

**STANDARD CONSTRUCTION
AND MATERIAL SPECIFICATIONS**

FOR

SANITARY SEWER EXTENSIONS

**LOWER PROVIDENCE TOWNSHIP
SEWER AUTHORITY
MONTGOMERY COUNTY
PENNSYLVANIA**

2018



Gannett Fleming
VALLEY FORGE, PENNSYLVANIA

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JANUARY 2018

GANNETT FLEMING, INC.
VALLEY FORGE, PENNSYLVANIA

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NOTE: These Specifications are arranged in the nationally recognized CSI (Construction Specifications Institute) Format. However, only the applicable Sections of certain Divisions are included which results in the Section numbering not being consecutive. This Table of Contents is included for convenience only. Its accuracy is not guaranteed.

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GENERAL INSTRUCTIONS

1.01 DEFINITIONS. Wherever in these Specifications the following words, terms and expressions, or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Approved, etc. The words "approved", "acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable, or satisfactory, to the Engineer, unless another meaning is plainly intended or otherwise specifically stated.

Authority: Lower Providence Township Sewer Authority, acting directly or through any agent, officer or employee duly authorized to act for the said party in the execution of the work required by the Contract.

Completion Certificate: The certificate of the Engineer approved by the Authority indicating the completion and acceptance of all work specified and performed under the Contract.

Contract: The written agreement executed by and between the Developer and the Contractor, covering the performance of the work and the furnishing of labor, materials, and service in the construction of sewer extensions to the Lower Providence Township Sewer Authority's Wastewater Collection System.

Contractor: Party of the Second Part or Second Party to the Contract, acting directly or through his authorized lawful agents, legal representatives, superintendents, or employees, appointed to act for said party in the performance of the work under contract.

Developer: Party of the First Part or First Party to the Contract; the corporation, partnership, or individual intending to develop for residential or other purposes a certain tract of land situated within the sewer franchise area of the Authority, acting directly or through any authorized lawful agents, legal representatives or employees appointed to act for said party in the execution of the work of the Contract.

Domestic Waste: The normal water-carried household and toilet wastes from residences, business buildings, institutions, and commercial and industrial establishments.

Drawings or Plans: Collectively, all of the drawings or plans (or reproductions of them) pertaining to the construction of the project and attached to the Contract or otherwise made a part thereof; and also such supplementary drawings as may be issued from time to time in order to elucidate or clarify said Contract Drawings, or for showing details which are not shown thereon.

Engineer: The person or organization duly employed by the Authority as consultant and authorized to inspect the results of the performance of the work under Contract by the Contractor, acting directly or through properly authorized agents, engineers, assistants, inspectors, or other representatives acting severally within the scope of the particular duties entrusted to them. The word "Engineer" shall include the officers, agents and employees of the Engineer. In cases where the Authority does not employ a consultant, the word "Authority" is substituted for "Engineer" throughout these Specifications.

Industrial Waste: Any solid, liquid, or gaseous substance or water-borne wastes or form of energy rejected or escaping from any industrial, manufacturing, trade, or business process or from the development, recovery, or processing of natural resources, as distinct from Domestic Waste.

Inspection: The examination of the work performed by the Contractor to ascertain its conformity with the Specifications.

Project: All the necessary performance, services and materials required for the satisfactory completion of the work under Contract as described in the Specifications and indicated on the Drawings.

Sewer Extension Agreement: The written agreement executed by and between the Authority and the Developer covering the performance of the work and the furnishing of labor, materials, and service in the construction of the Project. Also, any and all supplemental agreements which could reasonably be required to complete the construction contemplated.

Specifications: Collectively, all of the definitions, descriptions, directions, provisions, requirements, terms and stipulations contained in these Standard Specifications; and all written supplements thereto, made or to be made, pertaining to the Contract, and the materials and workmanship to be furnished under the Contract.

Subcontractor: A person, firm or corporation having a direct contact with the Contractor to perform part of the latter's contract; such as one who installs or furnishes and installs equipment forming a permanent part of the Contract work, or who furnishes labor for work required by the Contract in accordance with the Plans and Specifications. This term does not include individual workmen furnishing labor only, nor one who merely furnished material not worked to a special design.

Township: LOWER PROVIDENCE TOWNSHIP, acting directly or through any agent, officer or employee duly authorized to act for the said party.

1.02 DRAWINGS AND SPECIFICATIONS. The Drawings and Specifications are complementary, and the requirements of any one shall be considered as the requirements of all.

(a) The Specifications in this document are written as if they were included in the Contract Documents executed by and between the Developer and the Contractor. Whether they

are so used is at the discretion of the Developer; however, the Authority will not accept the sanitary sewer extensions provided by the Developer unless and until they conform to the requirements of these Standard Specifications.

(b) All drawings or plans pertaining to the Project (the Contract Drawings) shall be submitted by the Developer to the Authority for review. After review of these Contract Drawings by the Authority, the Developer shall make any corrections required, and submit corrected copies thereof to the Authority. The Authority's approval of the Contract Drawings shall not relieve the Developer from responsibility for errors or discrepancies in such drawings. All Contract Drawings shall be prepared and submitted in conformance with the requirements set forth in Section 01 33 00. Construction of the sanitary sewers may not commence until the Contract Drawings have been approved by the Authority and where applicable, by the Pennsylvania Department of Environmental Protection.

(c) Deviations from the Drawings or Specifications required by the exigencies of construction will be determined by the Owner only, and authorized in writing.

(d) At all times the Contractor shall keep on the Project, available to the Engineer and his representatives, one (1) copy of the Drawings, and Specifications.

1.03 PRELIMINARY INSPECTION. Unless the requirement is waived by the Engineer prior to the start of actual construction operations, the Contractor, or his authorized representative, shall go over the Project accompanied by the Engineer, or his designated representative, and shall observe for himself, with the approved Drawings before him, all pertinent conditions relative to the Contract, including the status of rights-of-way and structures, obstructions, or other objects to be removed, altered and changed.

1.04 COMPETENT WORKMEN. The Contractor shall employ only competent and efficient superintendents, foreman, clerks, timekeepers, equipment operators, laborers, and mechanics or artisans, for every kind of work. These requirements shall not operate against the employment of physically handicapped persons otherwise employable, where such persons may be safely assigned to work which they can ably perform. No person under the age of sixteen (16) years, and no person currently serving sentence in a penal or correctional institution, shall be employed to perform any work under the Contract. The contractor's site foreman shall be capable of speaking and understanding the English language.

The Contractor shall provide a competent and reliable person, who is delegated to be readily available and have full authority to act in the behalf of the Contractor, in case it is necessary to deal with any emergency situations, which may arise in connection with the project during off working hours, evenings, weekends, or holidays.

1.05 WORKING CONDITIONS.

(a) No night, Sunday, or legal holiday work, requiring the presence of the Owner or his representative, will be permitted, and then only with the written consent of the Owner with 3

days advance notice, and to such an extent as he may judge necessary. Inspection fees at the then current rate will be assessed.

(b) No work shall be done when, in the opinion of the Engineer, the weather is unsuitable for good and careful work to be performed. Should the severity of the weather continue, such that the work cannot be prosecuted successfully, the Contractor, upon order of the Engineer, shall cease all such work until directed to resume the same.

(c) The Contractor shall arrange for, and be responsible for, a sufficient amount of illumination at all times subject to the approval of the Engineer, to carry on all phases of the work.

(d) The Engineer shall be given at least three (3) working days notification prior to construction to schedule inspection.

1.06 MATERIALS.

(a) The Contractor shall furnish the Engineer, promptly after the award or execution of the Contract, with a complete statement of the origin, composition, and manufacture of all materials to be used in the construction of the Project. Only materials conforming to the requirements of these Specifications and approved by the Engineer shall be used in the work.

(b) Representative preliminary samples of the materials, of the character and quality prescribed in the Contract shall be submitted when indicated or directed, for advance examination or test. Written approval of the quality of such samples shall be received by the Contractor prior to obtaining materials from the respective sources of supply.

(c) Samples of all materials requiring laboratory tests shall be taken under the direction or supervision of, or in the manner prescribed by the Engineer. Such materials shall not be used until accepted as the result of such tests. Materials will be used only so long as the quality of the material remains equal to that of the accepted sample. The acceptance at any time of any material shall not be a bar to its future rejection, if it is subsequently found to be defective or inferior in quality to the material specified.

(d) Required laboratory tests of materials shall be made by a testing laboratory or agency selected or approved by the Engineer and in accordance with the methods indicated herein. When standard Specifications and serial numbers of technical societies and associations are stipulated, the reference shall be construed to be the latest of such Specifications and serial numbers.

(e) The Contractor shall furnish all labor, materials, and equipment necessary for collecting, packaging and identifying, representative samples of materials, and the shipping of such samples to the testing laboratory.

(f) For tests or inspections conducted by, and at the options of, the Engineer, at sites other than the testing laboratory and not under the jurisdiction thereof, the Contractor shall

furnish or arrange with the producer to furnish all material, labor, tools, and equipment, and every facility for the verification of the accuracy of all scales, measures and testing equipment, necessary for such tests or inspections.

(g) The Contractor shall permit or arrange with the producer to permit the Engineer or any agent of the testing laboratory to inspect or test any and all material being used or to be used, at any time before, during or after its preparation, or while being used during the progress of the work or after the work has been completed.

(h) Materials shall be stored so as to insure preservation of their specified quality and fitness for the work. When considered necessary they shall be placed on wooden platforms or other hard and clean surfaces, and not on the ground, and shall be placed under cover when directed. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without permission of the owner or lessee of the property.

(i) If any material intended for use in the construction of the Project has been inspected and rejected after such material has been delivered to the Site, all such rejected material shall be immediately removed from the property by the Contractor.

1.07 REFERENCED STANDARDS.

AASHTO: American Association of State Highway and Transportation Officials

ACI: American Concrete Institute.

AISC: American Institute of Steel Construction.

ANSI: American National Standards Institute.

ASTM: American Society for Testing Materials.

AWWA: American Water Works Association

Fed. Spec: Federal Specifications, United States Government.

1.08 ASSIGNED WARRANTIES. Manufacturer's warranties on materials and equipment, including internal components, exceeding the guarantee time period as stated in the Agreement, shall be assigned directly to the Authority. Assigned warranties shall be submitted to the Authority with the appropriate information required therein written and executed before final payment.

1.09 ADVERTISING. No advertising will be permitted on any part of buildings, scaffolding, fences, materials, obstructions, barricades, or work.

1.10 PERMITS AND LICENSES. The Contractor or Developer shall, unless otherwise specified, procure all necessary permits and licenses, pay all charges and fees therefore, and shall

give all notices necessary and incident to the proper and lawful prosecution of the work. The Authority requires the Developer to complete all necessary permit applications and supporting documentation.

Certain permits required in connection with a sewer extension must be obtained in the Authority's name. The permit applications shall be submitted to the Authority for review and submission to permitting agencies. The following permits, as applicable, must be acquired in the Authority's name:

(a) DEP Bureau of Water Quality Management Sewerage Permit. Complete, if applicable, the DEP Water Quality Management Permit Applications forms, supporting modules for sewers and/or pumping stations (as applicable), the application checklist, and the DEP General Information Form. The application must be accompanied by all of the supporting documentation required by DEP, including but not limited to construction plans and specifications, soil erosion and sediment pollution control plan and narrative, and the filing fee check made payable to the Commonwealth of Pennsylvania.

(b) PennDOT Highway Occupancy Permit. If the sewer extension is to be located in State highway, obtain and complete the Highway Occupancy Permit application form (PennDOT form M945A) and submit five copies to the Authority. Payment for personnel from State Agencies, as required to be on hand during the construction of work on Highways under their jurisdiction, shall be borne by the Contractor or Developer.

(c) Any pavement cut or excavation permits required by Lower Providence Township.

(d) After review of the applications by the Authority, the Developer shall make any corrections, if required, and submit corrected copies to the Authority. The Authority will forward the applications and fees to the applicable agency.

The Developer shall be responsible for compliance with and payment of costs (fees, inspectors, etc.) in connection with all permits, licenses, and regulations applicable to sanitary sewer extension construction.

Information on the permit forms specific to the Authority as applicant may be obtained from the Authority's Engineer.

1.11 CARE OF PUBLIC AND PRIVATE PROPERTY. The Contractor shall take all necessary precaution to prevent damage to all overhead and underground structures and to protect and preserve property within or adjacent to the Project and shall be responsible for damage thereto. Special care must be used by the Contractor in the prosecution of the work in order to avoid interference or damage to any operating utilities or plants; however, where there is any possibility of such interference or damage, the Contractor shall make satisfactory arrangements with responsible officers or with the owners of the utilities or plants, covering the necessary precautions to be used as safeguards during the performance of the work by the Contractor. Such arrangement shall be made before the work is started and shall be subject to the approval of the

Engineer, which approval will not be considered as releasing the Contractor from any responsibility for the acts of himself or his employees or representatives.

The Contractor shall protect all land monuments and property markers which will be affected by the construction until they have been correctly referenced. Monuments and markers which are disturbed by the Contractor during the construction of the Project or otherwise, shall be satisfactorily reset by him when directed.

(a) One Call: If public or privately owned utility pipelines, cables or structures exist below the surface within the construction area, no sub-surface work shall be done in the area without the presence or approval of an authorized representative of the utility company or agency having jurisdiction.

Attention is directed to the provisions of the Underground Utility Line Protection Law Act No. 287 (1974), as amended, and full compliance therewith is required of the Contractor.

The Contractor shall not proceed with construction operations in any work area where subsurface utility pipelines, cables, or structures may exist until he has:

- (1) Notified the facility owners through the One Call System (1-800-242-1776) not less than 3 nor more than 10 working days prior to excavation.
- (2) Determined from the owners of such and by use of other prudent techniques the precise locations of such pipelines, cables, or structures;
- (3) Made necessary arrangements with said owners for, and has had the locations of the existing pipelines, cables or structures shown on the surfaces by painted markings (or with wood stakes in earth surfaces) and also the kind of utility pipeline, cable or structure shown by painted markings (or markings on wood stakes in earth surfaces).
- (4) Maintained such painted markings and stakes until such time as the work in the area has been completed, and renewed such markings whenever deemed necessary by the Engineer during the maintenance period.
- (5) Otherwise complied with the requirements of Act No. 287 (1974) as amended.

1.12 SAFETY REQUIREMENTS.

(a) The Contractor is solely responsible for implementing any and all safety requirements.

(b) The Contractor shall furnish, erect and maintain at closures, intersections and throughout the Project, all necessary approved barricades, suitable and sufficient red lights, approved reflectors, danger signals, warning, and closure signs, provide a sufficient number of watchmen and take all necessary and legal precautions for the protection of the work and safety of the public. All barricades, danger signals, warning signs and obstructions shall be illuminated at night and all lights shall be kept operational from sunset until sunrise. All materials and safety devices (i.e., barricades, flashing warning lights, torches, reflectors and signs) which the Contractor provides for the purpose of protecting the work and the safety of the public and for

maintaining and protecting traffic must conform to the requirements specified in Section 901 of the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented and to the requirements specified in the current edition of PA Code Title 67, Transportation Chapter 203 - Work Zone Traffic Control which complements Section 901.

(c) If, and when the use of explosives is necessary for the prosecution of the work, the Contractor shall observe the utmost care, so as not to endanger life or property. All explosives shall be stored in a secure and safe manner in strict conformity to all State and local regulations, and all such storage shall be clearly marked "DANGEROUS EXPLOSIVES", and shall be in care of a competent watchman at all times.

(d) The safety provisions or applicable laws, and regulations of the Pennsylvania Department of Labor and Industry, and building and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with the safety provisions of the "Manual of Accident Prevention in Construction", published by the Associated General Contractors of America, to the extent that such provisions are not in contradiction of applicable state and local laws.

Observance of, and compliance with, said regulations shall be solely and without qualification, the responsibility of the Contractor, without any responsibility whatsoever on the part of the Authority or Engineer. The duty of enforcing such laws and regulations lies with the said Department, not with the Authority or Engineer.

(e) The provisions of the "OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970" of the U.S. Department of Labor shall be complied with in the performance of all work. Observance of, and compliance with, said Act shall be solely and without qualification the responsibility of the Contractor, without reliance on superintendence of, or direction by, the Authority or Engineer. The duty of enforcement of the provisions of the Act lies with the U.S. Department of Labor, not with the Authority or Engineer.

(f) Confined Spaces: The Contractor is hereby advised that confined space entry may be required in the performance of this work. No confined spaces shall be entered by Contractor personnel until Contractor written confined space entry procedures are developed for the Project in accordance with the provisions contained within 29 CFR 1910.146 Permit Required Confined Spaces - effective April 15, 1993. These procedures require the identification of potential hazards, safety precautions, protective equipment requirements and rescue procedures [29 CFR 1926.21 (b) (6)]. If respiratory protection is required for entry, the Contractor shall have a written respiratory protection program in effect and which defines attendant responsibilities, communication procedures and safety equipment utilization [29 CFR 1910.134 (e) (3)].

1.13 REGULATIONS OF THE DEPARTMENT OF LABOR AND INDUSTRY. The regulations of the Pennsylvania Department of Labor and Industry relating to wage scales, trenches and excavations, tunnel construction, equipment, materials, labor, safety, sanitation, and other regulations on which the Contractor shall be fully informed and with which he shall fully comply. Observance of and compliance with said regulations shall be solely and without

qualification, the responsibility of the Contractor, without reliance or superintendence of, or direction by, the Authority or Engineer. The duty of enforcing such laws and regulations lies with the said Department.

1.14 REGULATIONS AND REQUIREMENTS OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP). The Contractor and the Developer are advised that they will be required to design and conduct their work in compliance with the rules, regulations and requirements of the Pennsylvania Department of Environmental Protection.

1.15 OBSERVANCE OF LAWS. The Contractor at all times shall observe and comply with all Federal and State laws and regulations, and local bylaws, ordinances and regulations in any manner affecting the conduct of the work or applying to employees on the Project, as well as all safety precautions and orders or decrees which have been promulgated or enacted, or which may be promulgated or enacted, by any legal bodies or tribunals having authority or jurisdiction over the work, materials, equipment, employees or the Contract; such observance and compliance shall be solely and without reliance on superintendence or direction by the Authority or Engineer. The duty of enforcement of all of said laws, ordinances, regulations, orders or decrees lies with the body or agency promulgating them, not with Authority or Engineer.

1.16 CLEANING SITE. The Contractor shall at all times keep the Project Site free from accumulations of waste material or rubbish caused by the work. Before the work will be considered as having been completed, the Contractor shall clean and remove from the Project and adjacent property, all surplus and discarded materials, equipment and temporary structures. The Contractor shall also restore all cultivated lawns and shrubbery which he may have damaged in the course of construction.

1.17 AUTHORITY'S DUTIES, EXAMINATION AND INSPECTION. The work shall at all times be subject to the examination and inspection of the Authority and its authorized assistants, who shall have free access to the work, and be furnished by the Contractor with every reasonable facility for examination of the work, to the extent of uncovering, testing or removing finished portions thereof. The Contractor shall provide all labor and equipment necessary for such examinations. The Authority may require the Contractor to uncover for examination, or to remove any work done or placed in violation or disregard of instructions issued to the Contractor by the Authority or its representative.

If so delegated by the Authority, it shall be the duty of the Engineer to see that all materials and work are properly inspected and that all such materials and work conform fully to the requirements of the Specifications. The authority of the Engineer ("He") shall perform such other duties as may be assigned him from time to time and shall have such additional authority as may be defined elsewhere in these General Instructions. He shall in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the work by the Contractor.

He will not perform or be responsible for any hiring, firing, supervision, superintendence, direction of personnel, use of equipment, construction site safety, safety

programs or the direction of the manner of methods of construction employed by the contractors, their subcontractors, agents, servants or employees.

All inspections and tests shall be performed without unnecessarily delaying the work. All material and workmanship, if not otherwise designated by the Specifications shall be subject to inspection, examination and test by the Engineer or his duly authorized representatives. He shall have the right to reject defective material or workmanship, or require its correction. Rejected workmanship shall be satisfactorily replaced with proper material and the Contractor shall promptly segregate and remove rejected material from the premises. If the Specifications, the Authority's instructions, laws, ordinances, or any public authority require the work to be specially tested or approved, the Contractor shall give the Authority timely notice of its readiness for inspection.

The Authority shall, within a reasonable time after presentation to him, determine all questions in relation to the construction of the Project, and in all cases decide every question which may arise relative to the performance of the work covered by the Contract.

The Authority shall have full authority to decide all questions which may arise under the Contract relative to the quality and acceptability of materials furnished and the manner, rate of progress, quality and acceptability of work performed, and the interpretation of any or all Plans and Specifications.

Any verbal opinion or suggestion which the Authority may give the Contractor shall in no wise be construed as binding the Authority in any way.

In case of any dispute relative to the quality of materials or work, the Authority shall have authority to reject materials and to suspend the work.

Within ten (10) working days after the Developer notifies the Authority in writing that the collection system has been completed and is ready for final inspection, the Authority, or the Authority's agent, shall begin to inspect the collection system in order to verify that the system has been completed in accordance with the approved plans and Specifications. The costs incurred in performing the inspection and testing will be the responsibility of the Developer. The Developer agrees that all defects, problems, damages, or items of poor workmanship that may be found as a result of the inspection, field testing or by any other manner or means, shall be repaired by the Developer in proper manner under the direction and inspection of the Authority's representative prior to acceptance by the Authority. After the acceptance of the sewers, the Authority will notify the Township that connection permits may be issued.

1.18 **DEFECTIVE WORK.** When any material not conforming to the requirements of the Specifications and Drawings, has been delivered upon the Site of the Project, or incorporated in the work, or when any work performed is of inferior quality, such material or work shall be considered as defective and shall be immediately removed and renewed or made satisfactory as directed by the Authority. Failure or neglect on the part of the Authority to condemn or reject any bad or inferior work or materials, shall not be construed as to imply an acceptance of such

work or materials, if such bad or inferior material or work becomes evident at any time prior to the delivery of the Completion Certificate by the Authority to the Developer.

The Contractor shall remove any work or material condemned, and shall rebuild and replace the same.

The Contractor shall promptly move from the premises all materials condemned by the Authority as failing to conform to the Specifications, whether incorporated in the structure or not, and the Contractor shall promptly replace his own work in accordance with the Contract.

1.19 NOTICE. The service of any notice, by the Authority or Engineer to the Developer or Contractor, shall be considered accomplished upon completion of any one of the following procedures.

(a) When delivered, in writing, to the person in charge of the office used by the addressee to conduct business;

(b) When delivered, in writing, to the addressee or any of his authorized agents in person;

(c) When delivered, in writing, to the addressee or any of his agents at the office used by the addressee to conduct the business of the Contractor at or near the Site of the work;

(d) When deposited in the United States Mail, postpaid, and addressed to the party intended for such service at his office used for conducting the business of the Contract at the Site of the work, or his last known place of business; or

(e) When filed at any company operated office of the Western Union Telegraph Company and addressed to the party intended for such service at his last known place of business or for conducting the business of the Contract at the Site of the work.

1.20 ENGINEERING STAKES. The Contractor shall furnish, set and maintain without cost to the Authority, suitable stakes, grade boards, temporary structures, templates, and other materials for establishing and maintaining points, marks, and lines. The Contractor shall be held responsible for the preservation of all stakes and marks. Provide a level and rod for use by the Authority to verify accuracy of installation.

1.21 INSURANCE AND INDEMNITY REQUIREMENTS. If applicable, the Developer shall not commence work until all protections required under this section are in full effect and verified to the satisfaction of the Authority.

(a) Duties of The Developer. Four (4) copies of the original certificates must be prepared as indicated in the following subparagraphs and forwarded to the Engineer. In addition, the Authority or its representative, shall have the right to reject any form of security which does not meet nationally recognized standards for financial strength as indicated below. Contractors and subcontractors must satisfy all conditions to the same extent unless otherwise specified

herein. Protections as described shall be maintained until work in connection with the Project has been accepted by the Authority. In the case of wrap up policies or claims made policies, coverages shall be maintained for a minimum of two years after the project has been completed.

(b) Coverages to be Maintained by the Developer. The insurance types to be provided are General Liability, Automobile Liability, and Workers' Compensation, and Railroad Protective Liability when Contract includes work on, under or adjacent to Railroad rights-of-way or properties. The specific insurance coverages and limits of liability shall be those normally carried by the Developer and/or his Contractors and Subcontractors and subject to the review and approval of the Authority.

(c) Coverage Modifications Which Must be Obtained: Authority, Township, and Engineer and each of their Officers, Agents and Employees shall be named as additional insureds with respect to all work performed in connection with this Project. This applies to General Liability, Automobile Liability, and Railroad Protective Liability coverages.

Authority shall be notified by Registered United States Mail thirty (30) days in advance of any cancellation or any material change resulting in the elimination or reduction of any protection.

Waiver of Subrogation in favor of the Authority, Township, and Engineer and each of their Officers, Agents, and Employees applying to all Workers' Compensation coverages must be provided by the Developer unless not permitted by laws of the state in which this Agreement applies.

(d) Indemnification of Authority, Township, and Engineer by Developer: Developer is responsible for all liabilities and duties assumed by Developer including but not limited to the indemnity liability in the Agreement between Authority and Developer and the provisions of this subparagraph (d) and shall provide such protections for the Authority and Engineer whether or not such claims, losses, liabilities or expenses are covered by insurance.

The Developer shall at all times, indemnify and save harmless and Authority, Township, and Engineer, of and from all claims of whatsoever nature, including without limitation claims which may be made by any of the employees of the Developer or by any employees of any Contractor or Subcontractor to whom the Developer may have let the performance of any part of the work and the Developer will appear for and defend the Authority, Township, and Engineer against any and all such claims.

The status of the Developer in the work to be performed by him is that of an Independent Contractor and as such he shall properly safeguard against any and all personal injury including death, or damage to the public, to public and private property, materials and things; and as such, he alone shall be responsible for any and all damage, loss or injury to persons or property that may arise, or be incurred, in or during the conduct or progress of said work without regard to whether or not the Developer, Contractor, his Subcontractors, Agents, or Employees have been negligent; and the Developer shall keep the Authority, Township, and Engineer indemnified from and discharged of, and from any and all responsibility and liability

for risks and casualties of every description, as provided in the Agreement between the Authority and Developer.

The Developer shall assume and be liable for all blame and loss of whatsoever nature by reason of neglect or violation of any federal, state, county, or local laws, regulations or ordinances.

(e) Minimum Standards of Financial Strength and Policyholder Service Required of Insurance Carriers Providing Coverage for the Work: Insurance Companies used must be admitted carriers authorized to transact business in the Commonwealth of Pennsylvania unless Authority is notified and waives this requirement.

Insurance Companies used shall be rated (A 10) or better by Best's Rating Service unless Authority is notified and waives this requirement.

1.22 FEE REQUIREMENTS. The Developer shall be required to pay the following fees applicable to the sewer extension.

(a) Sewer Connection Charges and Tapping Fees. The developer shall pay to the Authority applicable connection charges and tapping fees as required by duly adopted Resolution of the Authority.

(b) Any other fees, inspection costs, and bonds associated with other permits, licenses, or approvals that are applicable to the extension.

1.23 ITEMS REQUIRED PRIOR TO BEGINNING CONSTRUCTION

(a) Sewer Connection Permit(s) applicable to the Project.

(b) Evidence that the final subdivision plan has been filed by the Township at the county courthouse, Recorder of Deeds office, if applicable.

(c) ESCROW Accounts or other financial security to assure completion of the sewer extension and to cover the warranty period.

Should the Surety of any Bond or the issuer of other financial security be deemed unsatisfactory or become unacceptable to the Authority at any time, the Developer shall, upon written notice of the Authority, promptly furnish acceptable or substitute security as may be required to protect the interests of the Authority or of persons supplying services (including rental of equipment), labor, or materials in the prosecution of the work.

(d) Receipt of a letter from the Developer stating the name of the Contractor who will be installing the sanitary sewer extension.

(e) Receipt from the Authority of a copy of the Water Quality Management Permit issued by DEP, if applicable.

- (f) A list of suppliers for the materials to be used in the sanitary sewer construction.
- (g) Shop drawings of manhole bases, manhole risers, manhole frames and covers, pipe and other necessary construction materials approved by the Authority.
- (h) Certification from the pipe manufacturer that the pipe meets or exceeds the requirements of the Authority's standard specifications.
- (i) Written approval by the Authority to proceed with construction.
- (j) Receipt by the Authority of the executed deeds of easements for all lots and properties that contain a sanitary sewer right-of-way.

1.24 DEDICATION OF SANITARY SEWER EXTENSION TO THE AUTHORITY. The Developer shall deliver a Deed of Dedication transferring ownership of the sanitary sewer extension to the Authority. Attached to the deed shall be a plat which accurately describes the location of the facilities to be dedicated. The description shall include bearings and distances which are tied to permanent features shown on a recorded plan of the property. If the Developer is a corporate entity, the deed of conveyance must be accompanied by a corporate resolution authorizing said conveyance. Upon receipt of the executed Deed of Dedication from the Developer, the Authority will release the Developer from all obligations to the Authority with respect to the extension, except that the Developer shall guarantee the extension installation including materials and workmanship for a period of one year from the date of the deed, or in the case of work on PennDOT right-of-way, for a period of five years from the date of the deed.

