acceptable.

3.5 SUPPORT OF EXCAVATION

- A. Support excavations with approved shoring or a "trench box" as required to comply with Federal and State laws and codes. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through negligence or fault of the Developer in any other manner shall be repaired at the Developer's expense.
- B. Withdraw shoring as backfilling proceeds unless otherwise directed by the Authority.

3.6 CONTROL OF EXCAVATED MATERIAL

- A. Keep the ground surface within a minimum of 2' of both sides of the excavation free of excavated material.
- B. In areas where pipelines parallel or cross streams, ensure that no material slides, is washed, or dumped into the stream course. Remove cofferdams immediately upon completion of pipeline construction.
- C. Maintain accessibility to all fire hydrants, valve pit covers, valve boxes, curb boxes, fire and police call boxes, and other utility controls at all times. Keep gutters clear or provide other satisfactory facilities for street drainage. Do not obstruct natural watercourses. Where necessary, provide temporary channels to allow the flow of water either along or across the site of the work.
- D. Provide temporary barricades to prevent excavated material from encroaching on private property, walks, gutters, and storm drains.
- E. Do not place or store excavated material on private property without a written agreement signed by the property owner.

3.7 DEWATERING

- A. Keep excavations dry and free of water. Remove precipitation and subsurface water clear of the work area.
- B. Maintain pipe trenches dry until pipe has been jointed, inspected, and backfilled, and concrete work has been completed. Prevent trench water from entering pipelines under construction. All pipe ends and cleanouts must be securely capped or plugged at the end of each day. Duct tape is not acceptable.
- C. Intercept and divert surface drainage away from excavations. Maintain storm drainage facilities, gutters, and natural surface watercourses open and in operation. Provide and install temporary facilities to maintain excavations free of water as required. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water. When mechanical equipment is utilized to control water conditions, provide and maintain sufficient standby units onsite.
- D. Comply with all Federal, State and Local requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.8 PIPE BEDDING REQUIREMENTS

- A. Type IV Bedding:
 - 1. Depth and type of bedding material aggregate as shown on Standard Detail 31-02.
 - 2. Provide Type IV bedding for all pipes.
- B. Shape recesses for the joints or bell of the pipe by hand. Assure that the pipe is supported on the lower quadrant for the entire length of the barrel.

3.9 PIPE LAYING

- A. Lay pipe as specified in the appropriate Section of these Specifications for pipeline construction.

3.10 THRUST RESTRAINT

- A. Provide pressure pipe with concrete thrust blocking or use restrained joint fittings at all bends, tees, valves, and changes in direction, in accordance with the Specifications, Drawings and Standard Details 03-03 and 03-04.

3.11 BACKFILLING TRENCHES

- A. After pipe installation and inspection, backfill trenches from the top of pipe bedding material with specified backfill material hand placed and carefully compacted with hand-operated mechanical tampers in layers of suitable thickness to provide specified density. Backfill and compact the remainder of the trench with specified backfill material.
- B. Exposed Joints for Testing:
 - 1. The Developer has the option to test the pipe prior to backfilling the trench. If this option is selected, install reaction blocks where required and place 2' of thoroughly compacted backfill over the pipe leaving pipe joints partially exposed.
 - 2. If the Developer elects to completely backfill the trench prior to testing, he shall be responsible for locating and uncovering leaks which may cause the test to fail.
- C. Lift Thickness Limitations:
 - 1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer's recommendations. However, if the equipment manufacturer's lift thickness recommendation is followed and the specified density is not obtained, the Developer shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.
 - 2. Compact each layer of backfill to 95% of the standard proctor maximum dry density as determined by ASTM D698 for roads and load bearing areas and 90% for all other areas.
 - 3. Lift thickness limitations specified for state highways, shoulders, or embankments govern over the compaction equipment manufacturer's recommendations.
 - 4. Notwithstanding the specified requirements for trench backfill compaction, trenches that settle below the surrounding grade prior to final completion shall be filled to surrounding grade level with appropriate materials.
- D. Uncompacted Backfill: Where uncompacted backfill is indicated on the Drawings, backfill the trench from one foot above the pipe to the top of the trench with material excavated from the trench, crowned over the trench to a sufficient height to allow for settlement to grade after consolidation.

3.12 STREAM CROSSINGS

- A. Construct pipeline stream crossings as shown on Standard Detail 31-05.
- B. After backfilling, protect the surfaces of the disturbed area within the stream channel with a 1 foot thick layer of rip rap stone.

3.13 CLAY DIKES

- A. Install clay dikes adjacent to stream crossings as shown on Standard Detail 31-05 and where indicated on the Drawings.
- B. Construct dikes impervious to the flow of water by backfilling the trench with compacted clay as shown on Standard Detail 31-06.

3.14 UTILITY MARKING TAPE

- A. Install magnetically detectable utility marking tape as specified above all non-ferrous pipelines, 12"-18" below final grade.

3.15 DISPOSAL OF EXCAVATED MATERIAL

- A. Excavated material remaining after completion of backfilling shall remain the property of the Developer. The Developer shall remove said material from the job site and legally dispose of it.

3.16 RESTORATION OF UNPAVED SURFACES

- A. Restore unpaved surfaces disturbed by construction to equal the surface condition prior to construction.

(SEE ATTACHED TABLE)

END OF SECTION 31 23 17

Size and Grading Requirements for Coarse Aggregates (Based on Laboratory Sieve Tests, Square Openings)

PADOT Number	AASHTO Number	Total Percent Passing															
		100 mm (4")	90 mm (3-1/2")	63 mm (2-1/2")	50 mm (2")	37.5 mm (1-1/2")	25.0 mm (1")	19.0 mm (3/4")	12.5 mm (1/2")	9.5 mm (3/8")	4.75 mm (No. 4)	2.36 mm (No. 8)	1.18 mm (No. 16)	150 pm (No. 100)	75 pin (No. 200)		
4	1	100	90-100	25-60		0-15		0-5									
3A	3		100	100	90-100	35-70	0-15		0-5								
	467				100	95-100			10-30	0-5							
	5				100	100	90-100	20-55	0-10								
2B	57				100	100	95-100		25-60		0-10	0-5					
2	67				100		90-100			20-55	0-10	0-5					
	7						100		90-100	40-70	0-15	0-5					
1B	8								100	85-100	10-30	0-10	0-5				
Screenings	10									100	85-100			10-30			
2A					100					36-70	24-50	16-38*	10-30				
OGS					100					136-65	8-40		0-12				
2RC					100						15-60			0-30			

* Applies only for bituminous mixtures.

Note A: A combination of No. 7 and No. 5 may be substituted for No. 57, provided that not more than 50% or less than 30% of the combination is No. 7 size.

Note B: Provide No. OGS material that has a minimum average coefficient of uniformity of 4.0. The average coefficient of uniformity is defined as the average of the sublots within each lot. Determine the coefficient of uniformity according to PTM No. 149 each time the gradation is determined. The required minimum coefficient of uniformity for individual samples is 3.5. If the coefficient of uniformity of any sample falls below 3.5, reject the lot. Do not use the coefficient of uniformity in the multiple deficiency formula.

SECTION 32 12 16.10 - PAVING RESTORATION

CONTRACTOR SHALL FOLLOW STATE AND/OR LOCAL PAVING RESTORATION REQUIREMENTS

SECTION 32 31 13.12 - CHAIN-LINK FENCES AND GATES

PART 1 GENERAL

1.1 DESCRIPTION

- A. The Work of This Section Includes, but is not limited to:
 - 1. Chain-Link Fencing, 6-foot high fabric
 - a. Vinyl coated galvanized steel fabric
 - b. Top rail, bottom tension wire
 - 2. Gates: Size as indicated on the Contract Drawings
 - 3. Accessories

1.2 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A120 - Pipe, Steel, Hot-dipped Zinc-coated (Galvanized) Welded and Seamless
 - b. A123 - Zinc (Hot-galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
 - c. F668 - Poly Vinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric

1.3 SUBMITTALS

- A. Manufacturer's Product Data: Submit manufacturer's latest publications of descriptive literature and product data.
- B. Samples:
 - 1. Fence fabric; one 12 inch square
 - 2. Posts, rails, caps, ties, hardware; one representative sample each
- C. Certificates: Submit manufacturer's certification attesting the fencing materials meet or exceed specified requirements.
- D. Shop Drawings: Submit shop drawings of fence layout, including details of gates, fittings, and hardware.

PART 2 PRODUCTS

2.1 CHAIN-LINK FABRIC

- A. Bonded PVC Coated Galvanized Steel; PVC coating of 6 mils minimum as per ASTM F668, Class 2B, vinyl coated before weaving.
 - 1. Vinyl Color: As selected by the Authority.
- B. 2 inch Diamond Mesh; 9 gage (0.148") wire, 1290#/F minimum breaking strength
- C. Selvages barbed and barbed

2.2 FRAMEWORK

- A. Galvanized Steel Pipe; ASTM A120, Schedule 40. Zinc-coated inside and outside, ASTM A123
 - 1. Bonded PVC coating, 10-15 mils; color matched to fence fabric.

- B. Gate Frames: 1.660" O.D. with diagonal truss rods.
 - 1. Horizontal center rail on gates over 6' high; vertical center upright on gate leaves over 8' wide.

2.3 FENCE POSTS

- A. Corner, Terminal and Pull Posts: 2.875 inches outside diameter
- B. Line Posts: 2.375 inches outside diameter
- C. Top Rail, Brace Rails: 1.660 inches outside diameter
- D. Truss Rods: 0.313 inch rod, turnbuckles

2.4 GATE POSTS

- A. Galvanized Steel Pipe; ASTM A120, Schedule 40. Zinc-coated inside and outside, ASTM A123.
 - 1. Bonded PVC coating, 10-15 mils; color matched to fence fabric.
- B. Gate Post Sizes:

<u>Single Gate</u>	<u>Double Gate</u>	<u>Post Size</u>
Up to 6'	Up to 12'	2.875" O.D.
7' to 12'	13' to 25'	4.000" O.D.
13' to 17'	26' to 35'	6.625" O.D.

2.5 GATE HINGES

- A. Non-lift-off Type, offset to permit 180-degree swing

2.6 FITTINGS

- A. Rail ends, brace ends, post tops, post caps and other appurtenances, including gate hinges:
 - 1. Malleable, pressed or cast steel galvanized after fabrication and bonded PVC coated. Color matched to fence fabric. Painted fittings not acceptable.

2.7 TENSION WIRE

- A. #6 gage Galvanized Coil Spring Tension Wire; #9 gage Hog Rings and Tie Wire.
 - 1. Bonded PVC coated, color matched to fence fabric.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that final grading in fence location is completed without irregularities which would interfere with fence installation.
- B. Do not commence work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure and layout complete fence line. Measure parallel to surface of ground.

- B. Locate and mark position of posts. Locate corner posts at each horizontal angle point. Locate line posts at equal distant spacing, on not more than 10 feet nor less than 8 feet centers, unless otherwise indicated on the Contract Drawings.

3.3 POST INSTALLATION

- A. Encase posts in concrete to minimum 3 foot depth. Extend concrete at least 6 inches below bottom of posts.
 - 1. 10 inch diameter encasement for line posts,
 - 2. 12 inch diameter encasement for end, corner, pull, and gate posts.
- B. Extended concrete two inches above finished grade, crowned to drain water away from the posts.
- C. Provide corner, end, and pull posts with a horizontal brace and tie rod on each side of the posts, extending and connecting to adjacent line posts.
- D. Provide fences higher than 8 feet with center rail.
- E. On fences under 6 feet high, attach post caps with setscrews.

3.4 FABRIC INSTALLATION

- A. Remove slack from fabric by means of mechanical fence stretchers before making attachment to posts.
- B. Cut fabric to form one continuous piece between terminal posts.
- C. Hold bottom of fabric two inches above finished grade.
- D. Attach fabric to terminal posts with tension bars held by tension bands.
- E. Fasten fabric to line posts with #9 gage ties, or by integral fabric lock loops as applicable. Maximum 1 foot intervals.
- F. Fasten fabric to top rail and intermediate rail with #9 gage ties at maximum two foot intervals.
- G. Fasten fabric to tension wire with hog rings and ties, maximum two foot intervals.

3.5 GATES

- A. Install gates of the size and swing as indicated on the Contract Drawings.
- B. Fill gate frame with same fabric as fence.
- C. Attach fabric to gate frame with side tension bars, top and bottom fabric ties.
- D. Fasten barbed wire to gate frame uprights.
- E. Locate gate stops, set in concrete, so that plungerbar fully engages. Plungerbar operable from either side of gate. Padlock hasp integral part of latch.
- F. Provide latch forks, lock keepers, catches, plungerbars and stop holders.
- G. Adjust hardware to provide smooth operation.

3.6 FIELD QUALITY CONTROL

- A. Remove and replace fencing which is improperly located, or is not true to line and grade, and posts which are not plumb.
- B. Adjust brace rails and tension rods for rigid installation.
- C. Tighten hardware, fasteners and accessories.
- D. Remove excess and waste materials from the project site.

END OF SECTION 32 31 13.12

SECTION 33 01 32 - SEWER AND MANHOLE TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Vacuum Testing Sewer Manholes
2. Testing Gravity Sewer Pipelines:
 - a. Low-pressure Air Test
 - b. Infiltration Test
3. Hydrostatic Testing Pressure Pipelines
4. Deflection Testing Plastic Pipelines
5. Closed Circuit Television Inspection of New Sewer Mains

B. Related Work specified elsewhere:

1. Section 33 01 33 - Closed Circuit Television Inspection of Existing Sewer Mains and Connections to Existing Manhole
2. Section 33 31 13 - Sanitary Sewer Pipe
3. Section 33 39 10 - Manholes

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. American Society for Testing and Materials (ASTM):
 - a. C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test
 - b. F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

B. Test Acceptance:

1. No test will be accepted until the results are below the specified maximum limits.
2. The Developer shall determine and correct the causes of test failure and retest until successful test results are achieved.

1.3 SUBMITTALS

A. Submit the following prior to start of testing:

1. Testing procedures

2. List of test equipment
3. Testing sequence schedule
4. Provisions for disposal of flushing and test water
5. Current certification of test gauge calibration must be provided.
6. Deflection mandrel drawings and calculations

1.4 JOB CONDITIONS

- A. Do not allow personnel in manholes during vacuum or pressure testing.
- B. Provide relief valves set at 10 psig to avoid accidentally over-pressurizing gravity sewer line during low-pressure air testing.
- C. Provide 72 hours notice to Authority prior to testing.

PART 2 - PRODUCTS

2.1 VACUUM TESTING EQUIPMENT

- A. Vacuum pump
- B. Vacuum line
- C. Vacuum tester base with compression band seal and outlet port
- D. Shut-off valve
- E. Stop watch
- F. Plugs
- G. Vacuum gauge, calibrated to 0.1" Hg

2.2 AIR TEST EQUIPMENT

- A. Air compressor
- B. Air supply line
- C. Shut-off valves
- D. Pressure regulator
- E. Pressure relief valve
- F. Stop watch
- G. Plugs

- H. Pressure gauge, calibrated to 0.1 psi

2.3 HYDROSTATIC TEST EQUIPMENT

- A. Hydro pump
- B. Pressure hose
- C. Water meter
- D. Test connections
- E. Pressure relief valve
- F. Pressure gauge, calibrated to 0.1 psi

2.4 DEFLECTION TEST EQUIPMENT

- A. Go, No-Go mandrels
- B. Pull/retrieval ropes

PART 3 - EXECUTION

3.1 TESTING MANHOLES

- A. Manhole construction must be complete and base course in place before testing can occur.
- B. Vacuum test in accordance with ASTM C1244 and as follows:
 1. Plug all pipe openings; take care to securely brace the plugs and pipe.
 2. Inflate the compression band to effect a seal between the vacuum base and the structure; connect the vacuum pump to the outlet port with the valve open; draw a vacuum to 10" of Hg; close the valve; start the test.
 3. Test:
 - a. Determine the test duration for the manhole from the following table:

VACUUM TEST TABLE

<u>Manhole Diameter</u>	<u>Test Period</u>
48"	60 sec.
60"	75 sec.
72"	90 sec.

- b. Record the vacuum drop during the test period; if the vacuum drop is greater than 1.0" of Hg during the test period, the manhole shall be repaired and retested; if a vacuum drop of 1" of

Hg does not occur during the test period, the test shall be discontinued and the manhole will be accepted.

- c. If the vacuum test fails to meet a 1" Hg drop in the specified time after repair, the unit shall be subjected to repair and retest as necessary.

3.2 PIPELINE PREPARATION

- A. Backfill trenches in accordance with Section 31 23 17.
- B. Provide pressure pipeline with concrete reaction support blocking or the use of restrained mechanical joint glands.
- C. Remove all debris, rocks, bituminous sealants and other debris from manholes and flow channels.
- D. Clean pipelines by means of a high velocity hydraulic sewer cleaner manufactured specifically for the purpose. Clean from the upstream manhole to the downstream manhole capturing and removing any debris removed from the sewer. An alternative physical cleaning is permitted using a porcupine and swab both specifically manufactured for this purpose. The Contractor must demonstrate to the Authority's representative that this procedure produces satisfactory cleaning. Chimney brushes and other devices not manufactured specifically for this purpose are not acceptable.
- E. Plug outlets, wye-branches and laterals; brace plugs to offset thrust.

3.3 TESTING GRAVITY SEWER PIPELINES

- A. Low-pressure Air Test:
 1. Test each newly installed section of gravity sewer line between manholes.
 2. Slowly introduce air pressure to approximately 4.0 psig.
 - a. If ground water is present, determine its elevation above the springline of the pipe for every foot of ground water above the springline of the pipe, increase the starting air test pressure reading by 0.43 psig; do not increase pressure above 9 psig.
 3. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or the increased test pressure as determined above if ground water is present. Start the test.
 4. Test:
 - a. Determine the test duration for a sewer section with a single pipe size from the following table at the end of this specification. No allowance will be made for laterals.
 - b. Record the drop in pressure during the test period; if the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed; if the 1.0 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted.
 - c. If the line fails, determine the source of the air leakage, make corrections and retest; the Contractor has the option to test the section in incremental stages until the leaks are isolated; after the leaks are repaired, retest the entire section between manholes.

3.4 TESTING PRESSURE SEWER PIPELINES

A. Hydrostatic Leakage Test:

1. Test each newly laid pressure pipeline, including any valved section thereof, hydrostatically at 1.5 times the working pressure of the pipeline based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge; obtain test pressure from the Authority.
2. Slowly fill the section to be tested with water, expelling air from the pipeline at the high points. Install corporation cocks at high points if necessary. After all air is expelled, close air vents and corporation cocks and raise the pressure to the specified test pressure.
3. Observe joints, fittings and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
4. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine the leakage rate. Maintain pressure within plus or minus 5.0 psig of test pressure. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test.
5. Compute the maximum allowable leakage by the following formula:

$$L = \frac{ND (P)^{1/2}}{7400}$$

Where: L is the allowable leakage in gallons/hour
 N is the number of joints in the section tested
 D is the nominal diameter of the pipe in inches
 P is the average test pressure in psig

If line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

6. If the test of the pipe indicates leakage greater than that allowed, locate the source of the leakage, make corrections and retest until leakage is within allowable limits. Correct visible leaks regardless of the amount of leakage.

3.5 DEFLECTION TESTING OF PLASTIC SEWER PIPE

- A. Perform vertical ring deflection testing on all portions of PVC and ABS sewer piping, in the presence of the Authority, after backfilling has been in place for at least 30 days but not longer than 12 months.
- B. The maximum allowable deflection for installed plastic sewer pipe shall be limited to 5% of the original vertical internal diameter.
- C. Perform deflection testing using a properly sized 'Go, No-Go' mandrel; the mandrel(s) shall be provided at the Contractor's expense and subject to the approval of the Authority.
- D. The mandrel shall have a diameter not less than 95% of the base or average inside diameter of the pipe as determined by the specific ASTM Specification to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D2122.
- E. The test shall be performed without mechanical pulling devices.
- F. Pipe exceeding the allowable deflection shall be located, excavated, replaced, and retested.

3.6 CLOSED CIRCUIT TELEVISION INSPECTION OF NEW SANITARY SEWER MAINS

- A. Authority will perform closed circuit television inspection of completed sanitary sewers.
- B. Fees will be charged for this inspection according to the current Authority fee schedule at the time of the inspection.
- C. If deemed necessary a reinspection will be performed and a fee will be charged at the time of the reinspection.

END OF SECTION 33 01 32

MANHOLE EXFILTRATION TEST

Manhole Depth	Leakage Factor	Allowable Leakage per Manhole Diameter and Depth					
		4'	5'	6'	7'	8'	9'
Feet	Meters	Feet	cm	Feet	cm	Feet	cm
4	1.2	0.00219	3	0.14	4	0.17	5
6	1.8	0.00225	5	0.21	6	0.26	8
8	2.4	0.00229	7	0.29	9	0.35	11
10	3.0	0.00223	9	0.35	11	0.42	13
12	3.7	0.00225	10	0.43	13	0.51	16
14	4.3	0.00227	12	0.50	15	0.60	18
16	4.9	0.00224	14	0.56	17	0.68	21
18	5.5	0.00225	16	0.64	19	0.77	23
20	6.1	0.00227	17	0.71	22	0.86	26
22	6.7	0.00224	19	0.78	24	0.93	28
24	7.3	0.00225	21	0.85	26	1.02	31
26	7.9	0.00226	23	0.93	28	1.11	34
28	8.5	0.00225	24	0.99	30	1.19	36
30	9.1	0.00225	26	1.06	32	1.28	39

SECTION 33 05 23 - BORING AND JACKING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Approach trench excavation
2. Installation of casing pipe
3. Installation of carrier pipe

B. Related Work specified elsewhere:

1. Section 31 23 17 - Trenching, Backfilling & Compacting

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A139 Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
3. ASTM C144 Specification for Aggregate for Masonry Mortar
4. ASTM C150 Specification for Portland Cement
5. ANSI/AWWA Ductile Iron Pipe, Centrifugally Cast for Water or C151/A21.51 Other Liquids
6. AASHTO M6 Fine Aggregate for Portland Cement Concrete

B. Contractor's Qualifications - Construction operations shall be undertaken only by a contractor well experienced in operations of similar magnitude and having had similar experience boring and jacking under transportation arteries and under surface areas which cannot be disturbed.

C. Design Criteria:

1. Pipe and joints of leakproof construction design for the earth and/or other pressures present, plus highway H20 live loading with the associated recommended impact loading.
2. Design bracing, backstops, and use jacks of sufficient rating so that the jacking can proceed without stoppage, except for adding pipe sections and, as conditions permit, to minimize the tendency of the ground material to "freeze" around the casing pipe.

D. Allowable Tolerances:

1. Do not overcut excavation by more than 1" greater than the outside diameter of the casing pipe.
2. Install casing pipe with the determined vertical and horizontal alignment prior to installation of the carrier pipe.
3. Maintain a minimum 1" design clearance between casing spacer runner O.D. and the casing I.D.

E. Reference Codes and Specifications:

1. Comply with applicable Federal, State and local ordinances, codes, statutes, rules and regulations, and affected jurisdictional bodies.
2. Pennsylvania Department of Transportation (PennDOT): Publication 408/2011 Specifications, as amended.

1.3 SUBMITTALS

- A. Certificates: Submit certification from materials manufacturers attesting that the materials provided and installed conform to specification requirements.
- B. Submit history of previous work completed of equivalent nature and scope. Include qualification and experience of key personnel.
- C. Submit description of proposed construction methods, including methods to establish and maintain vertical and horizontal alignment.
- D. Submit installation detail to Authority for approval in regards to boring and jacking operation.
 1. All boring must conform to State and railroad (as needed) requirements.

1.4 JOB CONDITIONS

- A. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger the integrity of surface or subsurface structures or utilities and landscape in the immediate or adjacent areas.
- B. When boring and jacking under State highways and public rights-of-way, comply with applicable right-of-way occupancy permits.
- C. If boring is obstructed, relocate or jack crossing as approved by the Authority's Engineer.

PART 2 - PRODUCTS

2.1 STEEL CASING PIPE

- A. ASTM A53; Grade 8, Black, Asphalt Coated; minimum thickness 0.375 inches; minimum yield strength 35,000 psi.
- B. Coat pipe, inside and outside, with a petroleum asphaltic coating 1 mil thick; coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun and adhere to pipe.
- C. Full circumference welded joints.
- D. Diameter and wall thickness as indicated on the Drawings.

2.2 CARRIER PIPE

- A. Ductile iron, ANSI/AWWA C151/A21.51, class as indicated on the Drawings.

2.3 CASING SPACERS

- A. Casing spacers shall be all non-metallic (polypropylene), molded in segments for field assembly without any special tools. Spacer segments shall be secured around carrier pipe by insertion of a Slide-Lock. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi, an 800 Volts/mil dielectric strength and impact strength of 1.5 ft-lbs./inch. Each casing spacer shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.
- B. The casing spacers shall be the PSI Ranger II® Casing Spacers as manufactured by Pipeline Seal and Insulator, Inc., Houston, Texas, or equal.

Carrier Pipe Diameter Inches	Model Number
0.83 to 3.07"	Micro
2.48 to 5.51"	Mini
5.51 to 16.65"	Midi
16.77 to 25.98"	Medi
25.98 to 37.60"	Maxi

2.4 TIMBER SKIDS

- A. Pressure treated, cut to a cross-sectional size to allow placement of the carrier pipe in the casing and to support the barrel of the carrier pipe. Provide with notches to accommodate fastening. Treat notches at time of pipe installation.

2.5 SAND (FINE AGGREGATE)

- A. AASHTO M6, Latest Edition

2.6 GROUT

- A. One part portland cement (ASTM C150) and 6 parts mortar sand (ASTM C144) mixed with water to a consistency applicable for pressure grouting.

2.7 STONE DUST

- A. AASHTO #10, crushed stone dust, 3/8" top size.

PART 3 - EXECUTION

3.1 APPROACH TRENCH

- A. Excavate approach trench using methods as site conditions require.
- B. Ensure pipe entrance face as near perpendicular to alignment as conditions permit.
- C. Establish a vertical entrance face at least 1 foot above top of casing.
- D. Install adequate excavation supports as specified in Section 02221, Trenching, Backfilling and Compacting.

3.2 CASING PIPE INSTALLATION METHODS

A. Boring:

1. Push the pipe into the ground with a boring auger rotating within the pipe to remove the soil.
2. Do not advance the cutting head ahead of the casing pipe except for that distance necessary to permit the cutting teeth to cut clearance for the pipe.
3. The machine bore and cutting head arrangement shall be removable from within the pipe.
4. Arrange the face of the cutting head to provide a barrier to the free flow of soft material.
5. If unstable soil is encountered during boring, retract the cutting head into the casing to permit a balance between the pushing pressure and the ratio of pipe advancement to quantity of soil.
6. If voids should develop greater than the outside diameter of the pipe by approximately one inch, grout to fill voids; grouting to fill voids will be at the expense of the Developer.

B. Jacking:

1. Construct adequate thrust wall normal to the proposed line of thrust.
2. Impart thrust load to the pipe through a suitable thrust ring that is sufficiently rigid to ensure distribution of the thrust load on the pipe.

C. Drilling and Jacking:

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

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

3.3 DEWATERING

- A. Intercept and divert surface drainage precipitation and groundwater away from excavation through the use of dikes, curb walls, ditches, pipes, sumps or other means.
- B. Develop a substantially dry subgrade for the prosecution of subsequent operations.
- C. Comply with Federal and State requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 PRESSURE GROUTING

- A. Pressure grout the annular space between the casing pipe and surrounding earth.

3.5 CARRIER PIPE INSTALLATION

- A. All provisions regarding cleaning, inspection and handling specified under pipe material sections apply to this work.
- B. Exercise care to prevent damage to pipe joints when carrier pipe is placed in casing.
- C. Support pipeline within casing so that no external loads are transmitted to carrier pipe; attach timber skids or casing spacers to barrel of carrier pipe; do not rest carrier pipe on bells.
- D. Space timber skids approximately three per joint of pipe or one timber skid per every 6'-7'.
- E. After the carrier pipe has been installed in the encasing pipe and has been tested, fill the encasing pipe with stone dust.
 - 1. Close one end of encasing pipe with brick and mortar before filling encasing pipe. Close other end of encasing pipe with brick and waterproofed mortar after filling encasing conduit or as the filling operation dictates.

END OF SECTION 33 05 23

SECTION 33 31 13 - SANITARY SEWER PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
1. Sanitary sewer gravity pipelines
 2. Sanitary sewer pressure pipelines
 3. Laterals/service connections
- B. Related Work specified elsewhere:
1. Section 31 23 17 - Trenching, Backfilling and Compacting
 2. Section 33 01 32 - Sewer and Manhole Testing
 3. Section 33 39 10 - Manholes
- C. For technical information regarding sanitary sewer pipe from the building to the cleanout, Contractors shall refer to Appendix A. For sanitary sewer pipe downstream of the cleanout, the Contractor shall refer to this specification section.
- D. Applicable Standard Details:
1. 03-01 Concrete Cradle and Encasement Details
 2. 31-01 Pipe Trench Detail
 3. 31-02 Pipe Bedding Details
 4. 31-04 Vertical Water Main Clearance
 5. 31-05 Stream Crossing Detail
 6. 33-01 Lateral Detail
 7. 33-02 Sloped Riser Lateral Detail
 8. 33-03 Vertical Riser Lateral Detail

1.2 QUALITY ASSURANCE

- A. Reference Standards:
1. American National Standards Institute (ANSI):
 - a. ANSI/AWWA C104/A21.4 Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - b. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3" through 48", for Water and Other Liquids
 - c. ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - d. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe Centrifugally Cast

2. American Society for Testing and Materials (ASTM):

- a. ASTM A48 Standard Specification for Gray Iron Castings
- b. ASTM D2241 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR-Series)
- c. ASTM D2680 Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
- d. ASTM D2752 Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- e. ASTM D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- f. ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- g. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- h. ASTM F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

3. American Water Works Association (AWWA):

- a. C301 Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
- b. C600 Installation of Ductile-Iron Water Mains and their Appurtances

B. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, acid solder, or degraded or discolored by exposure to ultraviolet light will be rejected. PVC pipe which is bent as to cause "ponding" in the pipe once it is laid will be rejected.

C. Cellular foam core pipe is not permitted.

1.3 SUBMITTALS

A. Submit each manufacturer's certification and shop drawings attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not place materials on private property without written permission of the property owner.

B. During loading, transporting and unloading, exercise care to prevent damage to materials.

C. Do not drop pipe or fittings.

D. Avoid shock or damage at all times.

E. Take measures to prevent damage to the exterior surface or internal lining of the pipe.

F. Do not stack pipe higher than recommended by the pipe manufacturer.

G. Store gaskets for mechanical and push-on joints in a cool, dry location out of direct sunlight and not in contact with petroleum products. PVC pipe degraded by exposure to the sun will not be accepted.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE

- A. Pipe, ANSI/AWWA C151/A21.51, 350 psi; standard cement mortar lining, ANSI/AWWA C104/A21.4, outside coated.
- B. Ductile Iron Fittings:
 - 1. ANSI/AWWA C110/A21.10, 350 psi pressure rating.
 - 2. Fitting to be cement mortar lined and outside coated as for ductile iron pipe.
- C. Joints (ANSI/AWWA C111/A21.11): Where not specifically indicated on the Drawings, joints may be either mechanical joint or push-on joint.
- D. Rubber Gaskets, Lubricants, Glands, Bolts and Nuts: ANSI/AWWA C111/A21.11.

2.2 ACRYLONITRILE-BUTADIENE-STYRENE (ABS) SEWER PIPE

- A. Gravity Sewer Truss Pipe and Fittings: ASTM D2680, push-on joints.
- B. Gravity Sewer Solid-Wall Pipe and Fittings: ASTM D2751, SDR-35, push-on joints
- C. Gaskets for Elastomeric Joints: ASTM F477.

2.3 POLYVINYL CHLORIDE (PVC) SEWER PIPE

- A. Gravity Sewer Pipe and Fittings:
 - 1. 4" to 15" Nominal Pipe Size: ASTM D3034, SDR-35; Material - ASTM D1784, 12454-B
 - 2. 18" to 27" Nominal Pipe Size: ASTM F679
 - 3. Where depth of pipe is greater than 14', ASTM D2241, SDR-26 is required.
 - 4. Flexible Elastomeric Seals: ASTM D3212
 - 5. Seal Material: ASTM F477

2.4 HDPE (HIGH DENSITY POLYETHYLENE)

- A. Pipe class SDR 7 (200 psi), supplied in sufficient lengths to avoid joints.
- B. Pipe materials shall have a PPI/ASTM standard thermoplastic designation code of PE3408 and a material classification code conforming to grade P34 for ASTM D3350.
- C. Fittings, adapters, valves, and other piping appurtenances shall be in strict accordance with the recommendations of the pipe manufacturer.
- D. Field splices, if required, shall be in accordance with ASTM D3261 (butt heat fusion) or with pipe manufacturers approved electrofusion fittings manufactured in accordance with ASTM F1055 and rated at a minimum operating pressure equal to the pipe itself.