1.25 STEEL PRODUCTS PROCUREMENT ACT. Special attention is drawn to the provisions of the Commonwealth of Pennsylvania "Steel Products Procurement Act" - Act No. 3 of 1978, as amended by Act No. 1982-161 and Act No. 1984-144 and subsequent amendments (73 P.S. 1881 et seq). The Authority requires all developers and contractors to comply with the Act, as amended from time to time. The Authority affirms its compliance with the Act. Developers and Contractors are required that only steel products as defined in said Act (which includes cast iron in the definition of steel products) shall be used or supplied in the performance of the contract for public works or any subcontracts thereunder.

END OF SECTION

SPECIFICATIONS
for
MAKING
CONNECTIONS
to the
LOWER PROVIDENCE TOWNSHIP SEWER AUTHORITY SEWER SYSTEM

I. DEFINITIONS

- A. Building Sewer: All sewer pipe and sewer appurtenances extending from the sewage drainage system of any structure to the lateral of a sewer.
- B. Commercial Facility: Any structure intended to be used wholly or in part for the purpose of carrying on a trade, business, or profession or for social, amusement, religious, educational, charitable or public uses.
- C. Housing Unit: Any structure intended to be occupied as a whole by one family or an apartment intended to be occupied by one family or any other one-family living unit, containing plumbing for kitchen or for toilet facilities.
- D. Improved Property: Any property upon which there is erected a structure intended for continuous or periodic habitation, occupancy or use by human beings or animals and from which structure sanitary sewage and/or industrial wastes shall be or may be discharged.
- E. Industrial Facility: Any structure intended to be used wholly or in part for the manufacturing, fabricating, storing, or warehousing, processing, cleaning, laundering or assembling of any project, commodity or article.
- F. Industrial Waste: Any solids, liquids or gaseous substance or form of energy rejected or escaping from any industrial, manufacturing, trade or business process or from the development, recovery or processing of natural resources and distinct from sanitary sewage.
- G. Lateral: That part of the sewer system extending from a sewer to the curb line or, if there shall be no curb line, to the property line or if no such lateral shall be provided, then lateral shall mean that portion of, or place in, a sewer which is provided for connection of any building.
- H. Owner: Any person vested with ownership, legal or equitable, sole or partial, of any improved property.

- I. Regional Authority Capacity Permit: A capacity permit for a connection to the Lower Providence Township Sewer Authority (LPTSA) sewer system are issued by the Lower Perkiomen Valley Regional Sewer Authority (LPVRSa).
- J. Permit: A permit for a lateral connection to the Lower Providence Township Sewer Authority sewer system as issued by LPTSA.
- K. Person: Any individual, partnership, association, society or corporation and any other entity capable of connecting to or using the Lower Providence Township Sewer Authority sewer system.
- L. Sanitary Sewage: The normal water-carried household and toilet wastes from any improved property.
- M. Sewage Drainage System: All sewer pipe and sewer appurtenances situated inside the walls of the structure to be served by a lateral connection.
- N. Sewer System Superintendent: Any person who may, from time to time, be placed in general charge of the Lower Providence Township Sewer Authority sewer system.

II. ADMINISTRATIVE PROVISIONS AND RESPONSIBILITIES OF THE OWNER

- A. Permission for connecting to the LPTSA sewer system must be obtained from the LPVRSa and the LPTSA through applications made by the property Owner or his agent. Blank forms for applications will be furnished by the LPVRSa and LPTSA.
- B. No repairs, alterations or additions to any connection to the LPTSA sewer system may be made until application has been made to and permission has been granted by the LPVRSa and LPTSA. The application for a Permit shall be supplemented by any plans, specifications, or other information considered pertinent in the judgement of the LPTSA.
- C. No connection shall be made until the LPVRSa capacity fee and the LPTSA tapping fee have been paid. All building sewers shall be inspected by the Township Building Inspector and/or such inspector as he may assign. Construction of the building sewer may not proceed until the lateral installation has been approved by the LPTSA.
- D. All new laterals shall be inspected by the LPTSA. Construction of the service connection and/or lateral may not proceed until the LPTSA has been notified and has authorized the construction to proceed.
- E. Wherever the surface of any public street, sidewalk or cartway is disturbed for

construction of any service connection or lateral, it shall be restored, at the cost of the Owner of the improved property being connected, in a manner satisfactory to the Township. All construction within the right-of-way of a public street of the Township shall be in compliance with the ordinances of the Township and all construction within the right-of-way of a County or State highway shall be in compliance with Montgomery County or Pennsylvania Department of Transportation requirements and specifications respectively.

- F. All permits issued for construction will require that streets or roads under construction remain passable for vehicular traffic during the period of construction. Every excavation for a service connection or lateral shall be guarded adequately with barricades and lights to protect all persons from damage and injury.
- G. If a building sewer, service connection or lateral becomes clogged, the opening, repair, or replacement of same shall be the responsibility of the property Owner.
- H. All costs and expenses for the installation and connection of the building sewer, service connection, and the lateral shall be borne by the Owner. The Owner shall indemnify the Township and the LPTSA from any loss or damage that may result directly or indirectly from the installation of the building sewer, service connection or the lateral.
- I. The Owner of an improved property, on which the principal building is situated 150 feet or less from the LPTSA sewer system, shall, upon direction from the LPTSA, connect to the sewer system. If the Owner of such improved property fails to connect to the sewer system within 60 days' notice from the LPTSA, or such longer time designated by the LPTSA, the LPTSA may enter upon such improved property and construct the sewer connection. The LPTSA may collect the costs and expenses of connection from the Owner of such improved property, in the manner approved by applicable State law.
- J. Before commencing any phase of the service connection or lateral construction, the contractor shall obtain a permit and shall notify the LPTSA as to when the construction will commence. At the time of final inspection, and before the service connection and lateral are approved, the contractor shall give to the inspector an as-built drawing of the service connection and lateral installation, which shall include:
 - 1. The plan view of the new service connection and lateral.
 - 2. Locations of all cleanouts and other special fittings.
 - 3. Point of connection to the sewer system.
 - 4. Accurate measurement of the service connection and lateral length and the depth at the point of connection to the sewer system.

- K. At least twenty-four (24) hours' notice of the time when such connection will be made must be given to the LPTSA prior to inspection.
- L. Any building sewer, service connection or lateral that is in violation of these specifications or of any other part of the Township Plumbing Code shall be relaid in the proper manner at the expense of the Owner.

III. GENERAL REQUIREMENTS FOR LATERALS

- A. No more than one (1) lateral per excavation ditch will be permitted. The minimum separation between two or more adjacent laterals shall be 10 feet. Each lateral and service connection to the sewer must be made within the Owner's property lines and/or the LPTSA's right-of-way or the public right-of-way.
- B. Lateral connections shall be laid to a straight line and grade. The minimum grade for a 6-inch I.D. pipe shall be 1/4 inch to the foot. Where physical conditions preclude the installation of pipe at a grade of 1/4 inch or more to the foot, a minimum grade of 1/8 inch to the foot may be used, but only with the prior approval of the LPTSA Sewer System Superintendent.
- C. Before commencing any phase of the construction for a lateral and service connection, the plumbing contractor shall locate and expose, where applicable, the existing wye or stub provided for the connection to connect the LPTSA sanitary sewer. If no service connection is provided, the contractor shall locate and expose the LPTSA sewer main at the point where the service connection is to be made. Upon exposing the wye, stub, or main, as applicable, the contractor shall then verify that there is 1/4 inch per foot fall by obtaining the differential elevation. If the elevations are such that the connection cannot be made at 1/4 inch per foot fall, he shall contact the LPTSA for permission to install the line at a minimum grade of 1/8 inch per foot fall. Under no circumstances is the trench between connections to be dug before it is ascertained that the minimum fall can be obtained. No cap, stopper or plug shall be removed or punctured until permission has been granted by the LPTSA.
- D. A separate and independent building sewer, lateral, and sewage drainage system shall be provided for every building. Notwithstanding the above, it is the intention of this section to require a separate and distinct permit, building sewer, lateral, and service connection for each individual building or housing unit whether constructed as a single-detached unit or as one of a pair of row houses or as one of a group of town houses or buildings or as one of any other multiple dwelling unit.
- E. Separate and independent sewer laterals and sewage drainage systems shall be

provided for each separate and distinct store, office or industrial facility within any multi-occupant building, where such unit has or may have separate sanitary facility or facilities to discharge liquid waste to the sewer system. So called "shell buildings" which may have moveable interior walls, which are used to establish separate commercial units shall have multiple laterals and sewage drainage systems of sufficient size and location as approved by the LPTSA. Regardless of the foregoing, it is the intention of this section to require that any commercial user which discharges or will discharge industrial waste to the LPTSA sewer system shall have a separate sewer system lateral and sewage drainage systems for such discharge. Such separate lateral and sewage drainage system shall not receive waste discharged from any other separate and distinct industrial or commercial units.

- F. The Owner of a commercial or industrial facility which discharges or will discharge industrial waste to the LPTSA sewer system shall install an industrial waste sampling and observation manhole on the lateral. The sampling manhole shall be located outside of the building between the building and the LPTSA sewer main at a location acceptable to and approved by the LPVRSAA. The sample manhole must be accessible at all times to authorized representatives of LPVRSAA. The sampling manhole must be designed in accordance with the LPTSA Specifications for a Standard Type - "A" manhole or the Type "B" manhole, as applicable. Refer to the Standard Construction and Materials Specifications for details of the manholes.
- G. Old laterals and sewage drainage systems may be used to serve new buildings only when approved by the LPTSA. At its discretion, the LPTSA may require the examination or testing of old laterals and sewage drainage systems, at the expense of the Owner, prior to approving or disapproving the lateral and sewage drainage system use.
- H. When a new lateral and sewage drainage system is to be installed for an existing building, such lateral must be connected to the existing lateral or building sewer on the building side of the septic tank/cesspool serving the building. New connections to the sewer system shall not be placed through a cesspool, privy vault, sinkhole, septic tank, drain field, or similar receptacle but must be placed on solid ground on the building side of the cesspool. Ductile iron water main pipe (Class 50) with mechanical joints may be used to span a cesspool, provided the cesspool is pumped and backfilled to grade at the expense of the owner of such improved property.

IV. BASEMENT SERVICE/PROHIBITED CONNECTIONS

- A. Floor drains will not be permitted to be connected to the building sewer, lateral or sewage drainage system except where it can be shown to the satisfaction of the LPTSA that their connection is absolutely necessary and that such

connection will not admit surface water or ground water to the sewer system. Where such drains are permitted, arrangements shall be made to maintain a permanent water seal in the traps.

- B. Sump pumps intended for basement dewatering and basement floor drains (where basements experience significant groundwater flooding) may not be connected to the sewer system.
- C. No person shall make temporary or permanent connection of roof downspouts, exterior foundation drains, areaway drains, or other sources of surface runoff or groundwater to the LPTSA's sewer system, either directly or indirectly.
- D. Whenever possible, the lateral shall be brought to the building at an elevation below the basement floor. In all buildings in which the building sewer is too low to permit gravity flow to the public sanitary sewer, sanitary sewage or industrial waste carried by such building sewer shall be lifted by an approved means and discharged to the lateral.

V. PIPE AND FITTING REQUIREMENTS - See **Standard Construction and Material Specifications**

VI. TRENCH AND PIPE BEDDING REQUIREMENTS - See **Standard Construction and Material Specifications**

VII. BACKFILLING - See **Standard Construction and Material Specifications**

VIII. CLEAN-UP - See **Standard Construction and Material Specifications**

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: General intent of these Standard Specifications.

1.02 SITE LOCATION

- A. Project location is Lower Providence Township Sewer Authority, Montgomery County, PA and any sewers owned by Lower Providence Township now or in the future outside the Township borders.

1.03 WORK COVERED BY STANDARD SPECIFICATIONS

- A. Without intending to limit or restrict extent of work required under these Specifications, Work to be performed comprises the following:
1. The work generally comprises construction of extensions to the existing wastewater collection system in accordance with these Specifications and the Sewer Detail Drawings bound herein
- B. Drawings: The following listed Sewer Detail Drawings represent the standards of construction of the Authority and are bound in these Specifications.
1. On the Sewer Detail Drawings, the words "Project Manual" are to be defined as these Standard Specifications.

<u>Detail No.</u>	<u>Drawing No.</u>	<u>Title</u>
1	A-35876	Simplex Grinder Pump
2	A-35877	Duplex Grinder Pump
3	A-35878	In-Line Valve, Pressure Wastewater Sewer
4	A-35879	Terminal Cleanout, Pressure Wastewater Sewer
5	A-35880	In-Line Cleanout, Pressure Wastewater Sewer
6	A-35881	Air Release Junction Chamber, Junction Cleanout, Pressure Wastewater Sewer
7	A-35882	Air Release Chamber, Pressure Wastewater Sewer
8	A-35957	Combination Air Release Chamber, Pressure Wastewater Sewer
9	A-36174	Pressure Lateral
10	A-36175	Low Pressure Drop Connection
17	A-31731	Cleanout Chamber
18	A-28778	Concrete Anchor
26	A-27016	Concrete Thrust Blocks
33	A-28777	Earth Dam

34	A-23528	Embankment
60-A	A-27030	Drop Manhole-Type "A" – PVC Pipe
60-B	A-27031	Drop Manhole-Type "B" – Ductile Iron Pipe
63	A-27065	Precast Reinforced Concrete Manhole Bases
64	A-27080	Standard Manhole – Type "A"
65	A-27081	Standard Manhole – Type "B"
66		Safety Platform Detail
67		Drop Manhole Safety Platform Detail
68		Doghouse Manhole Section and Base
69	A-27056A	Manhole Frame and Cover
70	A-27057	Manhole Steps
73	A-27017	Concrete Cradle
74	A-27019	Concrete Encasement
75	A-27038	First Class Bedding and Initial Backfill
92	A-26074	Service Connection Shallow Sewer
93	A-31498	Service Connection Deep Sewer
121	A-34280	Air Release Chamber
122		Sanitary Sewer Lateral – Existing Building
123		Sanitary Sewer Lateral – New Building
124		Cleanout Box
125		Manhole Casting Adjustment Detail for Paving
		Contracts
126		Encasing Conduit
127		Sewer Spigot Adaptor

1.04 PRELIMINARY REQUIREMENTS

- A. Engineer: Before any work is started, the Developer shall ascertain from the Authority whether or not the latter intends to employ an Engineer for the Project. If the Authority indicates that no Engineer will be employed, the word "Authority" is substituted for the word "Engineer" throughout these Specifications, and the Developer and Contractor shall be guided accordingly.
- B. Street Regulatory Requirements: Where sewers are to be installed within the limits of existing streets, all removal and protection of street paving, backfilling of trenches, temporary and permanent replacement of street paving, restoration of shoulders and the maintenance and protection of traffic will be performed in strict conformance with the requirements of Lower Providence Township Sewer Authority, and other governing municipality in the immediate vicinity, or the Commonwealth of Pennsylvania Department of Transportation, as applicable.
 1. The cost of inspection by personnel of the Commonwealth of Pennsylvania Department of Transportation shall be paid by the Developer.
 2. Perform work within the right-of-way of State Highways in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation,

Chapter 459, Occupancy of Highways by Utilities. The Regulations are made a part of these Specifications.

- C. Pennsylvania Department of Environmental Protection (DEP) Regulations and Requirements: The Contractor and Developer are advised that they will be required to conduct their work in complete compliance with all of the rules, regulations and requirements of the DEP. The DEP Domestic Wastewater Facilities Manual is available on their website at: <http://www.dep.state.pa.us/eps/>
- D. House or Building Sewer Requirements: If as part of the work of this project, house or building sewers are constructed from the main to the house or building, use materials as required by the Lower Providence Township codified ordinances, as amended.
 - 1. Test Tee Requirement: When service connections are required as work of this project, construct them from the test tee to the building using materials required by the current edition of the Lower Providence Township plumbing code, as amended.
- E. Sewer Locations: New sewers shall be located in streets and paved areas to the maximum extent possible, where feasible, to facilitate access for maintenance purposes. If sewers must be located on private property, a right-of-way at least 30 feet wide centered on the sewer shall be dedicated from the Developer to the Authority.
 - 1. The Authority will not grant final approval of the sewers for the project and will not grant approval to proceed with sanitary sewer construction until the Authority is in receipt of executed deeds of easement for the rights-of-way by the property owners. The plat must be prepared on a sheet which is a minimum of 8 ½ inches by 11 inches and a maximum of 11 inches by 17 inches. The descriptions and plat must be submitted separately for each lot impacted by the proposed easement.
- F. Unauthorized Connections to Sewers: In general, stormwater or groundwater drainage to any sewer extension of the Authority's system are unauthorized connections.
 - 1. No rain water leaders, roof drainage, area or yard drainage, basement, surface or water from fire hydrants, ground water or water from underground drainage fields shall be permitted to drain into or be admitted into the sanitary sewer system, nor shall any of these be admitted to the sanitary sewer system by the use of pumps of any type.
 - 2. The sanitary sewer system, and all extensions, are intended to convey sanitary sewage only and all sewer extensions will be strictly sanitary sewers.
- G. Interfacing Existing Construction:
 - 1. Do not permit ground or surface water to enter the existing sanitary sewer facilities through the new sewer piping connection.
 - 2. Do not flush, drain or deposit water or debris from the new sewer piping or related construction into the existing sanitary sewer facilities.
 - 3. Install a watertight plug in new sewer piping entering a new manhole. Maintain the plug until all debris and accumulated water have been removed from the new

sewer facilities and the new sewer facilities have passed all specified acceptance tests.

- H. During its review of Drawings for proposed subdivision sewers, the Authority or its Engineer will designate future connection points, if any, to the proposed sewers. The portion of the proposed sewer which is designated as a connection point shall be extended or situated (at the Developer's expense) on the property boundary at a depth and location provided by the Authority or its Engineer.
- I. Terminal Manhole Location: It is the policy of the Lower Providence Township Sewer Authority that all publicly owned sewers (including Developer's sewers which will be owned by the Authority constructed in Lower Providence Township Sewer Authority should be an integral part of the Authority's Wastewater Collection System. In order to provide an efficient collection system and to minimize sewer duplication, it is the Authority's policy that all publicly owned sewer extensions should be sized and located to accept the efficient connection of sewers from other subdivisions or future sewer areas of the Township.
- J. For all phased development, the connecting manholes (those manholes which will join the next phase sewers to the present phase sewers) shall be clearly identified. During the immediate phase of construction, the Contractor shall install the connecting manhole plus the next upstream manhole and connecting sewer. No stubs or openings shall be placed in the manholes for future connections.
- K. Service Connections: Provide a separate service connection for each separate residential, commercial, or industrial unit, which will be or may be individually owned and for each separate building to be connected to the Wastewater Collection System. However, a single service connection may be accepted by the Authority for schools or for multiple story office or apartment buildings or where the Authority determines the installation of separate connections to be impractical
 - 1. Where a complete service connection cannot immediately be installed, a wye or a tee may be placed on the sewer main to facilitate a future service connection, but only upon the prior approval of the Authority. For such approved installations, at least one full length of service connection branch shall be installed from the wye or tee. The end of the pipe must be sealed in accordance with the provisions of these Specifications.
 - 2. As directed by the Authority or its Engineer, provide a wye or tee and a complete capped service connection for each unsewered developed or undeveloped property which is within 150 feet of any new sewer or which is adjacent to the street or the right-of-way in which the sewer is to be located. Such service connection shall be placed at the location and elevation designated by the Authority or its Engineer.
 - 3. For any proposed Industrial Waste discharge, the Industrial Waste shall be segregated from Domestic Waste by providing separate service connections for the Industrial and Domestic wastes which will include a sampling manhole. The Authority will provide specifications for sampling manholes on a case by case basis.

1.05 PROJECT CONDITIONS

- A. Design Criteria: In addition to the design requirements of the DEP, comply with the following:
 - 1. Grade of Proposed Sewers: Minimum 0.40 percent on 8-inch mains and 1.00 percent on terminal manhole sewer runs.
 - 2. Minimum Cover: Provide a minimum cover of five feet over the sanitary sewers measured from finished grade elevation to top of pipe.
 - 3. Underground Utility Clearances:
 - a. Provide a minimum of 18-inches vertical clearance between sanitary sewers and domestic water supply lines. Provide a minimum clearance of 12-inches between sanitary sewers and other underground utilities.
 - b. Provide a minimum horizontal clearance of ten feet between sanitary sewers and other underground utilities. Provide a minimum horizontal clearance of five feet between the sanitary sewers and existing and proposed utility structures such as manholes, inlets, curbs, etc.
 - 4. All building lots shall be served with gravity basement drainage. Other than basement drainage situations will be considered on an individual case basis.
- B. DIP and Concrete Encasement Requirement: Wherever the required clearances between the sanitary sewer and domestic water supply lines, or the minimum cover over the sanitary sewer cannot be provided, the sanitary sewer shall be cement-lined ductile iron pipe (DIP) and encased in concrete.
 - 1. Concrete encasements shall extend a minimum distance of ten feet on either side of the area of sub-standard clearance or minimum cover deficiency.
 - 2. Whenever concrete encasement of the sanitary sewer is required, the entire length of sewer between manholes shall be DIP.
- C. Concrete Anchors: Whenever the sanitary sewer is constructed at a slope of twenty percent or greater, concrete anchors shall be used at intervals identified by DEP.
 - 1. Where concrete anchors are required on the sanitary sewer the entire length of sewer between manholes shall be run in DIP

1.06 SPECIAL REQUIREMENTS

- A. Parties who install sewer systems to be dedicated to the Authority shall provide manhole inserts for each new manhole in the project. The make and model are subject to Authority approval.
- B. Intermediate Landings or Safety Platforms: If deep sewers cannot be avoided, intermediate landings or safety platforms must be installed in manholes in accordance with Occupational Safety and Health Administration (OSHA) regulations.
 - 1. Diameter: These manholes shall be no less than six (6) feet in diameter.
 - 2. Detail: An appropriate detail of a typical manhole with intermediate landings should be included on the detail sheets and manholes so equipped must be clearly

- labeled on the drawing plan and profile views.
3. The detail is subject to Authority approval.

- C. All restaurants or structures with food preparation services must install a suitable grease trap on the lateral. All grease traps shall be a minimum of 1000 gallon capacity and have two compartments. Details shall be provided on the project drawings. Capacity and design is subject to Authority approval.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

NOT USED

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: General procedures and requirements for submittals.
- B. General Requirements: Developer shall make the various submissions as stated under the submittals Article in each Specification Section in addition to the requirements of this Section.

1.02 SHOP DRAWINGS

- A. The term shop drawing used throughout this Section and these specifications includes manufacturer's product data, shop drawings, samples and certificates.
 - 1. Product Data: Manufacturer's descriptive literature, product specifications, performance and capacity rating schedules, published details, and installation instructions.
 - 2. Shop Drawings: Contractor or manufacturer prepared, completely dimensioned and annotated detail drawings of the products presented.
 - a. Shop drawings shall include locations of services connections, internal and external power and control wiring diagrams, systems connections, anchor bolt layout and details of materials and construction.
 - b. Shop drawings shall include mechanical information such as diameter of shafting, rated horsepower of motors, gear and bearing ratings, service factors and weights of principal parts as well as the completely assembled equipment.
 - c. Shop drawings shall include elevation views of control panels identifying face-mounted and internally-mounted components.
 - d. Where specified, shop drawings shall include process and instrumentation diagrams employing Instrument Society of America symbols and nomenclature to identify control system function and components.
 - e. Shop drawings shall also include Contractor prepared layout and setting drawings as necessary to illustrate the assembly of various elements of the Work.
 - 3. Samples: Contractor or manufacturer prepared and delivered physical samples as requested in the various Specifications Sections.
 - 4. Certificates: Contractor or manufacturer prepared written instruments certifying product compliance with the Project Manual and Drawings. The written instruments shall include test records or reports, and such other types of certificates as required by the Specifications.

1.02 PROCEDURES FOR SUBMISSIONS

- A. Preliminary Submissions: At the time of submission of preliminary plans for the subdivision to the Township, complete the necessary documents and submit them to the Authority for review. Any documents requiring corrections will be returned to the Developer for correction and re-submission. Each time a submission is made to the Authority, three copies shall be provided. The required documents are as follows:
1. Contract Drawings. If the sanitary sewer extension is part of a larger project, those sections of the project specifications dealing with the sanitary sewer extensions shall be submitted.
 2. Copies of the Pennsylvania Department of Environmental Protection (DEP) Planning Modules, Components II and IV, and a copy of DEP's approval of Components II and IV. Where applicable, the DEP exemption request may be submitted in lieu of components II and IV.
 3. DEP Sewerage Permit Application form (Bureau of Water Quality Management) when applicable, Erosion and Sediment Pollution Control Plan and Narrative, and filing fee.
 4. Any other permit or license applications required to be in the Authority's name, including associated documents and fees.
 5. If the above documents meet the approval of the Authority, the Developer will be so notified. The Developer will then be required to furnish the DEP filing fee and additional copies of documents as may be required for submission to the permitting agency. (With current DEP procedures, four additional copies of all documents will be required in connection with DEP permit approval submissions.)
- B. The Developer may elect to submit the Contract Drawings for preliminary review and approval prior to completion of the required permit applications.

1.03 CONTRACT DRAWINGS - DEVELOPER SUBMISSION

- A. General Requirements: Submit two copies of drawings for review. After review of these drawings, make any corrections required and submit three corrected copies.
1. Sheet Size: 24-inches or 30-inches by 36-inches.
 2. Base elevations on the datum of the existing sewers.
 3. Include the following notes on the drawings:
 - a. Sanitary sewer construction methods and materials shall conform to the latest Standard Construction & Material Specifications for LOWER PROVIDENCE TOWNSHIP SEWER AUTHORITY, and shall be subject to approval by the Authority and Authority's Engineer.
 4. For details of manholes, bedding, encasement, service connections, etc., make reference to the appropriate "Sewer Detail Drawing" bound herein.
 5. Bind drawings in sets and number them consecutively.
 6. Include on the drawings a list of Act 287 (as amended) users. The list of Act 287 users may be obtained from the Montgomery County Recorder of Deeds, and shall include the name, address, phone number, and person to contact of each utility maintaining facilities in the area of the proposed extension.
- B. Indicate on the drawings the following general items:

1. Name of the Design Engineer.
2. Seal of the Design Engineer.
3. Signature of the Design Engineer.
4. Name of the development and the owners.
5. Date.
6. Indicate by note on the Index Map(s) or Plan and Profile sheet(s) the Water Quality Management Permit Number of the existing facility that the proposed sewers are connecting into.

C. Include the following drawings:

1. Location Plan: Showing approximate area of the municipality in which the project is located. No particular scale is required.
2. Index Map(s): Drawn to a scale of 1-inch equals 400-feet and having the following items included thereon:
 - a. Sanitary sewer, pumping stations, and force mains.
 - b. Sewer diameter for sewers larger than 8 inches.
 - c. Name of each street.
 - d. Number designation of each manhole. (Contact Authority to coordinate manhole numbering system.)
 - e. Provide an electronic copy.
3. Detail Sheets (Plan and Profile): Plan View drawn to a scale of 1-inch equals 50-feet and Profile View drawn to a horizontal scale of 1-inch equals 50-feet and a vertical scale of 1-inch equals 10-feet, or 1-inch equals 5-feet, and having the following items included thereon:
 - a. Location of each existing or proposed building with elevation of the existing or proposed basement (Plan View). If proposed basement elevations are not known, the drawings shall include a note stating which lots are not intended to be provided with gravity basement drainage.
 - b. Sewer ties to existing permanent and semi-permanent features (Plan View).
 - c. Top elevations of manholes (Profile View).
 - d. Invert elevations of manholes (Profile View).
 - e. Manhole numbers corresponding to those on Index Map (Plan View and Profile View).
 - f. Distance between manholes (Profile View).
 - g. Grade of proposed sewer (Profile View).
 - h. Size of proposed sewer (Profile View).
 - i. Location, size and elevation of all existing and proposed underground utilities (Plan View and Profile View).
 - j. The permit number and permittee of the existing receiving sewer (Plan View).
 - k. The lots which will not be provided with gravity basement drainage (Plan View).
 - l. Right-of-way limits (Plan View).
 - m. Service Connection Ties:

- 1) The measurement to locate the wye or tee branch is the horizontal distance measured along the centerline of the main sewer from the downstream manhole to the centerline of wye or tee branch.
 - 2) The ties and measurements necessary to locate the upper free end of the service connections are:
 - a) The horizontal distance measured to the closest tenth of a foot from the downstream and upstream property markers or house corners to the end of the service connection.
 - b) The horizontal distance from the center line of the main sewer to the end of the service connection.
 - c) The depth from the ground surface or the top surface of curb to the invert of the service connection.
- D. Record Drawings: Before the work will be accepted by the Authority, submit the record drawings on computer disk of all working drawings, modified as necessary to show the facilities as constructed.
1. Submit a certificate from the Developer's engineer with the record reproducibles attesting to the correctness of all information shown on the Drawings. The Authority intends to use prints of the reproducibles to provide information to designers and contractors as required by the Commonwealth of Pennsylvania Act 287 (as amended).

1.04 RIGHT-OF-WAY DRAWINGS

- A. Provide three (3) copies of the required plats and descriptions for rights-of-way on 8-1/2-inch by 11-inch paper.
- B. Authority will prepare Right-of-Way Agreements transferring the rights-of-way to Authority using plats and legal descriptions prepared by Developer-Applicant and approved by Authority.
- C. Provide a deed of conveyance transferring ownership of the sanitary sewer extension to the Authority.

1.05 CONSTRUCTION PROGRESS SCHEDULE - CONTRACTOR SUBMISSION

- A. At least seven days before work is commenced, submit three copies of a practicable and feasible progress schedule showing the order in which the Work is to be carried on, the dates on which salient features will start (including procurement of materials and equipment), and the contemplated dates for completing same.
- B. Prepare the schedule in chart form and of a suitable scale so as to appropriately indicate the percentage of Work completed at any time.

- C. At the end of each month, update the Construction Progress Schedule by entering the actual progress of the Work on the schedule. Deliver three copies of the updated Construction Progress Schedule immediately after its completion.

1.06 SHOP DRAWINGS - CONTRACTOR SUBMISSION

- A. Submit five copies of each shop drawing with such promptness as to avoid delay in the work.
- B. Each submission of shop drawings shall be accompanied by a letter of transmittal listing the items in the submission. Each shop drawing shall be marked with the name of the Project and the name of the Contractor and be numbered consecutively.
- C. When making a submission for approval, the Contractor shall do so with the understanding that he is considered to have checked the items in the shop drawing before submitting them and that he is satisfied that, in their present state, they not only meet the requirements of the Specifications, but will present no difficulties in erection and completing his Contract. The Contractor shall clearly note his approval on all shop drawings prior to their submission to the Engineer. Failure of the Contractor to note his approval will be reason for the Engineer to return such submission to the Contractor unchecked.
 - 1. If it appears that shop drawings submitted by the Contractor to the Engineer have not been properly checked, even though the Contractor's approval has been noted thereon, it will also be considered reason for the Engineer to return such submission to the Contractor unchecked.
 - 2. Markings, written or otherwise, made by the Contractor or by his suppliers or manufacturers shall be made on the Submittal in a color other than red. RED is reserved for the exclusive use of the Engineer in marking Submittals.
- D. If shop drawings show variations from the Specifications requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in his letter of submission in order that (if accepted) suitable action may be taken for proper adjustment in the Contract; otherwise the Contractor will not be relieved of the responsibility for executing the Work in accordance with the Specifications even though the shop drawings have been approved.
- E. The approval of shop drawings will be general and shall not relieve the Contractor from the responsibility for proper fitting and construction of the Work nor from furnishing materials and work required by the Specifications which may not be indicated on the shop drawings when approved.
- F. After review by the Engineer, shop drawings will be returned marked as follows: Approved, Approved with Changes Noted, Returned for Correction or Not Approved.
 - 1. Approved: When shop drawings are returned "Approved", that means the shop drawings have been found to be in conformance with the Specifications. The

Engineer's approval of the shop drawings does not relieve the Contractor from responsibility for errors or discrepancies in such shop drawings.

2. Approved with Changes Noted: When shop drawings are returned "Approved With Changes Noted" that means the shop drawings have been found to be in conformance with the Specifications, provided the changes noted by the Engineer are incorporated in the shop drawings. Shop drawings returned "Approved With Changes Noted" will not require re-submission.
3. Returned For Correction: When shop drawings are returned noted "Returned For Correction" that means the Contractor shall make the required corrections and resubmit five copies of corrected shop drawings to the Engineer.
4. Not Approved: When shop drawings are returned "Not Approved" that means the Contractor shall make completely new shop drawings and submit five copies to the Engineer for review.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SHOP DRAWING STAMP FORMAT

ABC Contractors, Inc.
Anytown, PA

Project: Contract No. XXX
Construction of
XYZ Plant

Authority:

Submittal No.: _____

Product: _____

Mfg. By: _____

Ref. Dwg/Spec: _____

"Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with the Contract Drawings, Specifications, other applicable approved Shop Drawings and all Contract requirements."

Contractors Review

☐ Approved

☐ Approved as Noted

By _____ Date _____

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for certain temporary facilities and controls (as specified throughout this Section) at the site or sites of the Work until the project is complete, and the Project facilities are placed under the Authority's operation.

1.02 TEMPORARY SERVICES AND FACILITIES

- A. General Requirements: The Contractor is solely responsible for temporary facilities and controls removal and restoration of the affected area when the temporary facilities and controls are no longer needed or required by Contract Time and extensions thereof.
- B. Temporary Sanitary Facilities: Provide and maintain as required by local laws, temporary toilet facilities for the workmen on the Project. Sanitary facilities shall conform to OSHA requirements.

1.03 TEMPORARY CONTROLS AND PROTECTION

- A. Temporary Stormwater Control: Each separate Contract is responsible for maintaining temporary stormwater control as specified hereinafter. The means and methods each Contractor uses to meet the above requirements are at their discretion.
 - 1. During the construction of the Work, maintain the flow of stormwater and naturally occurring water in existing facilities and channels affected by the Work.
 - 2. Each Contractor assumes risk from flooding and any damages done to the Work in progress or to Work completed. Make repairs and replacements to the satisfaction of the Engineer.
 - 3. Each Contractor assumes responsibility for damages to property caused by flooding of property due to blocking or restriction of storm water passages and natural waterways capacity during normal or excessive periods of water flow.
- B. Temporary Wastewater Control: During the performance of interface work with the existing piping systems, the General Construction Contract shall maintain continued plant wastewater flow when interface work necessitates an interruption in the wastewater flow.
 - 1. Bypass Pumping: Maintain continued flow by bypass pumping or other suitable means. In either case, the bypassing shall be through a properly sized and fail-safe means.
 - a. Ensure that the temporary bypass pumping equipment is properly maintained and responsible operator is on-site while the pumping system is in operation.
 - b. Particular attention is directed to this bypassing requirement in regard to the maintenance of flow in existing sewer service connections during removal and replacement of the sewer main.

2. Unlawful Sewage Discharges: The General Construction Contractor is hereby made aware that it is unlawful to permit wastewater (sewage) flow of the existing influent piping to discharge into nearby waterways or to flow on the ground surface. Furthermore, should an accidental discharge occur, immediately notify the Department of Environmental Protection at (484) 250-5900.
3. Penalties: Fines and related costs resulting from failure to provide adequate protection against overflow are the obligation of the General Construction.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 PERFORMANCE

- A. Temporary Bypassing: The means and methods of performing the bypassing operations described previously is the sole responsibility of the Contractor.
- B. Temporary Wastewater Flow Control: During the performance of work, maintain continued wastewater service and flow.
 1. Bypass Pumping: Maintain continued wastewater flow by bypass pumping or other suitable means of wastewater bypassing. In either case, the bypassing shall be through a properly sized and fail-safe means.
 - a. Ensure that the temporary bypass pumping equipment is properly maintained and that a responsible operator is on-site while the pumping system is in operation.
 - b. Particular attention is directed to this bypassing requirement in regard to the maintenance of flow in existing sewer service connections during removal and replacement of the sewer main.

3.02 ACCESS

- A. The Contractor shall construct stabilized construction entrances and restore to at least the original condition such entrances, parking areas, and storage areas located on site.
 1. Perform the access road construction in accordance with the requirements of the latest edition of the DEP Erosion and Sediment Pollution Control Program Manual.
 2. Maintain the above stated constructed areas in a reasonably smooth and stable condition throughout the life of the Project.

3.03 REMOVAL

- A. Dismantle (as required) and remove temporary facilities and controls, and temporary service extensions when no longer needed on construction site.

END OF SECTION

SECTION 01 55 26

TRAFFIC CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: General guidelines for control of traffic while Project work within street Right-of-Way is being performed. Goal is to help ensure safe and efficient traffic movement through work areas and provide safety for Contractor's work force.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Furnish, erect and maintain at closures, intersections, and throughout Project, necessary approved barricades, suitable and sufficient red lights, torches, approved reflectors, danger signals, warning, detour and closure signs. Provide a sufficient number of watchpersons and take necessary and legal precautions for protection of work and safety of public. Provide illuminated barricades, danger signals, signs and obstructions at night and keep lights burning from sunset until sunrise. Materials and safety devices (i.e., barricades, flashing warning lights, torches, reflectors and signs) to conform to State Department of Transportation Specifications.
 - 2. Perform traffic regulation on streets other than State Highways in accordance with requirements of local government.
 - 3. State Highways:
 - a. Provide traffic control in complete compliance with rules and regulations of Pennsylvania Department of Transportation (PDT), including but not necessarily limited to following:
 - 1) Publication 213 (67 PA Code, Chapter 212) - Work Zone Traffic Control Guidelines.
 - 2) 67 PA Code, Chapter 441 - Access to and Occupancy of Highways by Driveways and Local Roads.
 - 3) 67 PA Code, Chapter 459 - Occupancy of Highways by Utilities.
 - 4) Section 901 "Maintenance and Protection of Traffic During Construction" of Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408/90, as supplemented.
 - b. Requirements for traffic control specified in this Section are for convenience of Contractor and is not to be construed as a release from PennDOT requirements previously referenced.
 - c. Pay fines and related costs resulting from failure to provide adequate traffic control.
 - 4. Township Streets:
 - a. Provide traffic control as outlined for State Highways above.
 - b. Should Contractor determine a township street closure will be required, the Contractor must seek approval from the Lower Providence Township Sewer Authority. With that request the Contractor must submit an appropriate

detour plan and review such detour plan with emergency personnel, such as police, ambulance, fire company, local school districts, or any others deemed as necessary.

- c. Traffic control figures as required by the Township.
- 5. Locations, traffic control figures involved and a description of work on State Highways and township streets are indicated in the Traffic Control Plan at end of this Section.

B. Traffic Control Figures:

- 1. Traffic control requirements of construction site within State Highway Right-of-Way are attached to and made part of this Section by way of figures taken from Publication 213 (67 PA Code, Chapter 212), Official Traffic Control Devices.
- 2. Traffic control figures attached are to be used in conjunction with any separate Project Manual (if applicable) to establish minimum requirements for Project and in no way preclude installation of additional control measures.

C. Police Traffic Control:

- 1. When required by local traffic regulation provide traffic control in the form of police physically directing traffic. The costs for such police activity shall be borne by the Developer or Contractor, and paid directly to the local police force.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials and safety devices, including as barricades, flashing warning lights, torches, reflectors and signs, provided for purpose of protecting work and safety of the public and for maintaining and protecting traffic. Conform to the requirements specified in Section 901 of the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented, and to the requirements specified in the current edition of Bulletin No. 43 complementing Section 901.
- B. Provide orange colored danger signals and warning signs

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install traffic control devices immediately before the beginning of construction and keep in place as long as they are needed and remove immediately thereafter.

3.02 REMOVAL

- A. Remove, cover, or turn traffic control device that does not apply to the existing condition so as not to be readable by oncoming traffic.

END OF SECTION

TRAFFIC CONTROL PLAN
FOR

FOR THE

The following is a suggested Traffic Control Plan for construction of _____
_____ within PennDOT Rights-Of-Way of SR _____.

The Contractor shall comply with all requirements of figure(s) _____ from Publication 213
(67 PA Code, Chapter 212), Official Traffic Control Devices.

During non-working hours, the trench shall be backfilled or covered with steel plate.

The Contractor shall review the Traffic Control Plan with all emergency personnel, police,
ambulances, fire, etc.

SECTION 01 57 13

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for erosion and sediment control (E&S) measures for the earthwork activities as specified in various other Sections of the Project Manual.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractor Prepared Erosion and Sediment Pollution Control Plan:
 - 1. Prior to earth moving activities, prepare a soil erosion and sediment pollution control plan in accordance with rules and regulations adopted by the Pennsylvania Department of Environmental Protection (DEP).
 - 2. Detail requirements for the control plan are described in an Erosion and Sediment Pollution Control Program Manual that may be obtained from the Bureau of Soil and Water Conservation, Division of Soil Resources and Erosion Control, Harrisburg, Pennsylvania.
- B. Site Review: Arrange and conduct an on-site review of potential soil erosion problems with personnel of the Bureau of Soil and Water Conservation or with the County Soil conservation District.
 - 1. Select proper methods of soil erosion and sedimentation control acceptable to review agency.
 - 2. Describe selected methods on maps and in narrative report of Soil Erosion and Sedimentation Control Plan.
- C. Penalties: Fines and related costs resulting from failure to provide adequate protection against soil erosion and sedimentation are the obligation of the Contractor.
 - 1. Silt, sedimentation and mud leaving the site will be construed as damage to neighboring property and evidence of negligence on the part of the Contractor.
 - 2. Damages to neighboring property shall be rectified and/or restitution shall be paid by the Contractor.

1.03 SUBMITTALS

- A. Erosion and Sediment Pollution Control Plan: Prior to earth moving activities furnish two copies of plan approved by regulatory agency having jurisdiction.
- B. Samples: Submit samples of materials being used when requested by the Owner or Engineer including names, sources and descriptions.

ARTICLE 2 PRODUCTS

2.01 MATERIALS

- A. Materials for erosion control work are as described in the approved plan prepared by the Contractor.

ARTICLE 3 EXECUTION

3.01 PERFORMANCE

- A. Conduct work in compliance with rules, regulations and requirements of the Pennsylvania Department of Environmental Protection (DEP). Erosion and Sediment Pollution Control measures employed will be subject to approval and inspection by DEP.
- B. The Contractor shall keep on the Project one copy of the approved Erosion and Sedimentation Control Plan.

END OF SECTION

SECTION 02 30 00

SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Provision for subsurface information indicated on Drawings, and general requirements for digging test pits.

1.02 SITE CONDITIONS

- A. Limitations of Subsurface Information Indicated on Drawings: Certain information provided by the Authority or Engineer regarding the reputed presence, size, character and location of existing underground structures, pipelines and other utilities may be indicated on the Drawings.
 - 1. Accuracy of Location: There is no certainty of the accuracy of this information, and the location of underground structures indicated may be inaccurate and other obstructions than those indicated may be encountered.
 - 2. The Contractor hereby distinctly agrees:
 - a. That neither the Authority nor the Engineer is responsible for the correctness or sufficiency of the information given;
 - b. That in no event is this information to be considered as a part of the Contract;
 - c. That no claim will be made for delay or extra compensation or damage against the Authority or the Engineer on account of incorrectness of information given, or on account of the insufficiency or absence of information regarding obstruction either revealed or not revealed by the Drawings; and
 - d. That no claim will be made for relief from any obligation or responsibility under the Contract, in case the location, size or character of any pipe, electrical or signal facility or other underground structure is not as indicated on the Drawings, or in case any pipe, electrical or signal facility, or other underground utility or structure is encountered that is not indicated on the Drawings.
- B. Digging Test Pits:
 - 1. At locations required by Engineer, or indicated on Drawings, dig test pits to determine location, size, roundness and elevation of existing subsurface utility pipelines, electrical facilities, utilities or structures. Dig test pits in the presence of an authorized representative of the owner of the subsurface utility pipelines, cables or structures. No excavation, pipe laying or other work is permitted at above referenced locations without the presence or approval of an authorized representative of the owner of the subsurface pipelines, electrical facilities, utilities or structures.
 - 2. In locations where new pipelines are to be connected to existing facilities, do not order materials and proceed with new construction until digging test pits to

determine exact location, size, roundness and elevation of existing utilities. Dig test pits only at locations agreed to by the Engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Concrete formwork for construction of all concrete structures set forth on the Drawings and in these Specifications.

1.02 REFERENCES:

- A. American Concrete Institute:
 - 1. ACI 347R, Guide to Formwork for Concrete.
 - 2. ACI 350R, Environmental Engineering Concrete Structures.
- B. American Plywood Association: APA Grade – Trademarks.
- C. Southern Pine Inspection Bureau (SPIB): Standard Grading Rules for Southern Pine.
- D. U.S. Department of Commerce Product Standards:
 - 1. PS-1-74, Construction and Industrial Plywood.
 - 2. PS-20-70, American Softwood Lumber.
- E. Western Wood Products Association: WWPA Catalog "A" Product Use Manual.

1.03 SUBMITTALS

- A. Form Coating: Submit manufacturer's descriptive product data and current specification covering named product, include certification that material is acceptable for use in structures processing or storing potable water.
- B. Form Ties: Submit manufacturer's descriptive product data, current specification covering named product and two samples.

1.04 QUALITY ASSURANCE

- A. Formwork Design: Provide formwork designed to ensure the tolerances indicated and to include factors pertinent to safety of personnel during construction.
 - 1. Design formwork in accordance with American Concrete Institute's Guide to Formwork for Concrete, ACI 347R, and in accordance with the following:
 - a. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, temporary construction material, foundation pressures, stresses, lateral stability, and such other factors pertinent to safety of structure during construction.
 - b. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent construction.

- B. Allowable Tolerances: Set and maintain concrete forms within tolerance limits stated in American Concrete Institute's Guide to Formwork for Concrete, ACI 347R.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
 - 1. Protect formwork materials before, during and after erection to ensure acceptable finished concrete work. Also protect in-place materials and work of other trades in connection with concrete work.
 - 2. In event of damage to erected forms, make necessary repairs or replacements prior to concrete pours. Perform such corrective work at no increase in Contract Price.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lumber:
 - 1. Form framing, sheathing, struts, braces and shoring in conformance with WWPA Catalog A or SPIB Grading Rules.
 - 2. Rough Structural and Dimension Lumber: Provide lumber of allowable species, surfaced four sides as applicable, and grade stamped with the appropriate WWPA or SPIB stamp indicating product compliance with PS-20-70.
 - 3. Use lumber free of material defects that would deform the finished concrete product.
- B. Plywood:
 - 1. Form Sheathing and Panels: Not less than 5/8 inch thick Exterior Type B-B Plywood Class I and II EXT-APA conforming to U.S. Product Standard PS-1-74.
 - 2. Use Class II only on surfaces not exposed to view.
- C. Steel:
 - 1. Metal Forms of a pre-engineered standard design, conforming to the concrete sections indicated on the Drawings, may be used in lieu of wood forms.
- D. Form Ties:
 - 1. Provide factory-fabricated, adjustable-length, removable or snap-off metal form ties conforming to ACI 347R and ACI 350R.
 - 2. Use snap-off metal ties with ends that break at least 1½ inches from the face of the wall.
 - 3. Do not use removable ties that leave holes larger than one (1) inch.
 - 4. In construction of liquid-retaining structures and structures designed to exclude groundwater, use ties that are designed to prevent seepage or flow of water along the embedded item.
 - 5. Do not use removable type form ties in construction of liquid-retaining concrete structures.
 - 6. Do not use wire ties, flat bands or form ties fabricated on the project site.

7. Do not use wood spacers.

- E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds. On surfaces which will be in contact with potable water, use no material which will add taste, odor, or toxic effects to the water.

PART 3 EXECUTION

3.01 INSPECTION

- A. Prior to placement of concrete, inspect forms for cleanliness and accuracy of alignment.

3.02 PREPARATION

- A. Apply form coatings in accordance with manufacturer's specifications.
- B. Do not allow excess form coating material to accumulate in the forms.
- C. Do not allow form coatings to come in contact with construction joints and reinforcing steel.

3.03 ERECTION

- A. General: Construct forms in accordance with ACI 347R to required dimensions, plumb, straight, mortar tight, and paste tight where appearance is important.
 - 1. Securely brace and shore forms to prevent displacement, bowing and pillowing, and to safely support imposed concrete load.
 - 2. Provide offsets, keyways, recesses, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and such other features as required. Use selected materials to obtain above requirements.
 - 3. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
 - 4. Form intersecting planes to provide true, clean-cut corners with edge grain of plywood not exposed to concrete.
 - 5. Build into forms, or otherwise secure in forms, items such as inserts, anchors, miscellaneous metal items, and such other embedded items as indicated on Drawings.
 - 6. Wet forms sufficiently to prevent joints in wood forms from opening prior to concrete pour.
 - 7. Do not use stay-in-place metal forms.
- B. Openings: Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.

1. Securely brace temporary openings and set tightly to forms to prevent the loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible consistent with the requirements of the work.
 2. Provide openings in concrete formwork of the correct size and in the proper location to accommodate other items and operations of construction work passing through forms. Accurately place and securely support items to be built into forms.
- C. Earth Forms: Where soil conditions will permit excavation to accurate sizes without bracing, and soil subsidence can be prevented during the concrete pour, earth forms may be used.
1. Before concrete is poured, lightly wet earth forms but not to a muddy condition.

3.04 CONSTRUCTION

A. Form Removal

1. Remove forms in accordance with ACI 347R without damage to concrete and in a manner to ensure complete safety and serviceability of the structure.
 - a. Do not cut form ties back from the face of the concrete.
 - b. Concrete surface shall not contain residual form coating that will interfere with other materials or coatings to be applied.
2. Do not remove supporting forms or shoring until the members have acquired sufficient strength to safely support their weight and the anticipated construction loads without distortion or excessive deflection. The Engineer's consent to remove forms does not relieve the Contractor of the responsibility for the safety of the work.
3. When the atmospheric temperature at the site has been continuously above 50 degrees F. from the time of the pour, the forms shall be removed at the earliest practical time within the limits set forth in this paragraph, and wet curing shall continue without delay.
 - a. Forms for walls and other vertical faces may be carefully removed 24 hours after the last portion of concrete in the section involved has been placed, provided the concrete has sufficiently hardened to preclude damage resulting from form removal, and provided these members are not subjected to loads for a period of 14 days.
 - b. Maintain horizontal forms in place for a minimum of 14 days or until the concrete, as determined by job-cured cylinders, has attained a compressive strength of 3,000 psi.
 - c. When a water-reducing retarder is used in the concrete mix, the normal time periods for removing forms may need to be increased.
4. When the atmospheric temperature at the site drops below 50 degrees F., leave all forms in place for at least 5 days regardless of the temperature within the protective covering or enclosure.
5. Upon removal of forms, notify the Engineer in order that a review of the newly stripped surfaces may be made before patching.

3.05 RE-USE OF FORMS

- A. Forms for re-use shall meet new form requirements with respect to effect on poured concrete appearance and structural stability.
- B. Do not delay or change the concrete pour schedule as a result of reusing forms compared to the schedule obtainable if all forms were new (in the case of wood forms) or if the total required forms were available (in the case of metal forms).

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Furnishing and installing reinforcement for concrete structures.
- B. Related Sections:
 - 1. Concrete Forming and Accessories: Section 03 10 00.
 - 2. Cast-In-Place Concrete: Section 03 30 00.

1.02 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 315; Details and Detailing of Concrete Reinforcement.
 - 2. ACI 318-95; Building Code Requirements for Reinforced Concrete.
- B. American Society for Testing and Materials.
 - 1. ASTM A82; Specification for Cold-Drawn Steel Wire for Concrete Reinforcement.
 - 2. ASTM A185; Specification for Smooth Welded Steel Wire Fabric for Concrete Reinforcement.
 - 3. ASTM A307; Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - 4. ASTM A320; Specification for Alloy-Steel and Stainless Steel Bolting for Low Temperature Service.
 - 5. ASTM A615; Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, including Supplementary Requirements.
 - 6. ASTM A663; Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
- C. Concrete Reinforcing Steel Institute:
 - 1. CRSI, Manual of Standard Practice for Reinforcing Concrete Construction.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Prepare shop drawings of concrete reinforcement in accordance with American Concrete Institute's ACI 315.
 - 2. Provide drawings showing all fabrication dimensions and locations for placing reinforcement and bar supports; indicate bending diagrams, splicing and lap of rods, shapes, dimensions and details of bar reinforcing and accessories.
- B. Test Reports:

1. Submit two copies of reports showing the results of tests, conducted in accordance with the American Society for Testing and Materials Specifications.
2. Test Requirements may be waived based upon certified copies of mill test reports.

1.04 DELIVERY, STORAGE AND HANDLING

A. Storage of Materials:

1. Store reinforcing materials in a manner to prevent excessive rusting and fouling with dirt, grease and other bond-breaking coatings.
2. Identify bundles of reinforcing steel with tags wired to steel.

1.05 PROJECT CONDITIONS

- ##### A. Protection:
- Protect in-place reinforcement from excessive construction traffic and other work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel:

1. Reinforcement Bars: ASTM A615, Grade 60, deformed steel, which shall satisfy the exceptions in ACI Building Code, AASHTO and Federal Specifications.
2. Wire: ASTM A82.
3. Welded Wire Fabric: ASTM A185.
4. Metal Accessories: CRSI Manual of Standard Practice for Reinforcing Concrete Construction.

- ##### B. Rebar Splicing Coupler:
- A two-piece splicing system manufactured from ASTM A615 Grade 60 deformed rebar. A dowel bar splicer with integral nailing flange shall be threaded for a threaded down-in rebar such that the completed splice exceeds the tensile requirements of ACI 318.

1. Internal Coupler Protector: Provide coupler manufacturer's plastic internal coupler protector where couplers are provided for anticipated future additions.
2. Bar End Protectors: Plastic solid sleeve for placement over bar ends to protect threading from damage, contamination and rust.
3. Use Rebar Splicing Coupler only where shown on Drawings or where approved by the Engineer.
4. Acceptable Manufacturers:
 - a. Richmond Screw Anchor Co.
 - b. Dayton Superior.
 - c. Or approved equal.

C. Dowel Bars (for shear transfer)

1. Plain round bar conforming to requirements of ASTM A663, Grade 70, 75 or 80 which is not burred, roughened or deformed out-of-round so slippage is not hindered.
2. Coat with curing compound to render surface bondless.

- a. Curing Compound: Section 03 30 00.

2.02 FABRICATION

- A. General: Fabricate reinforcement to the dimensions indicated on the Drawings and within the tolerances given in ACI 315. Perform bending of steel reinforcement by the cold bending method.
 - 1. Do not use bars with kinks or bends not indicated on Drawings.
 - 2. Perform bar shape fabrication in a manner that will not injure the material or lessen the member strength.
 - 3. Use a designed bending machine, either hand- or power-operated.
 - 4. Do not field bend bars partially embedded in concrete unless approved by the Engineer.

PART 3 EXECUTION

3.01 INSPECTION

- A. Notify Engineer 48 hours before placing concrete so he can inspect placement of metal reinforcement.
- B. Verify that items to be embedded in concrete are secured in place and block-outs in formwork are secured in place as required. Formwork installed as work of Section 03 10 00.

3.02 INSTALLATION

- A. Placing:
 - 1. Place metal reinforcement accurately and securely brace against displacement within permitted tolerances and in accordance with ACI 318 through the use of reinforcing accessories.
 - 2. Terminate reinforcement two inches from face of expansion joints.
 - 3. Continue reinforcement across or through construction joints.
 - 4. When obstructions interfere with the placement of reinforcement, pass such obstructions by placing reinforcing around it. Do not bend the reinforcing to clear the obstructions.
 - 5. Install welded wire fabric as indicated, lapping joints eight inches and wiring securely. Extend welded wire fabric to within two inches of sides and ends of slabs.
 - 6. Do not lay metal reinforcement on formwork. Raise reinforcement as concrete is placed.
 - 7. Place slab reinforcement supported from the ground on concrete blocks of the correct height and having a compressive strength equal to or greater than the specified compressive strength of concrete being placed. Use concrete blocks not larger than 3 inches by 3 inches with a height equal to required bottom steel cover.