2.5 RIP RAP STONE

- A. Field stone or rough hewn quarry stone of approximate rectangular shape, hard and angular, and of such quality that it will not disintegrate on exposure to water or weathering.
- B. 9" minimum thickness, measured perpendicular to face, with no face dimension less than the thickness of the stone.
- C. Not less than 70% of the individual pieces weighing minimum of 150 lbs; not more than 10% of the individual pieces weighing less than 100 lbs.

2.6 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

- A. See Section 31 23 17.

2.7 FLEXIBLE COUPLINGS

- A. Elastomeric plastic sleeve resistant to chemicals and normal sewer gases leakproof and rootproof; positive seal against infiltration and exfiltration; stainless steel clamp bands.
- B. Manufacturer: Fernco, Davison Michigan, or equal.

2.8 SERVICE SADDLES

- A. Service saddles are not permitted. Repair couplings must be used to install service wyes into pipe. Properly sized Fernco or equivalent sleeves will be used to insert service wyes into vitrified clay or asbestos cement pipe.

2.9 AIR RELEASE/VACUUM RELIEF VALVES

- A. Combination Air Release Valve:
 - 1. Long body design, and shall operate by sealing the Buna-N Rubber seat with a stainless steel valve disc as the float rises when water enters the valve body.
 - 2. Standard operating pressure: 20 to 150 PSIG.
 - 3. Valve shall automatically open when the system drains, or is under negative pressure, so that air may enter the line.
 - 4. NPT screwed or ANSI Class 125 flanged inlet connection with cast iron body, top and inlet flange (where required), stainless steel trim and float.
 - 5. Outlet connection shall be cast iron body, top and inlet float (where required), stainless steel trim and float.
 - 6. Valve shall be Crispin Model SA Air and Vacuum Sewer Valves, as manufactured by Crispin-Multiplex Manufacturing Co., Berwick, PA.
 - 7. Valve shall be supplied with back flushing attachments so that the interior body can be flushed periodically for proper operation.
 - 8. Protectop shall be supplied to prevent debris from entering the outlet of the valve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform trench excavation to the line and grade indicated on the Contract Drawings and as specified in Section 31 23 17 - Trenching, Backfilling and Compacting.
- B. Unless otherwise indicated on the Contract Drawings, provide for a minimum cover of 4 feet above the top of piping laid in trenches.
- C. Provide pipe bedding as specified in Section 31 23 17 - Trenching, Backfilling and Compacting for each type of pipe used.
- D. Provide Type IV pipe bedding for all pipe.
- E. Place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.
- F. Install detectable utility marking tape above all plastic pipeline, 12" to 18" below final grade.

3.2 LAYING PIPE IN TRENCHES

- A. Give ample notice to the Authority in advance of pipe laying operations.
- B. Use laser alignment instruments.
- C. Lower pipe into trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to pipe. Do not drop pipe.
- D. Lay pipe proceeding upgrade with the bell or groove pointing upstream.
- E. Lay pipe to a true uniform line with the barrel of the pipe resting solidly in pipe bedding material throughout its entire length.
- F. Excavate recesses in pipe bedding material to accommodate joints, fittings and appurtenances.
- G. Do not subject pipe to a blow or shock to achieve solid bearing or grade.
- H. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to avoid offsets in the flow line. Ponding in any portion of the sewer shall be cause for rejection.
- I. Clean and inspect each section of pipe before joining.
- J. Assemble to provide tight, flexible joints that permit movement caused by expansion, contraction, and ground movement.
- K. Use lubricant recommended by the pipe or fitting manufacturer for making joints.
- L. If unusual joining resistance is encountered or if the pipe cannot be fully inserted into the bell, disassemble joint, inspect for damage, reclean joint components, and reassemble joint.

- M. Assemble joints in accordance with recommendations of the manufacturer.
- N. Push-on Joints:
1. Clean the inside of the bell and the outside of the spigot.
 2. Insert rubber gasket into the bell recess.
 3. Apply a thin film of gasket lubricant to either the inside of the gasket or the spigot end of the pipe, or both.
 4. Insert the spigot end of the pipe into the socket using care to keep the joint from contacting the ground.
 5. Complete the joint by forcing the plain end to the bottom of the socket.
 6. Mark pipe that is not furnished with a depth mark before assembly to assure that the spigot is fully inserted.
- O. Mechanical Joints:
1. Wash the socket and plain end.
 2. Apply a thin film of soapy water.
 3. Slip the gland and gasket over the plain end of the pipe.
 4. Apply soapy water to gasket.
 5. Insert the plain end of the pipe into the socket and seat the gasket evenly in the socket.
 6. Slide the gland into position, insert bolts, and finger-tighten nuts.
 7. Bring bolts to uniform tightness; tighten bolts 180 degrees apart alternately.
- P. Solvent Cemented Joints:
1. Chamfer and deburr pipe.
 2. Clean socket and plain end.
 3. Measure and mark the socket depth on the outside of the pipe.
 4. Apply primer to inside socket surface using a scrubbing motion to ensure penetration; repeated applications may be necessary.
 5. Soften surface of male end of pipe to depth of fitting socket by applying a liberal brush coat of primer.
 6. Do not pour primer on, or mix with cement.
 7. Assure entire surface is well softened.
 8. Repeat application of primer to inside socket surface, then apply cement to pipe while surfaces are still wet with primer.
 9. Apply cement uniformly taking care to keep excess cement out of socket.
 10. With truss pipe, seal truss section to avoid false air leaks.
 11. Immediately after applying the last coat of cement to the pipe, and while both the inside socket surface and outside pipe surface are soft and wet, forcefully seat the pipe into the socket.
 12. Turn the pipe 1/4 turn during assembly to distribute cement evenly.
 13. Assembly should be completed within 20 seconds after the last application of cement.
 14. Insert pipe with a steady, even motion.
 15. Do not use hammer blows.
 16. Hold joint in place until cement has set; wipe excess cement from the pipe.
- Q. Coupled Joints: Assemble in accordance with the manufacturer's recommendations.
- R. Disassemble and remake improperly assembled joints using a new gasket.
- S. Grade Check:

1. Check each pipe installed as to line and grade in place.
2. Correct deviation from grade immediately.
3. A deviation from the designed grade as shown on the Contract Drawings, or deflection of pipe joints, will be cause for rejection.
4. Deviation from design grade is easily detected during television inspection as water "ponding" in the pipe. Areas of ponding during television inspection will be cause for rejection.

T. Minimum Required Slope:

1. Minimum slope of sanitary sewer pipe is 0.5%.
2. Minimum slope required from terminal manhole to next manhole downstream is 1.0%.

U. Place sufficient backfill on each section of pipe, as it is laid, to hold firmly in place.

V. Clean interior of the pipe as work progresses; where cleaning after laying is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull forward past each joint immediately after the jointing has been completed.

W. Keep trenches and excavations free of water during construction.

X. When the work is not in progress, and at the end of each workday, securely plug open ends of pipe and fittings to prevent trench water, earth, or other substances from entering the pipes or fittings.

Y. When it is necessary to deflect pressure sewer mains from a straight alignment horizontally or vertically, do not exceed the following limits:

1. Ductile-Iron Pipe: Per AWWA C600.
2. PVC Pipe: Per manufacturer's recommendations.

3.3 WYE BRANCHES

- A. Install wye branches at locations indicated on the Contract Drawings concurrently with pipe laying operations.
- B. Use standard fittings of the same material and joint type as the pipeline into which they are installed. Wye branches shall connect to the pipeline at a 45 degree angle from the horizontal. See Standard Detail 33-01.
- C. When inserting a wye into dissimilar materials use a properly sized Fernco or equivalent sleeve.
- D. When inserting a wye branch into similar material as main line, use repair couplings. Fernco or equivalent sleeve will not be accepted.

3.4 LATERALS

- A. Construct laterals from the wye branch to a terminal point at the edge of right-of-way. Laterals shall have a minimum of 1/4" per foot for 4" pipe, or 1/8" per foot for 6" pipe for their entire length except that the connection to the main line shall be at 45 degrees.

- B. Where the depth of the main pipeline warrants, construct riser type laterals from the wye branch in accordance with Standard Detail 33-02 or 33-03.
- C. The determination as to the type of riser, slope, and depth of lateral pipe at the termination point will be made by the Authority's representative in the field.
- D. Install an approved watertight plug, braced to withstand pipeline test pressure thrust, at the termination of the lateral.
- E. Install a temporary marker stake extending from the end of the lateral to 1 foot above finished grade.

3.5 CAST-IN-PLACE CONCRETE CONSTRUCTION

- A. Conform to the applicable requirements of Section 03 30 53 - Concrete for Utility Construction.

3.6 CRADLES AND ENCASEMENT

- A. Provide concrete cradles and encasement for pipeline where indicated on the Contract Drawings, or as directed by the Authority, and in accordance with Standard Detail 5179. Encasements and cradles shall not be poured when there is a danger of freezing unless precautions are taken to prevent such freezing.

3.7 CARRIER PIPE IN CASINGS

- A. Applicable to casing pipe installed in open cut trenches; for installation by boring, jacking, or tunneling, consult with the Authority's Engineer.
- B. Provisions regarding pipe laying specified above also apply to carrier pipe installed in casings.
- C. Excavate trench to the additional depth and width necessary to accommodate the casing pipe and to maintain the line and grade of the carrier as indicated on the Drawings.
- D. Minimum inside diameter of the casing pipe: 4" greater than the largest outside diameter of the carrier pipe joints.
- E. Support pipeline within casing so that no external loads are transmitted to the carrier pipe.
- F. Attach wooden skids to barrel of carrier pipe; do not rest carrier pipe on pipe joint bells.
- G. Fill annular space between carrier pipe and casing pipe with packed sand or grout per Drawings.
- H. Close ends of casing.

3.8 STREAM CROSSINGS

- A. Construct sanitary sewer pipeline stream crossings in accordance with Standard Detail 31-05.
- B. Provide concrete encased mechanical joint ductile-iron pipe backfilled with minimum 3" size stone to the level of the stream bed, between the limits of the stream crossing.

- C. Do not backfill until concrete has achieved its initial set and concrete work is examined by the Authority.

3.9 BACKFILLING TRENCHES

- A. Backfill pipeline trenches only after examination of the pipe laying by the Authority.
- B. Backfill trenches as specified in Section 31 23 17 - Trenching, Backfilling and Compacting.

END OF SECTION 33 31 13

SECTION 33 32 17 - SEWAGE GRINDER PUMPING UNITS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Sewage grinder pumping units in fiberglass reinforced plastic basins.

1.2 QUALITY ASSURANCE

- A. Design Criteria:
 - 1. Units factory assembled and shipped as a complete unit ready for installation, UL and NSF listed, free of noise, odor, and electrical, fire and health hazards.
 - 2. Number of Pumps: 1
 - 3. The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.
- B. Grinder pump system shall be model DH-071-93 as manufactured by E/One Grinder Systems, or equal.

PART 2 PRODUCTS

2.1 GENERAL DESCRIPTION:

- A. Factory assembled units consisting of a fiberglass reinforced polyester basin with watertight cover, submersible sewage grinder pumps, mercury switch level controls, discharge piping, check valves with hydraulically sealed coupling, gate valve, pump slide rail supports, pump lifting chain, pump control panel, and other necessary appurtenances.

2.2 SEWAGE PUMPS

- A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal.
- B. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier.
- C. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied.
- D. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel.
- E. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance.
 - 1. Buna-N is not acceptable as a stator material.

2.3 SEWAGE GRINDER

- A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft.

- B. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable.
- C. The grinder impeller shall be a one-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance.
- D. The shredder ring shall be of the stationary type and the material shall be white cast iron.
 - 1. The teeth shall be ground into the material to achieve effective grinding.
 - 2. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.
- E. Sewage grinder assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:
 - 1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
 - 2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second.
 - 3. The inlet shroud shall have a diameter of no less than 5 inches.
 - 4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- F. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of “foreign objects,” such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4 inch diameter stainless steel discharge piping.

2.4 ELECTRIC MOTOR

- A. As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds.
- B. The motor shall be press-fit into the casting for better heat transfer and longer winding life.
- C. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor.
 - 1. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application.
 - 2. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability.
- D. The wet portion of the motor armature must be 300 Series stainless.
- E. Oil-filled motors are not be accepted.

2.5 MECHANICAL SEAL

- A. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump.

- B. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.6 TANK & INTEGRAL ACCESSWAY: HIGH DENSITY POLYETHYLENE CONSTRUCTION

- A. The tank shall be a watertight wetwell/drywell design made of high density polyethylene, with a grade selected to provide the necessary environmental stress cracking resistance.
- B. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring.
 - 1. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness.
- C. Any incidental sections of a single wall construction are to be 0.250" thick (minimum).
- D. All seams created during tank construction are to be thermally welded and factory tested for leak tightness.
- E. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth.
- F. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.
- G. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50 inch OD DWV or Schedule 40 pipe. The tank capacities shall be as shown on the Contract Drawings.
- H. The Drywell accessway shall be an integral extension of the wetwell assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability.
- I. The cover shall be high density polyethylene, green in color, with a load rating of 150 lbs per square foot.
- J. The accessway design and construction shall enable field adjustment of the station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
- K. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.
- L. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight.
 - 1. The EQD will be supplied with 32 feet of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel.
 - 2. The ESC shall be installed in the basin by the manufacturer.
 - 3. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque.
 - 4. The EQD shall be so designed to be conducive to field wiring as required.
- M. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

2.7 DISCHARGE PIPING

- A. Shall be constructed of 304 Series stainless steel.

- B. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4 inch Female NPT fitting.
- C. The discharge piping shall include a stainless steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted.
- D. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

2.8 CHECK VALVE

- A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping.
- B. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow.
- C. Moving parts shall be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.
- D. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure.
- E. The valve body shall be an injection molded part made of an engineered thermoplastic resin.
- F. The valve shall be rated for continuous operating pressure of 235 psi.
- G. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

2.9 ANTI-SIPHON VALVE

- A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping.
- B. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.
- C. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure.
- D. The valve body shall be injection-molded from an engineered thermoplastic resin.
- E. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

2.10 CORE UNIT

- A. The grinder pump station shall have a cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level controls, electrical quick disconnect and wiring.
- B. The core unit shall be installed in the basin by the manufacturer.
- C. The core unit shall seal to the tank deck with a stainless steel latch assembly. The latch assembly must be actuated utilizing a single quick release mechanism requiring no more than a half turn of a wrench.

- D. The watertight integrity of each core unit shall be established by a 100 percent factory test at a minimum of 5 PSIG.

2.11 CONTROLS

- A. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners.
- B. The wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls.
- C. The level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable.
- D. The level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc.
- E. The level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer.
- F. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch.
- G. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance.
- H. The air column shall have only a single connection between the water level being monitored and the pressure switch.
- I. Any connections are to be sealed radially with redundant O-rings.
- J. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit.
- K. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.
- L. All fasteners throughout the assembly shall be 300 Series stainless steel.
- M. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type.
- N. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit.
- O. Pump ON/OFF and high-level alarm functions shall not be controlled by the same switch.
- P. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes.
- Q. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a FACTORY INSTALLED NEMA 6P EQD half attached to it.

2.12 ALARM PANEL:

- A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting.

- B. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance.
- C. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel.
- D. The enclosure shall not exceed 10.5 inches wide by 14 inches high by 7 inches deep, or 12.5 inches wide by 16 inches high by 7.5 inches deep.
- E. The alarm panel shall contain one 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp single-pole circuit breaker for the alarm circuit.
- F. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
- G. The alarm panel shall include the following features
 - 1. External audible and visual alarm
 - 2. Push-to-run switch
 - 3. Push-to-silence switch; redundant pump start
 - 4. High level alarm capability.
- H. The alarm sequence is to be as follows when the pump and alarm breakers are on:
 - 1. When liquid level in the sewage wet-well rises above the alarm level, audible and visual alarms are activated, the contacts on the alarm pressure switch activate, and the redundant pump starting system is energized.
 - 2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
 - 3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.
- I. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H.
 - 1. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating.
- J. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB at 2 feet.
 - 1. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).
- K. The entire alarm panel, as manufactured and including any of the following options, shall be listed by Underwriters Laboratories, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install grinder pump units in accordance with manufacturer's instructions.
- B. Provide necessary piping, fittings, and valves as required for a complete operable unit as intended.

3.2 START-UP

- A. Upon completion of installation, examine, adjust and test each unit for proper operation under the direction of the manufacturer's field engineer.

- B. Check and adjust liquid level control and alarm settings.

3.3 PERFORMANCE TESTING

- A. Test each unit with clean water through minimum of four complete cycles including high-level and low-level conditions to demonstrate correct sequence of pump operation, control settings, alarm settings, freedom from pump vibration, noise and overheating.
- B. Demonstrate provision for core removal and replacement.

END OF SECTION 33 32 17

SECTION 33 33 00 - LOW-PRESSURE SEWER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
1. Sanitary sewer low-pressure pipelines
 2. Service connections
 3. In-line cleanouts
 4. Terminal cleanouts
 5. Air release valves
 6. Pressure to gravity connections
- B. Special approval must be obtained from the Authority for the installation of a low-pressure sewer system.
- C. For technical information regarding low pressure sewer from the grinder pumping station to the service valve, Contractors shall refer to Appendix A. For low pressure sewer downstream of the service valve, the Contractor shall refer to this specification section.
- D. Related Work specified elsewhere:
1. Section 31 23 17 - Trenching, Backfilling & Compacting
 2. Section 33 01 32 - Sewer and Manhole Testing
- E. Applicable Standard Details:
1. 31-04 Vertical Water Main Clearance
 2. 33-05 Typical Pressure Sewer Service Connection
 3. 33-06 Service Valve Detail
 4. 33-07 Valve Box Detail
 5. 33-08 In-line Cleanout Detail
 6. 33-09 Terminal Cleanout Detail

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 2. ASTM D1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
 3. ASTM D2241 Poly(Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
 4. ASTM D2466 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 5. ASTM D2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
 6. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 7. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.3 SUBMITTALS

- A. Submit manufacturer's instructions for installation of adapters and maximum recommended deflection per pipe joint.
- B. Submit manufacturer's certification attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. During loading, transporting and unloading, and storage on site, exercise care to prevent damage to materials.
- B. Do not drop pipe or fittings.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) SEWER PIPE

- A. Pressure Sewer Pipe and Fittings:
 - 1. Pipe: ASTM D2241, SDR21.
 - 2. Flexible Elastomeric Seals: ASTM D3139.
 - 3. Seal Material: ASTM F477.
 - 4. Fittings: ASTM D2466, Socket type, Schedule 40.
 - 5. Solvent Cement: ASTM D2564.

2.2 HDPE (HIGH DENSITY POLYETHYLENE)

- A. Pipe class SDR 7 (200 psi), supplied in sufficient lengths to avoid joints.
- B. Pipe materials shall have a PPI/ASTM standard thermoplastic designation code of PE3408 and a material classification code conforming to grade P34 for ASTM D3350.
- C. Fittings, adapters, valves, and other piping appurtenances shall be in strict accordance with the recommendations of the pipe manufacturer.
- D. Field splices, if required, shall be in accordance with ASTM D3261 (butt heat fusion) or with pipe manufacturers approved electrofusion fittings manufactured in accordance with ASTM F1055 and rated at a minimum operating pressure equal to the pipe itself.

2.3 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

- A. Refer Section 31 23 17, Trenching, Backfilling, and Compacting.

2.4 AIR RELEASE VALVES

- A. Air release valve for sewage service, with backflushing and cleaning accessories.
- B. Cast iron body and cover, stainless steel stem and float, stainless steel trim, Buna-N orifice seats.
- C. Constructed with long bodies and float stems so that operating mechanisms and orifice openings are kept free from contact with sewage during purging of air.
- D. Provide valves with backflushing and cleaning accessories comprised of:
 - 1. Shut-off valve at bottom inlet
 - 2. Blow-off valve near bottom of valve body
 - 3. Clear water inlet valve with quick-disconnect coupling
 - 4. Air inlet with quick-disconnect in the valve cover
 - 5. Hose with quick-disconnect couplings

2.5 VALVES

- A. PVC valves manufactured from a compound conforming to ASTM D1784, Class 12454-B.
- B. PVC Ball Valves: True union, double entry; fluorocarbon base, o-ring seals, teflon seats; 150 psi rated.
- C. PVC Check Valves:
 - 1. Gravity-operated, flapper-type providing full-ported passageway when open.
 - 2. Stainless steel hinge pin; elastomeric seal.
 - 3. 150 psi working pressure.
- D. Plug Valves (Line Size Valves 3"):
 - 1. Semi-steel body, mechanical joint ends; eccentric plug, rectangular or semi-circular ports. For 4" diameter and smaller plug valves, where rectangular port is furnished, the cross-sectional area shall be not less than 100% of the connecting pipe cross-sectional area.
 - 2. Plug valves shall have a cast iron plug having a resilient neoprene or Buna-N facing. Valve bodies shall be furnished with an 1/8" minimum welded overlay seat of not less than 90% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Valves shall have corrosion resistant bearing. Valve shaft seals shall be in accordance with AWWA C504 or C507. Valves shall have a 150 psi working pressure. Provide a square operating nut.

2.6 ADJUSTABLE VALVE BOXES

- A. Plastic; PVC, ABS, or reinforced olefin polymers.
- B. Plastic top tube, belled bottom; bell arched and flanged; slide friction adjustment.
- C. Cast iron top collar and lid; lid cast with "Sewer".

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform trench excavation to the line and grade indicated on the Drawings and as specified in Section 31 23 17 - Trenching, Backfilling and Compacting.
- B. Unless otherwise indicated on the Drawings, provide for a minimum cover of 4'-0" above the top of piping laid in trenches.
- C. Provide Type IV bedding as indicated on Standard Detail 31-02; place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.

3.2 LAYING PIPE IN TRENCHES

- A. Give ample notice to the Authority in advance of pipe laying operations.
- B. Lower pipe into trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to the pipe. Do not drop pipe.
- C. Lay pipe proceeding upgrade with the bell or groove pointing upstream.
- D. Excavate recesses in bedding material to accommodate joints, fittings and appurtenances. Do not subject pipe to a blow or shock to achieve solid bedding or grade.
- E. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to avoid offsets in the flow line.
- F. Clean and inspect each pipe and fitting before joining. Assemble to provide tight, flexible joints that permit movement caused by expansion, contraction and ground movement. Use lubricant recommended by the pipe or fitting manufacturer for making joints. If unusual joining resistance is encountered or if the pipe cannot be fully inserted into the joint, disassemble joint, inspect for damage, reclean joint components, and re-assemble joint.
- G. Do not deflect joints in pressure piping more than the maximum recommended by the pipe manufacturer.
- H. Place sufficient backfill on each section of pipe, as it is laid, to hold pipe firmly in place.
- I. Clean the interior of the pipe as the work progresses.
- J. Keep trenches and excavations free of water during construction.
- K. When the work is not in progress, and at the end of each workday, securely plug ends of pipe and fittings to prevent trench water, earth or other substances from entering the pipe or fittings.

3.3 THRUST RESTRAINT

- A. Provide pressure pipeline with restrained joints or concrete thrust blocking at all bends, tees, and changes in direction; construct concrete thrust blocking in accordance with Standard Details 33-03 and 33-04. If restrained joints are utilized, submit design calculations showing determination of restrained lengths and submit joint restraint details. Method of joint restraint shall utilize devices specifically designed for the application for which manufacturer's data is available for the application. Submit manufacturer's literature for approval.

3.4 AIR RELEASE VALVES

- A. Install air release valves and vaults where indicated on the Drawings.

3.5 SERVICE VALVES AND CLEANOUTS

- A. Provide service valves, in-line cleanouts, and terminal cleanouts where indicated on the Drawings.
- B. Construct as indicated on Standard Details 33-06 thru 33-09.

3.6 PRESSURE SEWER TO GRAVITY SEWER CONNECTIONS

- A. Connect low-pressure sewer system to gravity sewer system at manhole lined in accordance with Section 33 39 16 – Spray Applied Resin Manhole Liner.
- B. Line low-pressure sewer system discharge manhole, and two downstream manholes in accordance with Section 33 39 16 – Spray Applied Resin Manhole Liner unless otherwise approved by the Authority.

3.7 BACKFILLING TRENCHES

- A. Backfill pipeline trenches in accordance with Section 31 23 17 - Trenching, Backfilling and Compacting and only after examination of pipe laying by the Authority's Representative.
- B. Install detectable utility marking tape above all plastic sanitary sewer pressure pipeline, 12" to 18" below final grade.

3.8 HYDROSTATIC LEAKAGE TEST

- A. Hydrostatically test each newly laid pressure pipeline, including any valved section thereof, in accordance with Section 33 01 32 - Sewer and Manhole Testing.

END OF SECTION 33 33 00

SECTION 33 39 10 - MANHOLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Precast Concrete Manholes
2. Concrete Manhole Bases
3. Manhole Steps
4. Manhole Covers and Frames

B. Related Work specified elsewhere:

1. Section 03 30 53 - Concrete for Utility Construction
2. Section 31 23 17 - Trenching, Backfilling & Compacting
3. Section 33 01 32 - Sewer and Manhole Testing
4. Section 33 31 13 - Sanitary Sewer Pipe

C. Applicable Standard Details:

1. 33-17 Precast Manhole Base Detail
2. 33-18 Standard Shallow Precast Manhole
3. 33-19 Standard Deep Precast Manhole
4. 33-20 Manhole Cover with Anchor Bolt
5. 33-21 Manhole Step Detail
6. 33-22 Heavy Duty Watertight Manhole Frame and Cover with Gasket in Frame
7. 33-23 Type A Drop Manhole Details, PVC Pipe
8. 33-24 Type B Drop Manhole Details, PVC Pipe
9. 33-30 Precast Concrete Doghouse Manhole – Invert Section View
10. 33-31 Precast Concrete Doghouse Manhole

1.2 QUALITY ASSURANCE

A. Pennsylvania Department of Transportation (PennDOT):

1. Publication 408/2011 Specifications.

B. American Society for Testing and Materials (ASTM):

1. A496 Specifications for Steel Wire, Deformed, for Concrete Reinforcement
2. C270 Specifications for Mortar for Unit Masonry
3. C478 Specifications for Precast Reinforced Concrete Manhole Sections
4. C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
5. D1248 Standard Specification for Polyethylene Plastics
6. D448 Standard Sizes of Coarse Aggregate for Highway Construction
7. D4101 Specification for Propylene Plastic Injection and Extrusion Materials

- C. American Association of State Highway Transportation Officials (AASHTO):
 - 1. AASHTO M306-05 Standard Specification for Drainage, Utility, and Related Castings.
- D. Federal Country-of-Origin Marking Law:
 - 1. United States Federal Law requires that imported castings (manhole frame and covers) are subject to specific country-of-origin markings in order to legally enter the United States.

1.3 SUBMITTALS

- A. Submit shop drawings and certification from material suppliers attesting that materials meet or exceed AASHTO M306-05 requirements.
- B. Shop Drawings:
 - 1. Submit detailed shop drawings of manhole sections and precast bases.
 - 2. Submit detailed shop drawings of manhole frames and covers.
 - 3. Submit detailed shop drawings of manhole steps.
- C. Submit manufacturers' descriptive literature and installation instructions for the resilient pipe-to-manhole connection and for the joint sealant compound.
- D. Submit certification that material was manufactured in the United States of America.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Crushed Stone Subbase: ASTM D448, Size 57(PennDOT 2B) (AASHTO M-43) or Select Granular Material (PennDOT 2RC), Section 703.3 Publication 408/2011.
- B. Masonry Mortar: ASTM C270, Type S
- C. Cement Concrete: Section 03 30 53

2.2 MANHOLES

- A. Precast Concrete Manhole Sections:
 - 1. Conforming to ASTM C478, with 5.5% ±1% air-entrained cement concrete.
 - 2. Provide flat slab top sections for manholes less than 4' deep or as indicated on Contract Drawings.
 - 3. Provide eccentric cone sections for manholes greater than 4' in depth, except as indicated on Contract Drawings.
 - 4. Provide 26" minimum access opening.
 - 5. Precast riser sections of length to suit.
 - 6. Precast bases of a design similar to the precast riser sections. Base to be integral with first riser section, minimum height of riser - 24".

-
7. Manholes shall be as manufactured by CR Semlers, 11664 Mapleville Rd, Smithsburg, MD 21783-1806 with precast flow channels.
- B. Exterior Coating:
1. Factory applied bitumastic coating to manhole exterior.
 2. Prepare surface for coating application in accordance with coating manufacturer's instructions.
 3. Apply coating to minimum 20-mil dry film thickness.
- C. Manhole Steps:
1. Steel reinforced copolymer polypropylene meeting the following specifications:
 - a. ASTM C478
 - b. ASTM C497, Method of test
 - c. ASTM D4101, PP0344B33534Z02 copolymer polypropylene
 - d. ASTM A496, D20, 1/2" reinforced rod
- D. Manhole Frames and Covers:
1. Frames and covers shall adhere to specifications for AASHTO Designation M306-05.
 2. Casting shall be free of bubbles, sand and air holes, and other imperfections.
 3. Castings shall be perfectly round and not deformed.
 4. Lateral clearance between frame and cover shall not exceed a total of 1/4 inch.
 5. Contact surfaces machined and matched. No "rocking" shall be acceptable.
 6. Cast cover inscription with "Sanitary Sewer" and "GTA", if intended for a sewer system to be dedicated to the Authority. This shall be as required by the Authority.
 7. Cast cover inscription with "Sanitary Sewer" only if not intended for a sewer system to be dedicated to the Authority. This shall be as required by the Authority.
 8. 26" minimum clear access opening.
 9. Frames shall be compatible in all ways with East Jordan Iron Works 1119Z frames, covers shall be compatible in all ways with East Jordan Iron Works 1120AGS. If necessary, these same frames and covers come in a watertight configuration.
 10. Frames and covers not meeting these criteria will be immediately rejected.
 11. Certification that frames and covers are made in the USA will be required.
 12. East Jordan Iron Works as shown in Standard Detail 33-20.
 13. Watertight assembly (Standard Detail 33-22) required:
 - a. Bolt cover to frame with 4 1/2"-13 stainless steel hex bolts, with stainless steel washer and neoprene washer.
- E. Manhole Inserts:
1. Manhole inserts shall be either stainless steel Tetherlock Model Rainstopper as manufactured by Southwestern Packing and Seals, Shreveport, LA, Telephone (318)687-4330, or equal.
 2. High density polyethylene copolymer meeting ASTM designation D1248, Class A, Category 5, Type III. Inserts shall be a uniform 1/8 inch in thickness with a 1-inch wide polypropylene lifting handle attached with a wide head 3/16 inch SS rivet with a 3/4" stainless steel backup washer as supplied by Contractor Specialties and Supply Company, or equal.

- F. Joint Sealant: ASTM C990.
- G. Resilient Pipe-to-Manhole Connection: ASTM C923.
- H. Rubber Adjustment Riser Rings:
 - 1. Flat or tapered

Physical Properties	Test Results	Test Method
Density	+/- 1.098 g/cm ³	ASTM C642-90
Durometer Hardness Molded Surface Interior Surface	75A +/- 10 points 75A +/- 10 points	
Tensile Strength	1.6 MPa (232 psi) (not less than 1 MPa)	ASTM D412-87
Compression Deformation 1) Initial Compression Deformation 2) Final Compression Deformation	6 +/- 4% 6 +/- 4%	
Compression Set	0.4% (no more than 4%) under 1 MPa (145 psi)	ASTM D395
Freeze and Thaw When Exposed to Chemicals	No loss after 50 cycles	ASTM C672-91
Coefficient of Thermal Expansion	1.08x10 ⁻⁴ mm/mm/d C (6x10 ⁻⁵ in/in/d F)	ASTM C531-85
Weathering (70 hours at 70 degrees C) 1) Hardness Retained 2) Compressive Strength Retained 3) Tensile Strength Retained 4) Elongation Retained	100% +/- 5% 100% +/- 5% 100% +/- 5% 100% +/- 5%	

2. Manufacturer shall be GNR Technologies, Inc., Lasalle, Quebec, Canada (514)366-6116, or equal.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Perform excavation to the line and grade indicated on the Contract Drawings and as specified in Section 31 23 17 - Trenching, Backfilling and Compacting.
- B. Location and depth of manholes as indicated on the Drawings.

3.2 CONSTRUCTION

- A. Construct watertight manholes of precast concrete sections of the type indicated on the Contract Drawings.
- B. Construct 4' diameter manholes unless otherwise indicated.
- C. Construct drop connections of the required type as indicated on Standard Details 33-23 and 33-24. Encase drop connection in concrete. Inside manhole drops will be allowed only under limited circumstances at the Authority's sole discretion. Inside drop manholes must have a minimum inside diameter of 5.0' and be constructed in accordance with Standard Detail 33-25.
- D. Provide precast concrete bases.
 1. Install precast bases as shown on Standard Detail 33-17.
 - a. Set the precast base on 6" crushed stone subbase.
 - b. Provide a sealed, flexible resilient connection between pipe and precast base section. Normally this will be precast into manhole. If boring use link seal or Authority approved equal.
- E. Flow Channels:
 1. Provide precast flow channels.
 2. Gap between pipe and precast manhole must be filled with grout over rubber sleeve.
- F. Do not permit pipe to project more than 2" into the manhole. Influent and effluent pipe inverts and sides must be smoothly grouted in the flow channel and manhole with no offsets or "shoulders".
- G. Joint Sealant:
 1. Seal joints between precast concrete manhole sections with two (2) rows of joint sealant compound.
 2. Apply joint sealant compound in accordance with instructions of the manufacturer. Place compound on the interior and exterior sides of the joint to be squeezed out by the weight of the upper section.
 3. Excess sealant must be cut flush with the face of the manhole and removed. Do not pull excess to remove.
 4. Do not apply rigid mortar to the joints between manhole sections.