8. Reinforcement supported from formwork for slabs and beams not exposed to weather or to a continuous wet environment may use bar chairs made of plastic or metal. Use stainless steel boosters in areas exposed to a wet environment.
 9. Place additional reinforcement around openings in slabs and walls as detailed on the Drawings.
- B. Cleaning: Clean or otherwise protect metal reinforcement so that at the time concrete is placed, reinforcement is free from rust, scale or other coatings that will destroy or reduce bond.
- C. Concrete Reinforcement Protection: Provide protection for reinforcement during concrete pours in accordance with ACI 318, unless indicated otherwise on the Drawings.
1. On exterior exposed work, no ties or spacers will be permitted to remain within $\frac{3}{4}$ inches of the finished surfaces.
 2. Protection: Protect in-place reinforcing form excessive construction traffic and other work.
- D. Splicing:
1. Splice metal reinforcement as indicated on the Drawings and in accordance with ACI 318.
 2. Welding of crossing bars (tack welding) is not permitted.
 3. Secure metal reinforcement at intersections with not less than No. 16-gauge annealed wire or appropriate size clips. When bar spacing is less than 12 inches, tie alternate intersections.
 4. Make mechanical butt splices in accordance with rebar splicing coupler manufacturer's installation instructions.
- E. Dowel Bar Installation: Install one-half the length of coated bar dowel into slab to be poured.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Designing mix, furnishing, placing and curing Portland cement concrete, reinforced and unreinforced, as indicated.
- B. Related Sections:
 - 1. Concrete Forming and Accessories: Section 03 10 00.
 - 2. Concrete Reinforcing: Section 03 20 00.
 - 3. Work Specified Under Other Sections: Items to be embedded in concrete are as specified in the various Sections of this Contract Specification. The responsibility for coordinating concrete pours with embedded items rests solely with the Contractor.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials, AASHTO M 182 Burlap cloth made from Jute or Kenaf.
- B. American Concrete Institute:
 - 1. ACI 211.1; Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 2. ACI 301; Specifications for Structural Concrete for Buildings.
 - 3. ACI 304R; Guide for Measuring; Mixing, Transporting and Placing Concrete.
 - 4. ACI 305R; Hot Weather Concreting.
 - 5. ACI 306R; Cold Weather Concreting.
 - 6. ACI 308; Standard Practice for Curing Concrete.
 - 7. ACI 318; Building Code Requirements for Reinforced Concrete.
- C. American Society for Testing and Materials
 - 1. ASTM C31; Methods of Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33; Specification for Concrete Aggregates.
 - 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; Specification for Ready-Mixed Concrete.
 - 6. ASTM C143; Test Method for Slump of Portland Cement Concrete.
 - 7. ASTM C150; Specification for Portland Cement.
 - 8. ASTM C156; Test Method for Water Retention By Concrete Curing Materials.
 - 9. ASTM C171; Specification for Sheet Materials for Curing Concrete.
 - 10. ASTM C172; Methods of Sampling Freshly Mixed Concrete.

11. ASTM C173; Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
12. ASTM C192; Method of Making and Curing Concrete Test Specimens in the Laboratory.
13. ASTM C231; Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
14. ASTM C260; Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C309; Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C494; Specification for Chemical Admixtures for Concrete.
17. ASTM C881; Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
18. ASTM C882; Standard Test Method for Bond Strength of Epoxy - Resin Systems used with Concrete by Slant Shear.
19. ASTM D6; standard Test Method for Loss on Heating of Oil and Asphaltic Compound.
20. ASTM D297; Standard Test Method for Rubber Products – Chemical Analysis.
21. ASTM D570; Test Method for Water Absorption of Plastics.
22. ASTM D638; Standard Test Method for Tensile Properties of Plastics.
23. ASTM D695; Test Method for Compressive Properties of Rigid Plastics.
24. ASTM D732; Test Method for Shear Strength of Plastics by Punch Tool.
25. ASTM D790; Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
26. ASTM D1751; Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
27. ASTM D1752; Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
28. ASTM E329; Standard Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

D. U.S. Army Corps of Engineers Specifications:

1. U.S. Corps of Engineers CRD-C 572 Specification for Waterstop.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive product data and current specifications for the concrete accessories specified herein (admixtures, joint fillers, curing materials, floor hardeners, waterstops, etc.). Include installation instructions.
- B. Samples: Submit samples of materials being used when requested by the Engineer including names, sources and descriptions.
- C. Design Mix: Prior to production of concrete, submit for approval, on form attached at the end of this Section, all mix designs proposed for project. Include with the mix design a standard deviation analysis in accordance with ACI 301 Section 3.9.1 or trial mixture test data proposed in ACI 301 Section 3.9.3.3. Use materials in such

proposed design mix as specified herein. Make such adjustments in the proposed design mix as directed by the Engineer.

D. Test Reports:

1. Submit concrete test reports specified in Part 3, Field Quality Control in this Specification.

E. Certificates:

1. Furnish the Engineer and local authorities requiring same, certificates originated by the batch mixing plant certifying ready mixed concrete, as manufactured and delivered, to be in conformance with ASTM C94.

F. Delivery Tickets: A delivery ticket shall accompany each load of concrete from the batch plant.

1. Tickets must be signed by the Contractor's representative, noted as to time and place of pour and kept in a record at the site. Make such records available for inspection upon request by the Engineer.
2. Information presented on the ticket to include the tabulation covered by ASTM C94, Section 16, as well as any additional information the local codes may require.

G. Schedule: Submit schedule showing methods, construction joint locations and sequence of pouring a minimum of 10 days prior to placing concrete.

H. Testing Agency: Submit name and qualifications of Testing Agency to Engineer for approval prior to proceeding with testing.

1.04 QUALITY ASSURANCE

A. Testing Agency: An agency regularly performing work conforming to The American Society for Testing and Materials ASTM E329, Recommended Practice for Inspection and Testing Agencies for Concrete and Steel in Construction.

B. Source Quality Control:

1. Laboratory Tests: Materials stated herein require advance examination or testing according to methods referenced, or as required by the Engineer.
2. Compression Test Cylinders: For laboratory trial batches, make in accordance with American Concrete Institute ACI 301. Test to consist of three compression test cylinders for each class of concrete with one broken at seven days and two broken at 28 days; ASTM C192 and ASTM C39.

1.05 PROJECT CONDITIONS

A. ACI Compliance: Cast-in-place concrete work shall conform to ACI 301 except as modified by these Specifications or the Drawings.

- B. Concrete Encasement of Pipes: Encase pipes under structures and buildings indicated by the Drawings to be encased in concrete for the full length of the pipe run under the structure.
- C. Equipment Bases: Construct reinforced concrete bases for equipment and piping under this contract at no increase in contract price.

1.06 SEQUENCING

- A. Where other construction work is relative to concrete pours, or must be supported by or embedded in concrete, those performing such related work must be given five days notice to introduce or furnish embedded items before concrete is placed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement:
 - 1. Portland Cement: ASTM C150 of the following Type:
 - a. Type II, Moderate Sulfate Resistance Cement shall be used in concrete that is in contact with sewage and where concrete will be exposed to sewage gases.
 - b. Type I, Normal Cement shall be used in concrete for all other locations.
 - 2. Only one brand and manufacturer of approved cement shall be used for exposed concrete.
- B. Normal weight Concrete Aggregates: Process aggregate meeting requirements of ASTM C33 and subject to the following limitations.
 - 1. Coarse Aggregate Size: Maximum size of coarse aggregate shall not exceed the following requirements but in no case larger than 1½ inches.
 - a. One-fifth narrowest dimension between sides of forms within which concrete is to be cast.
 - b. Three-fourths of the minimum clear spacing between reinforcing bars.
 - c. One-third the slab thickness for unreinforced slabs.
 - d. Reduced aggregate concrete containing aggregate with particle size not less than 1/8 inch nor more than 1/2 inch in any dimension and a maximum of 5 percent of particles passing a No. 8 sieve.
- C. Water: Clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement.
- D. Concrete Admixtures:
 - 1. Prohibited Admixtures: Use only non-corrosive, non-chloride admixtures.
 - 2. Provide admixtures produced and serviced by established, reputable manufacturers and use in compliance with manufacturer's recommendations.
 - 3. Air-Entraining Admixture: Use a product conforming to requirements of ASTM C260.

4. Water-Reducing Admixture: Use a product conforming to requirements of ASTM C494 Type A. (Use this for all concrete except where an admixture listed below is used).
 - a. Acceptable Manufacturers:
 - 1) Eucon WR-75; The Euclid Chemical Company.
 - 2) Pozzolith 220N; Master Builders.
 - 3) Plastocrete 161; Sika Corporation.
 - 4) Or Approved Equal.
 5. Water-Reducing and Retarding Admixture: Use a product conforming to requirements of ASTM C494, Type D.
 - a. Acceptable Manufacturers:
 - 1) Eucon Retarder-75; The Euclid Chemical Company.
 - 2) Pozzolith 100XR; Master Builders.
 - 3) Plastiment; Sika Corporation.
 - 4) Or Approved Equal.
 6. Water-Reducing, and Acceleration Admixture: Use a product conforming to requirements of ASTM C494, Types C or E. Not permitted for use in concrete for water retaining structures.
 - a. Acceptable Manufacturers:
 - 1) Accelguard 80; The Euclid Chemical Company.
 - 2) Pozzutec 20; Master Builders.
 - 3) Plastocrete 161 FL; Sika Corporation.
 - 4) Or Approved Equal.
 7. Store admixtures in a manner to prevent contamination, evaporation, moisture penetration or damage. Do not use products which have been stored longer than 6 months.
 8. Prior to the mix design review by the Engineer, provide written conformance to the specified requirements of the admixture.
- E. Preformed Expansion Joint Fillers:
1. Nonextruding and Resilient Bituminous Types (for exterior use in pavements and sidewalks only): ASTM D1751.
 2. Sponge Rubber and Cork Type: ASTM D1752.
 3. Self Expanding Cork Type: ASTM D1752.
 4. Acceptable Manufacturers:
 - a. A. C. Horn.
 - b. W. R. Meadows, Inc.
 - c. Or Approved Equal.
- F. Tongue and Groove Joint Material:
1. Galvanized steel, stay-in-place, keyed form, such as manufactured by Heckmann Building Products, Inc., or approved equal.
 2. Use only for slabs in structures that do not retain water.
- G. Vinyl Waterstops: Ribbed type manufactured from virgin polyvinyl chloride plastic compound conforming to U.S. Corps of Engineers CRD-C 572.
1. 6-inch Waterstop: 6 x 3/8-inch, such as Vinylex Corporation; Cat. No. R6-38.

2. 9-inch Waterstop: 9 x 3/8-inch with center bulb of 1-inch outside diameter; such as Vinylex Corporation; Cat. No. RLB9-38.
3. Acceptable Manufacturers:
 - a. Vinylex Corporation (Catalog Nos. as specified above).
 - b. A. C. Horn Inc.
 - c. W. R. Meadows, Inc.
 - d. Or Approved Equal.
4. Retrofit Waterstop: 6 x 3/8-inch with 3-3/16 inch T leg; such as Greenstreak Product No. 609, or approved equal.

H. Injected Vinylester-Based Resin Waterstop:

1. Injection Hose: Multiple use injection hose composed of polyvinyl chloride (PVC) compound with solid core to absorb concrete pressure and lateral openings along each side, at staggered intervals, to ensure a uniform discharge of the injection material.
 - a. Outside diameter: 3/4 inch.
 - b. Longitudinal internal injection hole diameter: 1/4 inch.
 - c. Discharge internal injection hole diameter: 1/8 inch.
 - d. Injection hose to be field measured, cut and fabricated complete with reinforced PVC vent ends, color coded connecting nozzles, heat shrink-on sleeves and closure plugs, in strict accordance with the dimensions shown on the plans and as recommended by the manufacturer.
 - e. Acceptable Manufacturers:
 - 1) Fuko Injection Hose, BBZ USA, Inc.
 - 2) Or Approved Equal.
2. Injection Material: Solvent free, low viscosity, two-part, water-swelling, acrylate-ester based injection resin.
 - a. Non-foaming and acrylamide free.
 - b. Increases volume 100% to 200% when in contact with water.
 - c. Swelling behavior reversible and not subject to aging.
 - d. Passive toward steel and harmless to bitumen, membranes and concrete.
 - e. Bonds well to moist surfaces.
 - f. Resistant to weak acids, salt solutions, oil, fats, hydrocarbons, alcohol, and alkali.
 - g. Acceptable Manufacturers:
 - 1) Duroseal Inject, BBZ USA, Inc.
 - 2) Or Approved Equal.
3. Junction Box:
 - a. Non-corroding.
 - b. Approved for use with potable water.
 - c. Complete with cover.

I. Paste and Gasket Waterstop:

1. Paste material applied by cartridge which swells when in contact with water such as Duroseal Swelling Paste by BBZ USA, Inc., or approved equal.
2. Gasket waterstop is a soft, pliable, water-swelling vinylester such as Duroseal Swelling Gasket by BBZ USA, Inc., or approved equal.

- J. Bentonite Waterstop: A specially formulated joint sealant which swells upon contact with water, and which will adhere to joint surfaces and itself. Provide waterstop in rope style configuration, approximately one inch square and packaged in continuous length coils. Material composition as follows:
1. Butyl Rubber-Hydrocarbon; percent by weight of 24.9 when tested according to ASTM D297.
 2. Bentonite; 75 percent, conforming to SS-S-210A.
 3. Volatile Matter; one percent below the requirements of ASTM D6.
 4. Acceptable Manufacturers:
 - a. American Colloid Company; Waterstop RX.
 - b. Or Approved Equal.
- K. Surface Applied Waterstop: A specially formulated joint sealant which swells upon contact with water, and which will adhere to joint surfaces and itself. Provide waterstop packaged in continuous length coils. Material composition as follows:
1. Chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
 2. Waterstop shall have a coating formulated to inhibit initial expansion due to moisture presence in the fresh concrete.
 3. Size: Dual extrusion design; 10 mm by 20 mm.
 4. Waterstop shall be secured to hardened concrete with the waterstop manufacturer's standard adhesive binder.
 5. Acceptable Manufacturers:
 - a. Greenstreak; Hydrotite VCJ.
 - b. ADECA; Ultraseal.
 - c. Or equal.
- L. Curing Materials. Use curing materials that will not stain or affect concrete finish or lessen the concrete strength and comply with the following requirements:
1. Burlap: Materials conforming to AASHTO M 182.
 2. Sheet Materials: Material conforming to ASTM C171.
 3. Liquid Membrane-Forming Curing Compound.
 - a. Material conforming to ASTM C309, Type I, free of wax or other adhesive bond breaking ingredients.
 - b. Use curing compounds which are nontoxic and free of taste, odor and complies with low V.O.C. requirements.
 - c. Where a finish material is to be applied over concrete with architectural finish, provide certification by the product manufacturer certifying the curing compound as non-detrimental to the bond of the finish material.
 - d. Acceptable Manufacturers:
 - 1) L&M Cure; L&M Construction Chemicals, Inc.
 - 2) Kurez Formula E-100; Euclid Chemical Company.
 - 3) Masterkure 200W; Master Builders.
 - 4) Or Approved Equal.

M. Chemical Hardener:

1. Chemically reactive solution of inorganic siliceous materials formulated to harden and densify concrete surface.
 - a. Acceptable Manufacturers:
 - 1) ChemMasters - Chemisil Plus
 - 2) Or Approved Equal.
- N. Non-Slip (Dry-Shake) Aggregate Surfer: Aluminum-oxide non-slip aggregate surfer for dry shake application to fresh concrete.
 1. Acceptable Manufacturers:
 - a. Sonneborn; Frictex
 - b. Or Approved Equal.
- O. Epoxy Bonding Compound: A high-modulus, low-viscosity, moisture-insensitive epoxy adhesive having the following properties:
 1. Compressive Properties, ASTM D695 at 28 days;
 - a. Compressive Strength: 8,000 psi. min.
 2. Tensile Properties, ASTM D638 at 14 days.
 - a. Tensile Strength: 4,000 psi. min.
 - b. Elongation at Break: One to three percent.
 3. Modulus of Elasticity: 3×10^5 psi.
 4. Bond Strength, ASTM C882:
 - a. Plastic concrete to hardened concrete at 14 days (moist cure): 1,700 psi. min.
 5. Mixed epoxy resin adhesive shall conform to ASTM C881, Type II, Grade 2, Class B and C.
 6. Acceptable Manufacturers:
 - a. Sika Corporation; Sikadur 32 Hi-Mod.
 - b. Euclid Chemical Company; Euco Epoxy #452 MV or #620.
 - c. Or Approved Equal.
- P. Epoxy Adhesive (for grouting dowels): A high-modulus, moisture insensitive epoxy adhesive of thick (Gel) consistency having the following properties:
 1. Compressive Properties, ASTM D695.
 - a. Compressive Strength: 10,000 psi. min. at 28 days.
 2. Tensile Properties, ASTM D638.
 - a. Tensile Strength: 3,000 psi. min. at 14 days.
 3. Bond Strength, ASTM C882, hardened concrete to hardened concrete:
 - a. 14 day, moist cure: 2,000 psi. min.
 4. Mixed epoxy resin adhesive shall conform to ASTM C881, Type I, Grade 3, Class B and C.
 5. Acceptable Manufacturers:
 - a. Sika Corporation; Sikadur 31 Hi-Mod Gel.
 - b. Euclid Chemical Company, Euco Epoxy #452 Gel or #620 Gel.
 - c. Or Approved Equal.

2.02 MIXES

- A. Selection of Proportions of Normalweight Concrete: ACI 211.1.

- B. Proportions of Ingredients: Establish proportions, including water cement ratio on the basis of either laboratory trial mixture tests or standard deviation analysis, with the materials specified herein.
1. Laboratory Trial Mixture Test: ACI 301, Section 3.9 and ACI 318, Section 5.3.
 2. Standard Deviation Analysis: ACI 301, Section 3.9 and ACI 318, Section 5.3.
- C. Water-Cement Ratio:
1. Class A Concrete shall have a maximum water-cement ratio of 0.45.
 2. Class B Concrete shall have a maximum water-cement ratio of 0.55.
 3. Proportion Class C Concrete to meet the strength requirement.
- D. Slump: Proportion and produce concrete to a slump as indicated below. The slump ranges apply when vibration is used to consolidate the concrete.

Types of Construction	Slump, in.	
	Maximum*	Minimum
Reinforced foundation walls and footings	3	1
Plain footings, caissons, and substructure walls	3	1
Slabs, beams and reinforced walls	4	1
Building columns	4	1
Pavements and slabs-on-grade	3	1
Mass concrete	2	1

*May be increased 1 in. for methods of consolidation other than vibration.

1. Pumped concrete shall have a 5-inch maximum slump, measured prior to pumping.

2.03 ADMIXTURES

- A. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturers and use in compliance with manufacturer's recommendations.
1. Calcium Chloride: Not permitted.
- B. Air Entraining Admixture: Conforming to ASTM C260. Provide air-entrained concrete for each concrete pour except where indicated otherwise on the Drawings or specified herein. Total air content required as follows:

Maximum-Size Coarse Aggregate, Inches	Air Content Percent By Volume
1½	5 ± 1
¾ or 1	6 ± 1
⅜ or ½	7½ ± 1

1. Do not provide the air-entrained concrete where a hardener is indicated on the Drawings or specified herein.
- C. Water-Reducing Admixture: Conforming to ASTM C494 Type A and that is free of chloride. Unless high temperatures occur or placing conditions dictate a change, use concrete containing a water-reducing admixture.
- D. Water-Reducing and Retarding Admixture: Conforming to ASTM C494 Type D and that is free of chloride. When high temperatures occur or placing conditions dictate, the water-reducing admixture (Type A) may be replaced with a water-reducing and retarding admixture (Type D). Notify the Engineer of such change and submit product data prior to placement of concrete.
- E. Water-Reducing and Accelerating Admixture: Conforming to ASTM C494 Type E and that is free of chloride. When low temperatures occur or placing conditions dictate, the water-reducing admixture (Type A) can be replaced with a water-reducing and accelerating admixture. Notify the Engineer of such change and submit product data prior to placement of concrete. Water-reducing and accelerating admixture (Type C and E) will not be permitted in concrete for water retaining structures.

2.04 SOURCE QUALITY CONTROL

- A. General Requirement: Provide only Class A concrete in the project except for those cases where indicated otherwise on the Drawings or specified otherwise.
 1. Where in-ground encasement of piping is required, provide Class B concrete.
 2. Where in-ground encasement of conduit runs is required, provide Class B concrete.
- B. Classes of Concrete:
 1. Class A: 4,000 psi minimum compressive strength at 28 days; 564 pounds per cubic yard minimum cement content.
 2. Class B: 3,000 psi minimum compressive strength at 28 days; 517 pounds per cubic yard minimum cement content.
 3. Class C: 2,000 psi minimum compressive strength at 28 days; minimum cement content per cubic yard in accordance with current ready-mix plant standard practice.
- C. Specified Flexural Strength at 28 Days:

1. Class A: 560 psi.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions: Inspect work to receive cast-in-place concrete for deficiencies which would prevent proper execution of the finished work. Do not proceed with placing until such deficiencies are corrected to the satisfaction of the Engineer.

3.02 PREPARATION

- A. Joints and Embedded Items
 1. Construction Joints:
 - a. Place construction joints where indicated on the Drawings.
 - b. Secure Engineer's approval prior to making additional or revised locations of construction joints.
 2. Expansion Joints and Contraction Joints:
 - a. Install where indicated on the Contract Drawings.
 - b. Do not extend reinforcing or other embedded metal items through expansion and contraction joints except where indicated otherwise on Contract Drawings.
 - c. Sawcutting contraction joints will not be permitted.
 - d. Provide waterstops in joints exposed to liquids, in contact with earth, or subject to weather exposure.
 3. Bonding to New Concrete: Bond fresh concrete with hardened previously poured new concrete in accordance with the following:
 - a. Roughen and clean hardened concrete of foreign matter and laitance and dampen with water.
 - b. Cover the hardened concrete with a heavy coating of grout to approximately ½-inch thickness. Use grout of same material composition and proportions of concrete being poured except coarse aggregate omitted. Use grout with a slump of 6 inches minimum.
 - c. Place new concrete on grout before it has attained its initial set.
 - d. Other bonding methods must be approved by Engineer prior to use.
 4. Bonding to Existing Concrete: Roughen existing concrete in the area of bonding to produce exposed aggregate and an absolutely uncontaminated concrete surface.
 - a. Apply Epoxy Bonding Compound over existing prepared concrete in accordance with manufacturer's instructions.
 5. When concreting is to be discontinued for more than forty-five (45) minutes and if the construction plane is to be horizontal, install keyways, waterstops and embed dowels in the concrete before initial hardening. Use keyways and dowels in vertical concrete construction only when indicated or directed by the Engineer. Use waterstops for water retaining structures or structures below grade. Horizontal joints are not permitted in slabs or footings.

- a. Extend dowels placed in joint one splice length into wall and one splice length into next concrete pour.
- 6. Embedded Waterstop Installation: Install in construction joints, expansion joints and where required for watertightness.
 - a. Hold end joints to a minimum.
 - b. Make watertightness of joints the same as continuous waterstop material and to permanently develop not less than 50 percent of the mechanical strength of the parent section and to permanently retain their flexibility.
 - c. Adequately support waterstops to prevent displacement and deformity of the waterstops during concrete pours.
 - d. In substructures and other structures required to be watertight, install waterstops if concreting is discontinued for a sufficient length of time, which in the opinion of the Engineer, may result in seepage cracks in concrete.
- 7. PVC Waterstops:
 - a. Install in all joints where watertightness is required.
 - 1) Vinyl Waterstops:
 - a) Use ribbed-type waterstops of the following dimensions except as otherwise indicated on the Contract Drawings.
 - (1) Expansion joints in new construction: 9 inches wide by 3/8 inch thick, with center bulb.
 - (2) Contraction and construction joints: 6 inches wide by 3/8 inch thick; no center bulb.
 - b. Use continuous lengths without splices where possible.
 - c. Provide factory-formed and tested waterstop corners and intersections leaving only straight butt joint splice in the field.
 - d. Connect all adjoining waterstops including vertical and horizontal runs to provide a continuous water barrier.
 - e. Splices:
 - 1) Strength: Not less than 50% of the mechanical strength of the parent section.
 - 2) Watertightness: Make equal to that of continuous material.
 - 3) Heat seal adjacent surfaces in accordance with manufacturer's recommendations using a thermostatically controlled electric source of heat that provides sufficient heat to melt but not to char the material.
 - f. Adequately support waterstops to prevent displacement and deformity of the waterstops during concrete pours. Maintain two inch minimum clearance between waterstop and reinforcing steel.
 - g. Center waterstop on joint with one-half of waterstop width to be embedded in concrete on each side of joint. At expansion joints, keep center bulb unembedded.
 - h. In substructures and other structures required to be watertight, install waterstops if concreting is discontinued for a sufficient length of time which, in the opinion of the Engineer, may result in seepage cracks in concrete.
- 8. Application of Paste and Gasket Waterstop
 - a. Install only in joints designated on the Contract Drawings.

- b. Provide continuous strip of paste along existing concrete section with an overlap of not less than 2 inches.
 - c. Use paste strip which is minimum 3/4" x 3/4" and place no closer than 3 inches from edge.
 - d. Apply gasket to paste according to manufacturer's recommendations.
9. Injected Vinylester-Based Resin Waterstops:
- a. Install injection hoses and inject vinylester-based resin in strict accordance with the specifications and technical information provided by the manufacturer and as indicated herein.
 - b. Installation of injection hoses:
 - 1) Install in lengths not to exceed 40 feet.
 - 2) Install in center of walls and slabs as shown on the Drawings. Encase the injection hose and vent ends in not less than 3 inches of concrete.
 - 3) Attach to the substrate with plastic anchor clips spaced in accordance with the manufacturer's recommendations.
 - 4) Do not fasten injection hoses to reinforcing steel.
 - 5) Do not criss-cross any injection hoses. Use reinforced PVC vent ends for crossing over the injection hoses.
 - 6) Encase reinforced PVC vent ends in a junction box covered with a matching face plate and mounted firmly against the formwork.
 - 7) Inspect and obtain approval by the Engineer of all installations prior to pouring concrete.
 - c. Injection Application:
 - 1) Prepare injection material in strict accordance with the manufacturer's printed instructions and specifications regarding mixing, injection procedures, application life and equipment requirements.
 - 2) Inject the sealing material only when ambient temperatures are between 45 degrees and 100 degrees F.
 - 3) Injection operations should not begin prior to the normal 28-day concrete curing time period, in order to allow for shrinkage.
 - 4) Inject vinylester-based resin in accordance with manufacturer's recommendations.
 - 5) If the injection material penetrates the wall or slab surfaces, wipe clean with water and patch with rapid-setting cement.
 - 6) After injection is complete, evacuate injection hose with water following the manufacturer's recommended procedure.
 - d. Field support by manufacturer: A manufacturer's representative shall be present for the first installation operation and first injection operation and at any other times deemed necessary by the Engineer to ensure proper installation and injection of vinylester-based resin injection system.
 - e. If joints are determined to be leaking after water is placed inside structure, drain water from structure and reinject vinylester-based resin in injection hoses within the limits of the leak in accordance with the injection procedures previously described herein.
10. Bentonite Waterstop: Install as recommended by the manufacturer at locations designated on the Drawings.

11. Surface Applied Waterstop Installation: Install surface applied waterstop at such location where indicated on the Drawings.
 - a. Install the waterstop in strict accordance with the manufacturer's installation instructions and with respect to the environmental requirements specified therein and substrate preparation.
12. Embedded Pipes and Conduits: Material not harmful to concrete may be permitted to be embedded in concrete upon approval by the Engineer. Place embedded items accurately, and support them against displacement. Items embedded shall satisfy the following:
 - a. Maximum outside dimension not greater than one-third the overall thickness of the member in which it is embedded.
 - b. Minimum spacing between items not less than 3 widths on center nor 3 inches clear between items.
 - c. Item shall not impair strength of member.
 - d. Provide 2 inch minimum clearance to face of slab.
13. Anchoring Reinforcement Dowels into Existing Concrete.
 - a. Drill holes for each dowel to the size and depth indicated on the Drawings with carbide tip bit or star bit. Core drilling will not be permitted. Do not drill into or cut or otherwise damage existing reinforcement bars. If existing reinforcement bars are encountered during the drilling operation, relocate the hole to clear the existing reinforcement as directed by the Engineer.
 - b. Blow clean each finished hole with an oil free air jet and then flush with a jet of clean water.
 - c. Immediately prior to the grouting operation, remove all water from the hole and from the walls of the hole.
 - d. Mix and place the epoxy adhesive completely around the dowel bar in strict accordance with the manufacturer's recommendations, with particular attention given to manufacturer's specified time limit within which the material must be placed after mixing. Do not retemper grout that has begun to stiffen; discard such grout.

3.03 CONSTRUCTION

A. Production of Concrete

1. Ready-Mixed Concrete:
 - a. Batched, mixed and transported in accordance with ASTM C94.
 - b. Add admixtures to the mix in accordance with ACI 301.
 - c. Plant equipment and facilities conforming to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.

B. Placing

1. General: Conduct placement work in accordance with ACI 304R and such additional requirements as specified herein.
 - a. Complete discharge of the concrete within 1 ½ hours or before the mixing drum has revolved 300 revolutions, whichever comes first, after the

introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

2. Preparation:
 - a. Prepare formwork in advance and remove snow, ice, water and debris from within forms. Formwork as specified in Section 03 10 00.
 - b. Pre-position reinforcement in advance of concrete pours as specified in Section 03 20 00.
 - c. Pre-position waterstops, expansion joint materials, anchors and embedded items in advance of concrete pours.
 - d. Sprinkle subgrades sufficiently to eliminate water loss from concrete in accordance with ACI 301 Chapter 11.
 - e. Do not place concrete on frozen surfaces.
3. Conveying:
 - a. Handle concrete from mixer to final deposit rapidly by methods which will prevent segregation or loss of ingredients to maintain required quality of concrete.
 - b. Do not convey concrete through aluminum or aluminum alloy.
 - c. Do not place concrete by pumps or other similar devices without prior written approval of the Engineer.
 - d. Placing concrete by pumping methods shall conform to the applicable requirements of ACI 304R, Chapter 9, and ACI 304R.2.
4. Depositing:
 - a. Do not drop concrete freely where reinforcing will cause segregation, nor more than four (4) feet.
 - b. Deposit concrete in approximately horizontal layers of 12 to 18 inches.
 - c. Do not allow concrete to flow laterally more than three feet.
 - d. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
 - e. Do not deposit concrete on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within sections.
 - f. Do not use concrete which has partially hardened or has been contaminated by foreign materials.
 - g. Do not subject concrete to procedures which will cause segregation.
 - h. Do not place concrete in forms containing standing water or on frozen surfaces or around embedded items which have a surface temperature below freezing.
 - i. Make placement within sections continuously to produce monolithic unit.
 - j. Do not begin placement of concrete in beams or slabs until concrete previously placed in walls or columns have attained initial set.
 - k. Do not bend reinforcement out of position when placing concrete.
5. Consolidation:
 - a. Consolidate concrete by vibration, spading, rodding or other manual methods. Work concrete around reinforcement, embedded items and into corners; eliminate all air or stone pockets and other causes of honeycombing, pitting or planes of weakness.

- b. Use vibration equipment of internal type and not the type attached to forms and reinforcement.
 - c. Use vibrators capable of transmitting vibration to concrete in frequencies sufficient to provide satisfactory consolidation.
 - d. Do not leave vibrators in one spot long enough to cause segregation. Remove concrete segregated by vibrator operation.
 - e. Do not use vibrators to spread concrete.
 - f. Have sufficient reserve vibration equipment to guard against shutdown of work occasioned by failure of equipment in operation.
6. Cold Weather Concreting: Perform cold weather concrete work in accordance with ACI 306R and the following additional requirements.
- a. Provide concrete delivered at the job-site in accordance with the following temperature limitations:

Air Temperature Degrees F.	Minimum Concrete Temperature, Degrees F.	
	For Sections With Least Dimension Less Than 12 Inches	For Sections With Least Dimension 12 Inches or Greater
30 to 45	60	55
0 to 30	65	60

- b. Provide equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.
- c. Maintain concrete at temperatures listed in Table 1.4.1 of ACI 306R as follows, after the concrete has developed a compressive strength of 500 psi:
 - 1) Slab-on-grade: 2 days.
 - 2) Walls and supported slabs: 3 days.
- d. If the strength is not achieved, maintain the minimum temperature an additional 24 hours or until the 500 psi strength is reached.
- e. Make additional concrete cylinders to verify strength achievement of 500 psi; however, additional cylinders are not required for every pour, provided concrete temperatures are maintained fairly uniform. Once two sets of cylinders have been broken and a strength of 500 psi is achieved, additional cylinders will not be required, except for random testing as determined by the Engineer.
- f. Remove temperature protection after 500 psi is achieved, but in a manner so thermal shock does not occur to the exposed concrete. The removal criteria shall be as stated in ACI 306R.
- g. Leave housing, covering, or other protection used in curing intact at least 24 hours after artificial heating is discontinued.
- h. Surfaces with which the concrete is to come in contact must be free of frost, snow and ice. Subgrade shall be free of frost. Do not place concrete around any embedment which has a temperature below freezing.
- i. If water or aggregate is heated above 100 degrees F, combine water with aggregate in the mixer before cement is added. Do not mix cement with

- water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.
- j. Provide equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. Do not use foreign materials or materials containing snow or ice.
 - k. Surfaces with which the concrete is to come in contact with must be free of frost, snow and ice.
7. Hot Weather Concreting: Perform hot weather concrete work in accordance with ACI 305R and the following additional requirements.
- a. Temperature of concrete delivered at the job-site shall not exceed 90 degrees F.
 - b. Cool ingredients before mixing to prevent temperature in excess of 90 degrees F.
 - c. Make provisions for windbreaks, shading, fog spraying, sprinkling or wet cover when necessary.
8. Underwater Concreting: In general, perform underwater concreting work in accordance with ACI 304R Chapter 8 and the following requirements:
- a. When permitted by Engineer, foundation concrete may be placed in still water.
 - b. Concrete placed in water shall contain an additional twenty percent of cement above the amount specified for the particular class of concrete used. No additional compensation will be allowed for this added cement.
 - c. Do not deposit concrete in water which has a temperature below 40 degrees F.
 - d. Place the concrete underwater continuously through a tremie pipe. Diameter of the tremie pipe shall be approximately eight times the maximum size of the largest coarse aggregate. Use seal in pipe to start concrete placement, and keep filled with concrete continuously with the end of the pipe embedded in the placed concrete at all times. If seal is lost, withdraw pipe and reseal and start charging operations again.
 - e. Protect placed concrete from water motion for at least four days and longer if required.

C. Finishing:

- 1. General: Finish concrete in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material.
- 2. Formed Surfaces: Provide one or more of the following finishes to the surfaces of the concrete after removal of forms. The locations where these finishes are required are listed herein or specified on the Drawings. Allowable surface irregularities are designed as either "abrupt" or "gradual". Check gradual irregularities using 5 foot straightedges.
 - a. "Rough Form" finish: Surface may include roughness and irregularities not to exceed 1/2 inch, but tie holes and defects shall be patched.
 - b. "Ordinary Wall" finish: Surface that is true and uniform without any conspicuous offsets or bulges. Gradual irregularities not to exceed 1/2 inch and abrupt irregularities not to exceed 1/4 inch.

- c. "Plywood" finish: Similar to the ordinary wall finish. Construct the surface of the forms using 5/8-inch plywood or boards lined with tempered hardboard not less than 3/16 inch thick. Place the plywood or liner sheets in an orderly and symmetrical arrangement using sheets as large as practicable. Do not use sheets showing torn grain, worn edges, patches of holes from previous use, or other defects which will impair the texture of the concrete surfaces. Remove gradual irregularities exceeding 1/2 inch and abrupt irregularities exceeding 1/8 inch. Completely remove all fins on the surface. Rub all surfaces which cannot meet these requirements.
 - d. "Rubbed" finish: Apply to a freshly hardened "plywood" finish. Complete rubbing within one day of removal of forms. Wet surfaces and rub with a carborundum brick or other abrasive until all form marks, projections and irregularities have been removed and a smooth uniform surface, texture, and color are produced. Wash the surface clean after rubbing.
3. Unformed Surfaces: In concrete having unformed surfaces, use just sufficient mortar to avoid the necessity for excessive floating. Slope exposed unformed surfaces to provide quick, positive drainage and to avoid puddles in low spots. Unless otherwise noted, set floor drains 1/2 inch below the normal floor elevation and slope floor toward the drain. Slope all surfaces exposed to weather 1/4 inch per foot for drainage unless noted otherwise on Drawings.
- a. "Floated" Finish: After concrete has been placed, consolidated, struck off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after first floating, check planeness of surface with a ten foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots during this procedure to produce a surface with true planes within 1/4 inch in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction. Following straightedge checking, refloat slab immediately to a uniform sandy texture.
 - b. "Steel Trowel" Finish: Obtained by working a floated finish with a steel trowel. First troweling shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings by hand after the surface has hardened sufficiently. Perform final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by hand trowel operations. Produce finished surface essentially free of trowel marks, uniform in texture and appearance, with true planes within 1/4 inch in ten feet, as determined by a ten foot straightedge placed anywhere on the slab in any direction.
 - c. "Broom or Belt" Finish: Immediately after concrete has received a floated finish, give surface a coarse transverse scored texture by drawing a broom or burlap across the surface.
 - d. "Nonslip" Finish: The surfaces shall be given a "dry shake" application of non-slip aggregate surfacer. The rate of application of such material not to be

less than 25 pounds per 100 square feet. Apply in accordance with manufacturer's recommendations.

4. Special Finishes:
 - a. Weirs and Overflow Surfaces: Provide "hard steel trowel" finish to surfaces to produce a hard, dense, smooth, surface free of irregularities. Obtain finish by trowelling a regular steel trowel finish after the surface has nearly hardened. The hard surface will have a somewhat glossy appearance. The elevation of the weir crest shall be constant along its entire length.
 - b. Flumes and Troughs: Provide a "hard steel trowel" finish to the top of bottom slab. Use "plywood" formed finish on side walls, and an "ordinary wall" finish on overhead surfaces. Provide a "rubbed" finish on all surfaces which will not be in contact with water.
 - c. Deck Finish: Power or single hand trowelling of slab surface followed by a light hair broom drawn across the slab to produce fine shallow scored texture.
 - d. Architectural Finishes. Special finishes such as Vinyl Asbestos Tile, Quarry Tile, Ceramic Tile, or other, when used, shall be as specified herein or on the Drawings.
5. Application for Finishes: Except where the type of finish is indicated on the drawings or under "Special Finish", all concrete surfaces shall be finished as indicated below.
 - a. "Rough Form" Finish:
 - 1) All surfaces to be covered by earth and not exposed to view.
 - b. "Ordinary Wall" Finish:
 - 1) Interior and exterior wall and slab surfaces not exposed to view.
 - 2) Inside vertical surfaces of tank type structures below an elevation which is 18 inches below normal water surface.
 - 3) Interior walls of filters below an elevation which is 6 inches below the filter media.
 - 4) All wall and overhead surfaces or clearwells.
 - 5) Undersides of slabs which will be covered by architectural ceilings.
 - c. "Plywood" Finish:
 - 1) All surfaces to be painted.
 - d. "Rubbed" Finish:
 - 1) All interior and exterior surfaces exposed to view which are not to be painted.
 - 2) All exterior surfaces to a point 6 inches below finished ground.
 - 3) Inside vertical surfaces of tank type structures above an elevation which is 18 inches below normal water surface.
 - 4) Interior walls of filters to a point 6 inches below filter media.
 - 5) Equipment pads, pipe supports, etc.
 - e. "Floated" Finish:
 - 1) Bottoms of chambers, manholes, and other tank type structures.
 - 2) Surfaces to receive Steel Trowel Finish.
 - 3) Surfaces to receive Broom or Belt Finish.
 - f. "Steel Trowel" Finish:

- 1) Interior floor surfaces intended for pedestrian and vehicle traffic, and floor surfaces receiving decorative coverings.
- 2) Interior bottom surfaces of troughs, channels and such other passages for the flow of liquids.
- 3) Interior floors of structures except where Architectural Finish is to be applied.
- 4) Interior stair treads.
- 5) Tops of exposed walls.
- 6) Floors of clearwells and basins.
- g. "Broom or Belt" Finish:
 - 1) Sidewalks, exterior ramps and platforms.
 - 2) Unloading dock platform.
 - 3) Walkways on the process tanks.
- h. "Nonslip" Finish:
 - 1) Exterior stair treads and landings.
- i. Architectural Finishes:
 - 1) As specifically called for in these Specifications or on the Drawings.
- j. "Composite Elevated Tank" Finish:
 - 1) In accordance with Section 33 16 19.16.
6. Application of Chemical Hardener: Apply to floor surfaces as scheduled on Drawings. Concrete must be a minimum of twenty-eight (28) days old and cured by water or sheet material curing methods.
 - a. Concrete surfaces must be clean, dry and free of residues, oil, wax, sealers, curing compounds, laitance or other contaminants in order to promote maximum penetration of hardener.
 - b. Apply hardener in two applications in accordance with hardener manufacturer's instructions and by such methods as stated in instructions.
 - c. Application: Mechanical scrubbers, equipped with brushes are the preferred method of application for the first coat.
 - d. Pour chemical hardener directly from the container onto the surface to be treated, maintaining an application rate of 200 ft.² per gallon. Scrub chemical hardener into the surface for 15-20 minutes, working all areas evenly.
 - e. Apply second coat using sprayers or rollers in accordance with manufacturer's instructions.

3.04 PROTECTION

- A. General: Immediately after placement and finishing, protect concrete from premature drying, excessive hot or cold temperatures and mechanical injury. Perform curing by either water curing, sheet form curing or liquid membrane forming methods in accordance with ACI 308. Cure concrete continuously for a minimum of seven days at ambient temperatures above 40 degrees F.
- B. Hot Weather Curing: See Hot Weather Concreting this Section.
- C. Cold Weather Curing: See Cold Weather Concreting this Section.

- D. Water Curing Methods: Perform only water curing methods on concrete surfaces receiving surface applied grouts and other cementitious overlays.
- E. Application of Liquid Membrane-Forming Curing Compound: Compound shall restrict the loss of water to not more than .039 g/cm² of surface in 72 hours when tested in accordance with ASTM C156 at the coverage rate recommended by the manufacturer.
 - 1. Submit letter from manufacturer stating coverage rate to meet this restriction in loss of water.
 - 2. Finishing operations must be completed prior to application. Apply compound as soon as the free water on the surface disappears and no water sheen is visible. Surface shall be capable of taking walking workmen without being marred. Apply compound in two (2) applications.
 - 3. Do not apply curing compound to construction joint surfaces. Protect exposed reinforcement during application of curing compound. Water cure those areas not coated with compound.
 - 4. Do not use liquid membrane-forming curing compound when the ambient air temperature during placement and for 24 hours after placement is or will fall below 35 degrees F.
 - 5. Do not use liquid membrane-forming curing compounds on concrete surfaces which will receive later treatments, such as hardeners, special finishes, protective coating, dampproofing, waterproofing, future grout, grout fill or coatings.
- F. Curing of surfaces to receive Membrane Waterproofing shall be controlled by water fog spraying, water damped coverings, and/or impermeable sheet film cover for the full 7-day period specified above. All concrete surfaces shall have a minimum cure of 28 days before application of the membrane. The use of liquid membrane-forming curing compounds on these surfaces is prohibited.
- G. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

3.05 FIELD QUALITY CONTROL

- A. Testing and Inspection:
 - 1. During the entire period when concrete is being placed, provide testing services by an independent testing laboratory at no cost to the Authority.
 - 2. The Engineer reserves the right to make any and all tests as he deems necessary during the progress of the work.
 - 3. Failure of the independent testing laboratory or the Engineer to detect defective work will not prevent rejection when defect is later discovered, nor will it obligate the Engineer for final acceptance.
 - 4. The Independent Testing Laboratory shall:
 - a. Obtain composite samples in accordance with ASTM C172.
 - b. Mold and cure three test specimens for each strength test in accordance with ASTM C31 and as follows:
 - 1) Concrete compression test: Use standard 6 inch x 12 inch cylinders.

- 2) Concrete flexural strength: Use 6 inch x 6 inch x 12 inch beams.
 - 3) Identify each test by number, mix, amount of admixture, origin of sample in the structure, the date the test specimen was made, the date the test specimen was tested, the amount of slump determined, and the compressive and flexural strength test results.
 - 4) Test Methods:
 - a) Compressive strength test: ASTM C39.
 - b) Flexural strength test: ASTM C78.
 - c) Test one specimen at 7 days for information and test two specimens at 28 days for acceptance. A strength test is the average of the strengths of the two cylinders tested at 28 days.
 - d) Perform one strength test for each 50 cu. yds. of concrete poured, unless waived by the Engineer, but not less than one test for each structure.
 - c. Make slump tests for each truck load upon truck arrival at the job-site and whenever consistency of concrete appears to vary in accordance with ASTM C143.
 - d. Make air content tests for each truck load upon truck arrival at the job-site in accordance with ASTM C231 or ASTM C173. Except if aggregate with high absorptions are used, use the latter test method.
 - e. Prepare and submit all reports required in the various standards and specifications referenced herein.
 - 1) Distribution of reports shall be:
 - a) Two copies to the Engineer.
 - b) One or more copies, as required, to the Contractor.
 - f. Immediately notify the Contractor and the Engineer of any test results which do not conform to the Specification requirements.
- B. Evaluation and Acceptance:
1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength tests equal or exceed specified strength and no individual strength test result is below specified strength by more than 500 psi.
 2. If the concrete fails to meet the specified strength requirements the Engineer may require one or both of the following:
 - a. The Engineer shall have the right to order a change in the mix proportions for the remaining concrete being poured.
 - b. The Engineer may order tests on the in-place concrete. Testing shall be in accordance with ACI 301.

3.06 REPAIR/RESTORATION

A. Defective Concrete

1. Porous areas, open or porous construction joints and honeycombed concrete will be considered to indicate that the requirements for mixing, placing and handling have not been complied with and will be sufficient cause for rejection of the members of the structure thus affected.

2. Defective work exposed upon removal of forms shall be entirely removed or repaired within forty-eight hours after forms have been removed.
3. Repaired areas will not be accepted if:
 - a. The structural requirements have been impaired by reducing the net section of compression members
 - b. The bond between the steel and concrete has been reduced
 - c. The area is not finished to conform in every respect to the texture, contour, and color of the surrounding concrete.
4. If the above requirements are not satisfied or if there are excessive honeycombs or other defects, the Engineer may require that the members of unit involved be entirely removed and satisfactorily replaced at no additional expense to the Authority.
5. The Engineer will determine the extent and manner of action to be taken for the correction of defective concrete as may be revealed by surface defects or otherwise.
 - a. Prior to repair of structural defects or defects which impair watertightness (shrinkage cracks, etc.), submit proposed material and repair methods to the Engineer for approval.
6. As soon as the forms have been stripped and the concrete surfaces exposed, remove fins and other projections, fill recesses left by the removal of form ties, and repair surface defects which do not impair structural strength. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete to the satisfaction of the Engineer.
7. Hammer pack tie holes and other small cavities with a stiff mortar of the same material, but somewhat leaner than that in the concrete. Clean the cavity and the area wetted before mortar is placed.
8. Repair and patch defective areas with cement mortar of mix proportions and materials identical to those used in the surrounding concrete. Produce a finish on the patch that is indistinguishable from the surrounding concrete.
9. Where the honeycomb or voids are not excessive and repairs are authorized by the Engineer, chip out the defective areas in a square shape to sound solid concrete with a depth not less than 2 inches. Make edges of cuts perpendicular to concrete surface or slightly undercut to provide a key at the edge of the patch. Before placing cement mortar, thoroughly clean, dampen and brush coat area to be patched with neat cement grout. Other patching materials may be used if accepted by Engineer in writing prior to start of repair work. The patch should be kept damp for seven days at a temperature above 50 degrees F.

END OF SECTION

FINAL CONCRETE MIX DESIGN SUBMITTAL FORM

(One for each required mix design)

PROJECT: _____ Location: _____

General Contractor: _____

Mix design no.: _____ Design strength: _____

USE (Describe *): _____

Mix Design Preparation: Based on Standard Deviation Analysis: _____
(check one) or Based on Trial Mixture Test Data: _____

MATERIALS:

Aggregates: (Provide size, type, source, specification)

Coarse: _____

Fine: _____

Cement Type/Source: _____

Admixtures: (Provide product, manufacturer)

Water Reducer: _____

Air Entraining: _____

Accelerator: _____

Other: _____

CONCRETE PROPERTIES

Water/Cement Ratio: _____

Slump: _____ inches

Entrained Air: _____ %

Density _____ pcf

SPECIFIC GRAVITIES

Fine Aggregate _____

Coarse Aggregate: _____

ADMIXTURES

Accelerator _____ oz. per 100# cement

W. R. _____ oz. per 100# cement

A. E. _____ oz. per 100# cement

Other _____ oz. per 100# cement

MIX PROPORTIONS

Weight
(lbs)

Absolute Volume
(cubic feet)

Cement: _____

Fine **
Aggregate: _____

Coarse **
Aggregate: _____

Water: _____

Entrained
Air: _____

Other: _____

TOTAL: _____

TEST RESULTS SUBMITTAL FORM

METHOD 1 - STANDARD DEVIATION ANALYSIS (ACI 318-95 ¶ 5.3.2.1):

Number of Test Cylinders Evaluated: _____ Standard Deviation: _____
(Attach Copy of All Test Results)

Mix Designs Proportioned to Achieve Both of the Following:

$$f'_{cr} = f'_c + 1.34s = \text{_____} \text{ psi}$$

$$f'_{cr} = f'_c + 2.33s - 500 = \text{_____} \text{ psi}$$

$$\text{Actual } f'_c = \text{_____} \text{ psi } (\square f'_{cr})$$

$$\text{Slump} = \text{_____} \text{ in.}$$

$$\text{Air Content} = \text{_____} \%$$

METHOD 2 - TRIAL MIXTURE TEST DATA (ACI 318-95 ¶ 5.3.2.2):

Age (days)	Mix 1 (comp. str.)	Mix 2 (comp. str.)	Mix 3 (comp. str.)
7	_____	_____	_____
28	_____	_____	_____
28	=====	=====	=====
28 day avg.	_____	_____	_____

Mix Design Proportioned to Achieve the Following:

$$\text{or } f'_{cr} = f'_c + 1200 \text{ psi} \quad (\text{for } f'_c \square 5000 \text{ psi})$$

$$f'_{cr} = f'_c + 1400 \text{ psi} \quad (\text{for } f'_c > 5000 \text{ psi})$$

$$\text{Slump} = \text{_____} \text{ in.}$$

$$\text{Air Content} = \text{_____} \%$$

REMARKS: _____

Note: Fill in all blank spaces. Use -0- (zero) or N.A. (not applicable). See Design and Control of Concrete Mixtures, Portland Cement Association, for assistance in filling out this form.

SUBMITTED BY:

Ready-Mix Supplier: Name _____

Address: _____

Phone Number: _____

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Requirements for grouts, except for masonry grouts, indicated on the Drawings and required in other Specification Sections.
- B. Related Sections:
 - 1. Cast-In-Place Concrete: Section 03 30 00:

1.02 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 308, Recommended Practice for Curing Concrete.
- B. American Society for Testing and Materials:
 - 1. ASTM C33, Concrete Aggregates.
 - 2. ASTM C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
 - 3. ASTM C150, Portland Cement.
 - 4. ASTM C191, Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 5. ASTM C207, Hydrated Lime for Masonry Purposes.
 - 6. ASTM C404, Aggregates for Masonry Grout.
 - 7. ASTM C476, Grout for Masonry.
 - 8. ASTM C596, Drying Shrinkage of Mortar Containing Portland Cement, Measuring.
 - 9. ASTM C827, Early Volume Change of Cementitious Mixtures.
 - 10. ASTM C1019, Standard Method of Sampling and Testing Grout.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's descriptive product data and current specifications covering named manufactured products specified in this Section. Include placing instructions. Submit product data for the following:
 - 1. Non-Shrink Non-Metallic Grout.
- B. Design Mix (for Grout Swept in by Mechanism): Prior to production of this grout, submit for approval a design mix indicating materials proportions and water-cement ratio. Use materials in the proposed design mix as specified herein. Make such adjustments in the proposed design mix as directed by the Engineer. Make such adjustments at no increase in Contract Price.

1.04 QUALITY ASSURANCE

- A. Non-Shrink Grout Performance Qualifications: Furnish the grout manufacturer's current independent laboratory test results indicating the grout as non-shrink from time of placement as conforming to the Following:
 - 1. Indicating no expansion after final set, according to ASTM C 827.
 - 2. Indicating 4,000 psi strength developed with a trowelable mix within 24 hours, according to ASTM C 109.
 - 3. Indicating placement time based on initial set of not less than 60 minutes, according to ASTM C 191.
- B. Qualifying Test Results: Furnish from the grout manufacturer, test results indicating that in projects of similar scope and size, the effective bearing area was between 95 and 100 percent.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Provide protective covering over materials to prevent moisture damage and contamination of grout materials.
- B. Store materials in undamaged condition with seals and labels intact as packaged by manufacturer.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Protect against high and low temperatures and bad weather in accordance with American Concrete Institute standards for placement of concrete.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Non-Shrink Non-Metallic Grout: Factory premixed material containing no corrosive irons, aluminums, chemicals, or gypsums and complying with the following limitations:
 - 1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent sand cement and water mix as tested per ASTM C596.
 - 2. Grout shall be nonshrink before initial set and show no expansion after set as tested per ASTM C827.
 - 3. Initial set of grout not less than 60 minutes per ASTM C191 Test.
 - 4. Use Type I (Normal) cement for grout applications not in contact with sewage.
 - 5. Use Type II (Sulfate Resistant) cement for group applications in contact with sewage..
 - 6. Acceptable Manufacturer:
 - a. Five Star Products, Inc., Five Star Grout
 - b. Sonneborn

- c. Master Builders
 - d. L & M Construction Chemicals
- B. Water: Potable quality, free from deleterious amounts of acids, alkalis, and organic substances.

2.02 MIXES

- A. Non-Shrink Grout: Use ready-mix type requiring only the addition of water. Do not add other materials. Water requirement proportions to conform to manufacturer's specifications for desired mix consistency.

PART 3 EXECUTION

3.01 PREPARATION

- A. Preparation of Surface: Clean surfaces to be grouted to be free of oil, grease, laitance, dirt and other contaminants. Remove loose material. Remove rust, paint, and oil from metal components in contact with grout.
 - 1. Non-Shrink Grout: Perform additional surface preparation in accordance with manufacturer's instructions.
- B. Formwork: Use forming procedures that allow proper and complete placement of grout.
 - 1. Pre-treat wood forms with forming oils so that they do not absorb moisture.
 - 2. Anchor Support elements of formwork so no movement is possible. Remove supports only after grout has hardened.
- C. Grout Mixing: Use power operated mechanical mixer of sufficient capacity to carry out batch mixing without interruption.
 - 1. Non-Shrink Grout: Mix in accordance with manufacturer's instructions.

3.02 INSTALLATION

- A. Non-Shrink Non-Metallic Grout: Perform grout placement in accordance with recommendations of ACI and manufacturer's published specification for mixing and placing. Place non-shrink non-metallic grout only where indicated on Drawings.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Excavating, backfilling, and compacting trenches for pipelines and inline structures, within limits specified or indicated on Drawings.
- B. Related Sections:
 - 1. Temporary Erosion and Sediment Control: Section 01 57 13.
 - 2. Subsurface Investigation: Section 02 30 00.
 - 3. Cast-In-Place Concrete: Section 03 30 00.
 - 4. Shoring: Section 31 41 00.

1.02 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft.-lbf/ft.3).
 - 2. ASTM D1556; Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
 - 3. ASTM D2321; Standard practice for Underground Installation of thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 4. ASTM D2774; Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
 - 5. ASTM D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- B. Commonwealth of Pennsylvania Department of Transportation (PDT), Specifications Publication 408, as supplemented.
 - 1. PDT Section 220, Flowable Backfill.
 - 2. PDT section 701, Cement.
 - 3. PDT Section 703.1, Fine Aggregates.
 - 4. PDT Section 703.2, Coarse Aggregates.
 - 5. PDT Section 703.3, Select Granular Material (2RC).
 - 6. PDT Section 704, Cement Concrete.
 - 7. PDT Section 704.1 (c), Design Basis.
 - 8. PDT Section 704.1 (d), Testing and Acceptance.
 - 9. PDT Section 711.3, Concrete Admixtures.
 - 10. PDT Section 720.1, Water for Mixing or Curing Cement Concrete, Mortar, or Grout.

1.03 DEFINITIONS

- A. Earth Excavation: Removal down to subgrade elevation of clay, silt, loam, sand, gravel, slate, hard pan, pavements, soft sandstone, loose stone in masses, and boulders measuring less than 1/2 cubic yard.
- B. Unclassified Excavation: Material removal of any kind in excavation, including Rock Excavation.
- C. Unclassified Excavation Below Subgrade: As specified for Unclassified Excavation except performed below subgrade.
- D. Subgrade: Trench bottom prepared as specified to receive Pipe Bedding, Concrete Cradle or Concrete Encasement, or excavation bottom prepared to receive in-line structures.

1.04 SUBMITTALS

- A. Samples: Submit aggregate samples to the Engineer. Make such other required submission to the Engineer's Business Office street address.
 - 1. Aggregates: Submit a ten pound sample, packaged in container of suitable strength, for Engineer's verification and certification for submission to testing laboratory.
- B. Test Reports:
 - 1. Aggregate Material Tests: Submit testing laboratory aggregate test reports based on requirements stated in Quality Control.
 - 2. Compaction Density Tests: Submit compaction density test reports based on method of density determination as specified in Reference Standards and method approved by Engineer.
 - 3. Submit testing laboratory On-Site Backfill test reports, with a one quart jar of the representative samples and plan showing location and elevation from which samples were obtained, to the Engineer for approval at the preconstruction meeting.
- C. Aggregate Certificates: Submit certificate from aggregate supplier based on requirements stated in Quality Control, when requested by Engineer.
- D. Blasting Plan:
 - 1. Submit data concerning proposed blasting operations to Engineer, and utility owners if required.
- E. Testing Agency: Submit name and qualifications of Testing Agency performing seismographic tests to Engineer for approval prior to proceeding with blasting operations.