- H. Install manhole sections with steps in proper vertical alignment.
- I. Precast Manhole Rings:
 - 1. Use precast manhole rings to achieve elevation indicated for frame and cover. Steel grade adjustment rings are not acceptable for new construction.
 - 2. Do not adjust elevation more than 1 ft. with precast rings.
 - 3. Seal joints between precast rings with joint sealant compound.
- J. Rubber Manhole Rings:
 - 1. Use flat or tapered rubber manhole rings to achieve elevation indicated for frame and cover.
 - 2. Do not adjust elevation more than 6" with rubber manhole rings.
 - 3. Seal joints between rubber rings with sealant as recommended by the manufacturer.
- K. Install Manhole Frames and Covers:
 - 1. Set top of frames 1/8 inch below finished grade elevation or other elevation indicated on the Drawings.
 - 2. Manholes Located in Non-paved Areas that are not defined as wet areas by the Authority:
 - a. Set top of frames 1/8 inch below finished grade elevation or other elevation indicated on the Drawings.
 - 3. Manholes Located in Non-paved Areas that are defined as wet areas by the Authority:
 - a. Seal joint between manhole frame and manhole with joint sealant compound.
 - b. After firmly seating manhole frame and cover into the joint sealant and vacuum testing, neatly trowel a minimum of 3 inches of mortar over the flange unless under paved roadway.
- L. Where new manholes are to be constructed on existing pipelines, carefully excavate around existing pipeline for placement of the new manhole base; take all measures necessary to control flow through the existing pipeline and to prevent leakage into the new base; after completion of the manhole, carefully remove the top portion of the existing pipeline to its centerline. See Standard Details 5122 and 5123.

3.3 CONNECTIONS OF SEWER MAINS TO EXISTING MANHOLES

- A. Connections to existing manholes shall be made carefully and as shown in Standard Detail 33-26; excavating down on the outside of the manhole without causing damage to the manhole. Core drill an opening into the manhole, insert a sealed, flexible resilient connection for the new pipe entering the manhole; once the connection is complete, perform a vacuum test as specified in Section 33 01 32 on the existing manhole and provide by-pass pumping if required to do the testing. If the vacuum test fails, do necessary repairs and retest. Backfill around manhole in accordance with Section 31 23 17 - Trenching, Backfilling, and Compaction.
- B. Flow channels must be designed to create sound hydraulics, and the flow channels must be approved by the Authority.

3.4 BACKFILLING

- A. Test manhole as specified in Section 33 01 32 prior to backfilling.
- B. Perform backfilling as specified in Section 31 23 17 - Trenching, Backfilling and Compacting.
- C. Place backfill in approximately equal lifts on opposite sides of manhole to equalize opposing horizontal pressures.

END OF SECTION 33 39 10

SECTION 33 39 16 - SPRAY APPLIED RESIN MANHOLE LINER

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Manhole Interior Protective Liner

B. Related Work Specified Elsewhere:

1. Section 33 01 32 – Sewer and Manhole Testing

1.2 QUALITY ASSURANCE

A. Furnish materials of quality required by the American Society for Testing and Materials (ASTM) standards or other approved standards and specifications.

B. Provide guarantee against defective materials and workmanship in accordance with the requirements of these specifications.

C. The Contractor installing the finished protective liner will be a certified trained applicator of the specified process.

D. Provide verifiable independent third party creep test results documenting no less than 70% retention of flexural modulus of elasticity after 50 years of service. The third party testing firm may not be affiliated with the manufacturer in any way.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM) Annual Book of Standards:

1. ASTM D638 Test Method for Tensile Properties of Plastics.

2. ASTM D790 Test Methods for Flexural Properties of Unreinforced and reinforced Plastics and Electrical Insulating Materials.

1.4 SUBMITTALS

A. Submit certification from material suppliers attesting that materials meet or exceed specification requirements.

B. Shop Drawings:

1. Submit detailed shop drawings of manhole liner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Patching Mix: A quick setting cementitious material shall be used as a patching mix. It shall be mixed and applied according to the manufacturer's recommendations and shall meet the following minimum requirements.

- | | | | |
|----|-----------------------|------------|--|
| 1. | Compressive Strength: | ASTM C 109 | 1000 psi @ 1 hr
3500 psi @ 48 hrs
5000 psi @ 28 days |
| 2. | Tensile Strength: | ASTM C 307 | 200 psi @ 24 hrs
300 psi @ 7 days |

- B. Infiltration Control Mix: A rapid-setting cementitious product specifically formulated for leak control shall be used to stop minor water infiltration, shall be mixed and applied according to the manufacturer's recommendations and shall meet the following minimum requirements.

- | | | | |
|----|-----------------------|------------|---|
| 1. | Compressive Strength: | ASTM C 109 | 1,800 psi @ 1/2 hr |
| 2. | Tensile Strength: | ASTM C 190 | 4,000 psi @ 24 hrs
5,000 psi @ 7 days
300 psi @ 7 days
350 psi @ 28 days |

- C. Grouting Mix:

1. A cementitious grout shall be used for stopping very active infiltration, filling voids and shall be mixed /applied according to manufacturer's recommendations. The cementitious grout shall be volume stable having a minimum 28 day compressive strength of 250 psi and a 1 day strength of 50 psi.
2. Chemical grouts used for stopping very active infiltration shall be mixed /applied per manufacturer's recommendations.

- D. Resin Based Liner:

1. The resin based material shall be used to form the sprayed on/structural enhanced monolithic liner covering all interior surfaces of the structure including benches and inverts of manholes. The finished liner shall be SprayWall as manufactured by Sprayroq, Inc. or equal and conform to the minimum physical requirements listed below.

- | | | | |
|----|-----------------------------|--|-------------|
| a. | Compressive Strength: | ASTM D 695 | 10,500 psi |
| b. | Tensile Strength: | ASTM D 638 | 7,000 psi |
| c. | Flexural Strength: | ASTM D 790 | 12,000 psi |
| d. | Bond: | Shall exceed tensile strength of substrate | |
| e. | Flexural Modulus (initial): | ASTM D 790 | 735,000 psi |
| f. | Density: | 87 +/- pcf | |

The finished structure shall be corrosion resistant to: Hydrogen Sulfide; 20% Sulfuric Acid; 17% Nitric Acid; 5% Sodium Hydroxide as well as other common ingredients of the sanitary sewage environment.

2. Minimum application thickness shall not be less than 250 mils above the aggregate topmost surface.

PART 3 - EXECUTION

3.1 PREPARATION

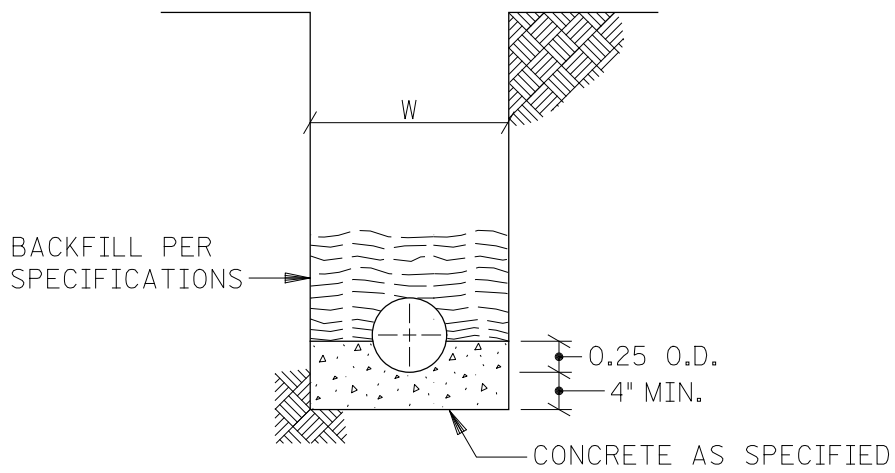
- A. Place covers over all pipe openings to prevent extraneous material from entering the sewer system.
- B. All foreign material shall be removed from the structure's wall and bench/floor using a pressure water spray (minimum 1200 psi). The use of acid for cleaning purposes, no matter how dilute, will not be allowed. Loose or protruding brick, mortar and concrete shall be removed by using a mason's hammer and chisel. Fill any large voids with quick setting patch mix as specified in this section. The surface to be repaired must be clean and free of any loose materials.
- C. Minor leaks shall be stopped using the quick-setting specially formulated infiltration control mix and shall be mixed and applied per manufacturer's recommendations. When severe infiltration is present, drilling may be required in order to pressure grout outside the structure using either a cementitious or chemical grout. Manufacturer's recommendations shall be followed when pressure grouting is required.

3.2 INSTALLATION/APPLICATION

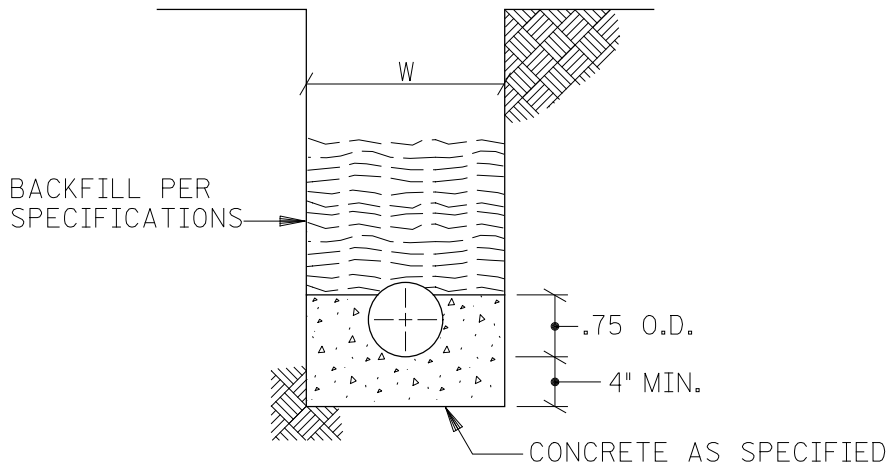
- A. Application Temperatures: No application of liner shall be made unless the ambient temperature inside the structure is 50°F or higher.
- B. Bench/Invert Repair for Channels to be Lined:
 1. The entire manhole bench and entire channel shall be lined.
 2. After blocking flow through the structure and thorough cleaning/preparatory work has been achieved, the sprayed on resin based liner shall be applied to the invert, bench and wall areas in the same manner as specified for the liner application below. The spray shall be applied such that the entire structure receives a structurally enhanced monolithic liner. The invert, bench and floor liner thickness shall be the same as that required for the structure walls.
 3. Liner shall overlap all connected pipes to ensure that all concrete surfaces are coated with the liner material.
 4. The finished invert surfaces shall be smooth, free of ridges and will be sloped in the direction of flow. Special care shall be used to insure a smooth transition between the new manhole invert and intersecting pipeline inverts such that flow will not be impaired.
 5. The flow through the structure shall be re-established as soon as practicable and following the liner manufacturer's recommendation for appropriate curing.
- C. Bench/Invert Repair for Channels to Remain Unlined:
 1. The manhole bench and channel to the flow line shall be lined.
 2. Install a bridge or flow-through tube.

3. After thorough cleaning/preparatory work has been achieved, the sprayed on resin based liner shall be applied to the channel, bench and wall areas in the same manner as specified for the liner application below. The spray shall be applied such that the entire exposed structure receives a structurally enhanced monolithic liner. The channel, bench and floor liner thickness shall be the same as that required for the structure walls.
 4. The finished invert surfaces shall be smooth, free of ridges and will be sloped in the direction of flow.
- D. Liner Application: The resin based liner shall be manually sprayed on to all surfaces by a trained technician who is experienced in the application of a spray applied resin and has been certified by the manufacturer. Appropriate personal protection equipment shall be utilized but in every case when applying the liner, the sprayer and personnel in direct contact with the spray atmosphere, will always be protected by supplied air. Special care shall be taken to ensure that all exposed surfaces at all pipe penetrations are completely lined.
- E. Curing: In extremely cool weather, the structure shall be protected while curing is in process to maintain temperatures within the range specified in the section.
- F. Holiday Detection Test:
1. A high voltage holiday detection system shall be used to determine if any holidays (voids) exist in the lining. Normally, the sensitivity control of the holiday tester is set to accommodate the thickness of the applied lining (100 volts for each 1 mil thickness).
 2. Follow the guidelines of the holiday manufacturer for correct control settings.
 3. Should a holiday be detected, it shall be marked and the Contractor will repair the void according to the correct procedure determined by the system manufacturer.

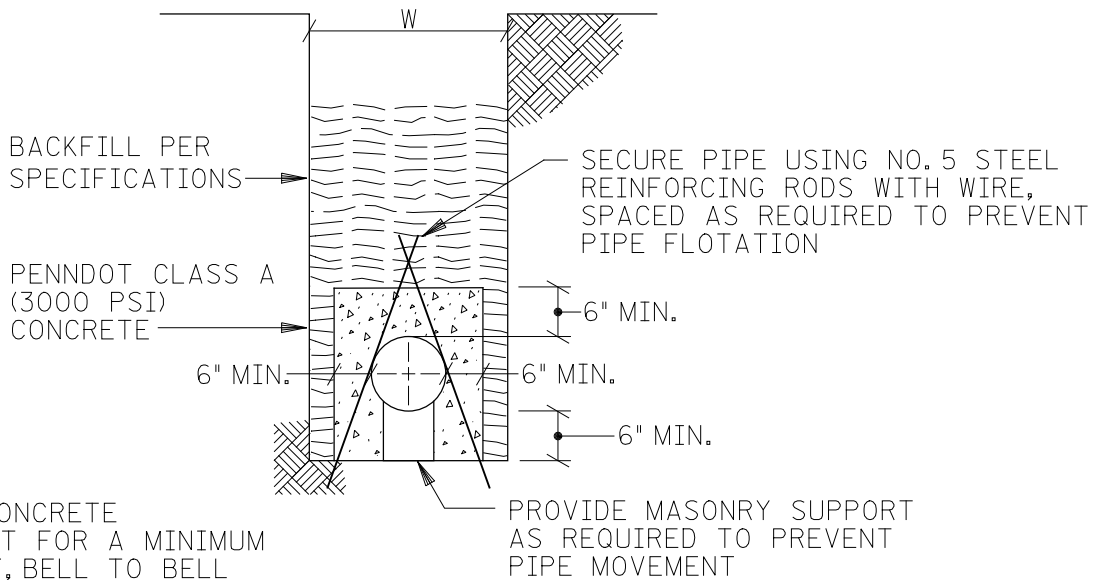
END OF SECTION 33 39 16



LOW CONCRETE CRADLE



HIGH CONCRETE CRADLE



CONCRETE ENCASEMENT TYPE I

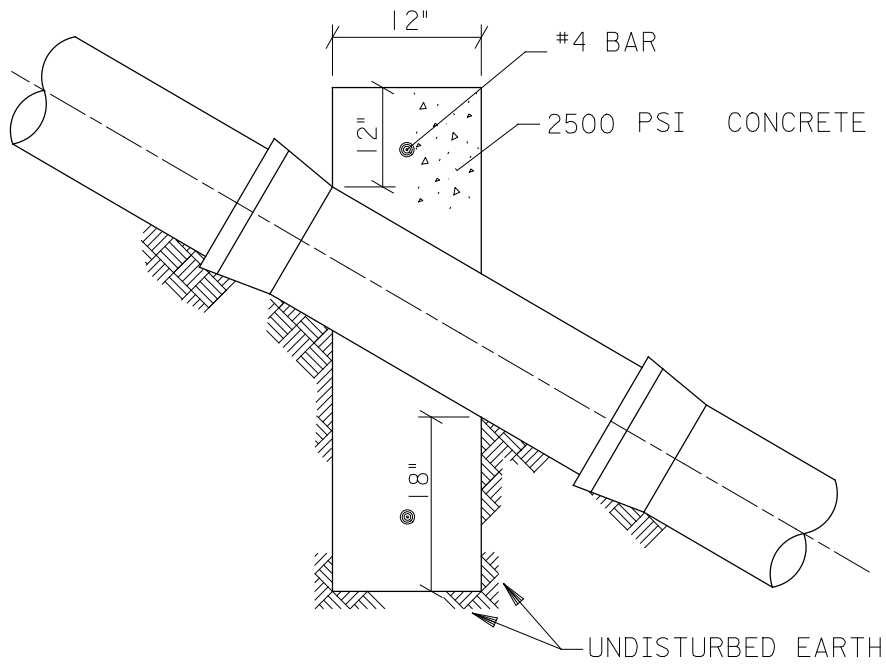
NOTE
 PROVIDE CONCRETE
 ENCASEMENT FOR A MINIMUM
 OF 10 FEET, BELL TO BELL

DRAWING NO.

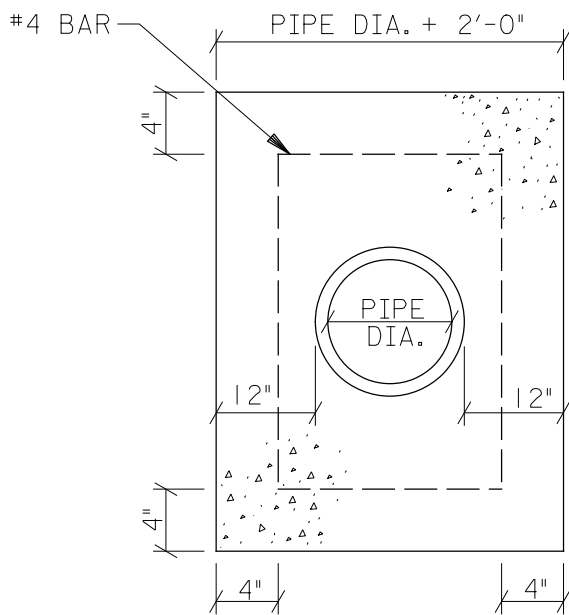
CONCRETE CRADLE AND
 ENCASEMENT DETAILS

03-01

DATE: 3/2015



PLAN



ELEVATION

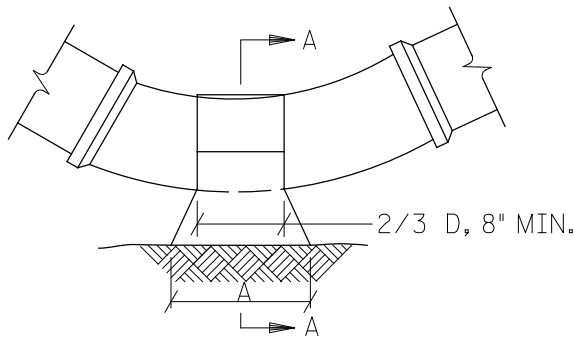
MAXIMUM SPACING
 36' C.C. FOR 20% TO 35% SLOPES
 24' C.C. FOR 35.1% TO 50% SLOPES
 16' C.C. FOR 50.1% OR GREATER SLOPES

DRAWING NO.

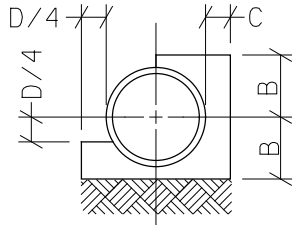
CONCRETE ANCHORS FOR
 STEEPLY SLOPED PIPES

03-02

DATE: 3/2015

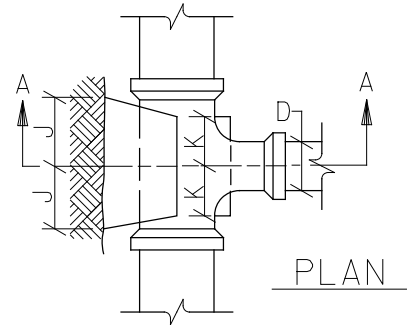


PLAN

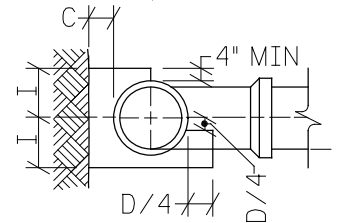


SECTION A-A

D= PIPE DIAMETER

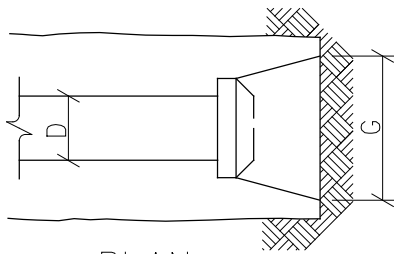


PLAN

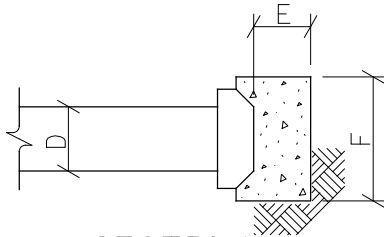


SECTION A-A

BUTTRESS FOR HORIZONTAL BENDS



PLAN



SECTION

BUTTRESS FOR CAPS

NOTE:

1. ALL BUTTRESSES TO BE CARRIED TO UNDISTURBED EARTH.
2. ALL CONCRETE TO BE AS SPECIFIED FOR MASS CONCRETE
3. BUTTRESS DIMENSIONS SHOWN ARE MINIMUM DIMENSIONS ARE BASED UPON SOIL BEARING PRESSURE OF 3,000 P.S.F. AND STATIC WATER PRESSURE OF 150 P.S.I. WHERE PRESSURE EXCEEDS 150 P.S.I. OR WHERE SOIL BEARING PRESSURE IS LESS THAN 3,000 P.S.F. SPECIAL BUTTRESS DESIGN IS REQUIRED.
4. USE DIMENSIONS SHOWN UNDER 4" PIPE FOR ALL PIPES LESS THAN 4" ϕ .

BUTTRESS FOR TEES

		BUTTRESS FOR HORIZONTAL BENDS					
BEND	°	SIZE OF BRANCH - D					
		4"	6"	8"	10"	12"	16"
11 1/4°	A	4"	6"	8"	10"	1'-0"	1'-4"
	B	5"	7"	8"	9"	10"	1'-0"
	C	5"	7"	7"	8"	8"	9"
22 1/2°	A	6"	9"	1'-0"	1'-6"	1'-9"	2'-3"
	B	6"	7"	8"	9"	10"	1'-0"
	C	6"	8"	9"	10"	11"	1'-2"
45°	A	10"	1'-3"	1'-8"	2'-1"	2'-6"	3'-4"
	B	7"	7"	8"	9"	11"	1'-3"
	C	7"	8"	9"	10"	11"	1'-2"
90°	A	1'-6"	2'-0"	2'-6"	3'-0"	3'-6"	5'-0"
	B	6"	6"	9"	1'-0"	1'-3"	1'-6"
	C	1'-6"	1'-10"	1'-9"	1'-8"	1'-7"	1'-5"
CAPS	E	6"	6"	8"	8"	10"	1'-0"
	F	9"	1'-0"	1'-4"	1'-8"	2'-0"	2'-9"
	G	11"	1'-5"	1'-11"	2'-5"	2'-10"	3'-9"
TEES	C	6"	8"	9"	10"	1'-0"	1'-2"
	H	6"	8"	9"	10"	1'-0"	1'-2"
	I	6"	9"	1'-0"	1'-3"	1'-5"	1'-11"
	J	4"	6"	8"	10"	1'-0"	1'-4"
	K	6"	6"	8"	8"	8"	10"

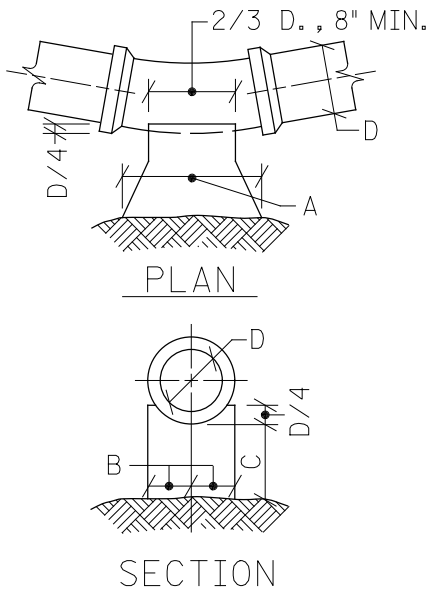
DRAWING NO.

THRUST BLOCK FOR BENDS, TEES, & CAPS

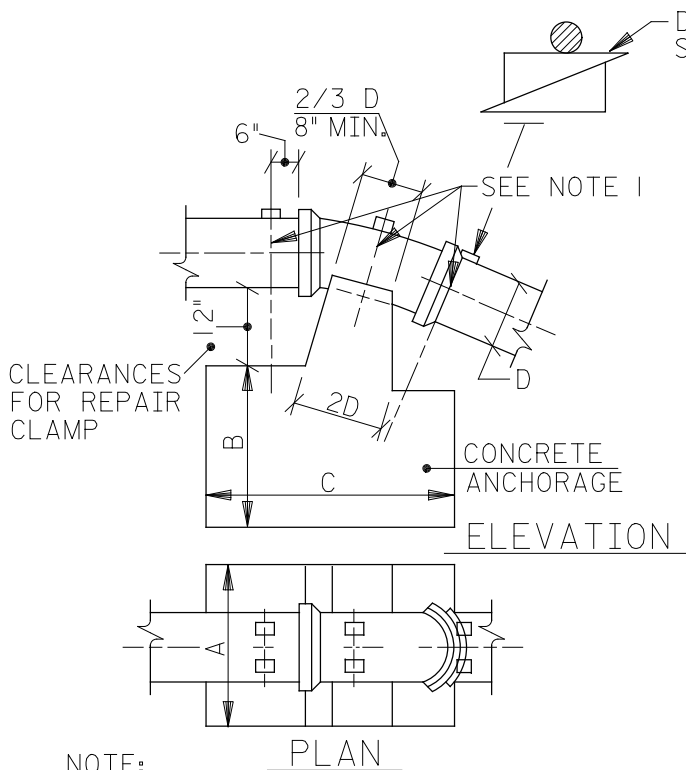
03-03

DATE: 3/2015

BUTTRESS FOR VERTICAL BENDS



BEND		BUTTRESS DIMENSIONS					
		SIZE					
		4"	6"	8"	10"	12"	16"
11 1/4°	A	4"	6"	8"	10"	1'-0"	1'-4"
	B	5"	7"	8"	9"	10"	1'-0"
1/32	C	5"	7"	7"	8"	8"	9"
	A	6"	9"	1'-0"	1'-6"	1'-9"	2'-3"
22 1/2°	B	6"	7"	7"	8"	10"	1'-0"
	C	6"	7"	7"	8"	8"	9"
1/16	A	10"	1'-3"	1'-8"	2'-1"	2'-6"	3'-4"
	B	7"	7"	8"	9"	11"	1'-3"
45°	C	7"	7"	8"	10"	11"	1'-3"
	A	10"	1'-3"	1'-8"	2'-1"	2'-6"	3'-4"
1/8	B	7"	7"	8"	9"	11"	1'-3"
	C	7"	7"	8"	10"	11"	1'-3"



BEND		ANCHORAGE DIMENSIONS					
		SIZE					
		4"	6"	8"	10"	12"	16"
11 1/4°	A	1'-4"	1'-6"	1'-6"	2'-6"	3'-0"	4'-0"
	B	1'-0"	1'-6"	1'-9"	2'-0"	2'-6"	2'-6"
1/32	C	2'-0"	2'-0"	2'-6"	3'-0"	3'-0"	4'-0"
	A	1'-8"	2'-0"	3'-4"	3'-8"	4'-0"	4'-4"
22 1/2°	B	1'-6"	1'-9"	2'-3"	2'-3"	2'-3"	2'-6"
	C	2'-0"	3'-0"	2'-8"	3'-10"	4'-0"	5'-9"
1/16	A	2'-3"	2'-6"	3'-0"	4'-0"	4'-6"	5'-2"
	B	1'-9"	2'-6"	2'-9"	3'-0"	3'-6"	4'-0"
45°	C	2'-6"	3'-0"	4'-0"	4'-6"	4'-9"	6'-6"
	A	2'-3"	2'-6"	3'-0"	4'-0"	4'-6"	5'-2"
1/8	B	1'-9"	2'-6"	2'-9"	3'-0"	3'-6"	4'-0"
	C	2'-6"	3'-0"	4'-0"	4'-6"	4'-9"	6'-6"

NOTE:

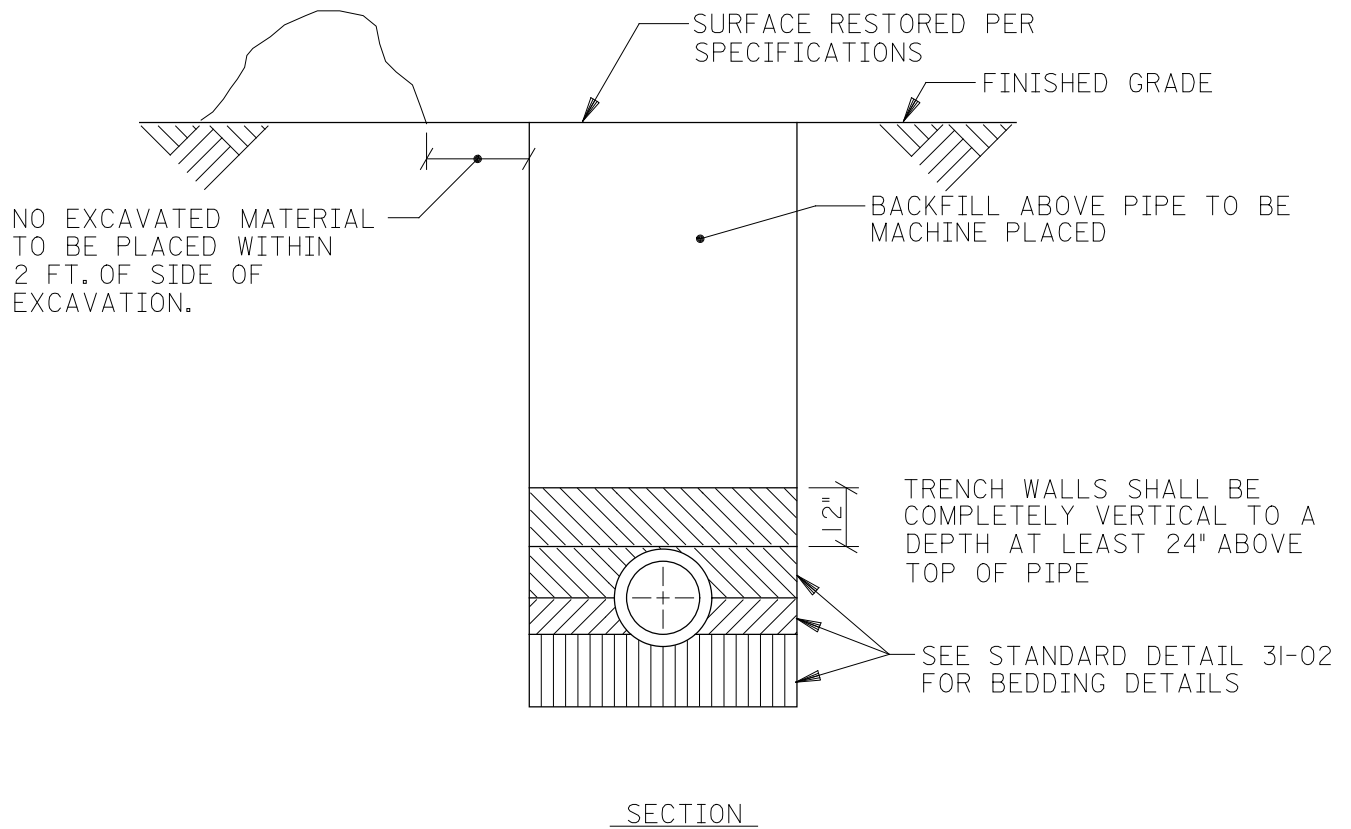
1. USE 3 #6 REINFORCING BARS AS SHOWN. IMBED 30 DIAMETERS IN CONCRETE AND PAINT EXPOSED SURFACE WITH 2 COATS OF APPROVED BITUMINOUS PAINT.
2. ALL CONCRETE TO BE CLASS AS SPECIFIED FOR MASS CONCRETE.
3. ALL BUTTRESSES TO BE CARRIED TO UNDISTURBED EARTH.
4. BUTTRESS DIMENSIONS SHOWN ARE MINIMUM. DIMENSIONS ARE BASED UPON SOIL BEARING PRESSURE OF 3,000 P.S.F. AND STATIC WATER PRESSURE OF 150 P.S.I. WHERE PRESSURE EXCEEDS 150 P.S.I. OR WHERE SOIL BEARING PRESSURE IS LESS THAN 3,000 P.S.F. SPECIAL BUTTRESS DESIGN IS REQUIRED.
5. USE DIMENSIONS SHOWN UNDER 4" PIPE FOR ALL PIPES LESS THAN 4" ϕ .