1.05 QUALITY ASSURANCE

A. Quality Control:

1. Laboratory Tests: Aggregate materials under Part 2 - Products require advance examination or testing according to methods referenced, or as required by Engineer.
 - a. Arrange for testing laboratory to furnish Engineer test result reports in triplicate. Test reports are considered sufficient evidence of acceptance or rejection of materials represented.
 - b. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard.
 - c. Engineer reserves right to accept aggregate materials based on certification from supplier that aggregate originates from a source approved by PennDOT and that aggregate complies with specified PennDOT requirements.
2. On-Site Backfill: Obtain samples of on-site backfill for testing in the presence of an inspector as provided by the Authority. Obtain samples from test pits dug at intervals of not less than 500 feet along the proposed alignment, or 250 feet if varying soils are encountered, as determined by the inspector. The Contractor shall reimburse the Authority for inspection services provided by the Authority.
3. Aggregate Material Tests: Conduct aggregate quality tests in accordance with the requirements of appropriate Reference Standard for such materials.
 - a. The Engineer reserves the right to accept aggregate materials based on certification from the supplier that the aggregate originates from a source approved by PennDOT and that the aggregate complies with specified PennDOT requirements.

B. Regulatory Requirements:

1. Work of this Section within State Highway Right-of-Way is subject to inspection by Commonwealth of Pennsylvania Department of Transportation representatives. Perform work in accordance with requirements of latest edition of Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities.

1.06 PROJECT CONDITIONS

- ### A. General Requirements:
- Excavate and backfill trenches necessary for completing work of this Contract. Excavate and backfill trenches by machinery or by hand, however, Engineer is empowered, if necessity exists, to direct that hand excavation and backfilling be employed. Perform excavation of whatever substances encountered, to grades and depths indicated on Drawings, as specified, or as directed by Engineer. Remove and waste excavated material not required for backfill.
- ### B. Environmental Requirements:
1. Do not perform trenching, backfilling or compacting when weather conditions or condition of materials will prevent satisfactory work, in opinion of Engineer.
 2. Do not use frozen materials as backfill or wet materials containing moisture in excess of quantity necessary for satisfactory compaction.

3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
4. Plan work to provide adequate protection during storms with provisions available constantly for preventing flood damage. Protect installed piping and other work against damage from uplift due to high ground water levels.
5. Accommodation of Drainage: Keep gutters, sewers, drains and ditches open constantly for surface drainage. No damming, ponding, water in gutters, or other waterways permitted, except where stream crossings are necessary and then only to extent Engineer considers necessary. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs. When required, provide pipes or troughs of sizes and lengths required at no expense to Authority. Perform grading in vicinity of trenches so that ground surface is properly pitched to prevent water running into trenches.
6. Pumping: Keep excavations free from water during performance of work at no expense to Authority. Build dams and other devices necessary for this purpose, and provide and operate pumps of sufficient capacity for dewatering excavations. Provide for disposal of water removed from excavations in a manner not to cause injury to public health, public or private property, work of others, portions of work completed or in progress, or produce an impediment to street, road and highway usage.
7. When necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials on roadways caused by hauling.
8. Provide effective dust control by sprinkling water, use of calcium chloride or other method approved by Engineer. Employ dust control when, where and in a manner required by Engineer.
9. Do not dispose of water in trenches by draining through completed portions of sewer piping.
10. Comply with Section 01 57 13, Erosion and Sediment Control.
11. In identified wetland areas, the construction sequence shall be in accordance with the permit issued.

C. Explosives and Blasting: Use and store explosives in accordance with requirements of Federal, State and local laws, rules, regulations, precautions, orders and decrees.

Additionally comply with following:

1. Do not use methods of blasting that result in breakage beyond trenching areas or is dangerous to public or destructive to property.
2. Assume sole responsibility for injury to persons or property as a result of explosives and blasting.
3. Schedule blasting in proximity of proposed new concrete work prior to placement of concrete.
4. Notify utility owners having structures or other installations above or below ground in proximity to trenching work prior to use of explosives. Give notice sufficiently in advance to enable utility owners to take steps necessary to protect their property from injury. Notifying utility owners does not relieve sole responsibility of damage resulting from use of explosives. The Engineer reserves

- the right to direct that rock within five feet of pipe, conduit or other structures encountered in the trench be removed by methods other than blasting.
5. Provide competent, licensed blaster to supervise blasting.
 6. Cease blasting operations when street paving adjacent to trench is damaged. Repair damaged street paving.
 7. Employ an independent testing laboratory, acceptable to Engineer, to conduct seismographic tests in conjunction with blasting operations. Tests will be made to establish acceptable blast patterns and procedures, and as often as Engineer deems necessary.
 8. Prior to starting work, furnish Engineer data concerning proposed blasting operations. Include location, depth, and area of blast; diameter, spacing, depth, pattern, and inclination of blast holes; type, strength, quantity, column load, and distribution of explosives to be used per hole, per delay, and per blast; sequence and pattern of delays; and description and purpose of special methods to be adopted. Engineer reserves right to limit maximum size of explosive charge.
 9. Engineer's acceptance of blasting data and techniques does not relieve responsibility to exercise proper supervision and field judgment and to produce specified results.
 10. Blasting is permitted only after proper precautions have been taken for protection of persons, work and property. Control fly rock and material to prevent damage to persons or structures. When directed by Engineer, use blasting mats in areas where overburden has been removed prior to blasting. Provide a positive means of dust control with equipment used for drilling of holes, subject to Engineer's approval.
 11. Perform blasting no closer than five feet from exposed existing utilities ten inches or less in diameter and no closer than ten feet from exposed existing utilities larger than ten inches in diameter. Before blasting within 150 feet of cured concrete, submit and obtain approval of a plan showing relative positions of concrete, area to be blasted, and blasting technique to be employed. Right is reserved by utility company not to allow blasting in trench adjacent to utility.
 12. Perform blasting no closer than 25 feet from existing utilities, transverse crossings and parallel installations, unless utility company relieves this requirement. Before blasting within 150 feet of cured concrete, submit and obtain approval of a plan showing relative positions of concrete, area to be blasted, and blasting technique to be employed. Right is reserved by utility company not to allow blasting in trench adjacent to utility.
 13. Use controlled blasting techniques. Modify blasting round as necessary to achieve best obtainable results and to keep air blast over pressure, vibrations and noise within limits specified. Exercise care in drilling and blasting operations to minimize overbreak and blast damage of adjacent unexcavated ground. Assume responsibility to produce a satisfactory excavated surface by determining proper relationships of factors of burden, spacing, depth of charge, quantity, and type of explosive, hole size and delay pattern, and other necessary considerations to achieve required results.
 14. Perform blasting operations during normal working hours 7 am to 6 pm prevailing time. In event of an emergency, for example a thunderstorm, prevents a blast

from being made before 6 pm, and holes are loaded, set blast off as soon as safety allows. In event blasting is found necessary during restricted hours, inform Authority and local residents, within hearing and vibration range, prior to firing. In addition, report in writing following day to Engineer, conditions requiring blasting during restricted hours. Impact or impulsive noise from blasting operations is not to exceed 130 dB peak sound pressure level measured at nearest structure or property line. Do not leave blasting materials in hole for extended periods of time.

15. Notify residents within hearing and vibration range, on morning of blasting as well as 72 hours in advance.
16. Store explosives on site only during blasting hours specified in preceding paragraph. Truck explosives to site at start of each work day from a magazine located remote from populated areas. Return surplus explosives to magazine at close of each work day. Locations of magazines on site and parking for explosives trucks will be determined by Engineer.
17. Monitor vibrations by measuring Peak Particle Velocity (PPV) in vicinity of blast at locations approved by Engineer. Provide experienced personnel to operate instrumentation used to monitor air blast overpressure and PPV. Arrange to have an experienced vibrations engineer available to review seismograph and instrumentation calibration data, and to recommend blasting techniques on Project. Data from measurements will be used in controlling blasting operations. PPV, as measured on or at structures in vicinity of blasting operations, is not to exceed two inches per second. Limitations on PPV do not relieve responsibility in ensuring integrity and safety of adjacent structures. PPV is defined as maximum of three velocity components of a vibration measured at any point in three mutually perpendicular directions by a seismograph approved by Engineer, capable of producing a permanent record and capable of internal dynamic calibration. Record air blast overpressure with a peak impact recording instrument having linear frequency response.
18. Furnish, install, and operate at site, an approved thunderstorm monitor and automatic lightning warning device. Make adequate provisions for transmitting alarms from device to locations where electric blasting or preparation for electric blasting is in progress. Locate and install system according to manufacturer's recommendations. Employ qualified personnel to operate and periodically test entire monitoring and alarm system for satisfactory operation, and promptly correct discovered defects. Provide for repair or replacement of facilities damaged by blasting operations at no cost to Authority.

D. Removal of Rock by Means Other Than Blasting: Where removal of rock by means other than blasting is required, in accordance with requirements of State and local laws, rules and regulations, and utility owner requirements, remove by use of mechanical surface impact equipment, or by drilling and hydraulic rock splitting equipment, or by other methods.

E. Responsibility for Condition of Excavation: Assume responsibility for condition and results of excavation. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.

- F. Protection: Assume risks attending presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work, existing structures and property of whatever nature. Responsibility for damages and expenses arising out of the Work, for direct or indirect injury to structures or to person or property by reason of them or by reason of injury to them; whether structures are or are not shown on Drawings, rests solely with the Contractor.
1. Outside Rights-of-Way: Take necessary precautions to protect trees, shrubs, lawns and other landscaping from damage. Restitution work for damages rests solely with Contractor and at no expense to Authority.
 2. Pipe Supports: Adequately support underground pipes or conduits not requiring removal and exposed as a result of excavations. Provide adequate support along entire exposed length by timber or planking. Install supports in a manner that backfilling may be performed without dislodging pipes or conduits. Place and carefully compact required Aggregate Backfill around supports, and leave in place as a guard against breakage due to backfill settlement. No additional payment will be made for support material left in place nor for labor of installing and maintaining supports.
 3. Temporary Protective Construction: Erect and maintain substantial temporary barricades and fences surrounding excavation to prevent unauthorized access.
 - a. Temporary Barrier: Where necessary, to keep one side of streets or roadway free from obstruction or to keep material piled alongside of the trench from falling on private property outside the right-of-way, erect and maintain a safe and substantial barrier fence.
 - b. Excavation Covers: Cover open excavation when work therein is suspended or left unattended, such as at the end of a work day. For such covers, use materials of sufficient strength and weight to prevent their removal by unauthorized persons.
 - c. Remove temporary protective construction at the completion of work on the Project.
- G. Structure Supports: Where excavations past buildings or structures that by their construction or position might exert detrimental pressure on the excavation, provide suitable structure supports for such builds or structures. Right is reserved by Engineer to require that buildings or structures, be underpinned or supported and protected, or special sheeting be driven, or that short lengths of trench be opened at one time.
- H. Removal of Obstructions:
1. Remove, realign or change direction of above or below ground utilities and appurtenant supports, if required in opinion of Engineer. Perform as extra work unless performed by owner of obstruction without cost to Contractor. However, uncover and sustain obstruction at no additional cost prior to final disposition of obstruction. No claims for damage or extra compensation due to presence of obstructions or delay in removal or rearrangement of obstructions will be made. Additional precautions concerning obstructions as follows:
 - a. Do not obstruct fire hydrants.
 - b. Do not interfere with persons, firms, corporations or utilities employing protective measures, removing, changing or replacing their property or

- structures, but allow taking measures necessary or advisable under circumstances, without relieving responsibilities of the Contractor.
- c. Without extra compensation, break through and reconstruct if necessary, invert or arch of sewers, storm drain, culvert or conduits encountered if structure is in a position, in judgment of Engineer, as not to require its removal, realignment or complete reconstruction.
 - d. Expenses incurred by owner of trackage for shoring his railroad tracks due to trenching adjacent to or tunneling under railroad Right-of-Way is Contractor's responsibility whether billed to him directly or to Authority. Should bills be unpaid by Contractor before final payment of Contract is made, Authority is empowered to pay bill and retain amount from moneys due or to become due Contractor.
- I. Advance Trenching: Where existing utilities or other suspected underground obstructions are within close proximity of proposed pipelines, uncover and verify exact location of obstructions far enough in advance of pipe laying to allow changes in pipe alignment or grade required to bypass obstructions and to avoid removing sections of pipe already installed. If sections of installed pipe require removal and reinstallation as a result of not verifying utilities or other underground obstructions far enough in advance, remove and reinstall pipe at no additional cost.
- J. Excess Materials: No right of property in materials is granted for excavated materials prior to backfilling. This provision does not relieve responsibility to remove and dispose of surplus excavated materials. Obtain written consent and any necessary permits and approvals before disposing of excess materials at an off-site location.
- K. Borrow Excavation: Where required quantity of backfill exceeds quantity of suitable material excavated within limits of Project site and Rights-of-Way, obtain sufficient material to complete backfill at no additional cost to Authority. If borrow excavation is needed, notify Engineer sufficiently in advance of borrow excavation requirements to permit Engineer to verify need for borrow excavation and to view proposed borrow pit and determine suitability of material to be provided. Borrow excavation from outside sources is subject to approval of Engineer. Obtain written consent and any necessary permits and approvals before use of borrow excavation from outside sources.
- 1. Borrow Material shall meet the requirements for On-Site Backfill material or On-Site Clean Earth Backfill material.
- L. Change of Trench Location or Depth:
- 1. Should Engineer require a change in location of a trench from that indicated on Drawings due to presence of an obstruction, or from other cause, and change in location is made before excavation is begun, no extra compensation or claim for damages will be granted.
 - 2. If a change in trench location made at requirement of Engineer involves abandonment of excavation already made, abandoned excavation, together with necessary refill is classed as unclassified excavation and backfill as applicable, in case full width of trench has not been abandoned.

3. If a change in trench location made at requirement of Engineer involves abandonment of excavation already made, abandoned excavation, together with necessary refill is classed as earth or rock excavation and backfill as applicable, in case full width of trench has not been abandoned.
 4. If a changed location of a trench is authorized by Engineer upon Contractor's request, Contractor is not entitled to extra compensation or to a claim for damage. If change of trench location involves abandonment of excavation already made, abandoned excavation and refill is at Contractor's expense.
- M. Accommodation of Traffic: Do not obstruct streets, roads and highways. Unless Municipality or Governing Agency authorizes in writing complete closing of street, road or highway, employ necessary measures at no expense to Authority to keep street, road or highway open and safe for traffic. Maintain a straight and continuous passageway on sidewalks and over crosswalks, at least three feet wide and free from obstructions. Do Not Obstruct Fire Hydrants.
- N. Classification of Excavated Materials: No consideration will be given to nature of materials encountered in trenching operations. Therefore, as unclassified trenching, no additional payment will be made for difficulties occurring in excavating and handling of materials.
- O. Maintenance of Roads:
1. The Contractor shall be responsible during the term of the Contract for the prompt and efficient removal, to the satisfaction of the Engineer and the owners of state, city, borough and township roads, of any soil or other debris deposited on roads or adjacent areas as a result of the Contractor's activities associated with the work to be performed under this Contract.
 2. Any potholes, ruts or other damage to existing state, city, borough or township road and adjacent areas which are created by the Contractor's activities shall be immediately repaired to the satisfaction of the owner of the road, using procedures and materials approved by the owner of the road.
 3. If the Contractor fails to repair or clean a road surface and adjacent areas in a timely manner or fails to repair or clean the road surface and adjacent areas to the satisfaction of the owner of the road, the owner of the road or the Authority has the right to perform the corrective work and charge the Contractor for the cost incurred. If the Contractor fails to pay the charges, said charges will be deducted by the Authority from the contract bid price.
- P. State Highway Pipe Foundation Underdrain: Replace underdrain which is damaged or removed during construction.
1. Use same type and quality of pipe, and coarse and fine aggregate backfill material as existing.
 2. Salvage and reuse of the piping will be permitted to reconstruct the pipe foundation underdrain; however, the Engineer will inspect this pipe after its removal and pipe determined unsuitable for reuse shall be replaced by the Contractor with new pipe.
 3. Use new coarse and fine aggregate backfill material.

4. Work shall be performed to the requirements and satisfaction of the Pennsylvania Department of Transportation.

PART 2 PRODUCTS

2.01 MATERIAL

- A. General: All materials to be free of topsoil, plant life, lumber, metal, refuse, coal waste, slag and cinders.
- B. Approved Backfill: On site excavated soil or soil-rock mixed materials free of rocks or similar hard objects larger than six inches in any dimension. Rocks or similar hard objects are not to represent more than 20 percent of backfill by volume.
- C. Select Backfill:
 1. On site excavated material free of rocks or similar hard objects larger than one inch in any dimension.
 2. AASHTO No. 8 Coarse Aggregate conforming to PDT Section 703.2.
- D. Aggregate Backfill: No. 2A Coarse Aggregate conforming to PDT Section 703.2. or Select Granular Material (2RC) conforming to PDT Section 703.3.
- E. Pipe Bedding:
 1. First Class Bedding: AASHTO No. 8 Coarse Aggregate conforming to PDT Section 703.2.
 - a. For piping having diameter of 21 inches and less use AASHTO No. 8 Coarse Aggregate.
 - b. For piping having a diameter of 24 inches and larger use AASHTO No. 57 Coarse Aggregate.
 2. Initial Backfill: Coarse Aggregate conforming to PDT Section 703.2.
 - a. For piping having a diameter of 21 inches and less use AASHTO No. 8 Coarse Aggregate.
 - b. For piping having a diameter of 24 inches and larger use AASHTO No. 57 Coarse Aggregate.
- F. Fine Aggregate: Conforming to PDT Section 703.1, for Type A sand.
- G. Reaction Backing, Concrete Cradle and Encasement: Per requirements of Section 03 30 00 and of following Class:
 1. H.E.S. concrete materials conforming to PDT Section 704.
 2. Class A (4,000 psi.) Concrete
 3. Provide Class B (3,000 psi.) Concrete for all other applications in trench excavation and backfilling work.
- H. Underground Warning Tape:
 1. Metallic Utility Lines: Printed 4-mil polyethylene non-detectable tape, six inches minimum width, color coded with black ink on APWA (American Public Works

- Association) approved colors, one inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.
2. Non-Metallic Utility Lines: Printed 5-mil polyethylene aluminum backed, detectable tape, six inches minimum width, color coded with black ink on APWA (American Public Works Association) approved colors, one inch minimum lettering, printed with name of utility buried below, and suitable for installation in all soil types.
 3. Provide underground warning tape for the following pipe lines and utilities as installed or encountered in the work:
 - a. Caution Buried Sewer Line Below - Green.
 - b. Caution Buried Water Line Below - Blue.
 - c. Caution Buried Gas Line Below - Yellow.
 - d. Caution Buried Electric Line Below - Red.
 - e. Caution Buried CATV Line Below - Orange.
 - f. Caution Buried Communication Line Below - Orange.
 - g. Caution Buried Fuel Line Below - Yellow.
 - h. Caution Buried Fiber Optic Cable Below - Orange.
 - i. Caution Buried High Voltage Line Below - Red.
 4. Acceptable Manufacturers:
 - a. Seton Identification Products.
 - b. Or Approved Equal.
- I. Flowable Backfill: Type A conforming to PDT Section 220.
1. Compressive Strength (PTM No. 604 28 Days): 125 psi.
- J. Trench Plugs:
1. Provide permanent trench plugs on critical slopes and on each side of wetlands to form a solid barrier against subsurface water movement. Permanent trench plugs shall consist of earth filled sacks packed tightly around pipe on critical slopes, as shown on the Drawings and bentonite filled sacks packed tightly around pipe where the pipe enters and leaves each wetland area, as shown on the Drawings.
 - a. Bentonite Trench Plugs: Provide sodium-based bentonite trench plugs consisting of 1/4 inch to 3/8 inch granules or chips. Product shall be natural occurring clay with the specific characteristic of swelling in fresh water.
 - b. Acceptable Manufactures:
 - 1) Falcon GDP; Holeplug.
 - 2) Black Hills Bentonite, L.L.C.; 3/8" Plug Trench Plugs.
 - 3) Or Approved Equal.

2.02 CONTRACTOR OPTION IN MATERIALS

- A. Backfill for Proposed Township Streets: For streets other than State Highways, it is a Township requirement that trenches be allowed to settle for a minimum of 90 days prior to replacement of permanent paving.
1. If permanent pavement is to be installed on or after the 90 day limit, use On-Site Backfill for trench refilling.

2. If permanent pavement is to be installed prior to the 90 day limit, use either one of the Aggregate Backfill Materials for refilling the trench.

PART 3 EXECUTION

3.01 PREPARATION

- A. Trench Line and Grade: Maintain trench line and grade as follows:
 1. Sewer Lines: Use Engineer's cutsheets as guides for rough excavation, allowing for excavating to accommodate the Pipe Zone Materials, and for Concrete Cradles or Concrete Encasements where indicated on the Drawings or required by the Engineer.
 2. DEP Requirements: Sewer grades shall conform to the requirements of the Pennsylvania Department of Environmental Protection (DEP). The minimum grade of terminal sewer runs shall be 0.60 percent. Where practical, however, a grade of at least 1.00 percent is preferred for terminal sewer runs.
 3. Control Points: Prior to excavation for a run of piping, set control points for line and grade indicated on the Drawings. Compute the depth of cut to pipe line invert from top of grade stakes or other control points. Use the computed depths of cut as guides for rough excavation allowing for excavating to accommodate the required bedding and concrete encasement or cradles.
 - a. Set control points sufficiently offset from the trench centerline to prevent loss of the points during the work. Set control points 25-feet apart maximum.
 - b. In unpaved areas, mark control points on the top portion of stakes and in paved areas, drive spikes or cut crosses into the paving, both encircled with paint.
 4. Batter Boards and Grade Stakes: As rough excavation is completed set grade stakes or batter boards of rough lumber across the trench opposite the control points. Securely set up and support each batter board to prevent accidental displacement and to ensure each board being leveled equidistant above the pipeline invert.
 - a. Run a taut string-line between the batter boards directly over the proposed pipeline centerline. Use the string-line as a control for maintaining pipeline grade and horizontal alignment.
 - b. To check the vertical distance from string-line to pipe invert, use a grade stake or pole, with a true right-angled offset designed to rest on the pipe invert.
 - c. Use a plumb line from the string-line to the center of pipe to maintain horizontal alignment.
 5. Maintenance of Line and Grade by Other Approved Methods: Subject to the Engineer's prior approval, the Contractor may have the option to use methods customary to the utilities construction industry to maintain lines and grades of pipelines.
 - a. Laser: If a laser beam instrument is approved for use by the Engineer, perform field checks of the beam position every fifty feet of installed pipeline. Use survey or other approved method to perform the laser beam position check.

6. Preparation of Surfaces: In sewer rights-of-way do not remove trees and other permanent plantings except by authorization of the Engineer. No additional compensation will be paid for hand excavation or tunneling in the vicinity of trees and other permanent plantings that are not being removed.
 - a. When tree and other permanent plantings removal is authorized, remove both the above ground and below ground portions by methods meeting Engineer's approval.
 - b. Trim merchantable timber of limbs and tops, and unless otherwise ordered by the Engineer, saw timber into eight foot lengths. Stock-pile timber at locations designated on the site by the Engineer. Merchantable timber is timber larger than six inches in smallest diameter from which saw logs, pulpwood, posts, poles, ties or cordwood can be produced.
 - c. Dispose of removed tree and permanent plantings debris in a lawful manner off site.
 - d. Where embankment is to be placed, clear and grub the area to a depth of not less than six inches below existing ground.

3.02 PERFORMANCE

- A. Perform soil erosion control work in accordance with requirements of Section 01 57 13.
- B. Perform sheeting and shoring in accordance with requirements of Section 31 41 00
 1. Excavating: Perform excavation and backfilling using machinery except that hand excavation and backfilling may be required where necessary to protect existing structures, utilities, private or public properties.
 2. Begin excavation in trenches at the control point having the lower invert and proceed upgrade.
 3. Remove surface materials of whatever nature, including pavement and topsoil, over line of trenches and other excavations and properly separate and store removed materials as suitable for use in backfilling or other purposes.
 4. Remove subsurface materials of whatever nature, including rock, masonry and cementitious materials, down to subgrade elevation. Properly separate and store removed subsurface materials as suitable for use in backfilling.
 5. Remove rock to subgrade at least 25 feet in advance of pipe laying.
 6. Paving Removal: Using a mechanical saw, cut paving to neat lines equidistant from the center line of the trench. Remove paving one foot beyond specified excavation limits.
 7. Remove rock below subgrade if shattered due to excessive drilling and blasting, and in opinion of Engineer it is unfit for foundations. Backfill to subgrade with Class B Concrete materials per requirements of Section 03 30 00, or other material acceptable to Engineer. No separate or additional payment will be made for removal and backfill due to excessive drilling and blasting.
 8. Excavate rock in miscellaneous excavations to extent required by Engineer.
 9. When rock is encountered in excavations where blank connections are to be left for future extensions of waterlines, remove rock for a distance of not less than ten

feet from blank connection in direction of future extension. Excavate trench to specified width, depth and length.

10. Remove and waste or otherwise dispose of excavated materials not required for backfill at no expense to Authority.
11. Pre-drilling or pre-drilling and blasting within State Highway Rights-of-Way not permitted. Prior to removal of rock within State Highway Rights-of-Way, strip earth to rock.
12. In State Highway rights-of-way remove the excavated materials as soon as such is excavated. Store and return this same excavated material for backfilling when required. In no case will the Contractor be allowed to cast excavated material beyond the curb or right-of-way lines or on sidewalks or lawns.

- C. Trench Width and Depth: For full depth of trench, maximum trench pay width is a vertical plane as specified in Table A. If sheeting is required, Table dimensions apply to the inside face of sheeting.

TABLE A	
Diameter of Pipe	Maximum Trench Width (Outside Diameter of Pipe at Barrel Plus)
3 through 36 inches	24 inches
42 through 72 inches	30 inches
Larger than 72 inches	36 inches

1. Depth: Excavate below planned bottom of pipe, 6 inches in earth and 8 inches in rock.
2. No additional compensation will be paid for excavation beyond trench widths indicated in Trench Width Tables unless approved in writing by Engineer.
3. Excavate rock for manhole, chamber, catch basin or other structure installations 1 foot outside exterior lines of structure walls and to a depth of outside bottom.

- D. Trench Width and Depth: For the purposes of measurement and payment only, trench widths and depths have been established as specified herein. No additional compensation will be paid for excavation beyond the specified trench width maximums in the Trench Width Table below.

1. Pipe Embedment Area: In the pipe embedment area (which extends from subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe), and for measurement and payment purposes only, the trench banks will be considered as nearly vertical and not less than the minimum nor more than the maximum width specified in Table A. below.

TABLE A		
Diameter of Pipe	Minimum Trench Width (Outside Diameter of Pipe at the Barrel Plus)	Maximum Trench Width (Outside Diameter of Pipe at the Barrel Plus)
through 24 inches	12 inches	16 inches
27 through 36 inches	20 inches	24 inches
42 through 72 inches	26 inches	30 inches
Larger than 72 inches	30 inches	36 inches

2. Remainder of Trench: Beginning at a point twenty-four inches above the top of the outside barrel of the pipe, and for measurement and payment purposes only, trench banks will be considered as nearly vertical, with the trench width at the top not exceeding the outside diameter of the pipe at the barrel plus the dimensions in Table B.

TABLE B	
Diameter of Pipe	Maximum Trench Width at Top of Trench (Outside Diameter of Pipe at the Barrel Plus)
through 24 inches	40 inches
27 through 36 inches	48 inches
42 through 72 inches	54 inches
Larger than 72 inches	60 inches

3. Excavation Width and Depth for In-Line Structures (Includes Manholes):
Excavations will be considered as nearly vertical beginning at bottom of excavation one-foot beyond in-line structure base outside dimension (six inches each side) to two feet beyond in-line structure base outside dimension for top of excavation limit (one foot each side).
- If surface pavement of any type is encountered (vehicle or pedestrian ways), cut such pavement to a rectangular shape as opposed to circular shape of in-line structure. Make limits of cut not to exceed one foot beyond top of excavation limit as specified. No additional compensation allowed for surface pavement cuts exceeding the specified limits.
 - Additionally, should bottom of excavation limit be exceeded, provide without additional compensation, concrete cradle or encasement for pipes entering or leaving manhole or in-line structure.
- E. Right-of-way or Easement Restrictions: Where pipe lines are constructed in rights-of-way or easements, the work shall be performed in compliance with OSHA, however the maximum trench width shall be kept entirely within the limits of rights-of-way or easements.
- F. Excavation Width and Depth for Manhole Rehabilitation: Excavate around the periphery of the manhole frame to a nearly vertical plane beginning at bottom of excavation one foot beyond the manhole base outside diameter (six inches each side)

to two feet beyond manhole base outside diameter for top of excavation limit (one foot each side).

1. Paving Removal: Using a mechanical saw, cut paving to neat lines equidistant from the center line of the manhole. Remove paving one foot beyond specified excavation limits.
2. Should bottom of excavation limit be exceeded, provide concrete cradle or encasement for pipes entering or leaving manhole.
3. Excavate rock for manhole installation one foot outside the exterior lines of the manhole walls and to a depth of the outside bottom.

G. When unsuitable material is found below subgrade, as determined by Engineer, remove material to a depth determined by Engineer, and provide Pipe Bedding compacted in 4 inch layers.