DRAWING NO.

THRUST BLOCK FOR
VERTICAL BENDS

03-04

DATE: 3/2015



NOTES:

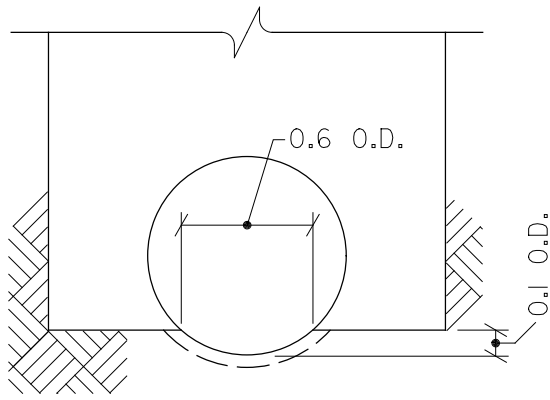
1. SHORING REQUIRED FOR ALL TRENCHES IN ACCORDANCE WITH OSHA AND APPLICABLE REGULATIONS LAWS & SAFETY CODES.
2. PLACE BACKFILL AROUND PIPE BY HAND AND COMPACT IN 6" LAYERS.

DRAWING NO.

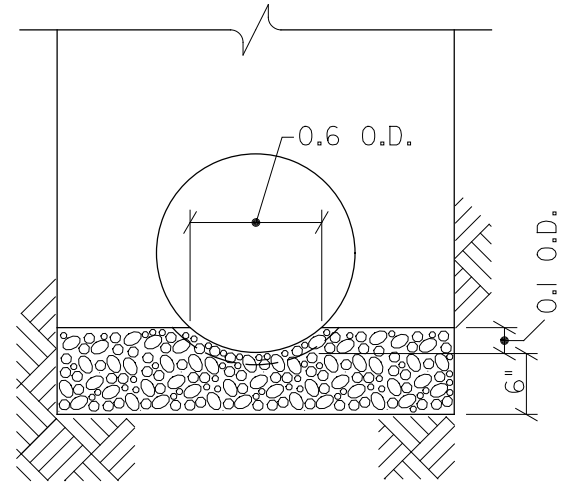
PIPE TRENCH DETAIL

31-01

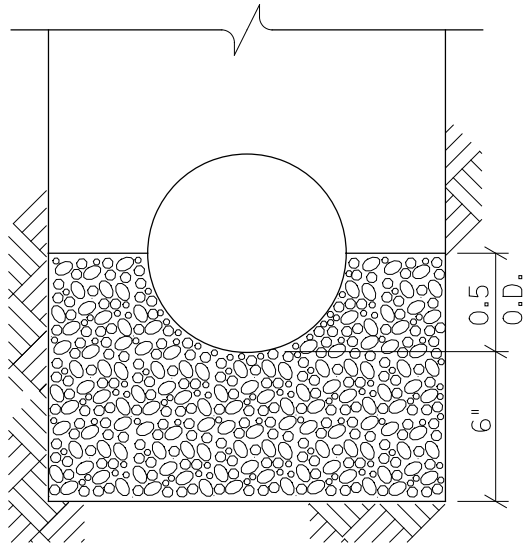
DATE: 3/2015



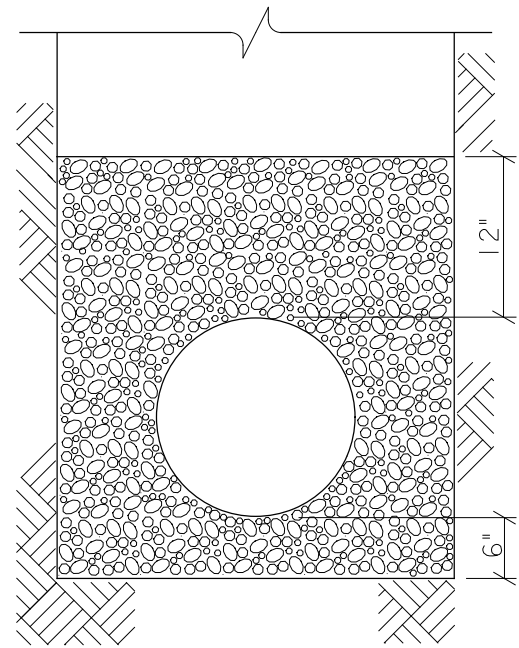
TYPE I BEDDING



TYPE II BEDDING



TYPE III BEDDING



TYPE IV BEDDING

NOTES:

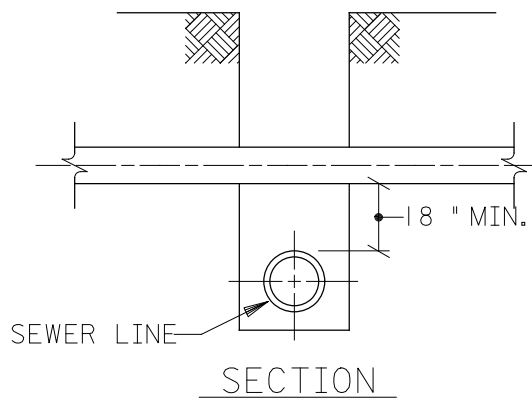
TRENCH BOTTOM TO BE FREE OF WATER BEFORE PLACING BEDDING.
 SHAPE RECESSES FOR BELL OF PIPE BY HAND.
 BACKFILL ABOVE BEDDING WITH SPECIFIED BACKFILL MATERIAL.

DRAWING NO.

PIPE BEDDING
 DETAILS

31-02

DATE: 3/2015

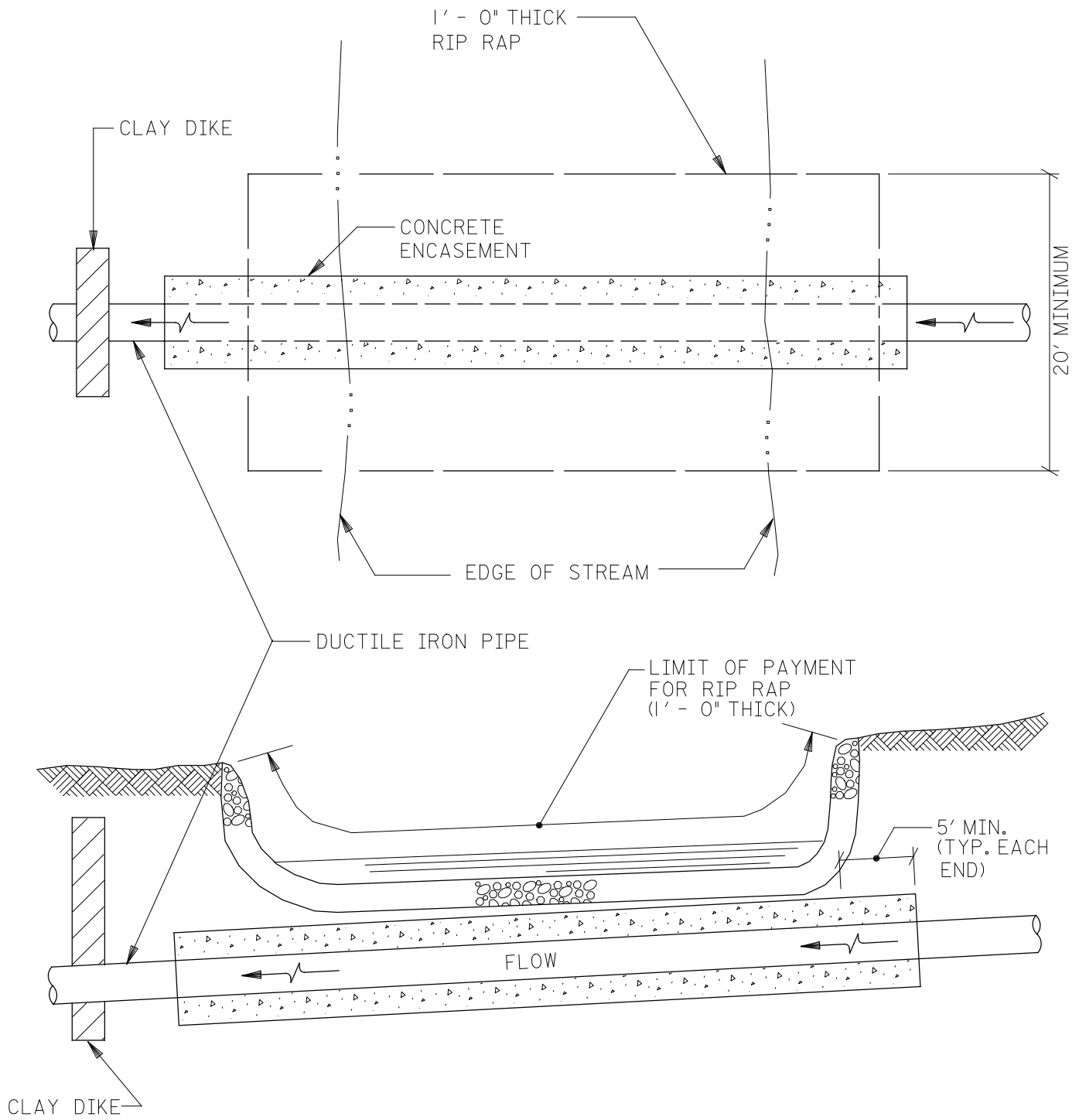


VERTICAL WATER MAIN CLEARANCE

NOTES:

1. IF JOINT ON WATER MAIN IS WITHIN LIMITS OF SEWER TRENCH, INSTALL MECHANICAL BELL JOINT CLAMP.
2. IF CLEARANCE IS LESS THAN 18", ENCASE SEWER PIPE 10 FT. EACH SIDE OF WATER MAIN. TO BE PAID AT UNIT PRICE BID PER CUBIC YARD OF CONCRETE.
3. IN NO CASE SHALL THE SEWER PIPE CONTACT ANY WATER MAIN, SERVICE LINE OR APPURTENANCE.

	VERTICAL WATER MAIN CLEARANCE	DRAWING NO. 31-04
		DATE: 3/2015

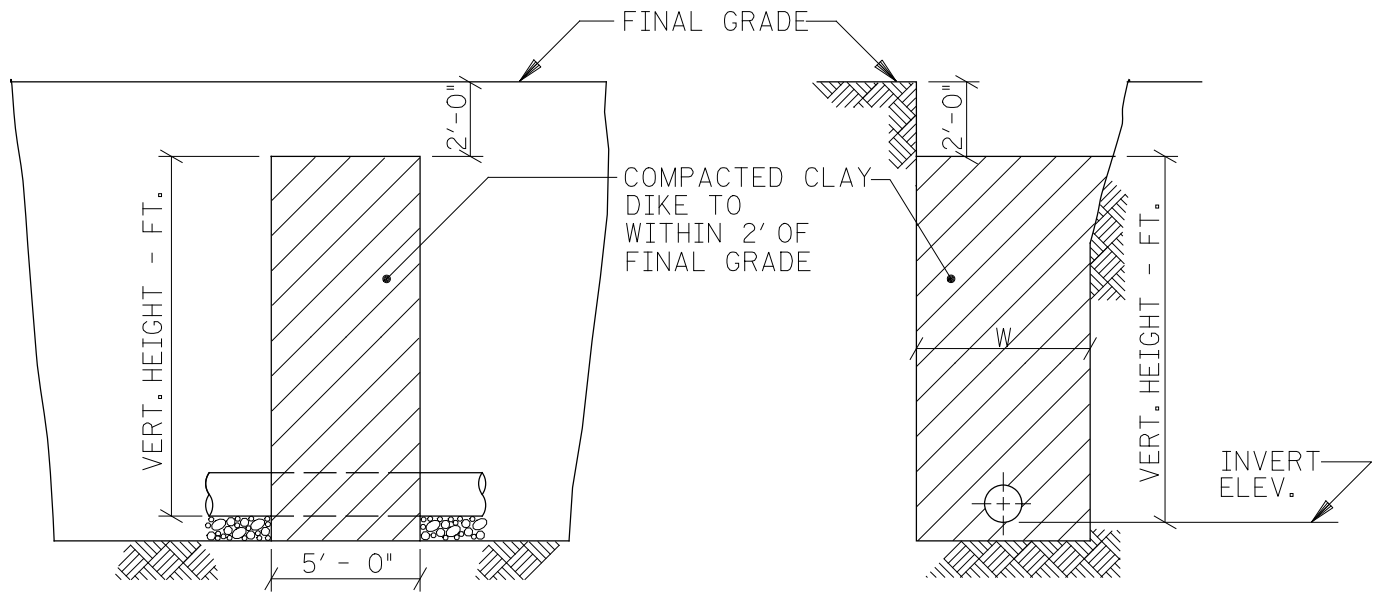


STREAM CROSSING
 DETAIL

DRAWING NO.

31-05

DATE: 3/2015



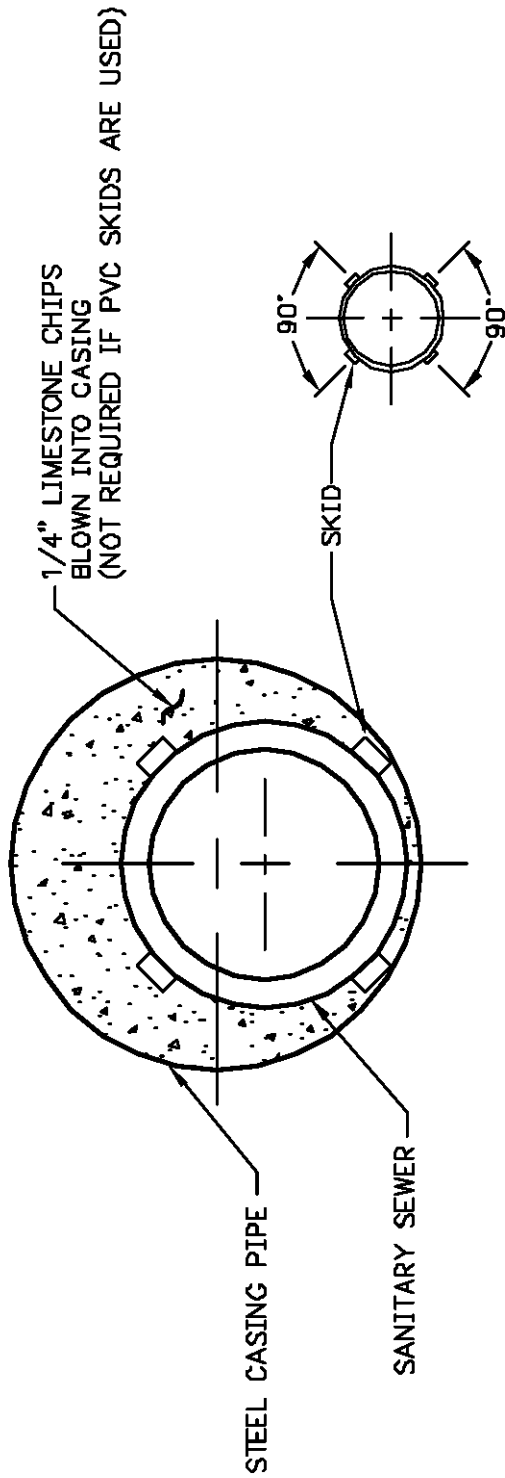
1. COMPACTED CLAY DIKES SHALL EXTEND VERTICALLY FROM UNDISTURBED GROUND AT BOTTOM OF TRENCH TO WITHIN TWO (2') FEET OF FINAL GRADE, AND FROM UNDISTURBED GROUND ON TRENCH SIDES FOR FULL WIDTH OF TRENCH.
2. EACH CLAY DIKE SHALL CONSIST OF CLAY CONTAINING NO MORE THAN 15% (BY VOLUME) STONE NOT LARGER THAN TWO (2") INCHES IN DIAMETER. CLAY SHALL BE PLACED IN SIX (6") INCH LIFTS AND COMPACTED BY MECHANICAL TAMPER TO NOT LESS THAN 95 PERCENT OF MAXIMUM DENSITY AT OPTIMUM MOISTURE CONTENT.

CLAY DIKE DETAIL

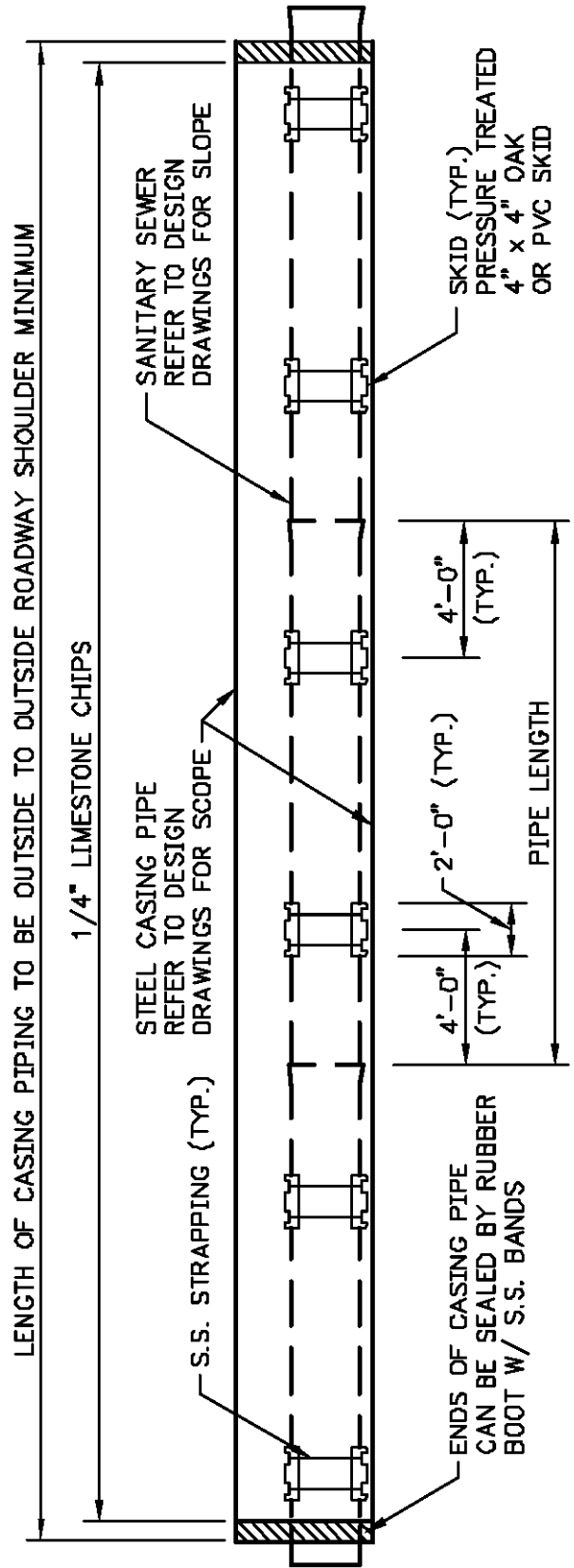
DRAWING NO.

31-06

DATE: 3/2015



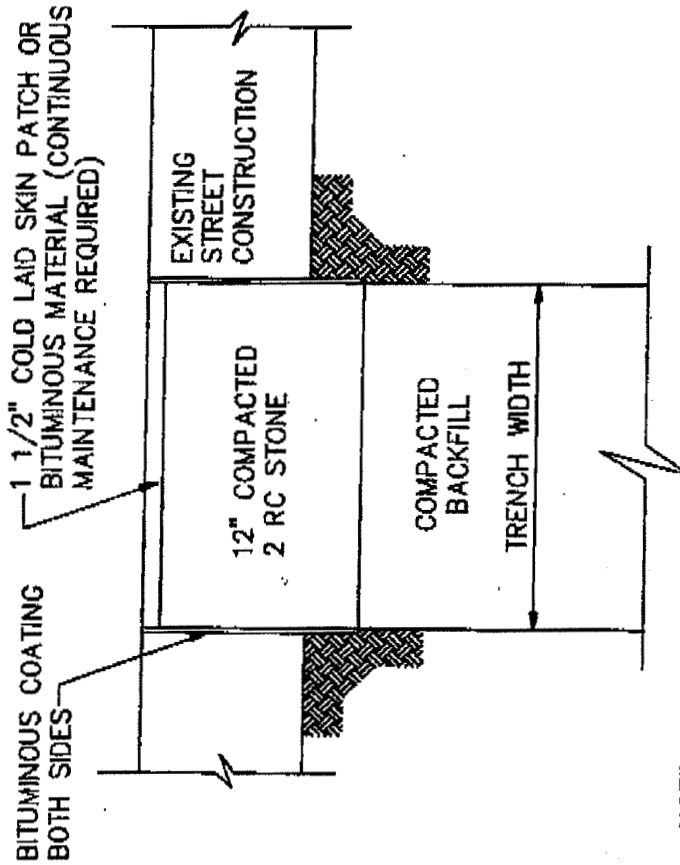
CASING SECTION



CASING ELEVATION

STEP I

TEMPORARY REPAVING DETAIL
(MINIMUM 3 MONTHS IN PLACE)



NOTE:

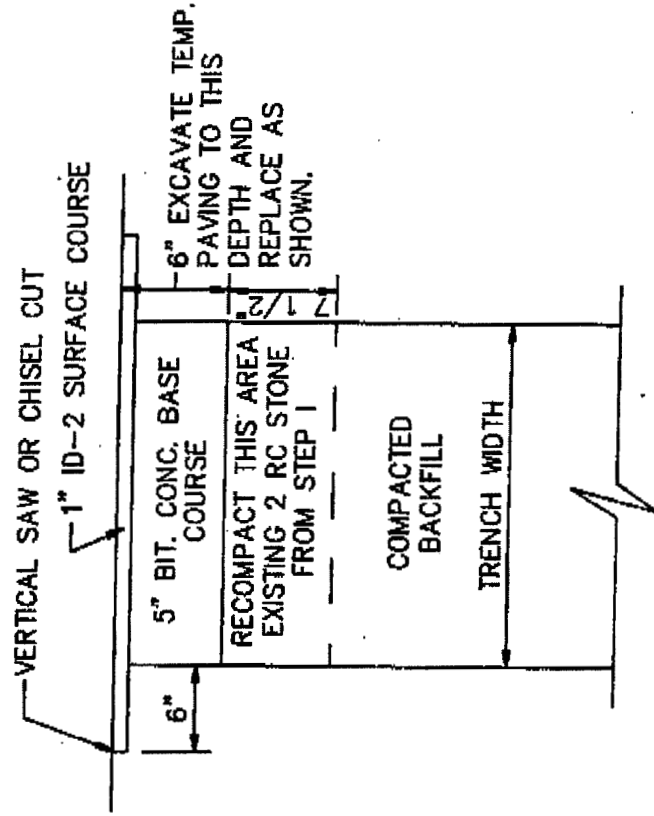
ALL BITUMINOUS MATERIAL & BLACK BASE FURNISHED & LAID IN PLACE IN ACCORD. WITH PENNDOT SPECS.

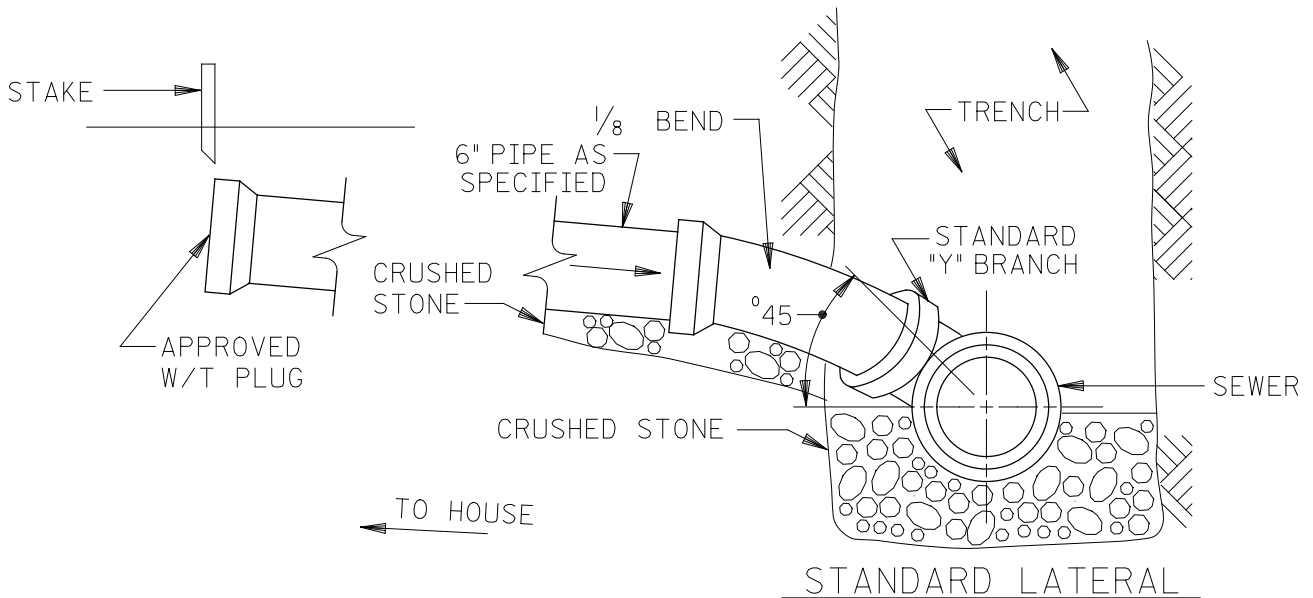
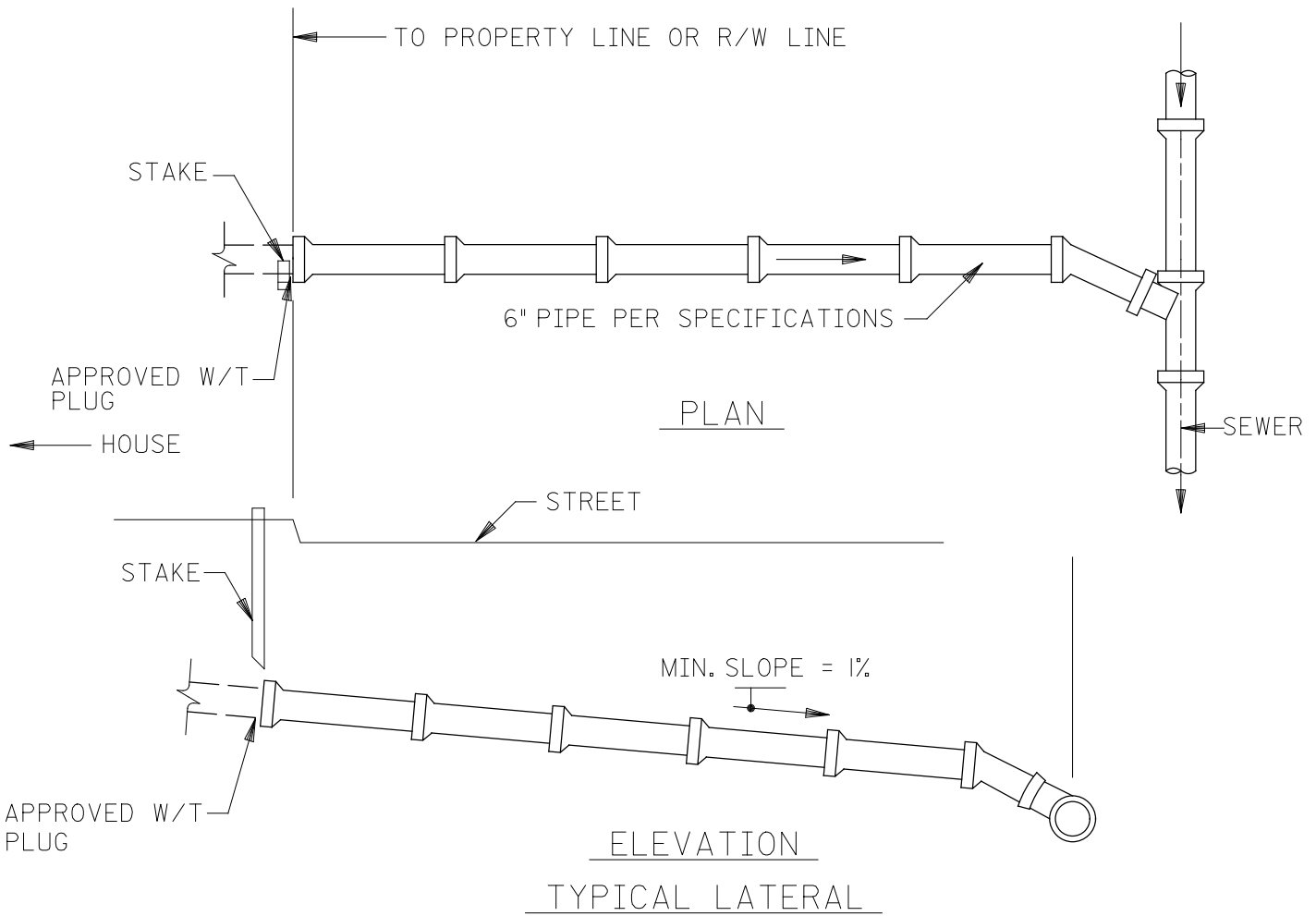
STEP I MUST PRECEDE STEP II.

STEP II MUST BE COMPLETED WITHIN SIX (6) MONTHS AFTER INSTALLATION OF STEP I.

STEP II

PERMANENT PAVING
(INSTALLATION ONLY BETWEEN APRIL 15 TO OCTOBER 15)





W/T - WATERTIGHT

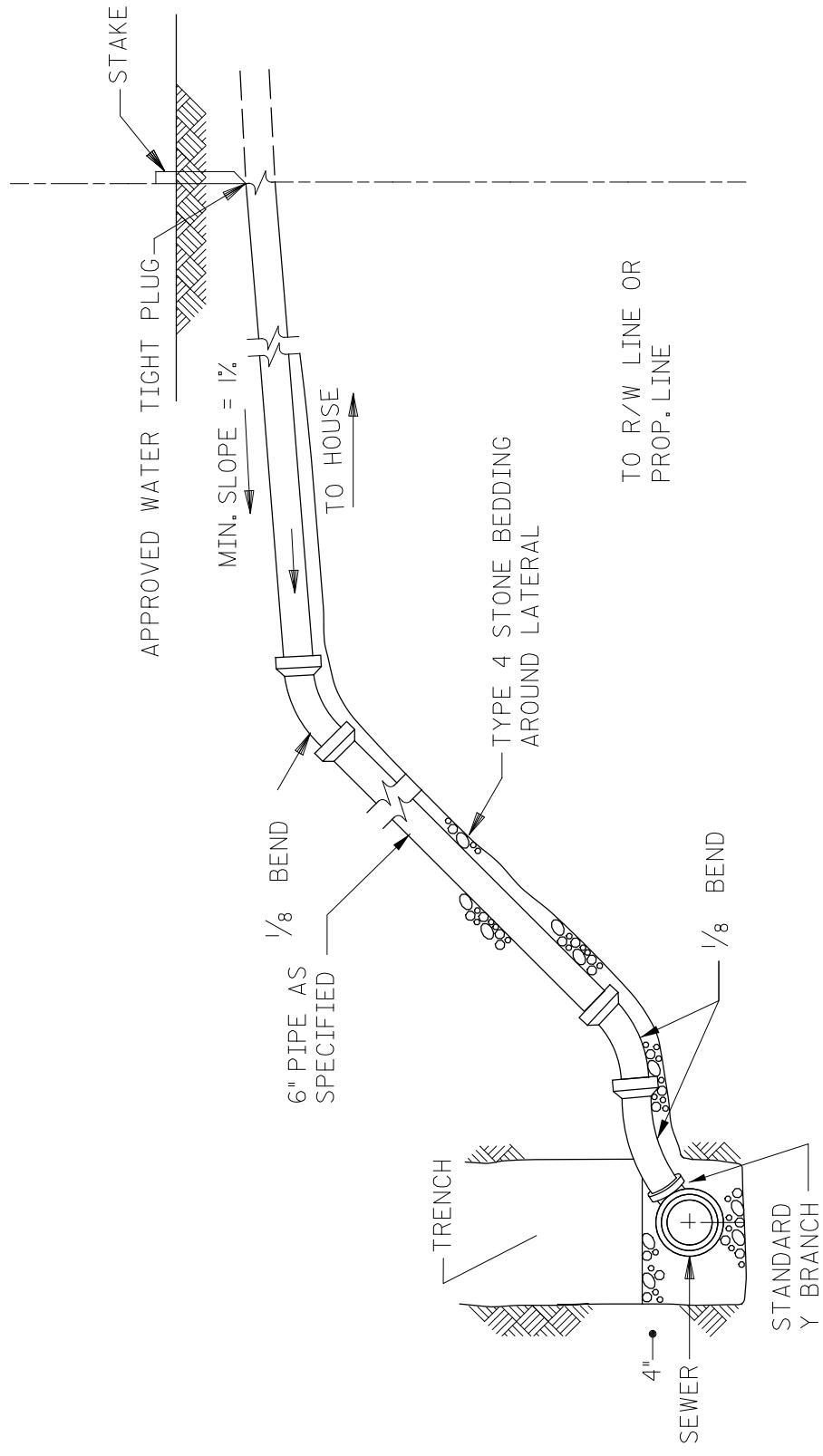
STANDARD HOUSE CONNECTION DETAILS

LATERAL DETAIL

DRAWING NO.

33-01

DATE: 3/2015



NOTE: END OF LATERAL TO HAVE APPROVED WATER TIGHT PLUG.

SLOPED RISER LATERAL DETAIL

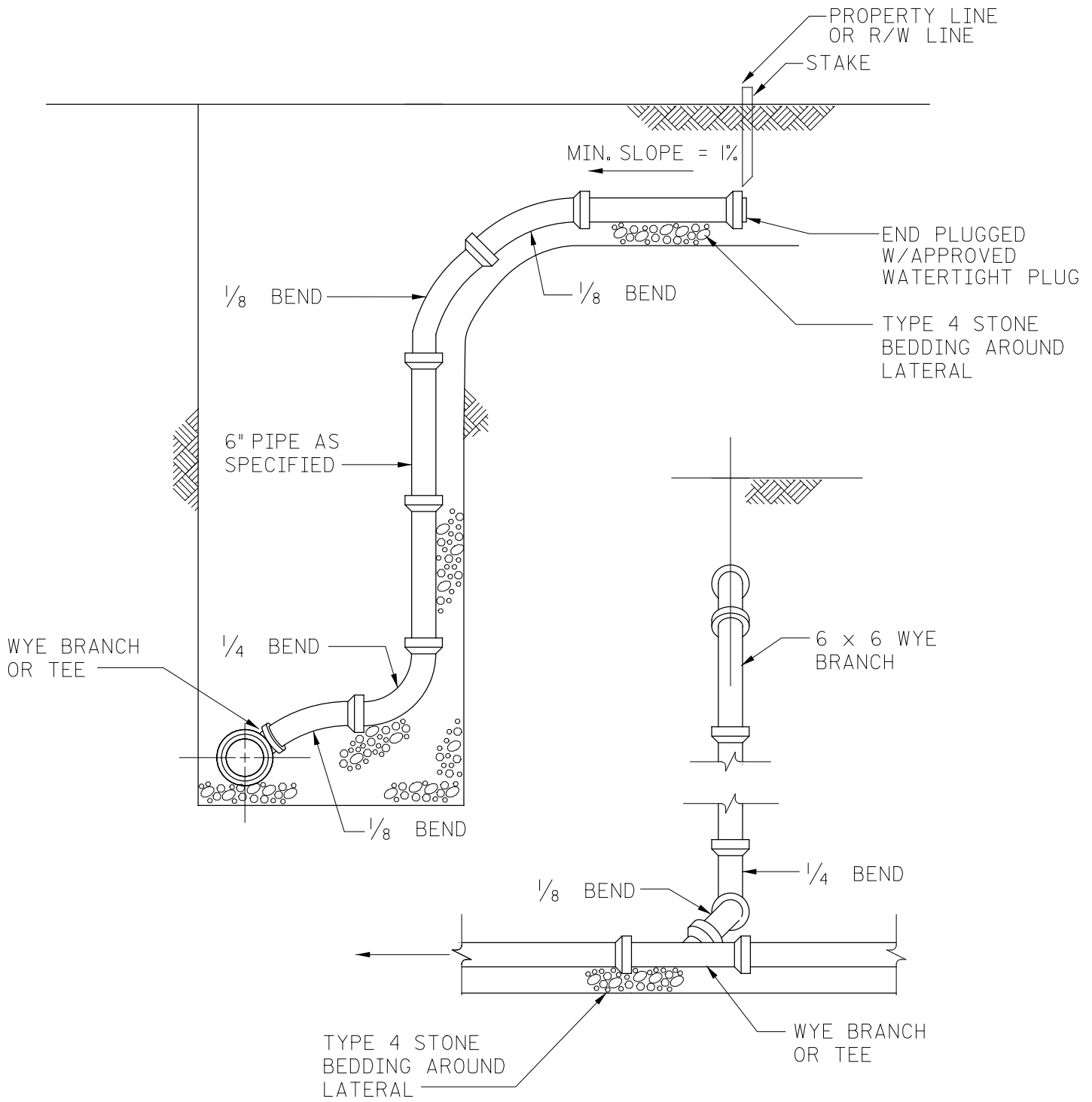
SCALE: NONE

SLOPED RISER
LATERAL DETAIL

DRAWING NO.

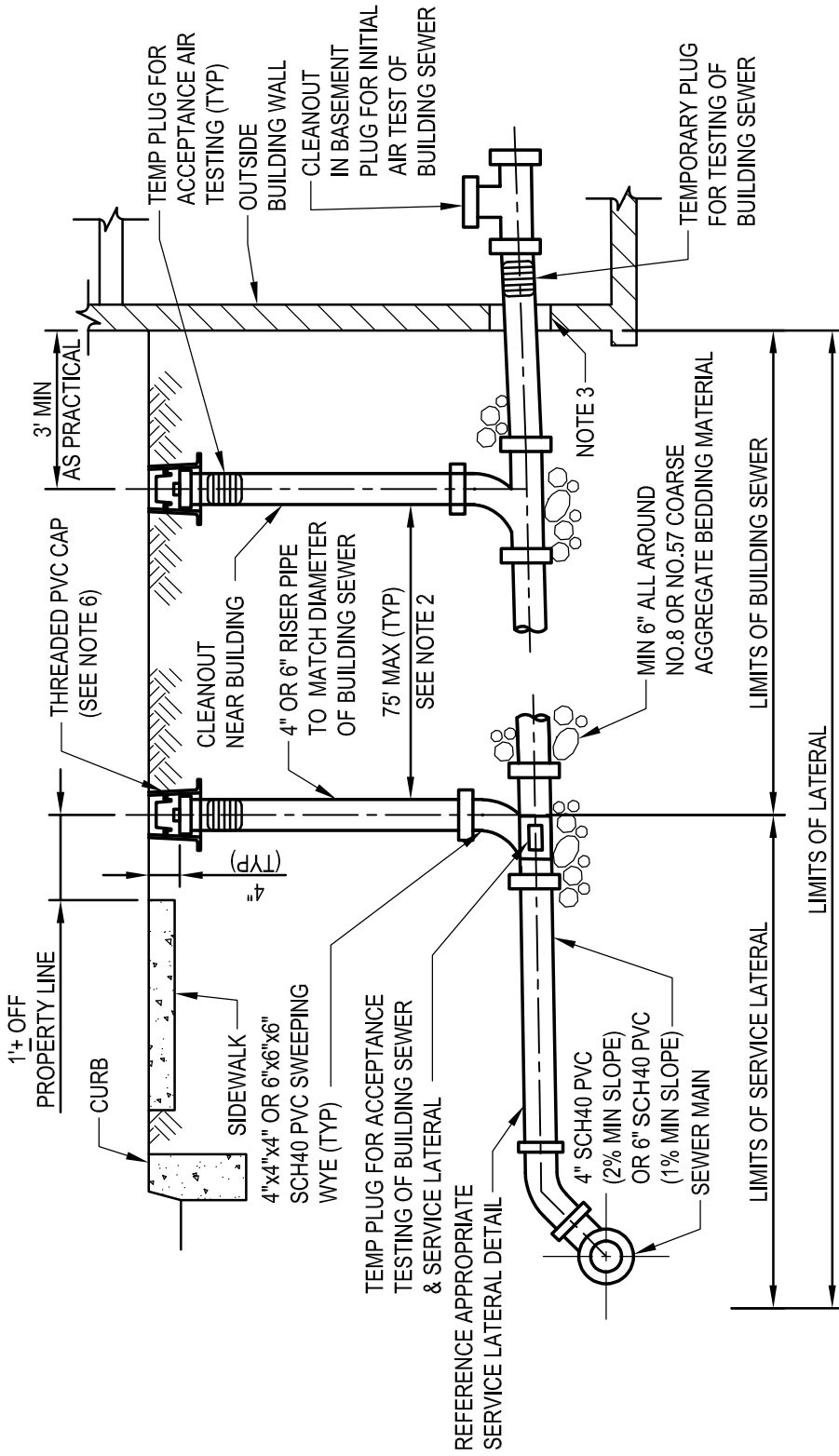
33-02

DATE: 3/2015



SIDE VIEW
VERTICAL RISER LATERAL DETAIL

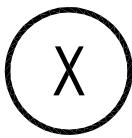
	VERTICAL RISER LATERAL DETAIL	DRAWING NO. 33-03 DATE: 3/2015
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ELEVATION

NOTES:

1. PIPE SIZES AND MATERIALS TO BE IN ACCORDANCE WITH CURRENT AUTHORITY REQUIREMENTS. ALSO SEE RULES AND REGULATIONS GOVERNING THE CONSTRUCTION OF BUILDING SEWERS.
2. CLEANOUT SPACING IS 75 FEET MAXIMUM. IF DISTANCE IS GREATER THAN 75 FEET, A 3RD CLEANOUT MUST BE INSTALLED.
3. WALL SLEEVE TO BE 2 x DIAMETER OF BUILDING SEWER PIPE AND SEALED WATER TIGHT.
4. ANY PIPE WITH LESS THAN 3 FEET OF COVER SHALL BE CAST IRON OR DUCTILE IRON.
5. THERE SHALL BE A 5 FOOT HORIZONTAL SEPARATION BETWEEN WATER SERVICE AND SERVICE LATERAL / BUILDING SEWER.
6. ALL CLEANOUT CAPS TO BE PVC WITH FLUSH THREADED CAP. CAST IRON CASTING MUST BE INSTALLED OVER PVC CAP IF INSTALLED IN DRIVEWAY OR CONCRETE SIDEWALK.



BUILDING SEWER DETAIL

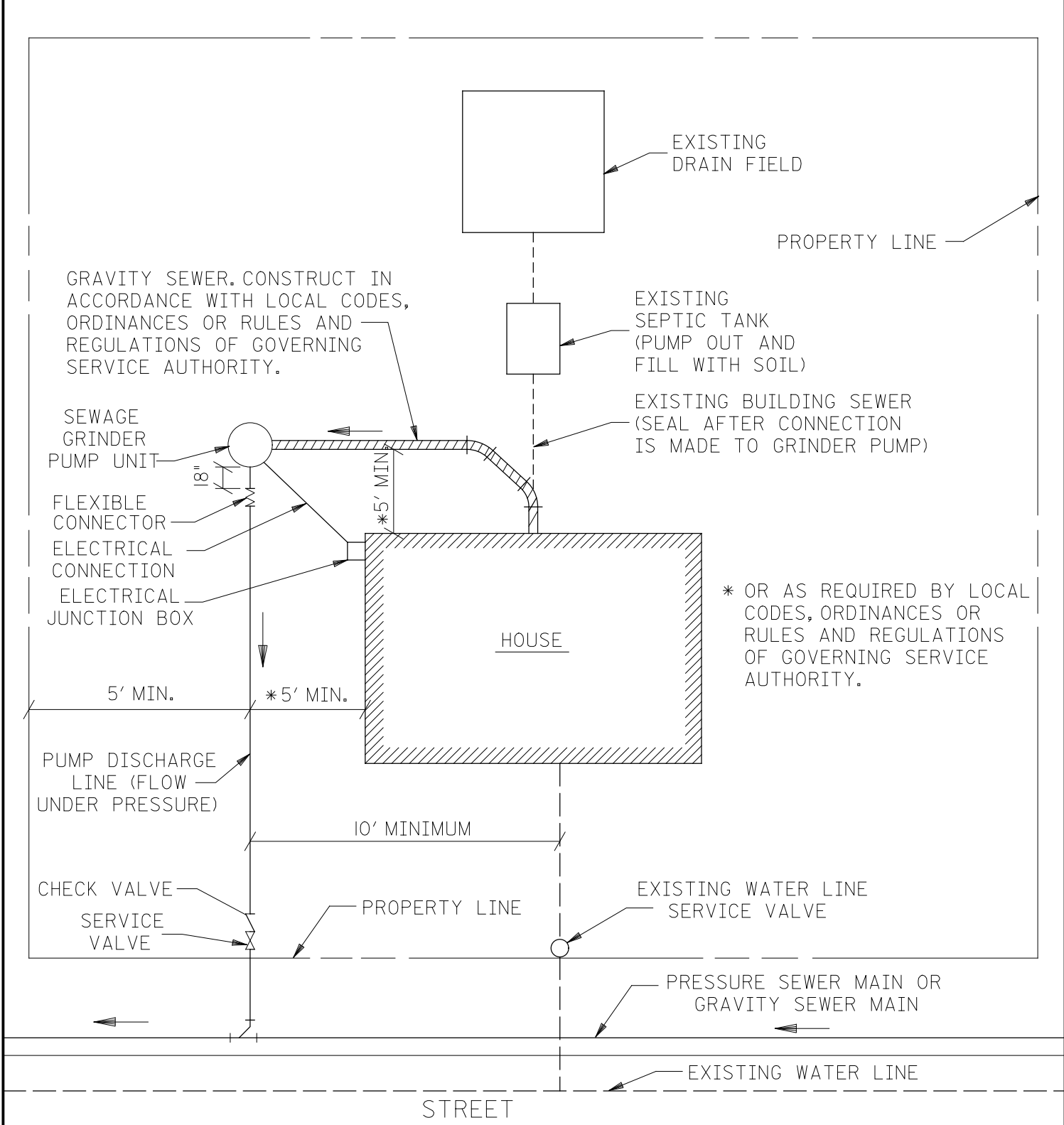
NOT TO SCALE

BUILDING SEWER

DRAWING NO.

33-04

DATE: 9/2022



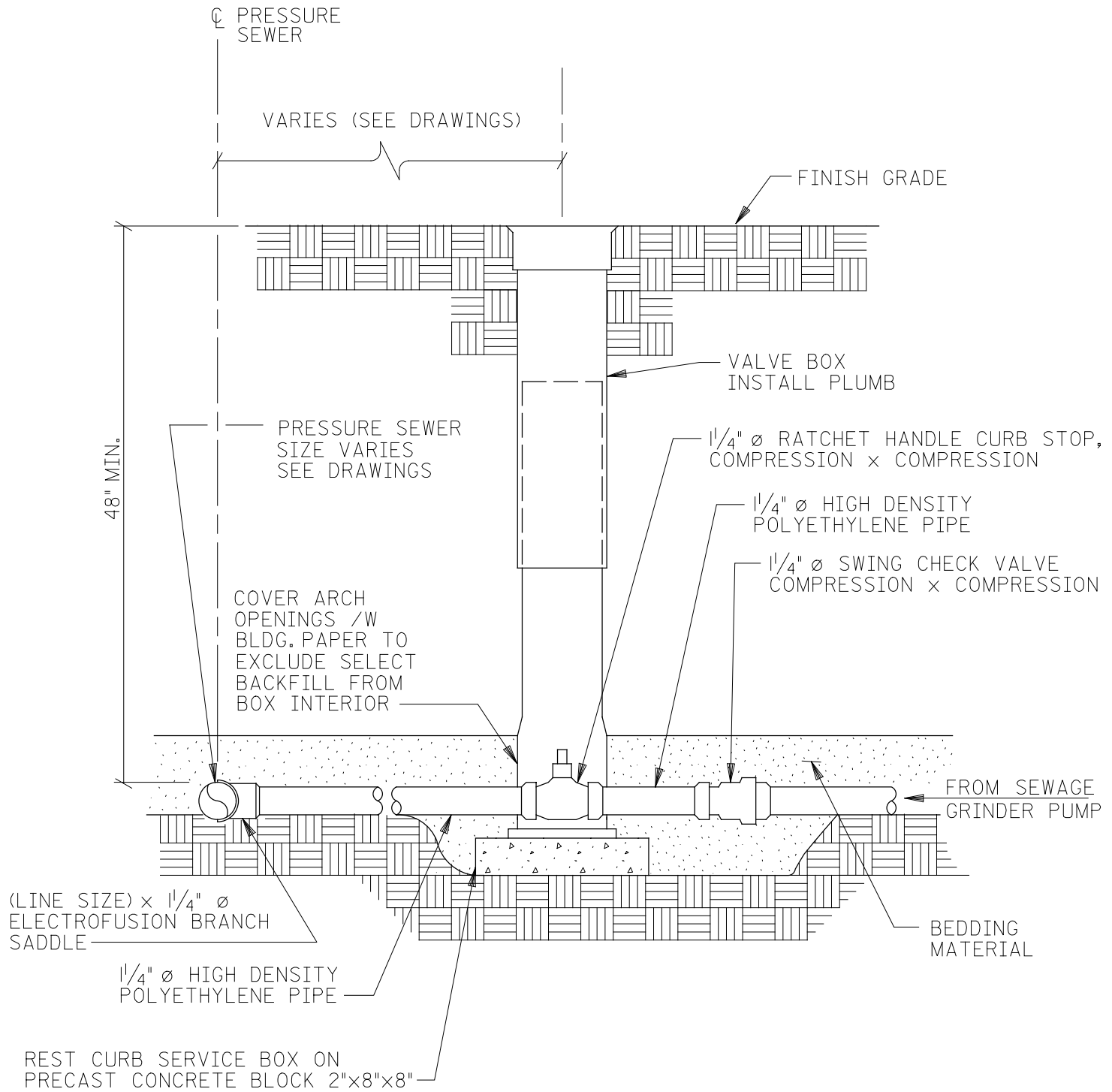
LEGEND:

- — — — — EXISTING WATER LINE
- — — — — EXISTING DRAIN LINE
- ////// BUILDING SEWER
- SGP DISCHARGE LINE
- SGP SEWAGE GRINDER PUMP

NOTE:

DISCHARGE LINE CHECK VALVE AND SERVICE VALVE NOT REQUIRED FOR CONNECTION TO GRAVITY SEWER MAIN

	<p>TYPICAL PRESSURE SEWER SERVICE CONNECTION</p>	<p>DRAWING NO. 33-05</p>
		<p>DATE: 3/2015</p>



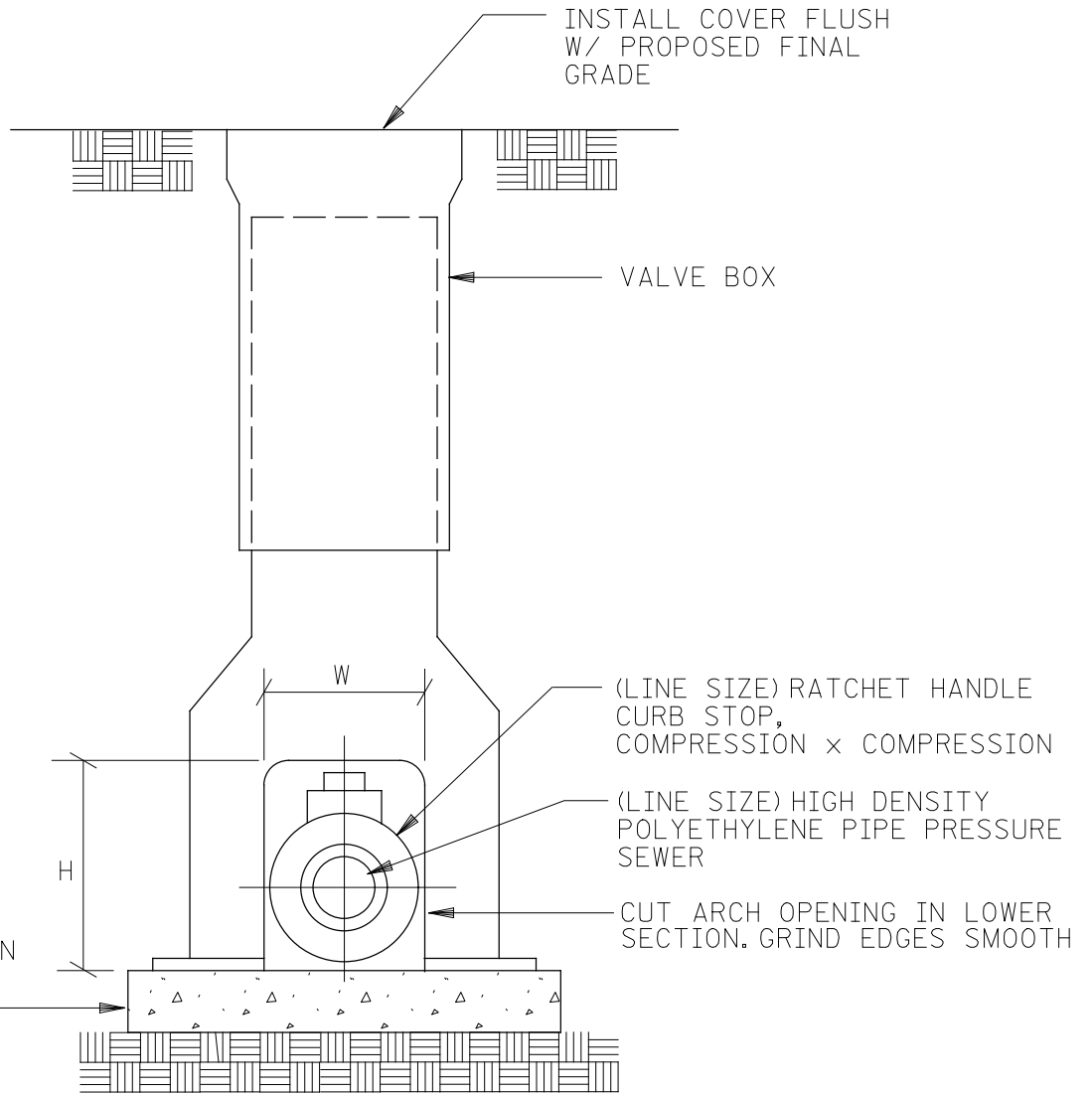
SERVICE VALVE
ASSEMBLY

DRAWING NO.

33-06

DATE: 3/2015

VALVE SIZE	H	W
1 1/4"	6"	4 1/2"
1 1/2"	6"	4 1/2"
2"	6"	4 1/2"
2 1/2"	6 1/2"	5 1/2"
3"	6 1/2"	6 1/2"

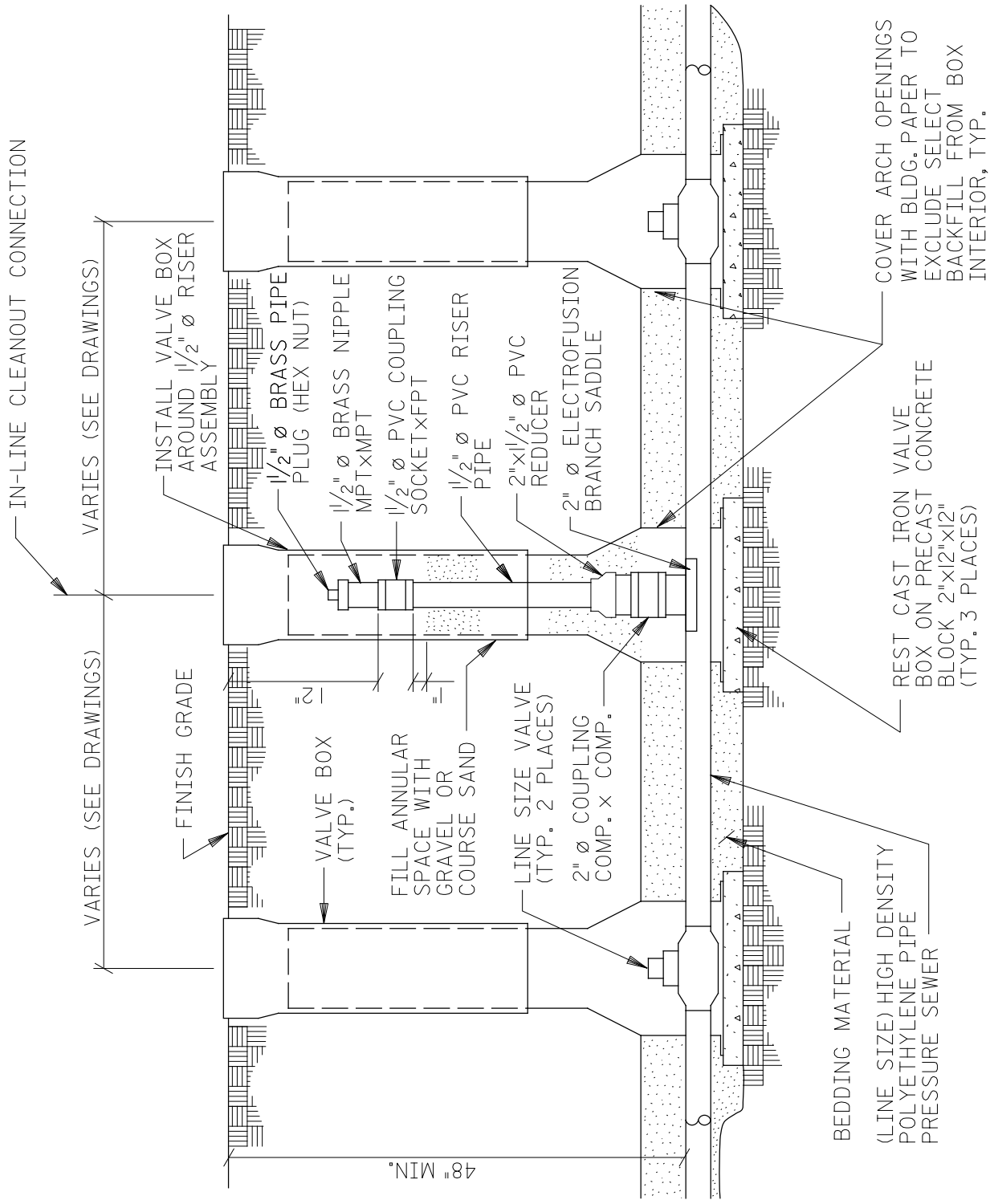


VALVE BOX DETAIL

DRAWING NO.

33-07

DATE: 3/2015



NOTES:

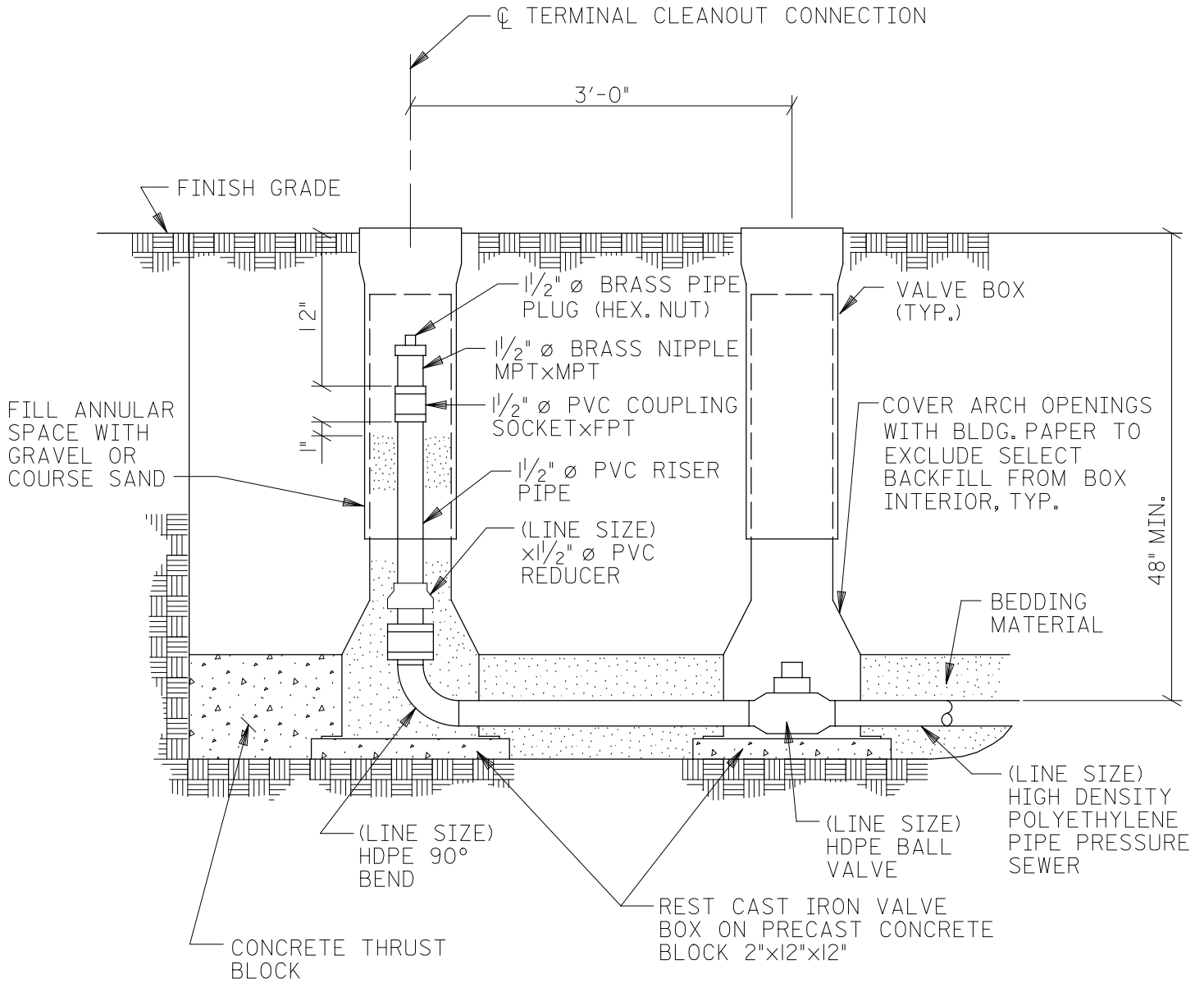
1. PRECAST CONCRETE BLOCKS TO REST ON UNDISTURBED EARTH OR FIRM SUBGRADE.

IN-LINE CLEANOUT CONNECTION DETAIL

DRAWING NO.

33-08

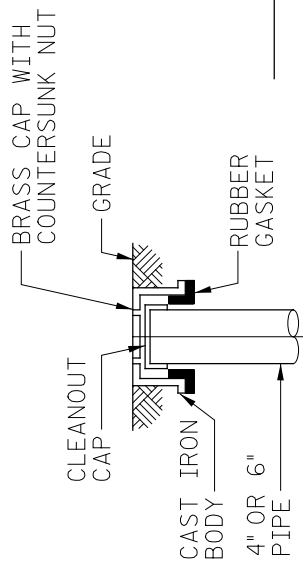
DATE: 3/2015



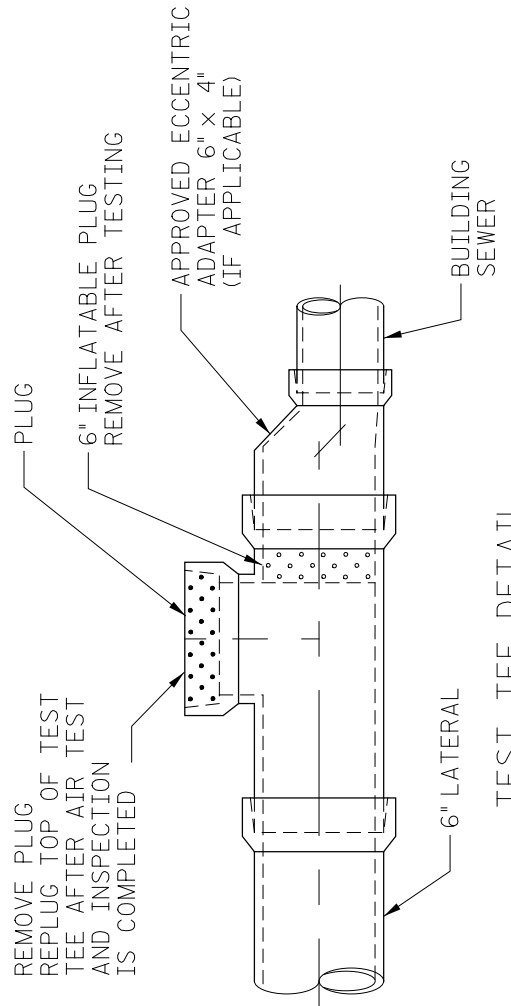
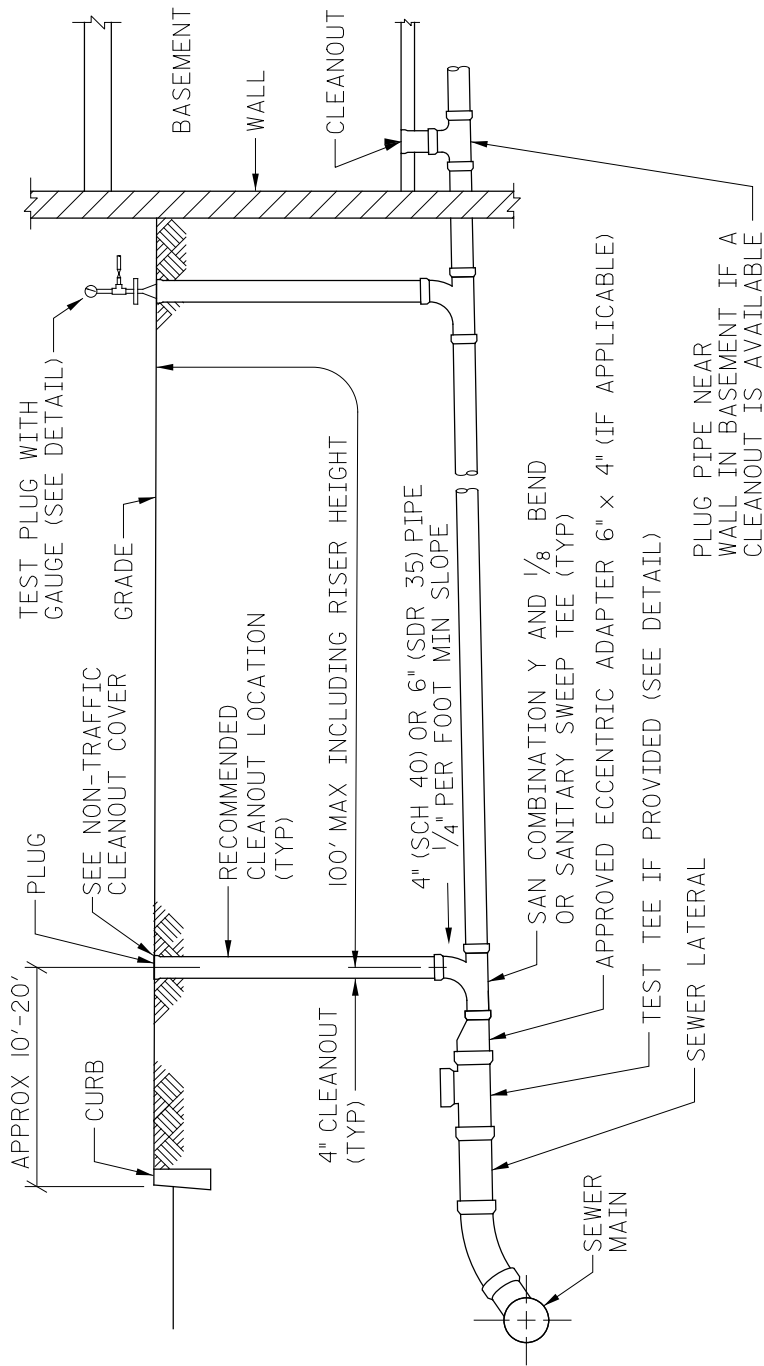
NOTES:

1. PRECAST CONCRETE BLOCKS TO REST ON UNDISTURBED EARTH OR FIRM SUBGRADE.
2. THRUST BLOCK TO REST AGAINST UNDISTURBED EARTH.
3. ALL PVC CONNECTIONS SHALL BE SOLVENT WELD EXCEPT WHERE NOTED OTHERWISE.