H. Length of Open Trench: Engineer has right to limit quantity of trench opened in advance of pipe laying and quantity of pipe laid in advance of backfilling, but in no case are these quantities to exceed 300 feet and 100 feet respectively. Complete trench excavation at least twenty five feet in advance of pipe laying and keep trenches free from obstructions, except that at end of a work day or at discontinuance of work, pipe laying may be completed to within five feet of end of open trench. Additional open trench limitations as follows:

1. Engineer is empowered to require trench backfilling over completed pipe lines at any time if in his judgment it is necessary. No claim for extra compensation will be allowed for trench refilling even though work stopped elsewhere as a result.
2. If trenching work is stopped for any reason, except as required by Engineer, and excavation is left open for an unreasonable period in advance of construction in opinion of Engineer, Engineer may order trench refilling at no additional expense and not allow trench reopening until ready for actual use.

I. Excavated Material Storage:

1. In streets, roads, and highways, or in other locations where working space is limited, remove excavated materials from first 100 feet of opening as soon as its excavated, when required by Engineer. Store and return excavated materials for backfilling when required, at no expense to Authority. In no case cast excavated material beyond curb or Right-of-Way lines or on sidewalks or lawns.
2. Where more material is excavated from trenches than can be backfilled or stored on street or within Rights-of-Way limits, leaving space for traffic and drainage, remove and store excess material. Return excess material for backfilling when required, at no expense to Authority.

J. Subgrade Preparation: Provide Pipe Bedding in trenches as pipe foundations. Depth of Bedding is indicated on Drawings. In lieu of Pipe Bedding, provide concrete encasement or concrete cradle or other type of bedding as indicated on Drawings or required by Engineer. If maximum trench widths specified in Trench Width Table are exceeded, provide concrete cradle or concrete encasement at no expense to Authority.

- K. Excavation Below Subgrade: Do not excavate below depths indicated or specified except where unstable or unsuitable material is encountered at subgrade. Excavate such material to the increased depth as may be required by the Engineer and refill to the proposed subgrade with thoroughly compacted Foundation Backfill material or construct timber foundation as required by the Engineer.
1. If excavations are carried below indicated or specified subgrades without written permission, refill excavations to proper subgrade with thoroughly compacted Foundation Backfill material.

3.03 BACKFILLING:

- A. Backfill Restrictions:
1. Do not use in backfilling work materials such as house ashes, putrescible refuse and such other materials considered unsatisfactory by the Engineer. Do not permit excavations to be used as dumping areas for refuse.
 2. Do not use frozen backfill materials or place backfill materials on frozen subgrade or trench surfaces.
 3. Should there be a deficiency of proper backfill material, provide acceptable borrow material.
 4. Except for temporary use in backfilling, no permanent bulkheads or retaining walls will be allowed in the trenches over piping.
- B. Pipe Bedding (Subgrade Preparation): Provide six inches of First Class Bedding as pipe foundations in trenches made in both earth and rock. Instead of First Class Bedding provide Concrete Encasement or Concrete Cradle, or other type of bedding, where and as shown on the Drawings or required by the Engineer. If maximum trench widths specified in Table A (shown previously) are exceeded, provide Concrete Cradle or Concrete encasement in such locations. Construct First Class Bedding, Concrete Encasement and Concrete Cradle as specified and in accordance with Detail Drawings.
- C. Perform trench backfilling and backfilling excavations for other in line structures by methods resulting in thorough compaction of backfill material without displacement of grade and alignment of pipeline and its appurtenances and minimum settlement of backfilled material. Displacement of pipeline and settlement of backfill will be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require regrading and realigning pipeline and removing and recompacting settled material at no expense to Authority. Following pipe bedding, piping and inline structure installation, backfill trenches in following manner:
1. Initial Backfill: Following pipe bedding and piping and inline structure installation, backfill trenches to a height at least two feet above the top of the pipe barrel with Initial Backfill material placed in four inch compacted layers. This backfill shall be carefully placed in trenches in such manner as not to damage or disturb the pipe.
 2. Backfilling In Other Than Roadways: Backfill remainder of the trench using backfill placed in layers not exceeding six inches in thickness after compaction. Exercise care to carry backfill up evenly on opposite sides of the piping. Replace

topsoil to approximate depth of existing as final backfilling operation and crown to such height as required by the Engineer. Maintain crowned surface to the satisfaction of the Engineer, during the Guarantee Period.

3. Backfilling in Roadways: Backfill remainder of the trench using backfill materials specified below. Exercise care to carry backfill up evenly on opposite sides of the piping.
4. State Highway and Shoulder, Municipal Streets, Paved Entrances, Parking Lots, and Driveways: Backfill trenches to a height at least one foot above top of outside barrel of pipe with Select Backfill material placed in four inch layers. Carefully place this backfill in a manner not to damage or disturb pipe. Backfill remainder of trench with Aggregate Backfill compacted in four inch layers to bottom of temporary or permanent paving. If vibratory compaction equipment is used, lifts may be 8 inches.
5. Unpaved Shoulder Along Municipal Streets: If edge of trench is three feet or more from edge of road, backfill trench with Select Backfill compacted in four inch layers flush with existing shoulder. If edge of trench is less than three feet from edge of road, backfill trench with Select Backfill within 18 inches from top of trench; remaining 18 inches to be backfilled with Aggregate Backfill; entire depth to be compacted in 4 inch layers, unless vibratory compaction equipment is used, then lifts may be 8 inches.
6. Unpaved Areas: Backfill trenches to a height at least one foot above top of outside barrel of pipe with Select Backfill material placed in four inch layers. If vibratory compaction equipment is used, lifts may be 8 inches. Carefully place this backfill in a manner not to damage or disturb pipe. Backfill remainder of trench with Approved Backfill compacted in eight inch layers to bottom of topsoil. Replace topsoil to approximate depth of existing, as final refill operation and crown to height required by Engineer. Maintain crowned surface as required by Engineer, during guarantee period.
7. Additional Requirements for Piping Bedding and Backfill:
 - a. Assure that sufficient Pipe Zone Bedding material is worked under the haunching of the pipe to provide adequate side support.
 - b. Prevent movement of pipe during placing of material under the pipe haunch. Walking or standing on pipe will not be permitted.
 - c. Excessive tamping of Select Backfill material over the top of the pipe will not be permitted.
 - d. Do not use rolling equipment or heavy tampers to consolidate backfill until at least two feet of backfill is placed over the top of the pipe.

3.04 ANCILLARY WORK

- A. Earth Dams: Construct Earth Dams composed of On-Site Select Earth Backfill material. Construct Earth Dams in accordance with the Drawing Detail. Place Earth Dam material by hand and compact with proper tools designed especially for such purpose.
 1. Locations For Earth Dams:
 - a. Construct Earth Dams in main sewer trenches at 100 foot intervals.

- b. Construct Earth Dams at a point not less than three feet upstream from in-line structures.
 - c. Construct Earth Dams in trenches for service connections at a point not less than three feet from the main sewer trench.
 - d. Construct additional Earth Dams in trenches at such other locations required by the Engineer.
- B. Service Connections: Excavate depth of cut to invert predetermined by Engineer. Where required by Engineer, excavate entire length of service connection trench before laying pipe.
 - 1. Rock Excavation: If rock is encountered within ten feet of buildings, remove by methods other than blasting. Remove rock to one foot beyond end of service connection.
 - 2. Curb and Sidewalk Restoration: If curbs and sidewalks are disturbed during service connection work, restore such curbs and sidewalks to as new conditions.
 - 3. Markers (For New Installations): Do not backfill upper free end of service connection until elevation and location points are inspected and approved by Engineer. Install a two by four-inch lumber marker set plumb and flush with invert of upper free end of service connection. Cut top of marker flush with existing grade.
- C. Backfill for Manhole Rehabilitation:
 - 1. Streets with a Bituminous Concrete Base Course or HMA Base Course:
 - a. Prior to placing any backfill, paint the outside surface of the manhole walls, leveling units, manhole frame and edges of existing paving with a thin application of PG 64-22 asphalt cement to provide a closely bonded, watertight joint.
 - b. Backfill the excavation around the manholes with base course material to a point 1 1/2 inches below the top surface of the adjacent existing paving. Place the base course material in layers not more than four inches thick after compaction. The bituminous concrete surface course shall consist of a 1 1/2 inch thick wearing course of ID-2 or HMA bituminous concrete and the completed surface thereof shall be flush with the surface of the adjacent street paving.
 - 2. Streets with a Cement Concrete Base Course:
 - a. Prior to placing any backfill, paint the outside surface of the manhole walls, leveling units, manhole frame and edges of existing paving with a thin application of PG 64-22 asphalt cement to provide a closely bonded, watertight joint.
 - b. Backfill the excavation around the manholes with high early strength concrete to a point three inches below the top surface of the adjacent existing paving. The bituminous concrete surface course shall be placed in two courses, consisting of a binder course and a wearing course. The binder course shall not be less than 1 1/2-inches thick after compaction and the wearing course shall not be less than 1 1/2-inches thick after compaction and the completed surface thereof shall be flush with the surface of the adjacent street paving.

- D. Stream Crossings: Excavate trenches in stream crossings to the depth shown on the Drawings or otherwise required by the Engineer.
1. Material excavated may be used as backfill unless specifically prohibited by the state agency having jurisdiction.
 2. Make the necessary provisions for cofferdaming, dewatering and removal of excess excavated material.
 3. Maintain the flow in the stream.
 4. Where rock is encountered in the stream crossings, do not use forms to construct the concrete encasement; place concrete on firm rock below the pipe and against firm rock on both sides of the pipe to provide a firm bond between the encasement and the rock. Should the Contractor excavate beyond the dimensions specified previously for the concrete encasement, he shall furnish and place the additional concrete encasement beyond the dimensions shown on the Drawings.
- E. Underground Warning Tape: For the purposes of early warning and identification of buried pipes during future trenching or other excavation, provide continuous identification tapes in trenches. Install in accordance with printed recommendations of the tape manufacturer, and as specified herein:
1. Bury tape at a depth of 12-inches below grade. In pavements measure 12-inches from subgrade of pavement.
 2. Provide warning tape in trenches for utilities specified previously.
- F. Compacting: During course of backfilling and compacting work, Engineer may, at any location or depth of trench, require Contractor to perform tests to determine whether compaction operations are sufficient to meet specified requirements. Trench excavation and backfill on State Highways is subject to inspection by representatives of Pennsylvania Department of Transportation. Similar inspection and requirements apply to township street excavations. Compact trench backfill as follows:
1. Solidly tamp each layer of required backfill around pipeline with proper tamping tools made especially for this purpose.
 2. Thoroughly compact aggregate backfill with a vibratory compactor of type and size satisfactory to Engineer and/or PennDOT as applicable. Compacting of aggregate backfill by puddling or jetting is not permitted.
 3. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density at bottom of each layer of not less than 90 percent of maximum density obtained at plus or minus two percentage points of the optimum moisture content as determined by ASTM D698. Perform field determinations of density, in accordance with ASTM D1556 or D2922.
 4. Where approved On-Site Backfill material is used under existing and proposed streets other than State Highways, compact the materials to produce a density of not less than 90 percent of maximum density up to the bottom of paving or proposed grade.
 - a. Perform two to five field determinations of density for every 200 linear feet of trench backfilled at locations and depths determined by the inspector. The Contractor shall reimburse the Authority for inspection services provided by the Authority's inspector.

- b. Field determinations of density shall be performed by an independent testing agency provided by the Contractor, subject to the approval of the Engineer, or performed by the Engineer. The testing agency shall furnish test results verbally to the Contractor and the Authority's inspector immediately upon completion of each test, and furnish two copies of each test result report to both the Contractor and the Engineer within 48 hours of the completion of each test.
 - c. The use of puddling or jetting for compacting backfill in trenches is prohibited.
 - d. Compacting Backfill In State Highways: Trench excavation and backfill within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania, Department of Transportation, and the work shall be performed in accordance with the requirements of that department even though such requirements may entail more labor or services than the methods herein described.
5. From a point two feet above top of pipe to subgrade of paving (or below surface where paving is not required), compact backfill by tamping. Use of Hydra-Hammer for compacting backfill in trenches is prohibited.

G. Embankment Construction for Pipelines:

- 1. Embankment Construction: Construct embankments in accordance with the following paragraphs:
 - a. Embankment Foundation: Remove existing embankment foundation material when determined unsatisfactory by the Engineer. Refill such areas to original elevation in the same manner specified for formation of embankment.
 - 1) Scarify embankment foundation surface where embankment three feet or more in height is to be placed. Scarify or otherwise loosen embankment foundation surface to a depth of six inches where embankment less than three feet in height is to be placed.
 - 2) Existing embankment foundations having a slope steeper than four to one shall be plowed to provide embankment binding when required by the Engineer. On steeper slopes the Engineer may require the foundation to be cut into steps or berms.
 - 3) Fill existing natural depressions or such other depressions resulting from the site work to the level of adjacent ground elevation in the same manner specified for formation of embankment prior to starting initial embankment layer.
 - b. Formation of Embankment: Use On-Site Backfill material placed in nine inch layers and each compacted separately using equipment meeting with Engineer's approval. Carry the whole embankment up evenly the required elevation without breaks or irregularities in material distribution or in the formation of layers. Trim embankment slopes and leave in a neat and acceptable condition.
 - 1) Add water to On-Site Backfill material which does not contain a sufficient amount of moisture to obtain the required compaction. On-Site Backfill material containing moisture in excess of the amount required to obtain the necessary compaction density may not, without

written approval, be incorporated in the embankment until allowed to dry to a moisture content not greater than two percentage points above optimum for that particular material.

- 2) When pipe is to be laid in fill, bring embankment height to at least four feet above the top of the pipe before the trench is excavated.
- 3) Compact embankment material to a minimum final density of not less than 90 percent of the maximum dry weight density at its optimum moisture content.

H. Flowable Backfill: Mix and transport in accordance with PDT Section 704. Submit sequence of operations for approval prior to placement.

1. Testing and Acceptance: Conforming to PDT Section 704.1(d) except as follows:
 - a. Concrete for flowable backfill will be tested for slump in accordance with PTM No. 600, and for yield in accordance with PTM No. 613.
 - b. Cylinders for compressive strength testing will be molded in accordance with PTM No. 611 and cured in accordance with PTM No. 611, Section 11.1".

I. Cleanup:

1. Remove surplus excavated material, rubbish and other construction debris, and keep removed to a point not more than two hundred feet from head of open trench, unless otherwise authorized by Engineer.
2. After trenches and other excavations are backfilled and work completed, remove surplus excavated materials, rubbish or other materials from work site. Dispose of materials off site in a lawful manner at no additional expense to Authority.
3. Evenly spread and leave in neat, smooth condition excavated material disposed of lawfully on public property.
4. Furnish and place topsoil, fertilize and seed grassed areas, within and outside Rights-of-Way affected by construction. Reseed and refertilize areas that fail to show a uniform stand of grass. Water, mow, rake, weed and otherwise maintain grass until final acceptance of Contract.
5. Restore area covered by temporary and permanent Rights-of-Way to as near original conditions as is practical. Bring area up to original grade, place topsoil, seed, replant or replace shrubbery, repair or replace walks, driveways, fences and other improvements, damaged or removed.
6. Place topsoil, lime, fertilizing and seed in a manner consistent with acceptable trade practices for the area involved.
7. When repaving over trenches and other excavations is completed, sweep paved surfaces affected by work using hand or power sweepers, and if required by Engineer, flush with water to remove dust and small particles.
8. In case Contractor fails or neglects to do so or makes unsatisfactory progress in doing so, within twenty four hours after receipt of a written notice from Engineer, Authority may remove surplus material and clear roadways, sidewalks and other places, and expense for work charged to Contractor and deducted from moneys due or to become due him under Contract.

- J. Maintenance: Assume responsibility for injury or damage resulting from lack of trench maintenance during guarantee period. If trench surfaces are not satisfactorily maintained or repairs begun within seven days after written notice from Engineer, repairs may be made by Authority, and cost charged against Contractor.

END OF SECTION

SECTION 31 41 00

SHORING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Provision for protection of excavations by sheeting and shoring.
- B. Related Sections:
 - 1. Trenching and Backfilling: Section 31 23 33.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Furnish shoring materials and install work conforming to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.
 - 2. The duty or responsibility for inspection, determination, compliance and enforcement of Federal, State, local laws, rules, regulations, requirements, precautions, orders and decrees rests with such department or agency and not with the Authority or Engineer.
 - 3. Provide material for sheet piling, sheeting, bracing and shoring and drive or set in place in accordance with Federal, State and local laws for excavations and construction; and as required to protect workers and public, or to maintain trench widths specified in Section 31 23 33, regardless if considered necessary by Contractor.

1.03 PROJECT CONDITIONS

- A. Responsibility for Condition of Excavation:
 - 1. Failure or refusal of Engineer to suggest use of bracing or sheeting, or a better quality, grade, or section, or larger sizes of steel or timber, or to suggest sheeting, bracing, struts, or shoring be left in place, does not relieve Contractor of responsibility concerning condition of excavation or of his obligations under Contract, nor impose liability on Engineer or Authority. Delays, whether caused by action or want of action on part of Contractor, or by act of Engineer, Authority, or their agents, or employees, resulting in keeping of excavation open longer than would otherwise have been necessary, does not relieve Contractor from necessity of properly and adequately protecting excavation from caving or slipping, nor from his obligations under Contract relating to injury to persons or property, nor entitle him to claims for extra compensation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Wood Materials: Use wood sheeting, sheet piling, bracing and shoring in good serviceable condition and timbers of sound condition, free from large or loose knots, and of proper dimensions.
- B. Metal Materials: Steel or manufactured aluminum sheet piling and bracing of equal strength may be substituted for wood.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Using skilled labor, drive or set sheeting, sheet piling, braces or shores in place and arranged that they may be withdrawn as excavations are backfilled, without injury to piping and structures, and without injury to or settlement of adjacent structures and pavements.
- B. Drive sheeting in advance of excavation when tight plank or steel sheeting is required. Make joints of tongue and groove or interlocking type and as watertight as possible.
- C. Remove sheeting, bracing and shores as trenches and other excavations are being backfilled, except where and to extent Engineer requires, in writing, it be left in place or where permitted to leave in place at Contractor's own request and cost.
 - 1. In withdrawing sheeting and sheet piling, exercise care to ensure that voids or holes left by planks as they are withdrawn are backfilled and thoroughly rammed with thin rammers provided especially for that purpose.
 - 2. Exercise care to carry backfill up evenly on all sides of items installed in excavations.
- D. Cut off sheeting or sheet piling left in place as required by Engineer and remove from work portion cut off. No additional compensation allowed for cutting and removal of sheeting or sheet piling left in place.

END OF SECTION

SECTION 31 70 00

TUNNELING AND MINING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for construction of a pipeline by tunneling or boring and jacking construction methods.
 - 1. Contractor has the option to perform the pipeline crossing work of this project by any of the above stated methods. A combination of the methods will not be allowed.
- B. Related Sections:
 - 1. Temporary Erosion and Sediment Control: Section 01 57 13.
 - 2. Cast-In-Place Concrete: Section 03 30 00.
 - 3. Trenching and Backfilling: Section 31 23 33.
 - 4. Shoring: Section 31 41 00.
 - 5. Gravity Wastewater Utility Piping: Section 33 31 19.
 - 6. Wastewater Utility Force Mains: Section 33 34 16.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (H-20): (AASHTO) Loading for Conduits Installed Under Streets, Road, or Highways.
- B. American Railway Engineering Association (A.R.E.A.) (Cooper E-80).
- C. American Society for Testing and Materials:
 - 1. ASTM A53, Pipe Steel Black and Hot Dipped Zinc-Coated Welded and Seamless.
 - 2. ASTM A123, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A139, Electric-Fusion (Arc)-Welded Steel Pipe (Sizes 4 inch and over).
 - 4. ASTM A307, Carbon Steel Bolts, Studs, and Threaded Rod (60,000 PSI Tensile Strength).
 - 5. ASTM A569, Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.
 - 6. ASTM A615, Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 7. ASTM C32, Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
 - 8. ASTM C33, Concrete Aggregates.
 - 9. ASTM C144, Aggregate for Masonry Mortar.
 - 10. ASTM C150, Portland Cement.
 - 11. ASTM C207, Hydrated Lime for Masonry Purposes.
 - 12. ASTM C 270, Mortar for Unit Masonry.
 - 13. ASTM F467, Nonferrous Nuts for General Use.

14. ASTM F468, Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.

D. American Welding Society: AWS D1.1 Structural Welding Code.

E. CE-8 Specifications for Pipeline Occupancy of Consolidated Rail Corporation Property.

F. Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation Chapter 459, Occupancy of Highways by Utilities, January 1982.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design Criteria for Under Highways: Encasing conduit under highways to be of sufficient strength to support all superimposed loads, including an H 20 AASHTO live loading.
2. Design Criteria for Under Railroads: Encasing conduit under railroad tracks shall be of sufficient strength to support all superimposed loads, including a Cooper E 80 Loading with impact for applicable heights of cover.

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned Shop Drawings, Catalog Cuts or other data required to provide a complete description of products to be installed.

1. The shop drawings shall show the cross section dimensions, diameter and thickness gauge of the liner plate.

B. Furnish PennDOT and the railroad company (as applicable) for approval, detail drawings, accompanied by design calculations, for the tunneling shield, tunneling pits, including sheeting and bracing therefor, tunnel liner plate and tunneling procedure and grouting method and all such drawings and computations shall bear the seal of a Registered Professional Engineer.

C. Certificates: Certified records or reports of results of shop tests. Records or reports to contain a sworn statement that shop tests have been made as specified.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Use personnel thoroughly trained and experienced in skills required. Field supervisor of boring operations and boring machine operator to have not less than 12 months experience in operation of equipment being used.
2. Make welds only by welders, tackers and welding operators previously qualified by tests as prescribed in Structural Welding Code AWS D1.1 to perform type of work required. Show proof of certification when requested by Engineer.

B. Design Criteria:

1. Encasing conduit under railroad tracks shall be of sufficient strength to support all superimposed loads, including a Cooper E 80 Loading with 50 percent added for impact.

C. Regulatory Requirements:

1. State Highway Requirements:

- a. Materials and methods of construction used on State Highway right-of-way are subject to approval of Commonwealth of Pennsylvania Department of Transportation.
- b. Work of this Section within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania Department of Transportation, and the work will be performed in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities.
- c. Inspection, insurance or other charges demanded by PennDOT, or other authority having jurisdiction shall be paid for the Authority.

D. Source Quality Control:

1. Laboratory Tests: The Engineer reserves the right to require that laboratory tests be conducted on materials. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. These laboratory tests will be paid for as provided in the Bid Form from the fund stipulated for the purpose.
2. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following. Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.
3. Inspection and Certification by Manufacturer:
 - a. Steel Pipe: Furnish manufacturer's sworn statement that inspection and specified tests have been made on steel pipe as required by ASTM A139 and results comply with requirements of that standard.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store materials and products specified in a manner recommended by respective manufacturers to prevent damage and defects.

1.07 PROJECT/SITE CONDITIONS

A. Scheduling:

1. Do not start work within State Highway Right-of-Way until authorization is received from PennDOT to do so. If required by Highway Occupancy Permit, continue boring operations once started, until completed.

2. Do not start work within railroad company property until authorization is received from railroad company to do so. If required by railroad company, continue boring operations once started, until completed.
- B. Environmental Requirements:
1. As specified in Sections 31 23 33 and 33 31 19.
- C. Protection: As specified in Section 31 23 33 and the following:
1. Utility Supports: Adequately support and protect utilities and facilities encountered in, or affected by work.
 2. Blasting not permitted under or near State Highways or railroads.
 3. Structure Supports: As specified in Section 31 23 33.
 4. Accommodation of Traffic: As specified in Section 31 23 33.
 5. Excavation Conditions: As specified in Section 31 23 33.
 6. Excess Materials: As specified in Section 31 23 33.
 7. Borrow Materials: As specified in Section 31 23 33.
 8. Sheet, shore, and brace excavations as required to prevent subsurface subsidence.
 9. Keep boring pits dewatered, and pumps attended on a 24 hour basis, if conditions require. Maintain close observation to detect settlement or displacement of highway embankment, pavement, and facilities during dewatering operations. Dewater into a sediment trap and comply with applicable environmental protection criteria specified elsewhere in Contract Documents.
 10. Maintain suitable air in pipe when hand excavating for health of workers.
- D. Classification of Materials:
1. No consideration will be given to the nature of materials encountered in tunneling, boring or jacking operations. Remove rock encountered during the tunneling, boring or jacking operation. No separate or additional payment will be made for tunneling through rock.

PART 2 PRODUCTS

2.01 ENCASING CONDUIT

- A. Steel Casing Pipe for Highway Crossing: ASTM A139, Grade B or ASTM A53.
1. Minimum diameter and wall thickness is indicated on Drawings.
- B. Steel Tunnel Liner Plate: Cold formed, steel, four flanged liner plates of minimum inside neutral axis diameter as indicated on the Drawings, or as indicated by the Engineer.
1. Material: Structural quality hot rolled carbon steel conforming to ASTM A569, and hot-dipped galvanized conforming to ASTM A123.
 - a. Minimum Thickness: U.S. Standard Gauge 8, marked on each liner plate by manufacturer.
 2. Grout Holes: Provide tapped grout holes and plugs, minimum 1 1/2-inch diameter, in every third plate.

3. Nuts and Bolts: Minimum 1/2-inch diameter, coarse thread, conforming to ASTM A307, Grade A.
 4. Coating: Factory coated inside and outside with asphaltic material to a minimum thickness of 0.05 inch.
 5. Acceptable Manufacturers:
 - a. Armco Drainage and Metal Products, Inc.
 - b. Republic Steel Corp.
 - c. Commercial Shearing and Stamping Company.
 - d. Or equal.
- C. Steel Pipe: Conforming to ASTM A139, Grade B or ASTM A53, Grade B, and of minimum diameter as indicated on the Drawings.
1. Minimum Wall Thickness: As required by the individual site design criteria.
- D. Reinforced Concrete Pipe (RCP): As specified in Sections 33 31 19 and 3 34 16.

2.02 CARRIER PIPE AND FITTINGS

- A. Sewer Pipe and Fittings:
1. Ductile Iron Pipe (DIP): As specified in Section 33 31 19.
 - a. Use mechanical joint pipe.
 2. Reinforced Concrete Pipe (RCP): As specified in Section 33 31 19.

2.03 MISCELLANEOUS MATERIAL

- A. Aggregate Backfill: Aggregate material conforming to the following and the choice of material being as required according to the Engineer's direction in the field.
1. AASHTO No. 8 Coarse Aggregate conforming to PDT Section 703.2.
 2. Select Granular Material conforming to PDT Section 703.3.
- B. Sand: Conforming ASTM C33, fine aggregate.
- C. Flowable Fill: Conforming to the requirements of PDT Special Provision S94 (S2060130) Flowable Backfill for Pipe Trench, specifically Type A or Type B.
1. Material Properties and Criteria: As specified in PDT Special Provision S94 (S2060130).
- D. Concrete: Class B (3,000 psi.), as specified in Section 03 30 00.
- E. Lean Concrete: Plant mixed concrete of 2,000 psi compressive strength at 28 days with minimum cement content per cubic yard in accordance with current ready-mix plant standard practice.
1. Reduced Aggregate: Lean concrete shall contain aggregate with particle size not less than 1/8-inch or more than 1/2-inch in any dimension and a maximum of five percent of particles passing a No. 8 sieve.
- F. Waterproofed Mortar: Material composition meeting requirements of ASTM C270 for Type M, 2,500 psi (Parts by volume include: One part cement, 1/4 part lime, and

sand at not less than 2-1/4 nor more than three times the sum of the volumes of cement and lime used and of the following materials:

1. Waterproofing Agent: Add the Medusa product in the ratio of two pounds per bag of cement; add the other products per manufacturer's recommendations.
2. Acceptable Manufacturer's:
 - a. Medusa Cement Company; Medusa Waterproofing Paste or Powder.
 - b. Grace Construction Materials; Hydratite.
 - c. Chem-Master Corporation; Hydrolox.
 - d. Or Approved Equal.
3. Portland Cement: Conforming to ASTM C150, Type I.
4. Hydrated Lime: Conforming to ASTM C207, Type S.
5. Sand: Conforming to ASTM C144.
6. Water: Clean and free from deleterious amounts of acids, alkalis, and organic materials.

G. Casing End Seals: Provide end seal pulled around casing and carrier pipes after installation to provide a barrier to backfill debris and seepage. Each end seal kit is comprised of virgin SBR rubber seal, bonding cement, and T-304 stainless steel bands.

1. Acceptable Manufacturer:
 - a. Cascade Waterworks Manufacturing; Style CCES Casing Ends.
 - b. PSI Pipeline Seal and Insulator, Inc.
 - c. Or Approved Equal.

H. Casing Spacers: Support water mains inside steel casing pipe by use of casing spacers to prevent direct contact between water main and steel casing. Casing spacers also facilitate installation of pipe within casing, and limits movement of pipe within casing, both vertically and horizontally.