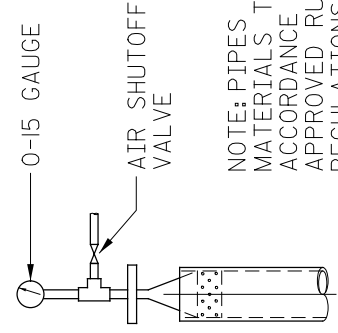
	TERMINAL CLEANOUT CONNECTION	DRAWING NO. 33-09 DATE: 3/2015
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NON-TRAFFIC
CAST IRON
(PANELLA TYPE)
PUSH-ON
CLEANOUT COVER
NO SCALE



TEST TEE DETAIL
NO SCALE



NOTE: PIPES SIZES AND MATERIALS TO BE ON ACCORDANCE WITH APPROVED RULES AND REGULATIONS

TEST PLUG DETAIL
NO SCALE

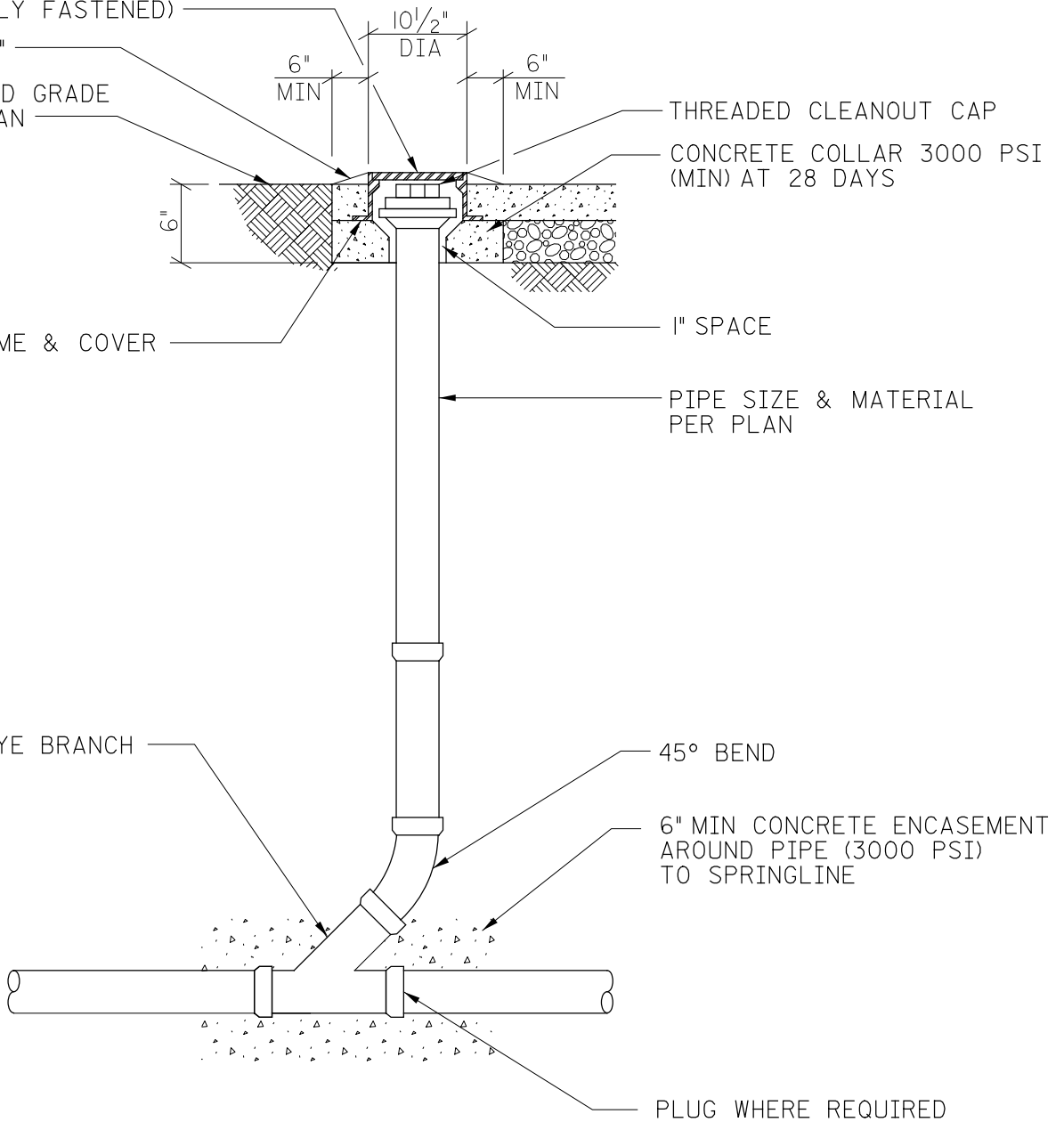
COVER TO BE "FLUSH" WITH GRADE (COVER MUST BE SECURELY FASTENED)

SLOPE 1"

FINISHED GRADE PER PLAN

CI FRAME & COVER

45° WYE BRANCH



THREADED CLEANOUT CAP

CONCRETE COLLAR 3000 PSI (MIN) AT 28 DAYS

PIPE SIZE & MATERIAL PER PLAN

6" MIN CONCRETE ENCASEMENT AROUND PIPE (3000 PSI) TO SPRINGLINE

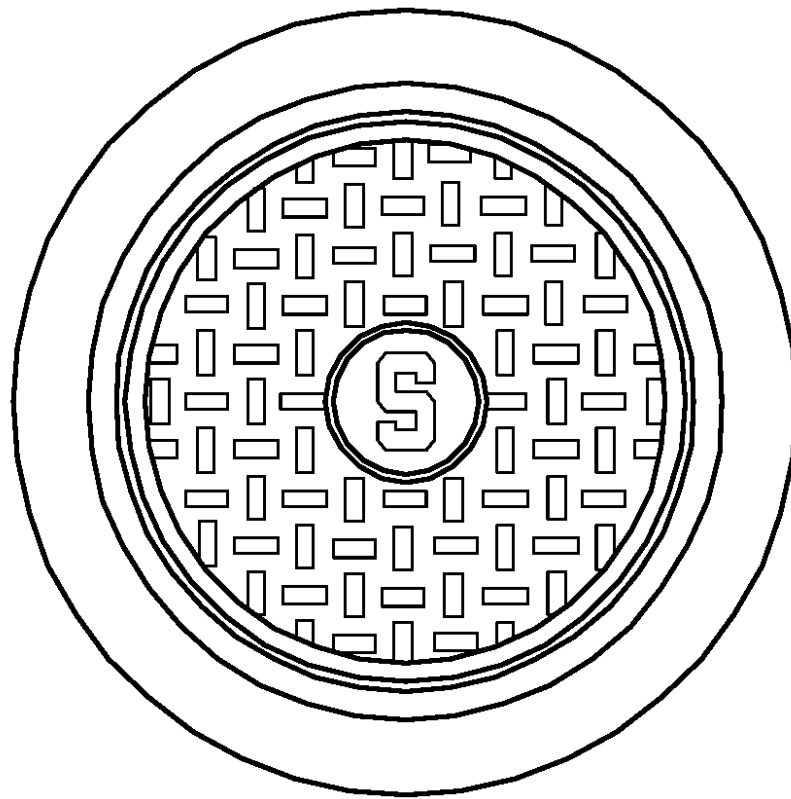
PLUG WHERE REQUIRED

DRAWING NO.

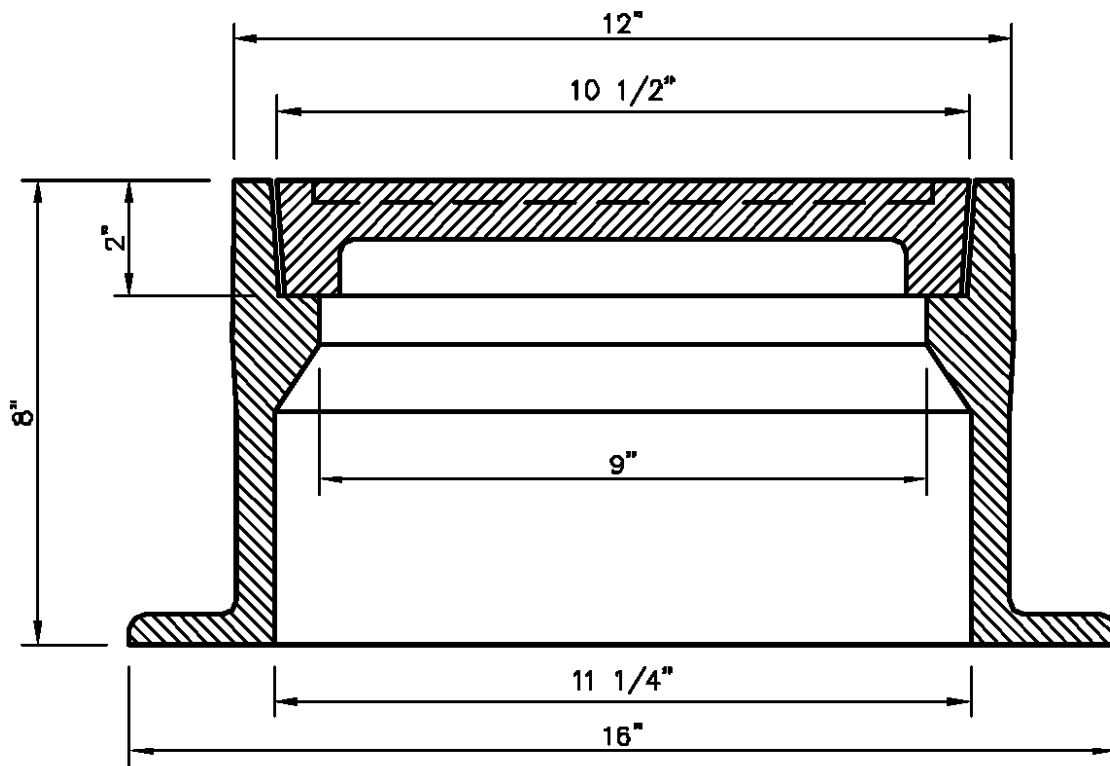
TRAFFIC PROTECTED CLEANOUT

33-11

DATE: 3/2015



PLAN



SECTION

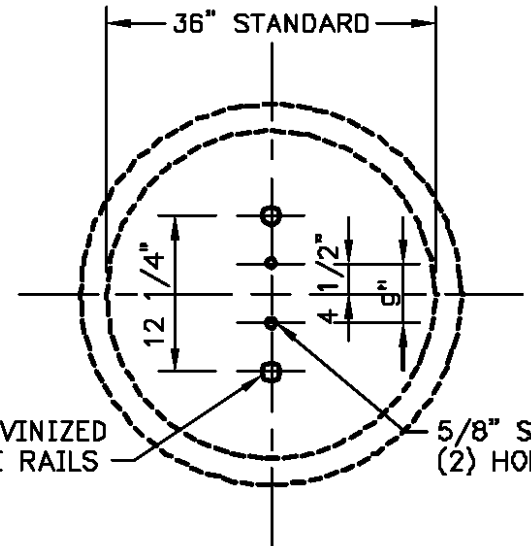
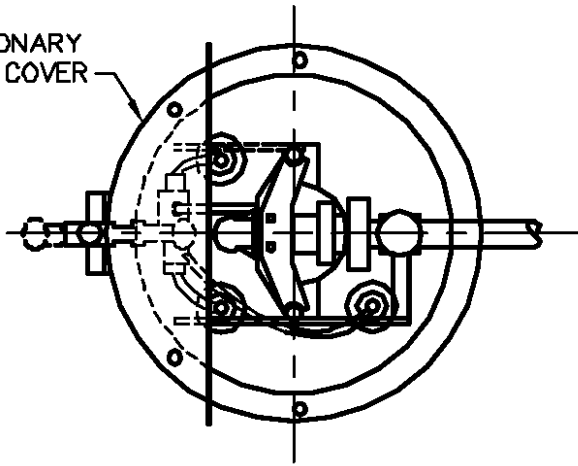
DRAWING NO.

CLEANOUT CAP PROTECTION

33-12

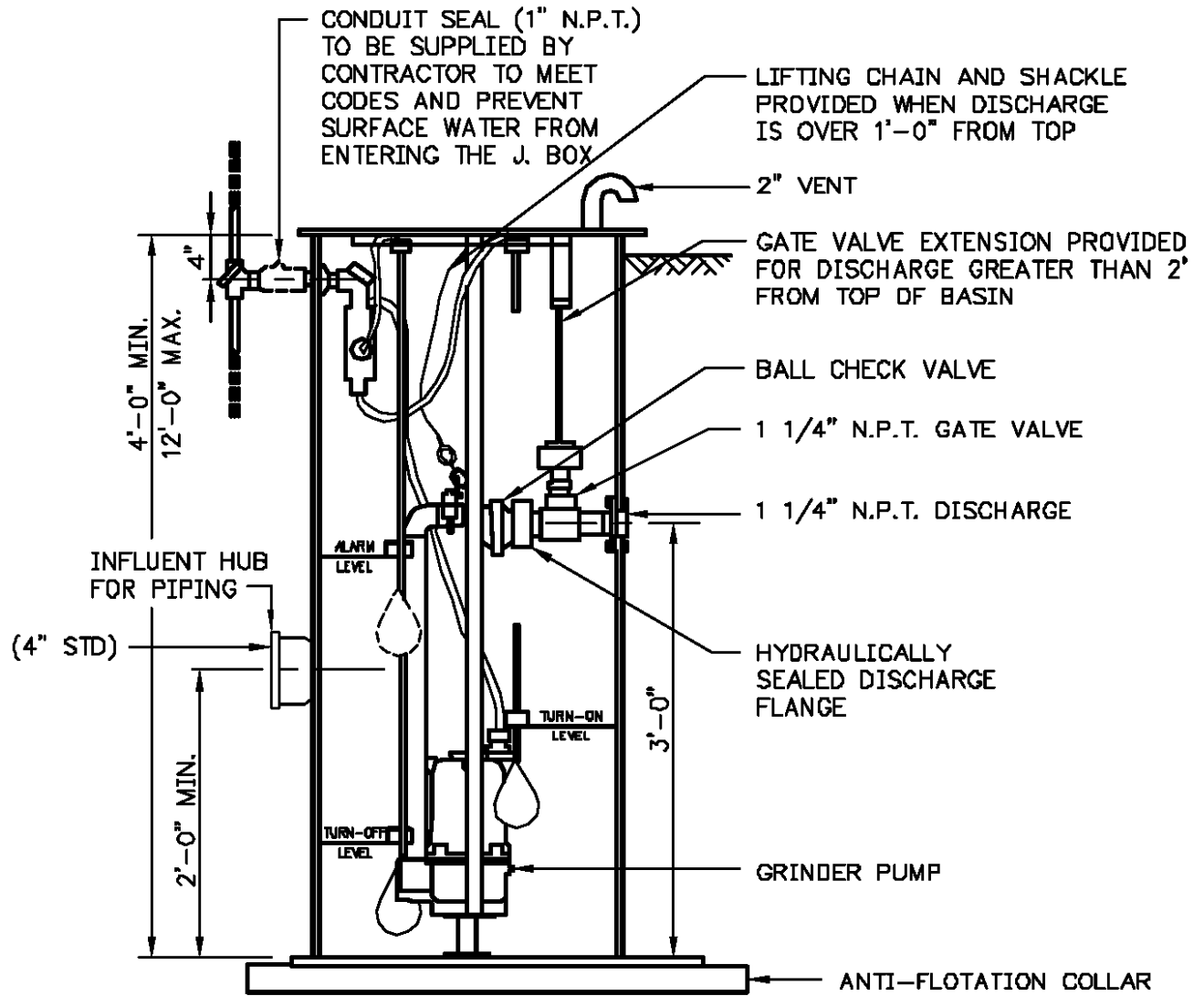
DATE: 3/2015

STATIONARY
SUMP COVER



1 1/2" GALVINIZED
PIPE GUIDE RAILS

5/8" STUDS
(2) HOLES

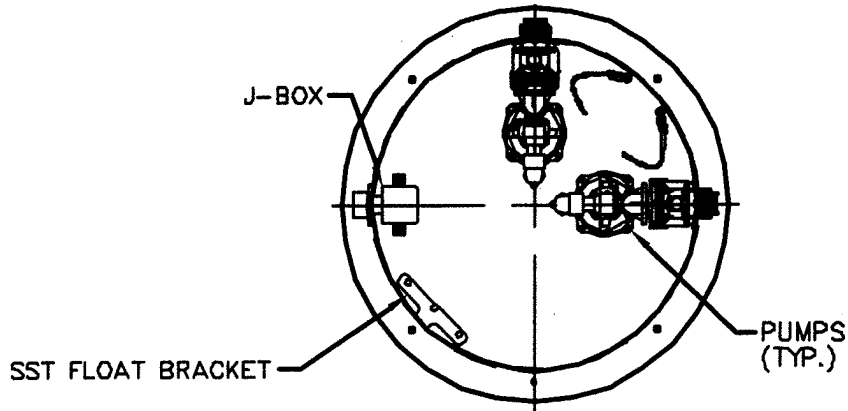


DRAWING NO.

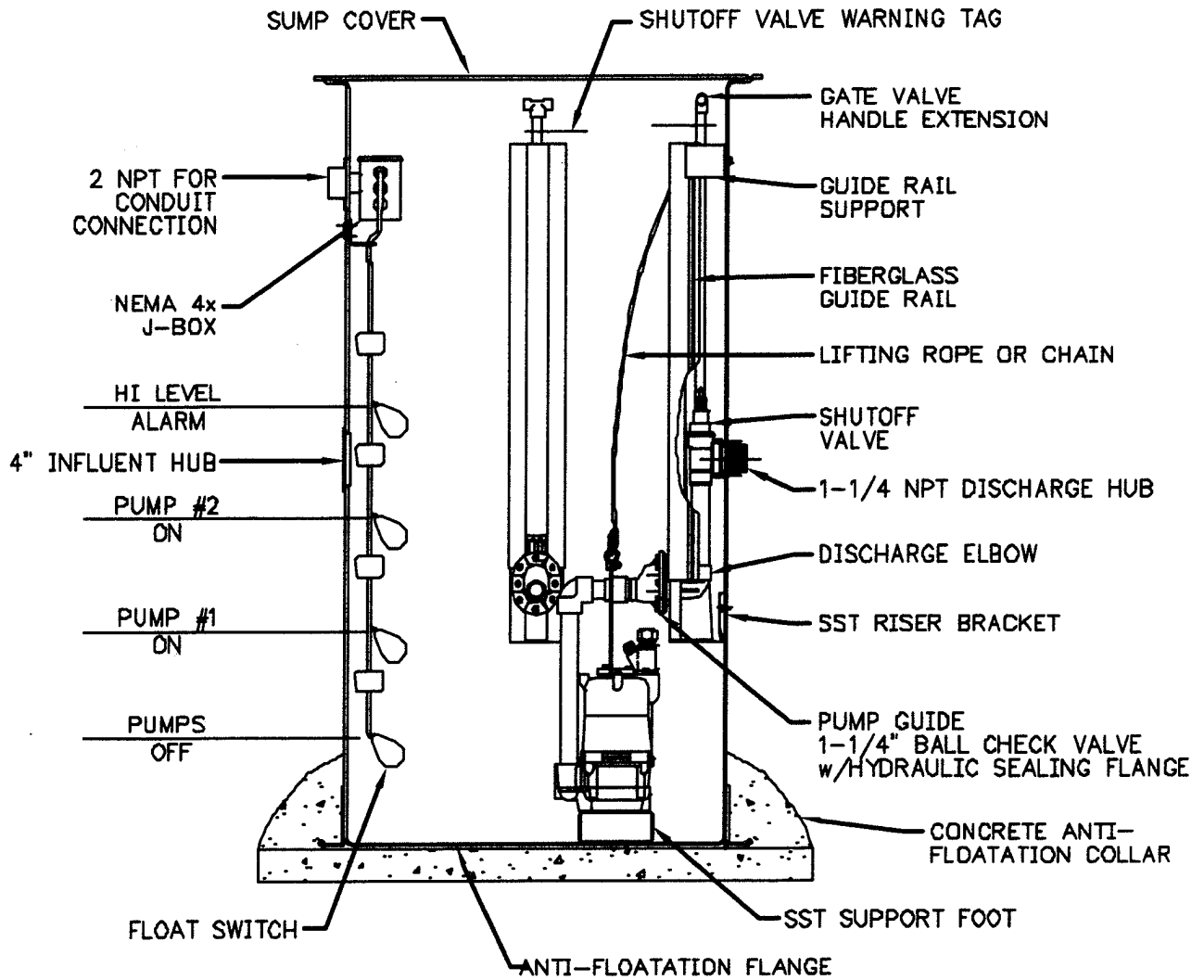
SIMPLEX GRINDER
PUMP STATION

33-13

DATE: 3/2015



PLAN



ELEVATION

DRAWING NO.

DUPLEX GRINDER
PUMP STATION

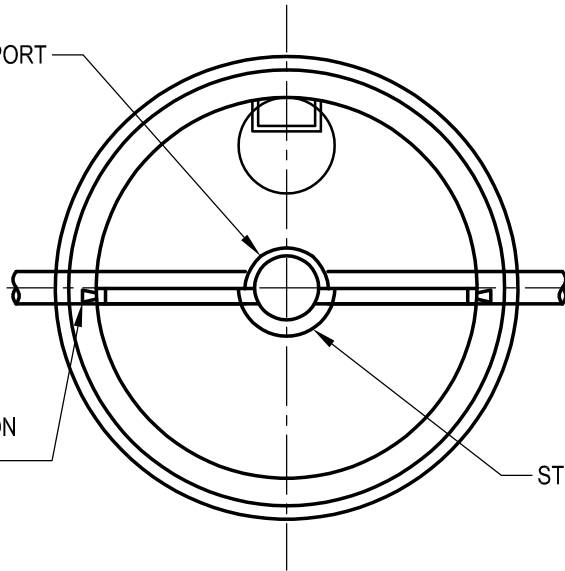
33-14

DATE: 3/2015

GALVANIZED SUPPORT

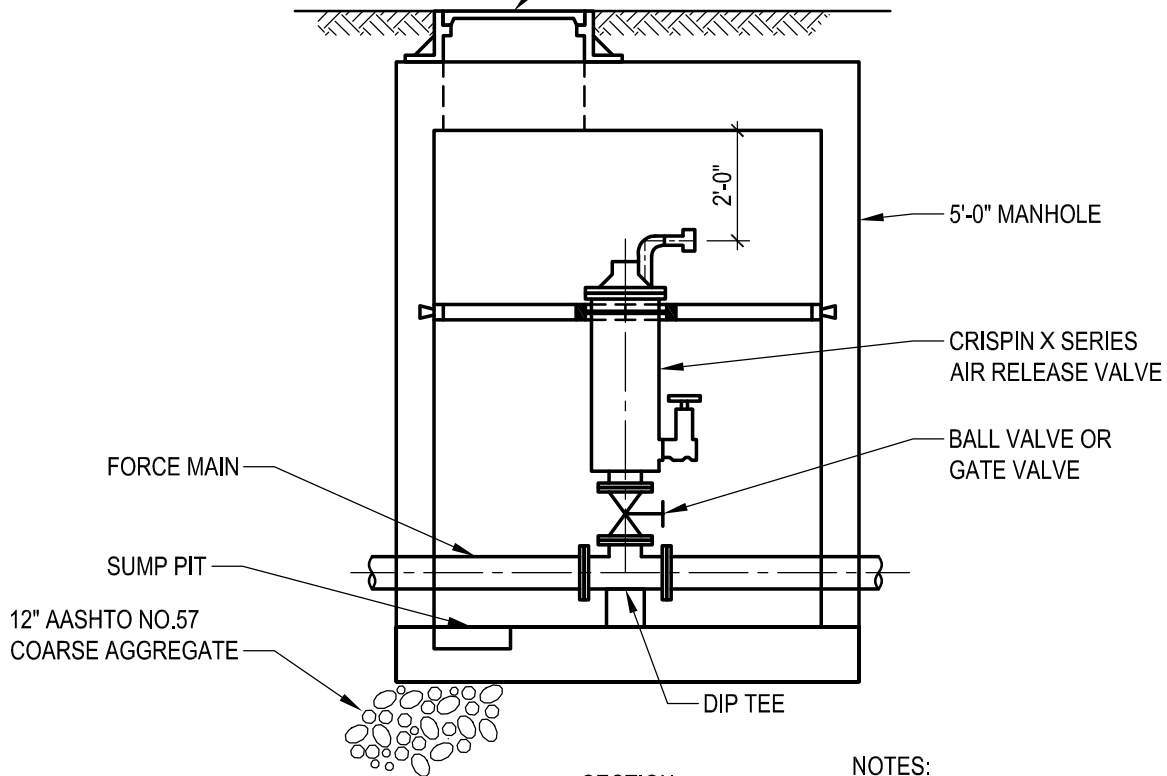
STL STL EXPANSION ANCHOR (TYP)

STL STL U BOLT



PLAN

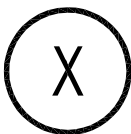
FRAME AND COVER
COVER TO HAVE 4 VENT HOLES



SECTION

NOTES:

- 1. STAINLESS STEEL HARDWARE TO BE USED.
- 2. MANHOLE TO BE EPOXY LINED.



AIR RELEASE CHAMBER DETAIL

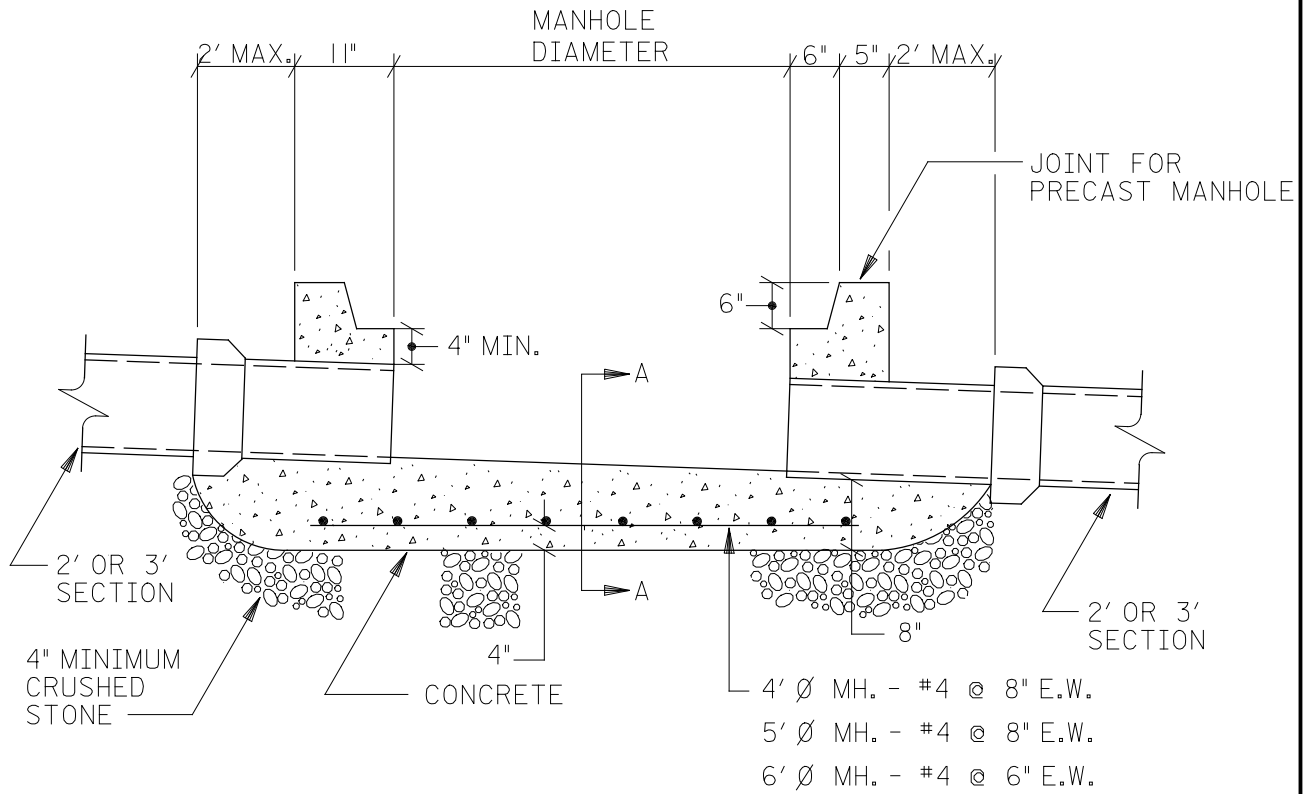
NOT TO SCALE

DRAWING NO.

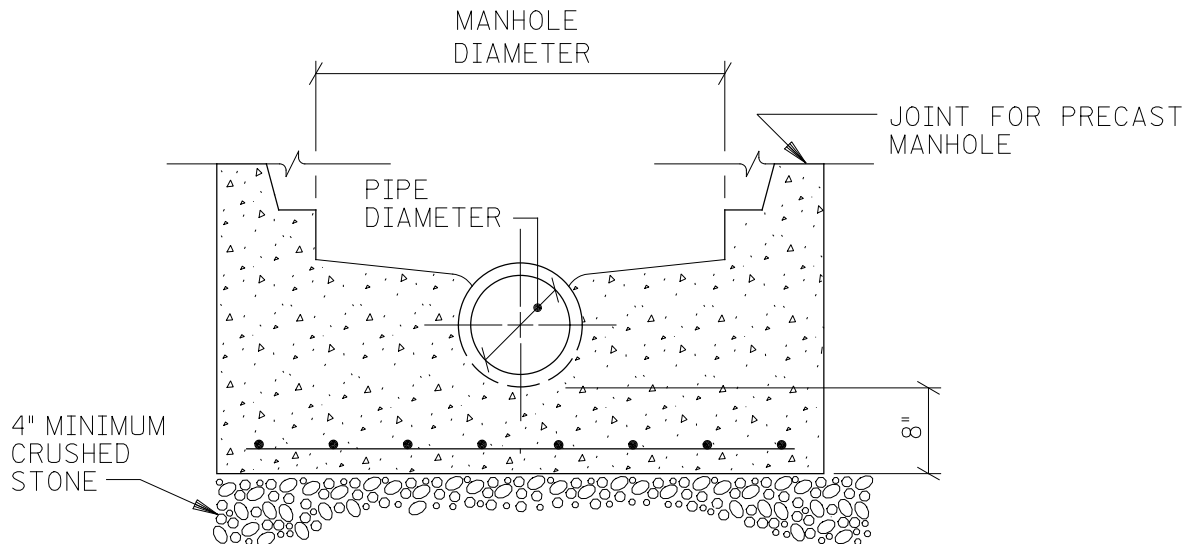
AIR RELEASE CHAMBER

33-15

DATE: 9/2022



ELEVATION



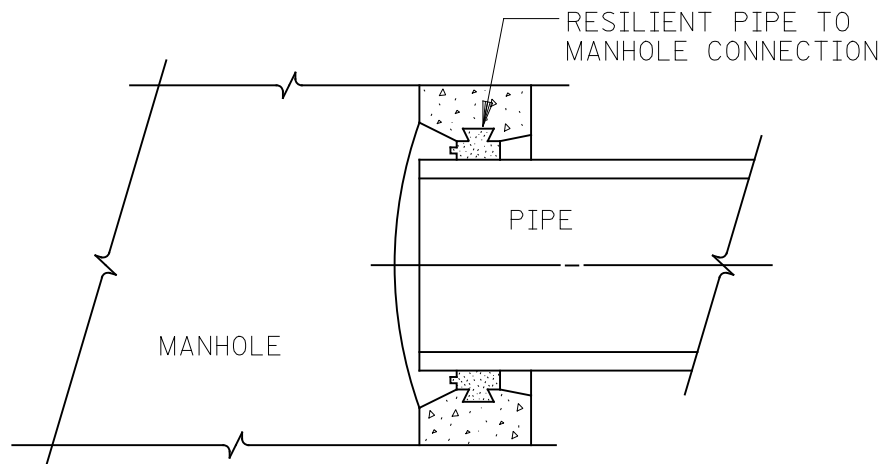
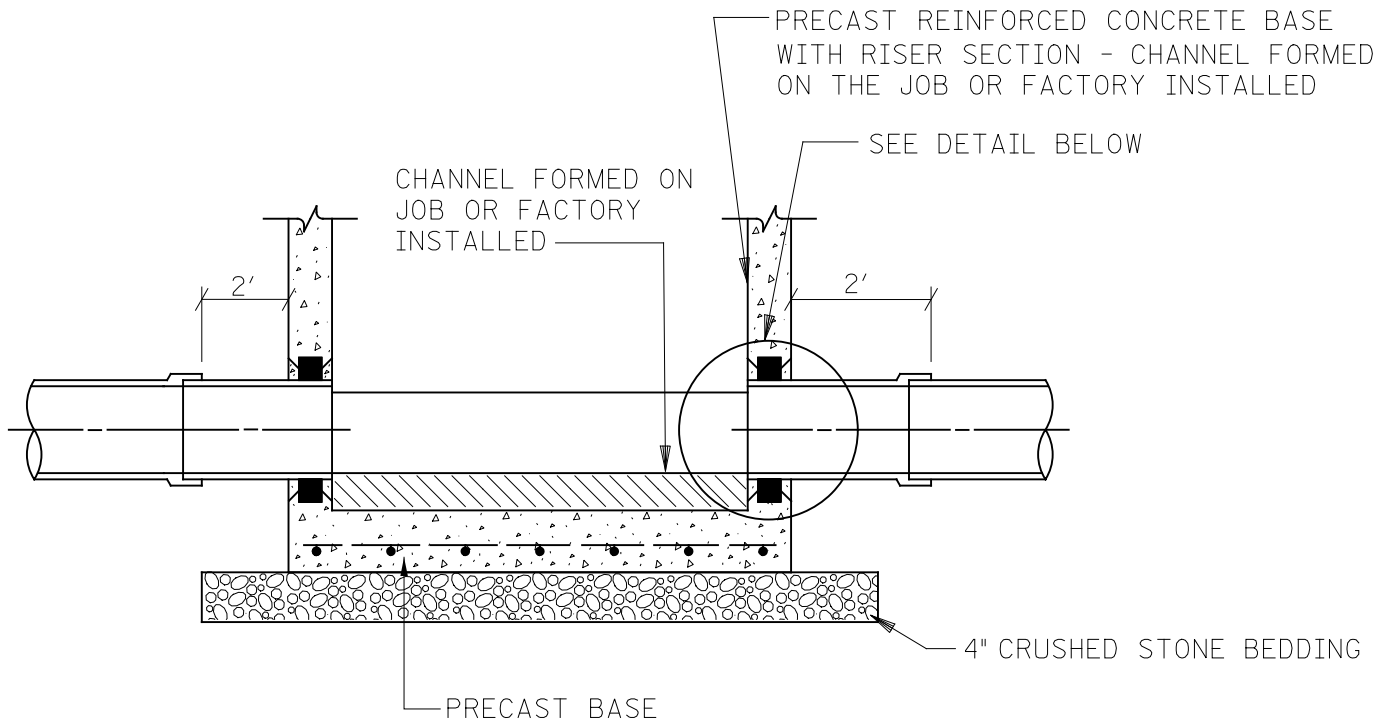
SECTION A - A
 CONCRETE MANHOLE BASE DETAILS

DRAWING NO.

CONCRETE MANHOLE
 BASE DETAILS

33-16

DATE: 3/2015



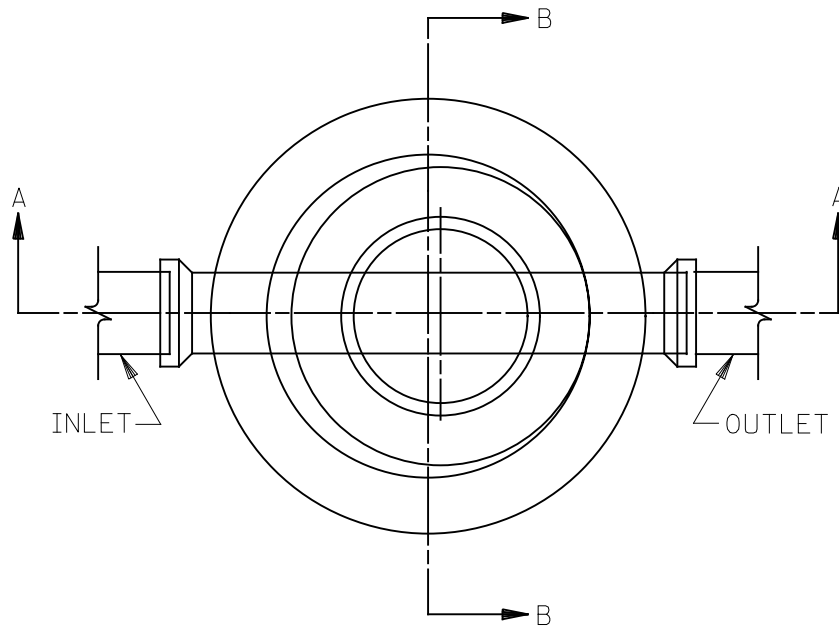
DETAIL

DRAWING NO.

PRECAST MANHOLE BASE
DETAIL

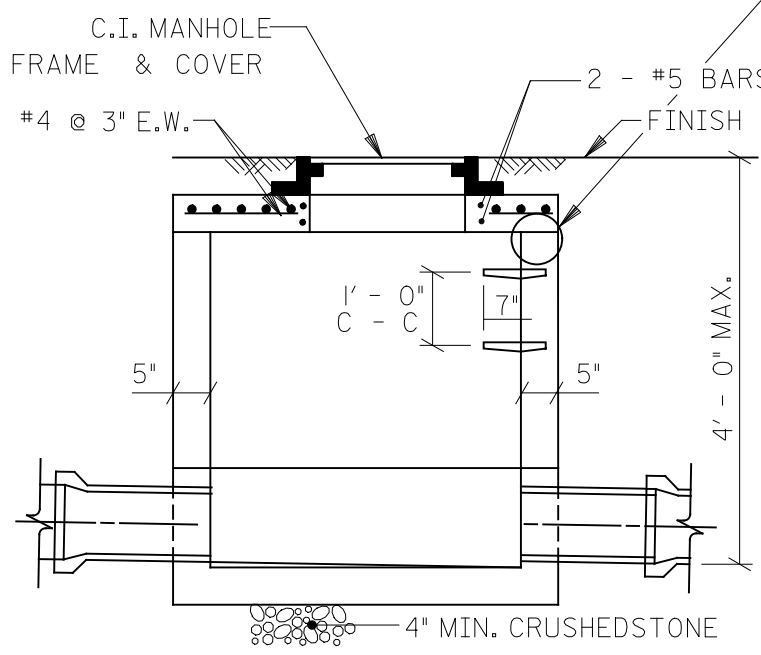
33-17

DATE: 3/2015

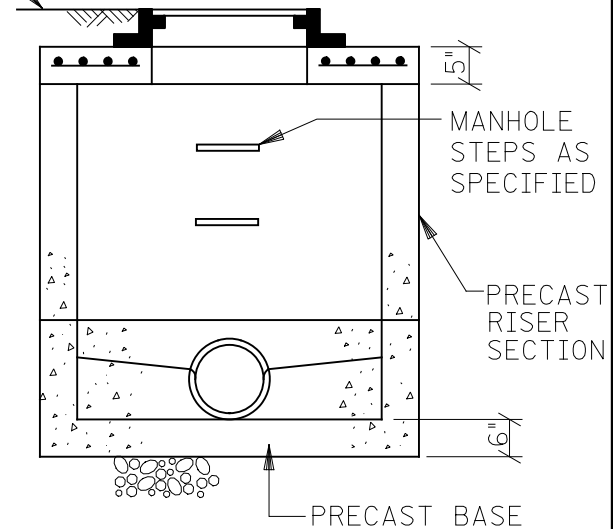


PLAN

IF PRECAST LID IS USED, JOINT TO BE COVERED W/ PREFORMED JOINT SEALANT COMPOUND PRIOR TO INSTALLATION OF CONCRETE COVER.



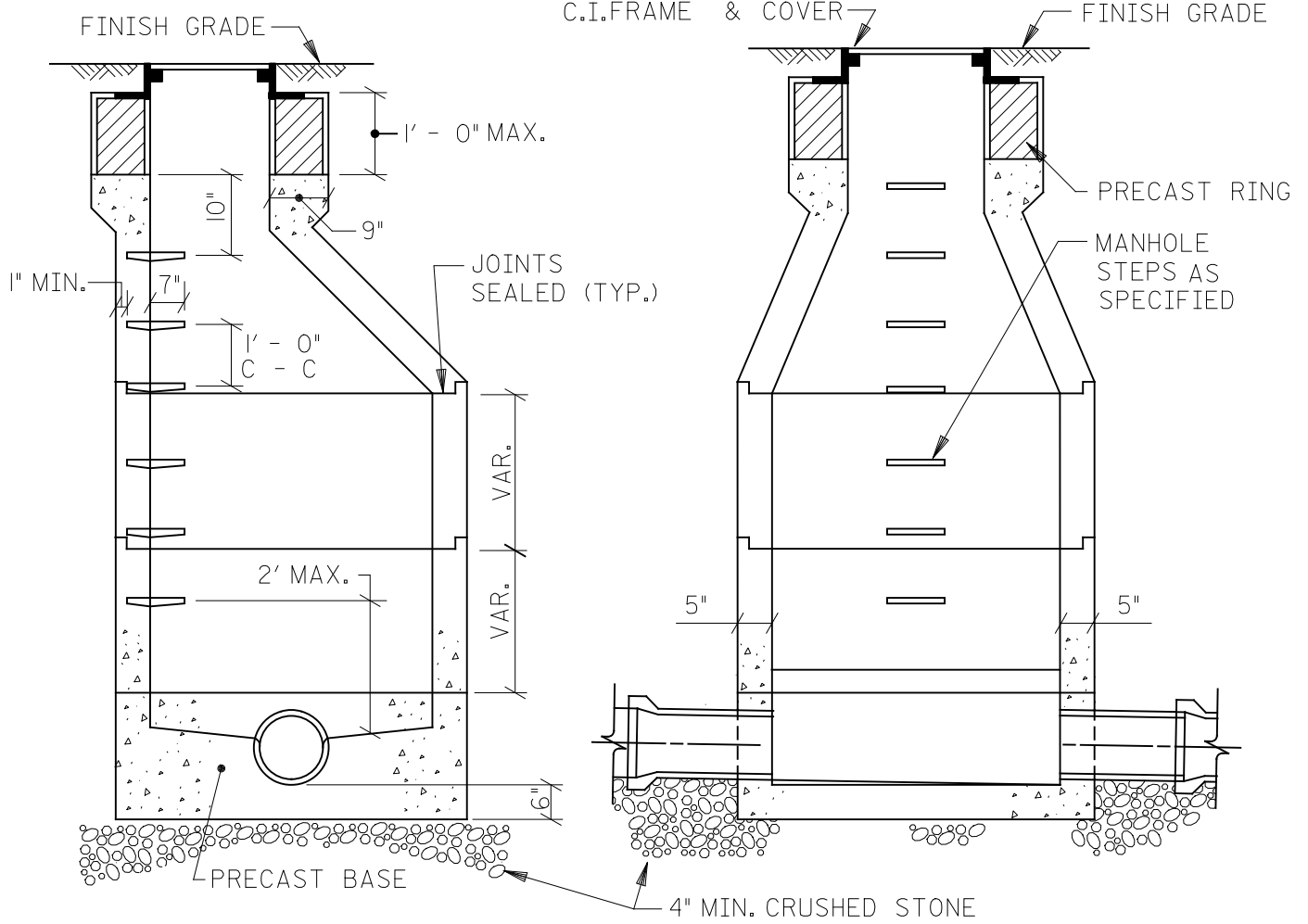
SECTION A - A



SECTION B - B

STANDARD SHALLOW PRECAST MANHOLE

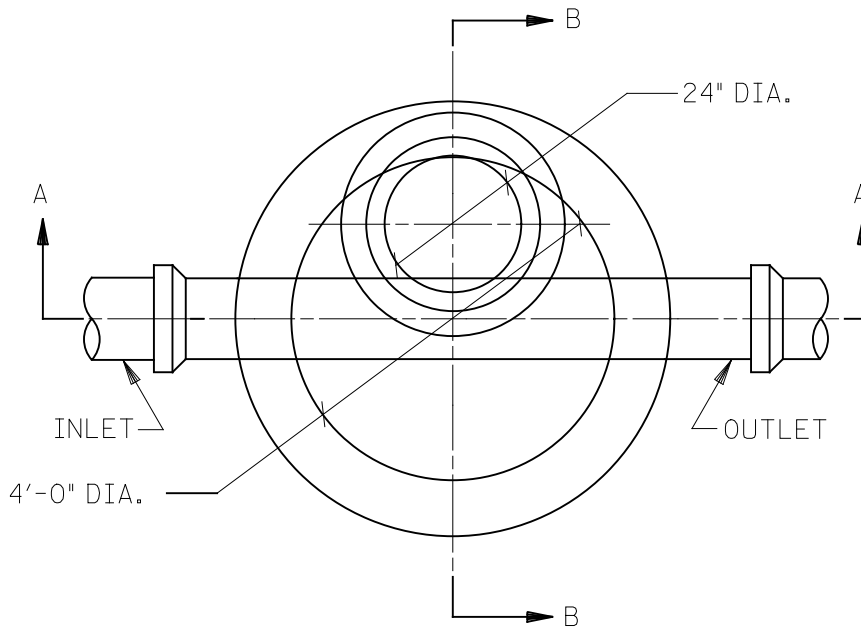
	<p>STANDARD SHALLOW PRECAST MANHOLE</p>	<p>DRAWING NO. 33-18 DATE: 3/2015</p>
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SECTION B - B

SECTION A - A

DETAIL OF STANDARD DEEP PRECAST MANHOLE



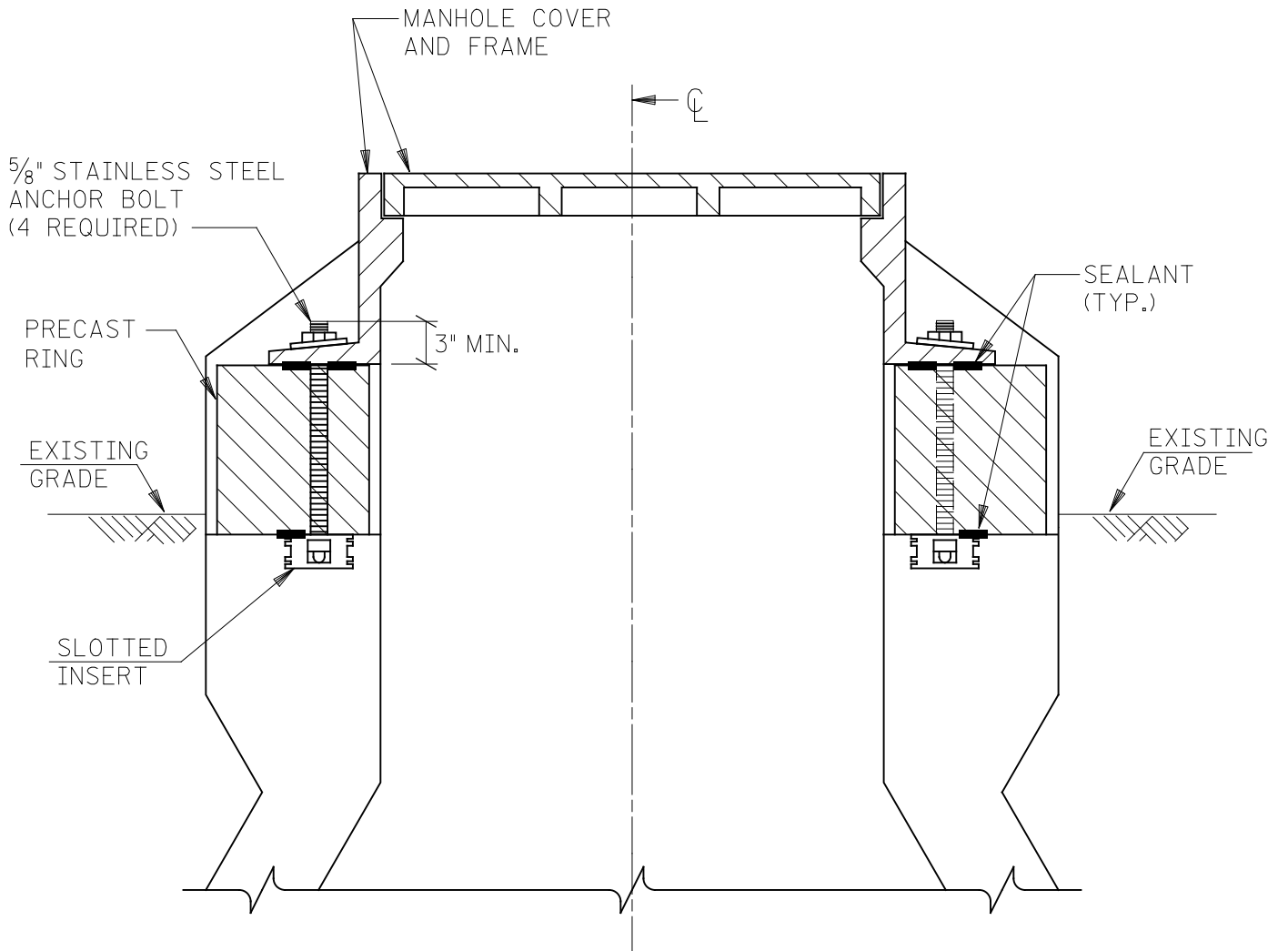
PLAN: PRECAST CONCRETE MANHOLE

STANDARD DEEP
PRECAST MANHOLE

DRAWING NO.

33-19

DATE: 3/2015



MANHOLE COVER WITH ANCHOR BOLT

SCALE: NONE

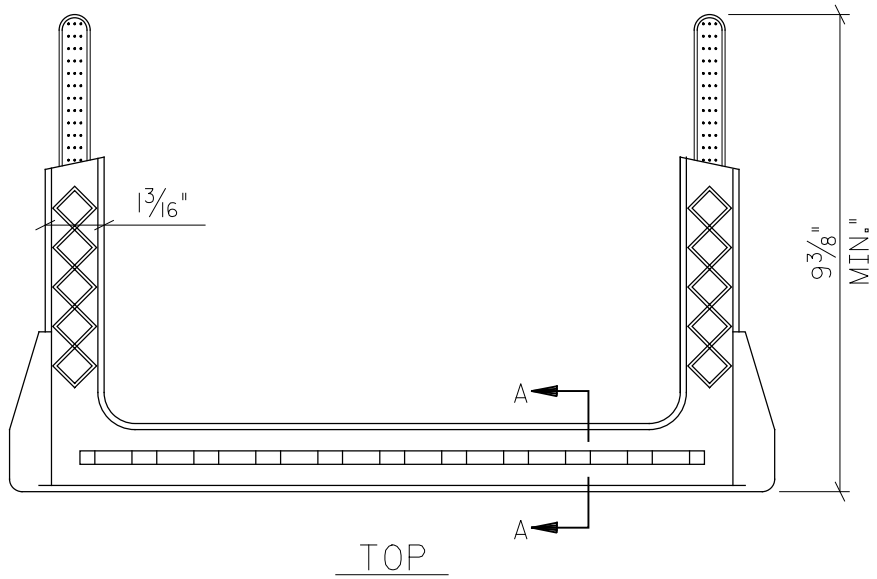
USE ONLY WHEN M.H. COVER AND FRAME
EXTEND ABOVE GRADE

DRAWING NO.

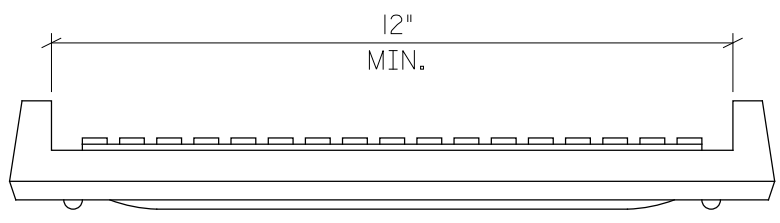
MANHOLE COVER WITH
ANCHOR BOLT

33-20

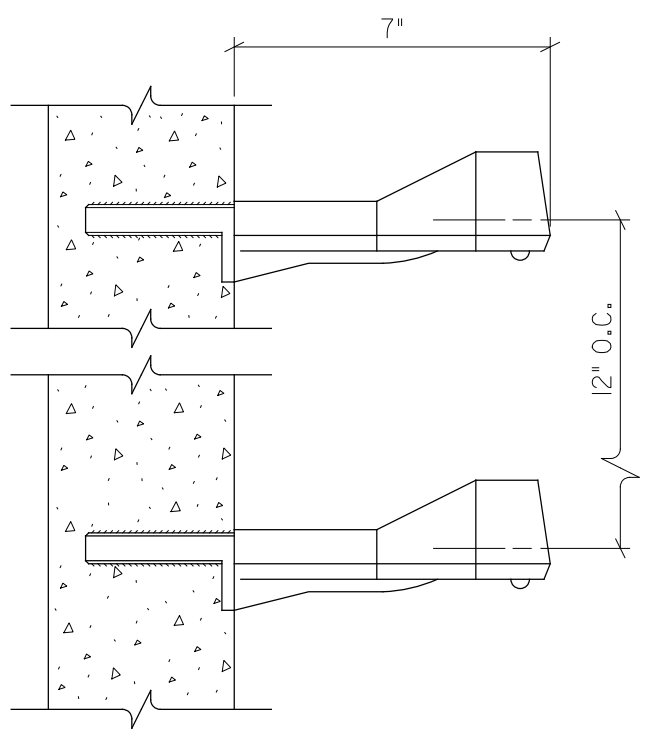
DATE: 3/2015



TOP



FRONT



ELEVATION

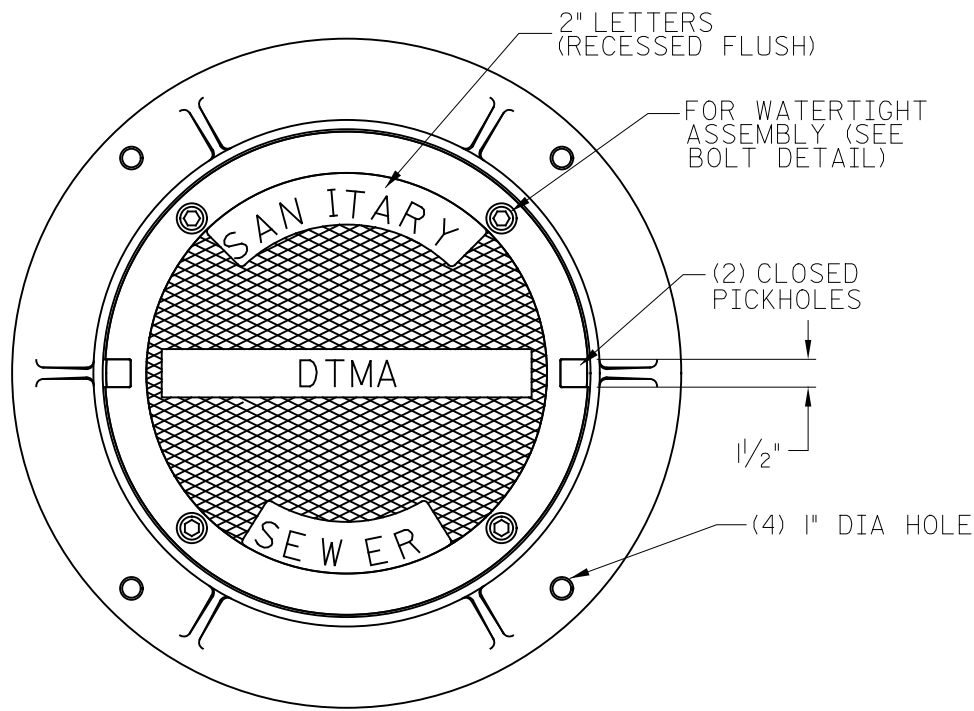


SECTION A-A

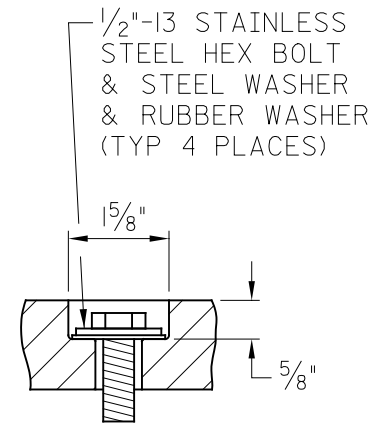
NOTES:
 MANHOLE STEPS TO BE COPOLYMER POLYPROPYLENE PLASTIC
 DISTANCE FROM RIM OF MANHOLE TO TOP STEP SHALL NOT BE GREATER THAN 2 FT.
 DISTANCE FROM BOTTOM STEP TO FLOOR OF MANHOLE SHALL NOT BE GREATER THAN 2 FT.

MANHOLE STEP DETAIL

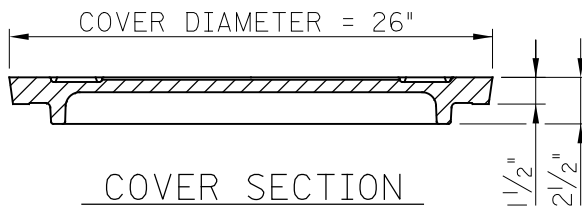
	<p>MANHOLE STEP DETAIL</p>	<p>DRAWING NO. 33-21 DATE: 3/2015</p>
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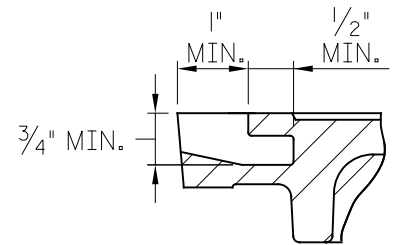
PLAN



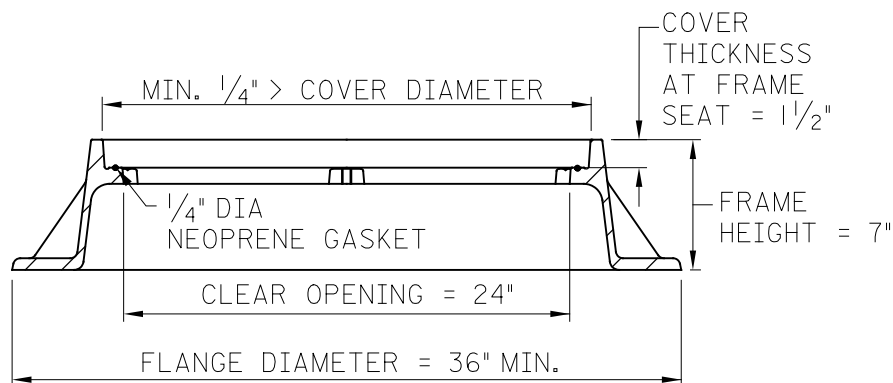
BOLT DETAIL



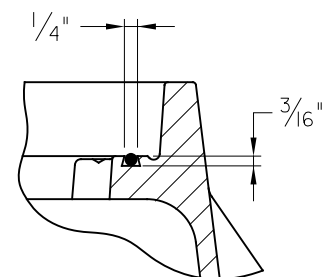
COVER SECTION



PICKHOLE DETAIL



FRAME SECTION



GROOVE DETAIL

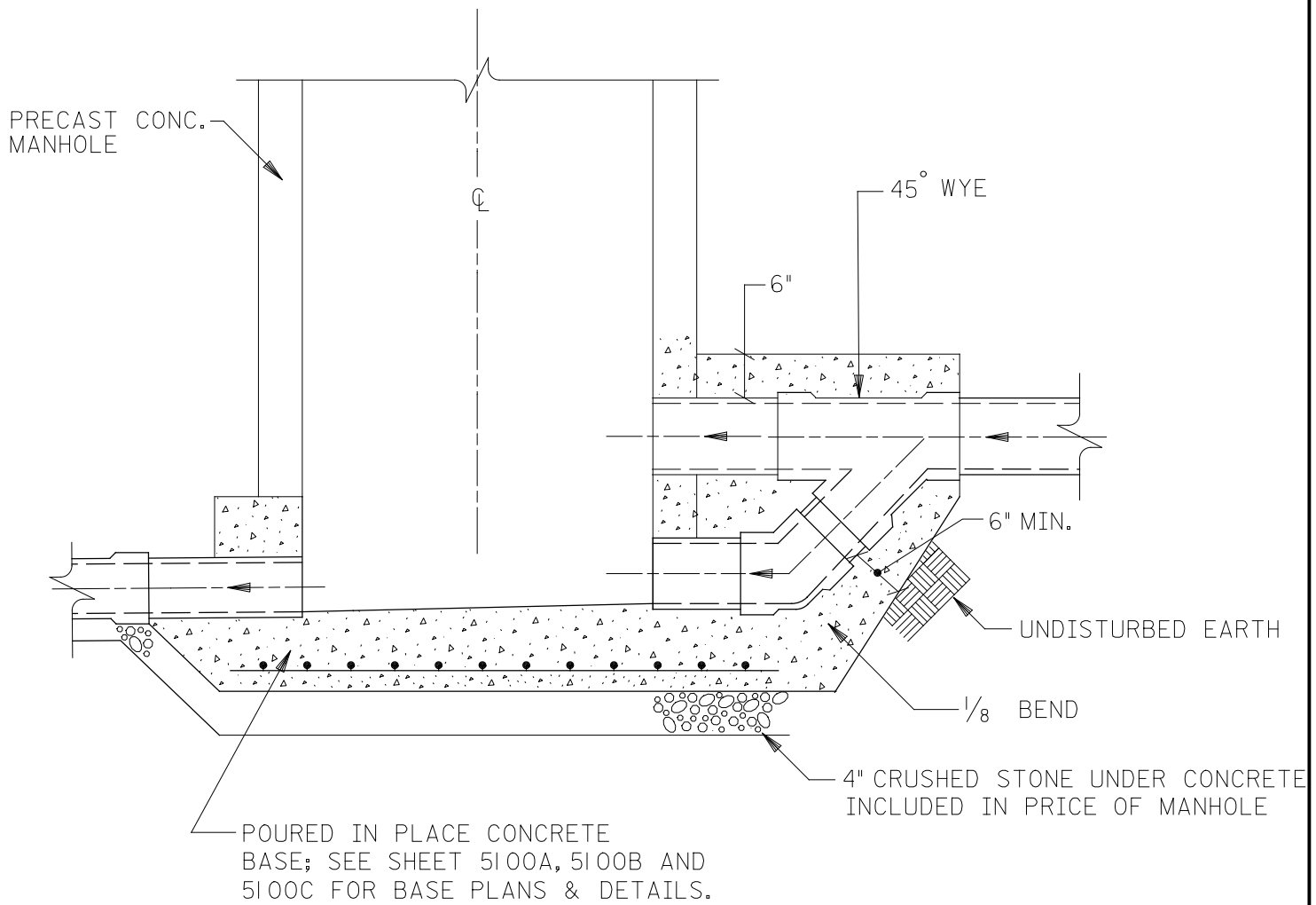
NOTE: MINIMUM H-25 LOAD RATING

HEAVY DUTY WATERTIGHT
MANHOLE FRAME & COVER
W/ GASKET IN FRAME

DRAWING NO.

33-22

DATE: 3/2015



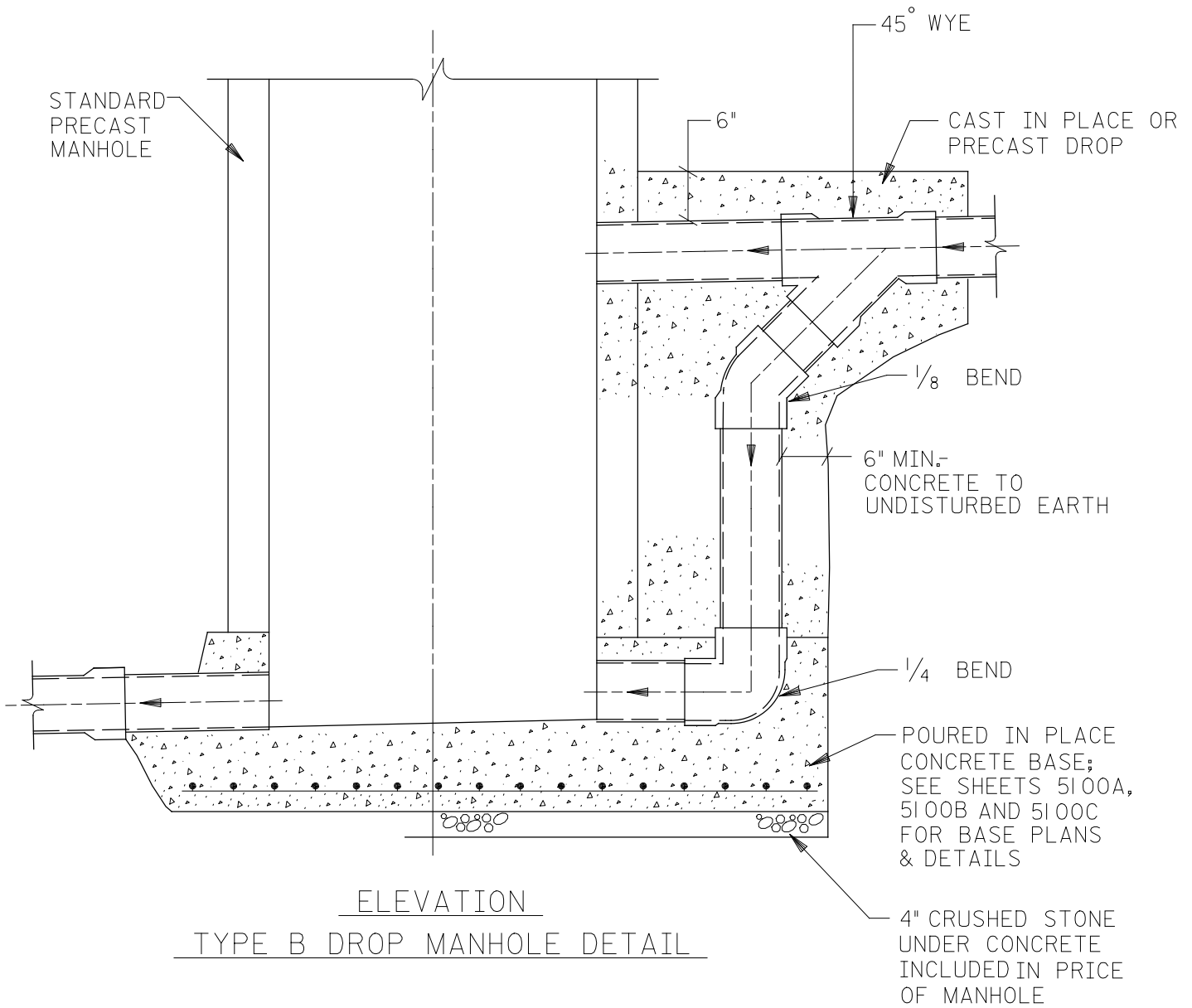
ELEVATION
TYPE A DROP MANHOLE DETAILS

<u>SIZE OF SEWER</u>	<u>MIN. DROP</u>	<u>MAX. DROP</u>
8"	1' - 9"	2' - 8"
10"	2' - 0"	2' - 10"
12"	2' - 2"	3' - 3"
* 15"	3' - 2"	6' - 8"

- NOTE:
1. CONCRETE INCLUDED IN UNIT PRICE BID FOR DROP MANHOLE CONNECTION.
 2. * - INDICATES DIMENSIONS FROM FABRICATED FITTINGS.

PVC PIPE
TYPE A DROP MANHOLE DETAIL

DRAWING NO.
33-23
DATE: 3/2015

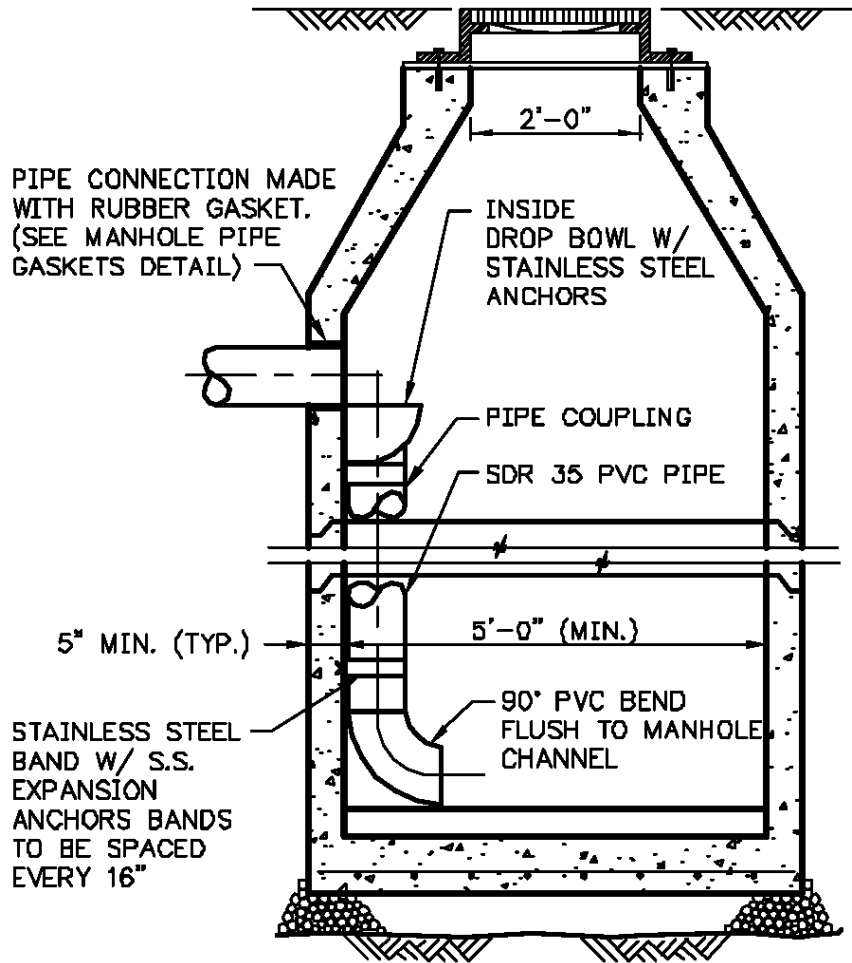


ELEVATION
TYPE B DROP MANHOLE DETAIL

<u>SIZE OF SEWER</u>	<u>MIN. DROP</u>
8"	2' - 8"
10"	2' - 10"
12"	3' - 3"
* 15"	6' - 8"

NOTES:
1. * - INDICATES DIMENSIONS FROM FABRICATED FITTINGS.

	PVC PIPE TYPE B DROP MANHOLE DETAIL	DRAWING NO. 33-24
		DATE: 3/2015



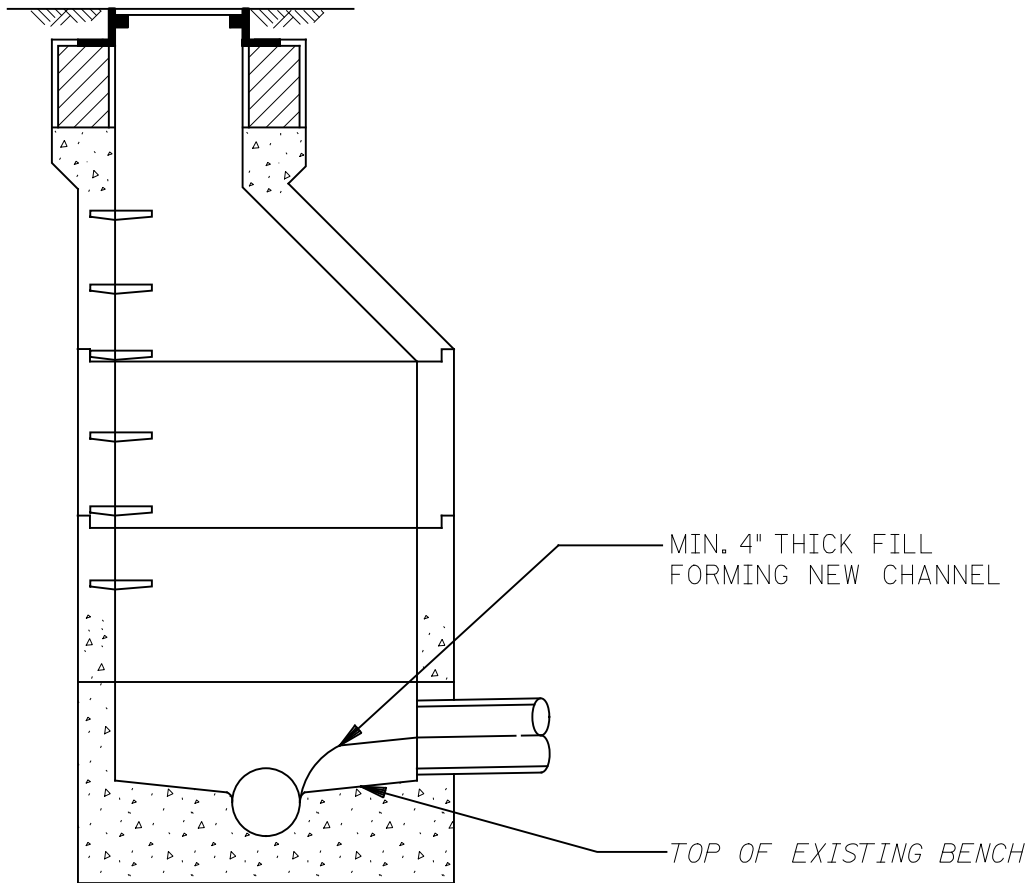
SECTION

DRAWING NO.

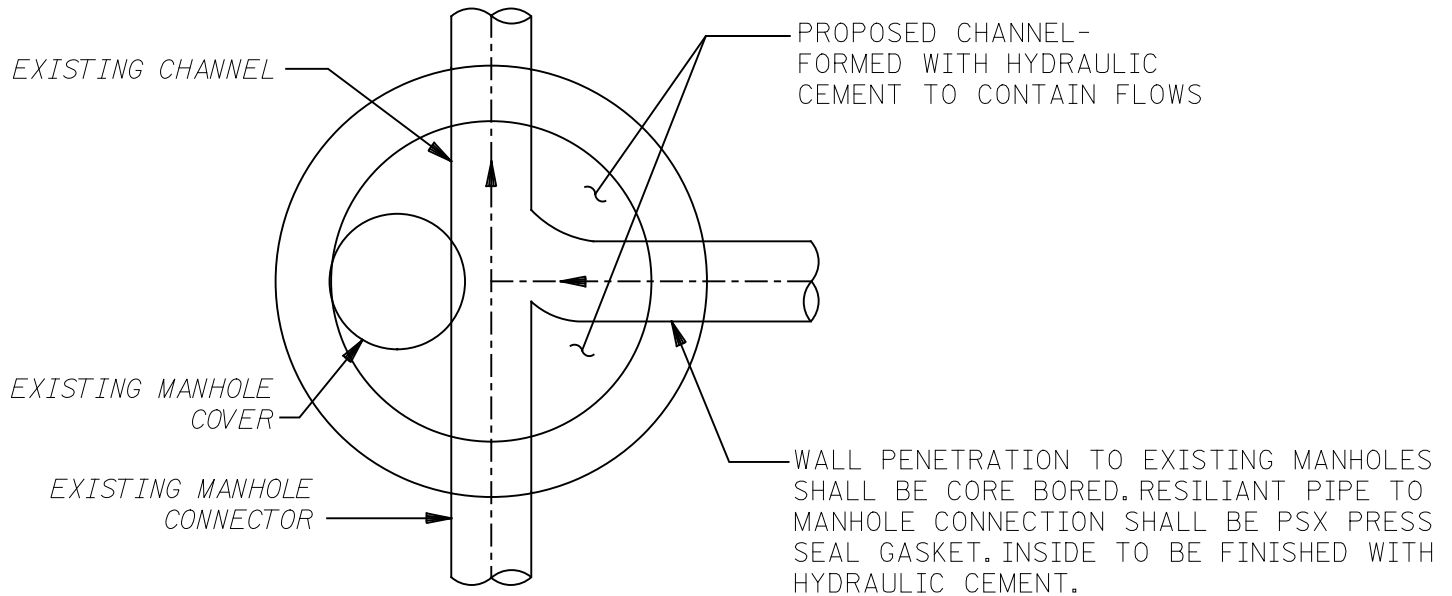
INSIDE DROP MANHOLE

33-25

DATE: 3/2015



DETAIL OF STANDARD DEEP PRECAST MANHOLE

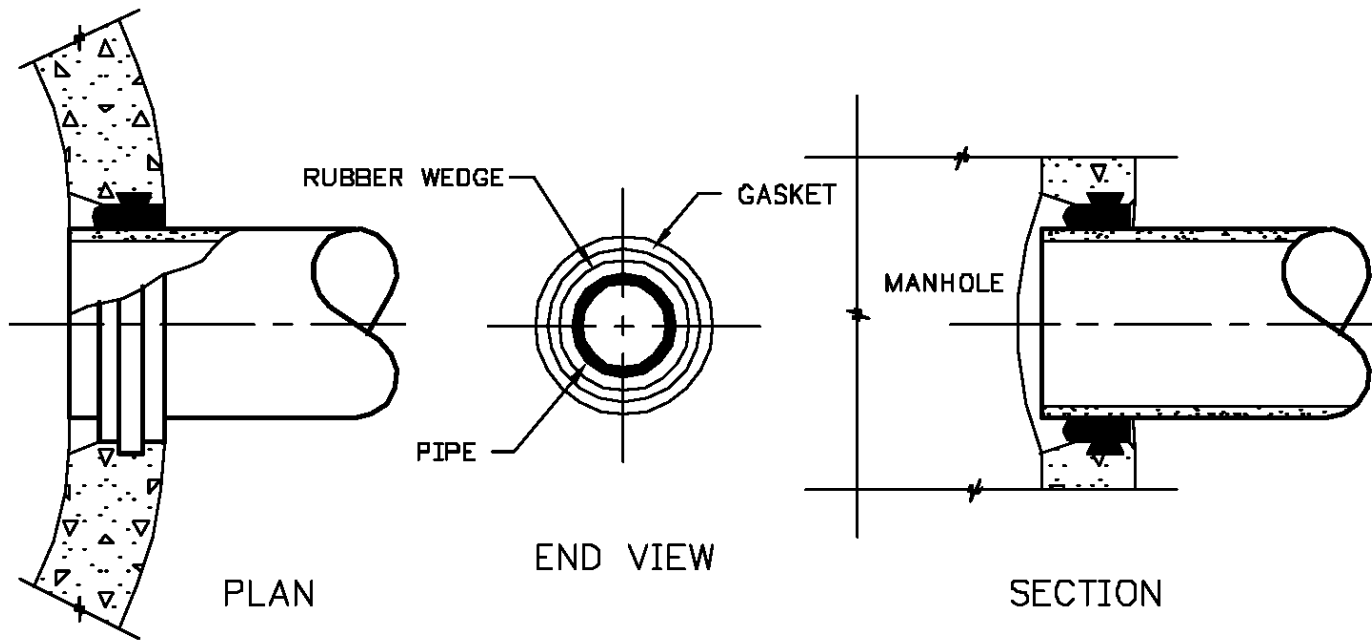


PLAN: PRECAST CONCRETE MANHOLE

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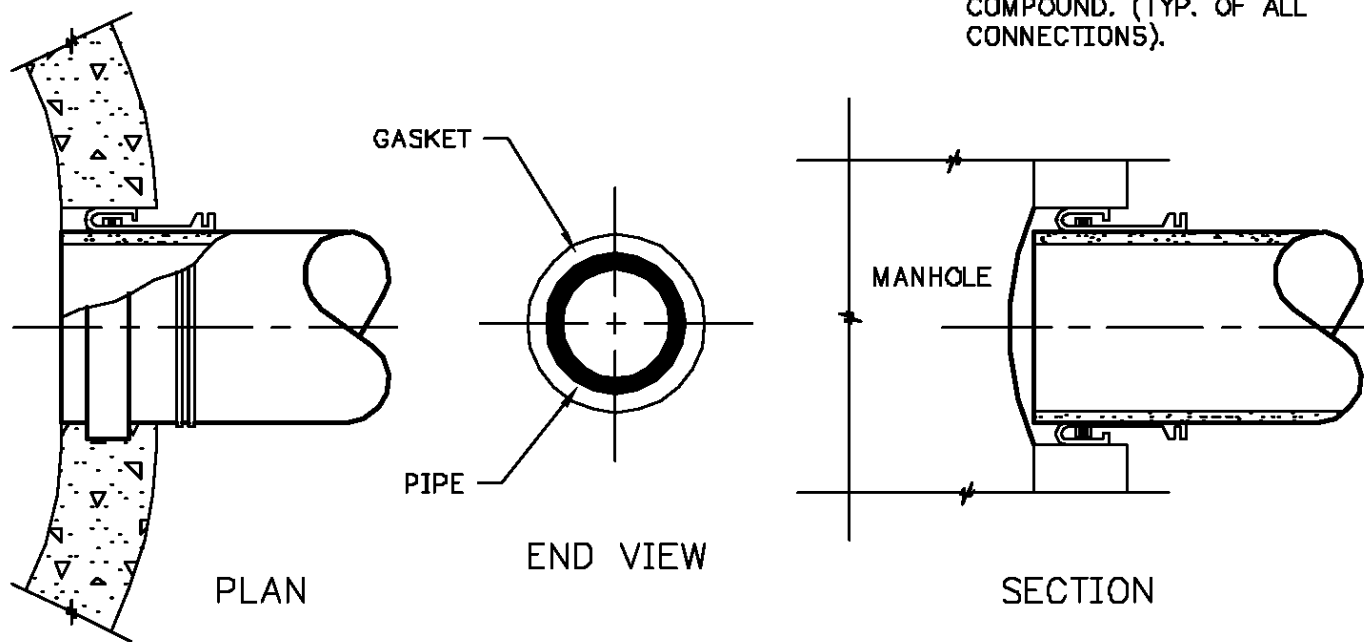
MANHOLE CONNECTION DETAIL

DRAWING NO.
33-26
DATE: 3/2015



TYPE 1
 RUBBER GASKET CAST INTO
 PRECAST PIPE OPENINGS

NOTE: AFTER PIPE-TO-MANHOLE INSTALLATION, SEAL ANNULAR SPACE AROUND PIPE, INSIDE AND OUTSIDE OF MANHOLE WITH POLYURETHANE SEALING COMPOUND. (TYP. OF ALL CONNECTIONS).



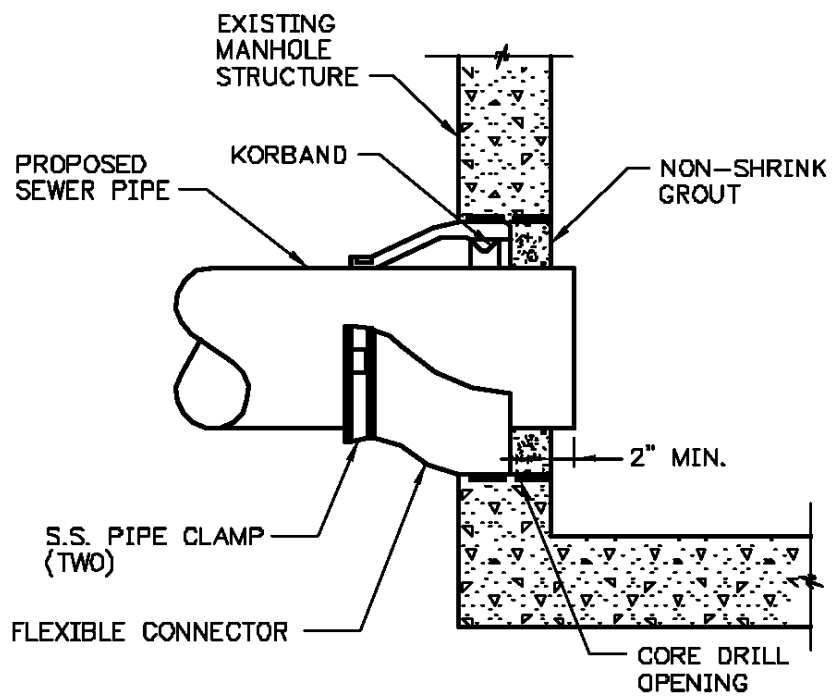
TYPE 2
 RUBBER GASKET COMPRESSION RING
 INSERT FOR PRECAST PIPE OPENINGS

DRAWING NO.

MANHOLE PIPE GASKETS

33-27

DATE: 3/2015



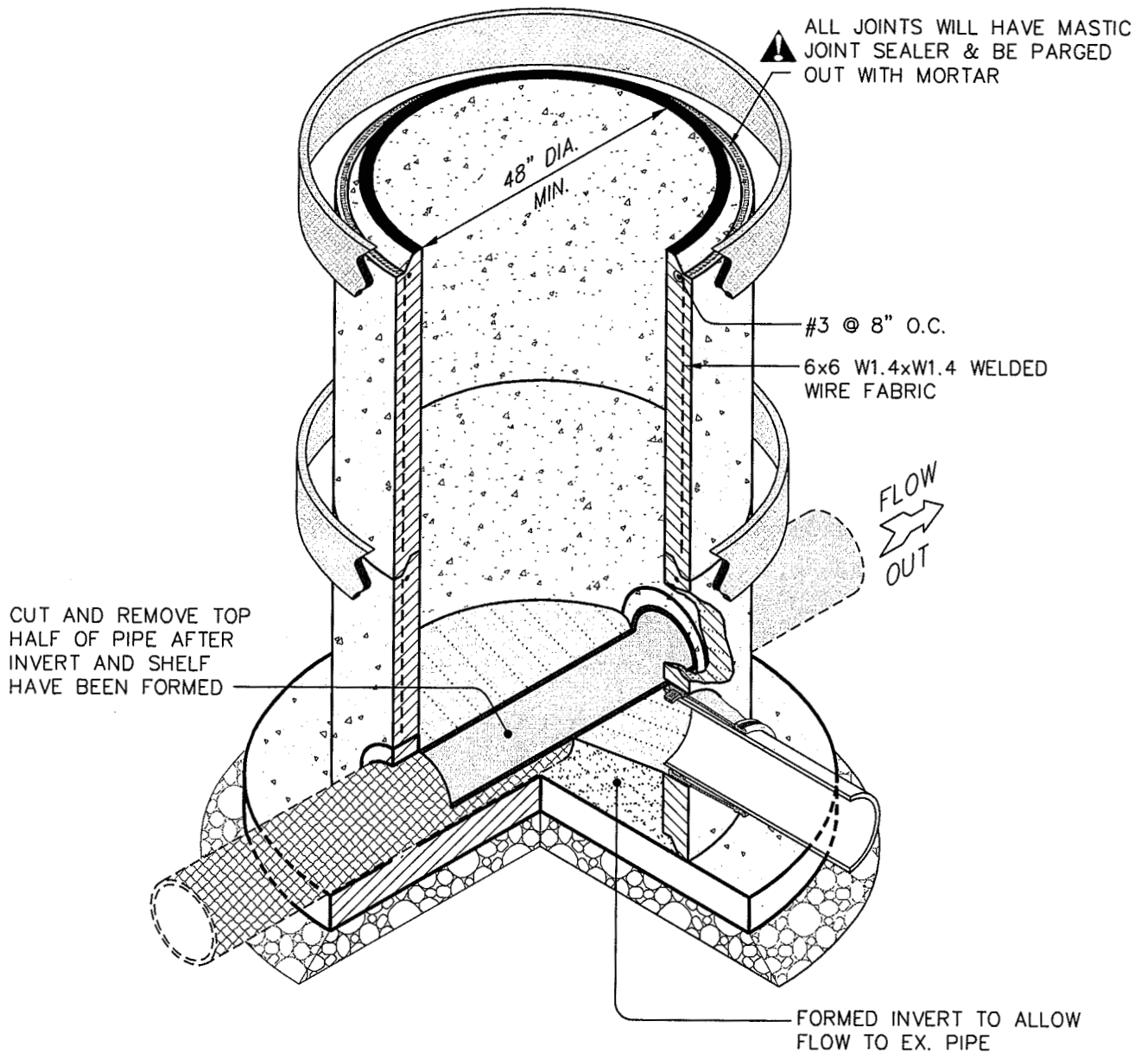
KOR-N-SEAL DETAIL

DRAWING NO.

MANHOLE PIPE ADAPTER

33-28

DATE: 3/2015



2. PRECAST CONCRETE DOGHOUSE MANHOLE MUST BE APPROVED BY THE AUTHORITY.

PRECAST CONCRETE
DOGHOUSE MANHOLE
SECTION VIEW

DRAWING NO.

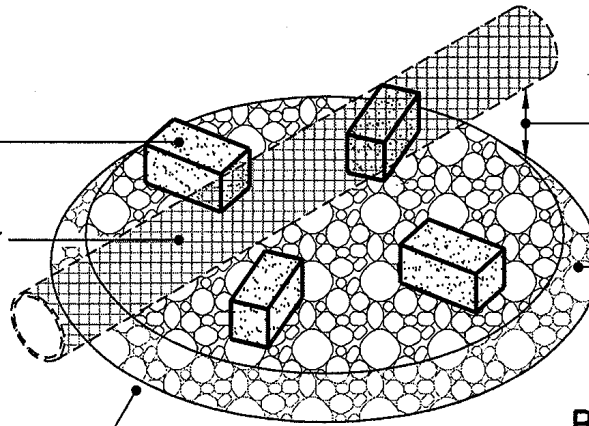
33-29

DATE: 3/2015

8x8x16 SOLID
CONCRETE BLOCK
CENTER W/RISER
WALL (4 EACH)

EXISTING SANITARY
SEWER PIPE

SEE SPECS FOR
FOUNDATION
IMPROVEMENT
WHEN NEEDED



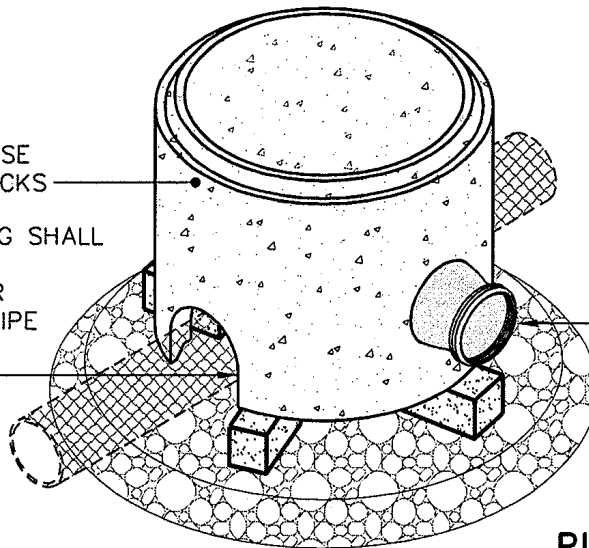
MIN. 8" CLEAR
BETWEEN EXISTING
PIPE AND PROPOSED
STONE

12" THICK NO. 57 STONE(2B)
ALLOW 1'-0" BEYOND RISER
STRUCTURE DIMENSION FOR
CONCRETE BASE

BASE ISOMETRIC VIEW

SET DOGHOUSE BASE
ON CONCRETE BLOCKS

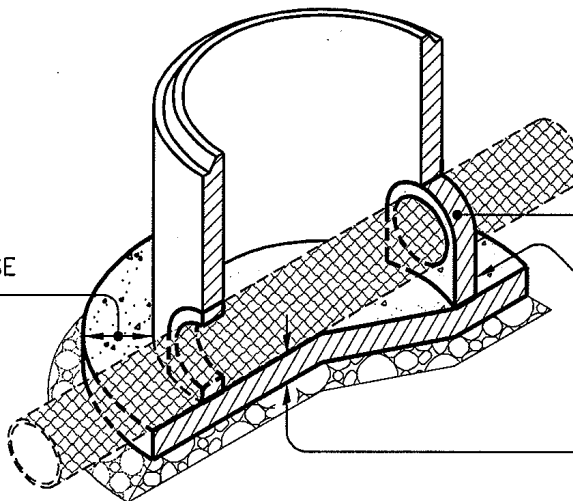
DOGHOUSE OPENING SHALL
BE PREFORMED BY
MANUFACTURER OR
SAW CUT TO FIT PIPE
OUTSIDE DIAMETER
PLUS 6".



SEE PLANS FOR
PROPOSED INVERT(S)
LOCATION & ELEVATION

RISER ISOMETRIC VIEW

ALLOW CONCRETE
TO FLOW A MIN.
1'-0" BEYOND BASE
OF STRUCTURE



FILL DOGHOUSE OPENING
AROUND EXISTING PIPE
WITH 3,000 PSI CONCRETE

CONTRACTOR TO APPLY
WATER PROOFING
SEALANT AT JOINT

8" MIN. CAST-IN
PLACE BASE

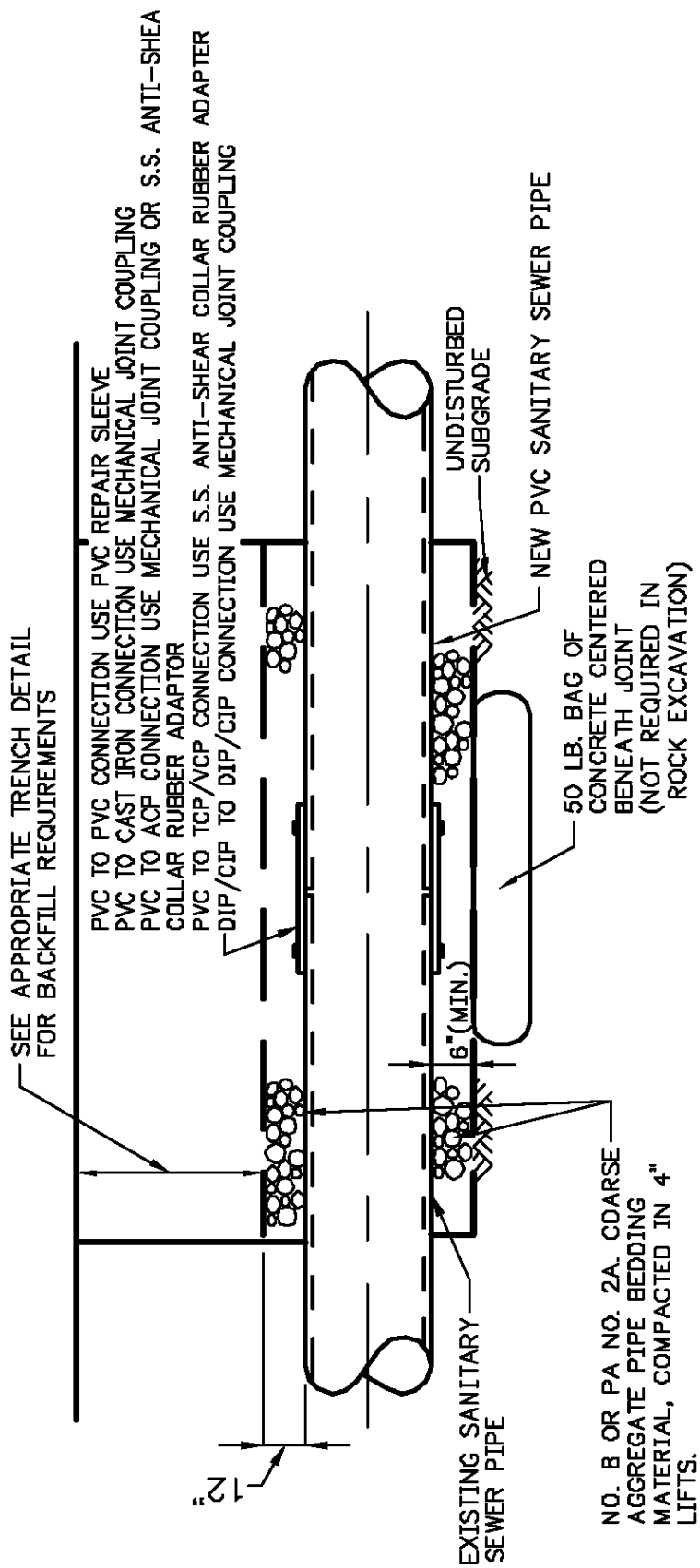
FOUNDATION SECTION VIEW

DRAWING NO.

PRECAST CONCRETE
DOGHOUSE MANHOLE

33-30

DATE: 3/2015



NOTE: RECONNECTIONS TO BE AIR TESTED IN ACCORDANCE WITH SPECIFICATIONS.

MECHANICAL JOINT COUPLINGS TO BE SMITH-BLAIR, DRESSER, OR APPROVED EQUAL

PIPE RECONNECTION

DRAWING NO.

33-31

DATE: 3/2015



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