1. Provide casing spacers of the following design type:
 - a. Bolt on style, T-304 stainless steel (14 gauge) shell and risers, lined with ribbed PVC extrusion, and ultra high molecular weight polymer insulating runners. All fasteners to be T-304 stainless steel.
2. Acceptable Manufacturers:
 - a. PSI Pipeline Seal and Insulator, Inc.
 - b. Cascade Waterworks Mfg. Co.
 - c. APS Advance Products and Systems, Inc.

I. Hold Down Rod: Reinforcement bar conforming to ASTM A615, Grade 60, deformed.

1. Field coat hold down rods with a coal tar product such as No. 46-465 H.B. Tnemecol as manufactured by Tnemec Company, Inc., or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Drawings indicate smallest diameter casing acceptable for installations. A larger diameter casing can be used if expectations of encountering rock or boulders would

require hand mining. If electing to utilize casing diameter called for on Drawings, rock is encountered and installation is abandoned due to nonability to hand mine in casing, installation will be abandoned at no expense to Owner. Abandonment of a casing due to an obstruction is identified below.

B. Obstruction:

1. An obstruction is defined as being any physical object including water, electric, gas, sewer, telephone lines, and manholes, encountered during installation of casing pipe. Rock, boulders, sandstone, shale, or similar objects encountered during construction of a crossing are not considered as obstructions and are to be removed.
2. If an obstruction is encountered during installation of steel casing pipe, cease operations and notify Engineer immediately. In event installation cannot be modified and continued, abandon steel casing pipe in place and fill completely with grout.
3. If required to shift location or depth of crossing because of encountering an obstruction, work related to adding fittings, pipe, and appurtenances other than that shown on Drawings necessary for connecting mains prior to passing through casing conduit and additional excavation will be paid for by Change Order.

3.02 EXAMINATION

- A. Field Inspection: Inspect materials and products before installing in conformance with inspection requirements of appropriate referenced standard.
- B. Rejected Products: Remove rejected materials and products from Project Site and replace with new Products at no increase in Contract Price.

3.03 PREPARATION

- A. Excavation Work: As specified in Section 31 23 33 and such added requirements as specified herein:
 1. Over Excavation: Should the Contractor in constructing an access pit excavate below the subgrade for the proposed crossing, he will be required to backfill the area excavated below the subgrade with Aggregate Backfill or with Class B concrete as required by the Engineer and at no increase in Contract Price.
 2. Access Pit for Boring or Jacking: Preliminary work shall consist of excavating and shoring an acceptable shaft on the downstream side of the crossing and the installation of a backstop and guide timbers.
 - a. Bracing and Backstop Design for Jacking: The bracing and backstops shall be so designed, and jacks of sufficient rating shall be used, so that the jacking can be progressed without stoppage except for adding lengths of pipe. Accurately place guide timbers on line and grade.
 - b. Shoring: As specified in Section 31 41 00.

3.04 CONSTRUCTION

- A. Construction Options: The Contractor shall have the option to construct the pipeline crossing encasing conduit by tunneling or boring or jacking methods. A combination of the methods will not be allowed.
1. The Contractor shall have the option to install a larger diameter encasing conduit than shown on the Drawings, provided the Contractor has secured prior written approval of the applicable agencies having jurisdiction.
 - a. If the Contractor elects to install a larger diameter encasing conduit than shown on the Drawings, the Contractor shall maintain the required clearances in the type of crossing involved. Substitution of a larger diameter encasing conduit will be made without an increase in Contract Price.
 2. The Contractor shall have the option to install the encasing conduit by the boring or jacking method. The Contractor is solely responsible for the means and methods chosen to perform the encasing conduit installation.
 3. No increase in Contract Price will be allowed for difficulties encountered in the tunneling, boring or jacking operations.
- B. Tunneling Operations: Tunneling operations shall conform to the applicable requirements of Section 31 23 33 and the applicable requirements of the appropriate referenced regulatory agencies.
1. Install the Steel Tunnel Liner Plate to the limits indicated on the Drawings or required by the Engineer or the regulatory agencies.
 2. Exercise care in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material wherever possible.
 3. Do not advance excavation ahead of the previous installed liner plates any more than is necessary for the installation of the succeeding liner plate.
 4. Support the vertical face of the excavation as necessary to prevent sloughing. Completely bulkhead the heading at any interruption of the tunneling operation.
 5. Painting: Field paint the bolt heads and nuts of the installed tunnel liner plate.

3.05 PERFORMANCE

- A. Excavation and Backfill: As specified in Section 31 23 33.
1. Locate boring pits outside highway Right-of-Way limit. Boring pits not permitted closer to highway unless lesser distance is specifically authorized in writing by PennDOT.
 2. Cut end of boring pit away from boring face, perpendicular to axis of boring operation to provide a bearing surface for back stop and blocking.
 3. Construct back stop of heavy timber or steel rails capable of withstanding jacking force during boring operation.
 4. Nominal boring pit dimensions are 30 feet long, 8 feet wide and a depth of 1 foot below invert elevation of casing pipe.
 5. If excavation performed below required subgrade for water main, backfill area below subgrade with coarse aggregate backfill or with concrete as required by Engineer at no additional cost to Owner.

6. Sheet and shore boring pit as specified in Section 31 41 00. Provide a sump pump in one corner of pit to provide for dewatering.
- B. Boring Operations: Boring operations shall conform to the applicable requirements of the appropriate referenced regulatory agency and additional requirements specified herein:
1. Install the encasing conduit by the boring method to the limits indicated on the Drawings or such additional limits required by the Engineer or regulatory agency.
 2. Provide devices at the front of the pipe to prevent auger and cutting heads from leading the encasing conduit. Unsupported excavation ahead of pipe is prohibited.
 3. Over-cut by the cutting head shall not exceed the outside diameter of the encasing conduit by more than one-half inch.
 4. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
 5. If voids develop, or if bored hole diameter is more than one inch greater than the outside diameter of the encasing conduit, place Grout to fill the voids.
 6. Check conduit alignment in a manner and at time intervals as required by Engineer. Check alignment and grade at least once during each working shift as the work progresses.
 7. Completely bulkhead the heading at interruptions in boring operation.
 8. Completely butt-weld joints around the circumference between sections of steel pipe encasing conduit.
- C. Jacking Operations: Jacking operations shall conform to the applicable requirements of the regulatory agencies involved and such additional requirements specified herein. Perform encasing conduit jacking without handmining ahead of the conduit and without the use of any type of boring, augering, or drilling equipment.
1. Install the encasing conduit by the jacking method to the limits indicated on the Drawings or such additional limits required by the Engineer or the regulatory agencies.
 2. Bracing and backstops shall be so designed and installed, and jacks of sufficient rating used, so that the jacking can progress in a continuous operation except for adding lengths of pipe. Accurately place guiding apparatus on line and grade. Support the vertical face of the excavation as necessary to prevent sloughing.
 3. Use adequate soil support systems and bulkheads as required if subgrade conditions in the heading are unstable.
 4. Jacking and excavation within the pipe shall proceed simultaneously with the ground being cut no more than two inches outside the pipe at the top and sides and not less than two inches above subgrade at the bottom.
 5. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
 6. If voids develop, or if jacked hole diameter is more than one inch greater than the outside diameter of the encasing conduit, place grout to fill voids in manner approved by the regulatory agencies.

7. Check conduit alignment in a manner and at time intervals as required by Engineer. Check alignment and grade at least once during each shift as the work progresses.
 8. Completely bulkhead heading at interruptions in jacking operation.
 9. Completely butt-weld joints around the circumference between sections of steel pipe encasing conduit.
- D. Grouting Operations: Completely fill the voids behind the tunnel liner plate or encasing conduit by placing a uniform mixture of grout under pressure.
1. Provide grout holes tapped for no smaller than 1 1/2-inch pipe, spaced at approximately three feet around the circumference of the tunnel liner plates in every third ring.
 2. Start grouting at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel.
 3. Install threaded plug in each grout hole as the grouting is completed at that hole.
 4. Proceed with grouting as required by the Engineer, but in no event shall more than six linear feet of tunnel be progressed beyond the grouting.
- E. Installation and Testing Carrier Pipe:
1. Install water main pipe one length at a time and push through steel casing pipe on high density polyethylene casing spacers. Casing spacers are specified in Section 33 11 23. Use restrained joint pipe as specified for ductile iron pipe in Section 33 11 23.
 2. Laying and Supporting Pipe: Lay the pipeline in the tunnel or encasing conduit as specified in Sections 33 31 19 and 33 34 16 and such added requirements included herein:
 - a. Support and maintain the alignment and grade of the pipeline until the concrete cradle is poured and the hold down rods are set.
 - b. Provide concrete cradle as indicated on Detail Drawings. Concrete construction as specified in Section 03 30 00.
 - c. Support and maintain the alignment and grade of the pipeline using Treated Wood Blocking arranged in the manner as indicated on the Drawings. Strap the blocks sufficiently secure to prevent displacement during pipe installation but not so tight as to cause deformity of the pipe.
- F. Tunnel or Encasing Conduit Filling and Closing: After the pipeline has been installed in the encasing conduit, and has been tested, fill the encasing conduit using materials as required by the regulatory agency.
1. Close both ends of encasing conduit with Casing End Seal.

3.06 FIELD QUALITY CONTROL

- A. Testing: After laying pipe line in encasing conduit and before filling conduit, conduct line acceptance testing as specified in Sections 33 31 19 and 33 34 16 as applicable.

3.07 CLEANING

- A. Cleanup: As specified in Section 31 23 33. Restore highway and railroad property to condition equal to or better than existed prior to start of work.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for precast concrete cylindrical manhole components and appurtenances.
2. Requirements for rectangular or square precast concrete structures and appurtenances.

B. Related Sections:

1. Cast-In-Place Concrete: Section 03 30 00.
2. Grouting: Section 03 60 00.
3. Excavation and Fill: Section 31 23 00.
4. Trenching and Backfilling: Section 31 23 33.
5. Gravity Wastewater Sewer: Section 33 31 19.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M-198, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. AASHTO Standards as referenced throughout these Specifications.

B. American Society for Testing and Materials.

1. ASTM A 48, Specification for Gray Iron Castings.
2. ASTM A240, Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
3. ASTM A276, Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
4. ASTM A307, Specification for Carbon Steel Externally Threaded Standard Fasteners.
5. ASTM A615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
6. ASTM C144, Specification for Aggregate for Masonry Mortar.
7. ASTM C150, Specification for Portland Cement.
8. ASTM C207, Specification for Hydrated Lime for Masonry Purposes.
9. ASTM C270, Specification for Mortar for Unit Masonry.
10. ASTM C361, Specification for Reinforced Concrete Low-Head Pressure Pipe.
11. ASTM C443, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
12. ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections.

13. ASTM C497, Standard Methods of Testing Concrete Pipe, Manhole Sections, or Tile.
14. ASTM C923, Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
15. ASTM C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
16. ASTM D412; Standard Test Methods for Rubber Properties in Tension.
17. ASTM D518; Standard Test Method for Rubber Deterioration - Surface Cracking.
18. ASTM D573; Standard Test Method for Rubber - Deterioration in an Air Oven.
19. ASTM D624; Standard Test Method for Rubber Property - Tear Resistance.
20. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
21. ASTM D2000, Standard Classification System for Rubber Products in Automotive Applications.
22. ASTM D2137; Standard Test Method for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics.
23. ASTM D2240, Test Method for Rubber Property-Durometer Hardness.
24. ASTM D3676; Standard Specification for Rubber Cellular Cushion Used for Carpet or Rug Underlay.
25. ASTM D4101, Specification for Propylene Plastic Injection and Extrusion Materials.
26. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
27. ASTM F594, Specification for Stainless Steel Nuts.

C. American Water Works Association:

1. AWWA C302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Structure Compressive Strength: 5,000 psi minimum strength at 28 days.

B. Design Loading:

1. Design loadings to include dead loads, live loads, impact loads due to water table, and other loads placed on structure.
2. Design live loading for AASHTO H-20 or HS-20 as indicated on Drawings. Designed wheel load is 16 kips. Live load is load producing maximum shear and bending moments in structure.

C. Contractor Option: Certain reinforced concrete components indicated on Drawings may be either prefabricated manufactured products or field cast-in-place. However, in either case, attain compressive strength specified.

D. Field Cast Option: Conform to requirements of Section 03 30 00.

1.04 SUBMITTALS

A. Shop Drawings and Product Data:

1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Contractor prepared drawings as applicable.
 2. Manufacturer's descriptive literature and specifications covering product specified. Include installation information.
 3. Shop Drawings to indicate types of materials, dimensions and details including location of reinforcement, inserts, anchors, connections, accessories, joints, openings, and setting details.
- B. Certificates:
1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
 2. Manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components and products.
- C. Design Calculations: Submit structural calculations for structures furnished under this Section. Have calculations sealed and signed by a Registered Professional Engineer.

1.05 QUALITY ASSURANCE

- A. Quality Control: Maintain uniform quality of products and component compatibility by using the products of one manufacturer for precast reinforced concrete manholes.
- B. Certifications:
1. Obtain certificate of materials and construction compliance with ASTM C478 from the precast reinforced concrete manhole manufacturer. Submit this certificate as part of required submittals.
 2. Obtain certificate of material and construction compliance with ASTM A48, Class 30 tensile strength from the manhole frame and cover manufacturer. Furnish certification that tensile test bars were from same pour as castings. Submit the certificate as part of required submittals.
- C. Shop and Laboratory Tests: As a condition of the Contract, the materials stated herein require periodic testing according to methods referenced, or as required by the Engineer.
1. Laboratory Tests: Submit three manhole frame and cover tensile test bars for each 50 manhole frames and covers, or less if the total required is less than 50. Submit one machined test bar ready for testing. Engineer will verify certifications, release one bar for the Machine Bar Tensile Test, and retain two remaining bars.
 - a. Testing Laboratory shall furnish both Engineer and Contractor two copies of test result reports. These reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
 2. Shop Tests: The manhole component manufacturers shall have the capability to perform the number of tests that the Engineer may require to establish the quality of the proposed manhole components. Manufacturers shall furnish to the

Engineer certified test records or reports with sworn statement of tests made as specified.

- a. Precast Reinforced Concrete Manholes: Conduct tests as specified in ASTM C478.
 - b. Manhole Frames and Covers: Test for AASHTO H-20 highway loading. Test one manhole cover of each design submitted for approval.
3. The Engineer reserves the right to accept certified test records or reports of previously conducted tests.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Transport and handle precast concrete components, and other products specified herein, in a manner recommended by their respective manufacturers to prevent damage and defects.
 1. Through-wall lifting holes are not permitted in precast concrete component construction.
- B. Lift precast concrete members with slings of nylon, steel cable or chain looped to balance and properly carry members.
- C. Store on wood sleepers in position to prevent warp, twist or cracking.
- D. Storage: Store precast reinforced concrete manhole components in accordance with their manufacturer's recommendations to prevent joint damage and contamination. Exercise such care in storage of other specified products as recommended by their respective manufacturers.

1.07 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
 1. Do not set or construct manhole or structure bases on subgrade containing frost.
 2. To improve workability of Preformed Plastic Sealing Compound during cold weather, store at temperature above 70 degrees F or artificially warm compound in a manner as recommended by manufacturer.
 3. During warm weather, stiffen Preformed Plastic Sealing Compound as recommended by the manufacturer.

PART 2 PRODUCTS

2.01 BASIC MATERIALS

- A. Cast-In-Place Concrete Products: As specified in Section 03 30 00.
 1. Use Class A (4000 psi) quality concrete, unless indicated otherwise on the Drawings.
- B. Non-Shrink Non-Metallic Grout: As specified in Section 03 60 00.

- C. Waterproofed Mortar: Conforming to requirements of ASTM C270 for Type M, 2500 psi. Parts by volume include: One part cement, 1/4 part lime, and sand at not less than 2-1/4 nor more than three times the sum of the volumes of cement and lime used and of the following materials:
1. Waterproofing Agent: Medusa Waterproofing Powder by Medusa Portland Cement Co.; Hydratite by Grace Construction Materials; or Hydrolox by Chem-Master Corp. Add the Medusa product in the ratio of two pounds per bag of cement; add the other products per manufacturer's recommendations.
 2. Portland Cement: Conforming to ASTM C150, Type I.
 3. Hydrated Lime: Conforming to ASTM C207, Type S.
 4. Sand: Conforming to ASTM C144.
 5. Water: Clean and free from deleterious amounts of acids, alkalis, and organic materials.
- D. Epoxy Bonding Compound: Provide a high-modulus, low viscosity, moisture insensitive epoxy adhesive having the following characteristics.
1. Mix Ratio: 100 percent solids, two-component; mixed one part by volume component B to two parts by volume component A.
 2. Ultimate Compressive Strength: 13,000 psi after cure at 73 degrees F. and 50 percent relative humidity determined in accordance with ASTM D695.
 3. Acceptable Manufacturers:
 - a. Sika Corporation: Sikadur Hi-Mod.
 - b. Euclid Chemical Company; No. 452 Epoxy System.
 - c. A. C. Horn, Inc.; Epoxitite Binder.
 - d. Or Equal.
- E. Concrete Masonry Units for Manholes: Commercially manufactured solid precast concrete masonry units of segmental design and meeting requirements of ASTM C139.
- F. Manhole Steps: The Contractor is permitted the option to provide one type of manhole step in the Project as selected from the step types and designs below:
1. Reinforced Plastic Step: Composed of a 1/2 inch Grade 60, ASTM A615 deformed steel reinforcing bar completely encapsulated in Grade 49108, ASTM D4101 polypropylene copolymer compound, Type II.
 - a. Acceptable Manufacturers:
 - 1) M. A. Industries, Inc., Type PS2-B.
 - 2) Or Equal.
 2. Aluminum Step: Aluminum Alloy AA Designation 6061-T6. Coat that portion of aluminum step being embedded in concrete with heavy bodied bituminous paint.
 3. Step Inserts: Both aluminum and plastic steps may be installed in manhole walls using plastic inserts. Step inserts shall be polypropylene compositions meeting the requirements of ASTM C478 Section 12 and performance and test procedures of ASTM C497. Step inserts shall be cast integrally in precast concrete wall sections.

- G. Manhole Frame and Cover: Gray iron castings conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Frame and cover design and dimensions are as indicated on Drawings.
1. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting finished to meet AASHTO Specification M 306, 4.3.3. Painting, Welding, Plugging not allowed.
 2. Identification: Cast the applicable word SEWER as indicated on Drawings or required by Engineer, integrally on cover in two inch size raised letters.
 3. Frame Hold-down Bolts: Conforming to ASTM A307.
 4. Tensile Test Bar: Size B, cast separately, but poured from same iron as castings they represent.
 5. O-ring Cover Gasket: One piece O-ring gasket factory installed in a machined rectangular or dovetail groove in the bearing surface of the cover.
 - a. Gasket material of neoprene composition having good abrasion resistance, low compression set, Type D 40 durometer hardness determined in accordance with ASTM D2240 and suited for use in sanitary sewer manholes.
 - b. Gluing of gasket is not permitted.
- H. Watertight Manhole Frame and Cover: Gray iron castings conforming to specified requirements for Manhole Frame and Cover with the addition of cover hold-down bolts.
1. Cover Hold-down Bolts: AISI Type 316 stainless steel conforming to ASTM A276 for bolts and washers, or manufacturer's standard bronze bolts and washers.
- I. Precast Concrete Component (Section-to-Section) Seals: The Contractor is permitted the option to provide one type of component seal in the Project as selected from seal types specified below, except where required otherwise on the Drawings:
1. Preformed Plastic Sealing Compound: Flexible rope gasket of butyl rubber material meeting or exceeding all requirements of ASTM C990 and AASHTO M198, extruded in rectangular or square shapes and provided in rolls on coated release paper.
 - a. Dimensions: Size the cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference of each component section joint when joint is completed.
 - b. Acceptable Manufacturers:
 - 1) Concrete Sealants, Inc., ConSeal CS-102B.
 - 2) Press-Seal Gasket Corporation, EZ-STIK.
 - 3) Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2.
 - 4) Continental Concrete Products, Inc., PRO-STIK.
 - 5) Henry Company; RUB'R-NEK.
 2. Rubber Compression Gasket: Of material composition conforming to ASTM C361 or ASTM C443.
- J. High Density Polyethylene Manhole Inserts: Inserts shall be provided for all standard manhole frame and cover assemblies.

1. Constructed of High Density Polyethylene Copolymer material and meet the requirements of ASTM D 1248, Class A, Category 5, Type III.
 2. Sized for the frame and cover used.
 3. Minimum impact brittleness of -105 degrees F. in accordance with ASTM D746-70.
 4. Thickness shall be a uniform 1/8".
 5. The insert shall have a system for relieving gas and/or vacuum pressure from the manhole. Two (2) 3/16" holes 180 degrees apart, approximately one inch from the top of the insert to allow for constant ventilation.
 6. The insert shall have either a close cell neoprene or cross linked polyethylene gasket installed upon the insert rim by the manufacturer.
 7. The insert shall have a corrosion resistant nylon strap installed for easy removal of the re-installation into the manhole frame.
 8. Acceptable Manufacturers:
 - a. Parson Environmental Products, Inc.
 - b. Or Equal.
- K. PVC Waterstop: Provide PVC waterstop for use on pipe entering manhole base where the manhole base is of cast-in-place construction.
1. Material Composition: Gasket type waterstop composed of virgin polyvinyl chloride (PVC) material.
 2. Acceptable Manufacturers:
 - a. Atlantic Concrete Products, A-LOK.
 - b. Or Equal.
- L. Sleeve Type Pipe Seal: Use sleeve type pipe seal in making a core-drilled connection of piping to existing manholes or structures. Pipe seal construction as follows:
1. In general, the pipe seal shall conform to the requirements of ASTM C923 and shall incorporate a positive compression fit of the gasket to both the manhole and the pipe.
 2. Acceptable Manufacturers:
 - a. Press-Seal Gasket Corp.; PSX Seal.
 - b. NPC Inc.; Kor-N-Seal.
 - c. A-LOK Products, Inc.
 - d. Or Approved Equal.
- M. Modular, Mechanical Type Pipe Seal: Use modular, mechanical type pipe seal in making a core-drilled connection of piping to existing manholes or structures. Pipe seal construction as follows:
1. The seal shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 2. The elastomeric element of the seal shall be sized and selected in accordance with the seal manufacturer's recommendations. Elastomeric element shall conform to ASTM D2000 requirements for EPDM material.
 3. The hardware provided in the seal shall be as recommended by the seal manufacturer for buried service such as will exist at the project site.
 4. Acceptable Manufacturers:

- a. Thunderline Corporation; Link-Seal.
 - b. Or Equal.
- N. Surface (Expanding-Type) Waterstop: A specially formulated joint sealant which swells on contact with water. Provide waterstop packaged in continuous length coils. Material composition as follows:
 - 1. Chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
 - 2. Waterstop shall have a coating formulated to inhibit initial expansion due to moisture presence in the fresh concrete.
 - 3. Waterstop configuration shall be of dual extrusion design and 10 mm by 20 mm dimensions.
 - 4. Waterstop shall be secured to hardened concrete with the waterstop manufacturer's standard adhesive binder.
 - 5. Acceptable Manufacturers:
 - a. Greenstreak, Inc.; Hydrotite VCJ.
 - b. Or Equal.
- O. Manhole Exterior (Infiltration Prevention) Seals: New manholes shall be sealed on the exterior using the following seals:
 - 1. Preformed Plastic Sealing Compound: Conforming to Fed. Spec. SS-S-210A, Type 1, Rope Form, of either bitumastic base compound or butyl rubber base compound, and shipped protected in a removable two-piece wrapper. Size the cross-section of rope form to provide squeeze-out of material around entire interior and exterior circumference of each manhole section joint when joint is completed.
 - a. Acceptable Manufacturers:
 - 1) K.T. Snyder Company, Inc.; RAM-NEK.
 - 2) K.T. Snyder Company, Inc.; RUB'R-NEK.
 - 3) Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2.
 - 4) Or Equal.
- P. Intermediate Landings or Safety Platforms: If deep sewers cannot be avoided, intermediate landings or safety platforms must be installed in manholes in accordance with OSHA requirements.
 - 1. Diameter: Refer to Sewer Detail Drawing.
 - 2. Detail: An appropriate detail of a typical manhole with intermediate landings should be included on the detail sheets and manholes so equipped must be clearly labeled on the drawing plan and profile views.
 - 3. The detail is subject to Authority approval.

2.02 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

- A. Materials and Fabrication: Conforming to requirements specified in ASTM C478 except as follows:

1. Concrete: Composition and compressive strength conforming to ASTM C478 except use Type II or Type III cement in manhole components and increase compressive strength to 4,500 psi (at 28 days) in precast bases.
 2. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C302.
 3. Manhole Steps: Factory installed in manhole components, prealigned vertically, spaced on equal centers, and located the minimum distance from ends of risers and top sections as indicated on Drawings.
 4. Manhole Component Seals: As specified previously. Manhole component joints factory formed for self-centering concrete to concrete bearing employing either a rubber compression gasket or preformed plastic sealing compound.
 - a. Rubber Compression Gasket: Of material composition conforming to ASTM C361 or ASTM C443.
 - b. Preformed Plastic Sealing Compound: As specified herein.
 5. Manhole Component Design: Designs shall conform to ASTM C478. Base, tapered and straight riser section, and top section dimensions and diameters, not consistent with ASTM C478, are as indicated on Drawings.
 6. Lifting Holes and Lugs: Through-wall lifting holes not permitted in manhole component construction. Factory-install lifting keys or lugs integrally in manhole components.
- B. Precast Base and Riser Sections: Design, materials and construction as specified previously under Materials and Fabrication.
1. Pipe Openings: Provide precast base sections with custom preformed pipe openings with integral pipe seals. Preform the pipe opening to accommodate the type of pipe and pipe opening seal required.
 2. Prefabricated Pipe Opening Seals: Provide precast base sections with resilient gaskets of the types and designs which conform to the requirements specified in ASTM C923.
 3. Doghouse Style/Poured-In-Place Base: Precast base section designed to fit over an existing active pipeline allowing the construction of the bottom portion (slab) to be poured-in-place. Construct the poured-in-place portion in accordance with the requirements specified hereinafter for Cast-In-Place Concrete Manhole Base.
- C. Precast Top Sections: Designs as required by the Drawings, and of materials and construction as specified herein, except additional and differing requirements as follows:
1. Hold Down Bolt Inserts: Factory cast the inserts in the top section with no fewer than two 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Provide threaded inserts of three inches depth and designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert locations in the top sections to match the bolt hole locations in the manhole cover frames.
 2. Flat Slab Tops: Thickness versus diameter is as indicated on the Drawings. Tops factory formed to properly accept and support required manhole cover frame and properly formed underside to join the top section to the riser section in a matching joint.

3. Eccentric Cone Tops: Provide precast tops of the same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.
- D. Precast Grade Rings: Provide one-piece design (two-piece design not acceptable) precast concrete leveling and adjusting units of three inches or four inches thickness, and of materials and construction as specified previously under Materials and Fabrication.
1. Provide precast grade rings with hold down bolt holes matching location of bolt holes in the cast iron manhole cover frame.
 2. The grade ring design shall provide for full bearing of the cast iron manhole cover frame.
- E. Dampproofing Coating: Provide asphalt compound coating of either the solvent type or the emulsion type. However, mixtures of the two types in the Project is not permitted.
1. Solvent Type: Brush or spray-on asphalt compound, cold-applied and conforming to Federal Specification SS-A-701 B.
 2. Emulsion-Type: Brush or spray-on asphalt-base, clay emulsion with fibers, cold-applied and conforming to Federal Specification SS-R-1781.
 3. Acceptable Manufacturers:
 - a. W. R. Meadows, Inc.; SEALMASTIC.
 - b. Coopers Creek; Coopers Black.
 - c. Tnemec; 46-465.
 - d. Or Approved Equal.
 4. Application: The coating may be either shop or field applied. Apply coating to the exterior of manhole components.
 - a. Apply coating in two coats at the rate of 75 to 100 square feet per gallon per coat. Allow 24 hours drying between coats.
- F. Protective Coatings: Prior to application of coatings, prepare manhole surfaces for coating in accordance with the written instructions of the coating manufacturer, including mechanical cleaning, blast cleaning or acid etching as required.
1. Coat precast components at the factory.
 2. Exterior Surface Coating; Use one of the following:
 - a. Tnemec Company, Inc., 46H-413, 20 dry mils minimum thickness.
 - b. Roskote Mastic A-51 as manufactured by Royston Laboratories, Inc., Pittsburgh, Pennsylvania. Apply two coats, each coat to have a dry film thickness of 12 mils.
 3. Interior Surface Coating; Use one of the following:
 - a. Tnemec Company, Inc.; 104 H. S. Epoxy, 12 to 16 mils minimum thickness.
 - b. Roypex as manufactured by Royston Laboratories, Inc., Pittsburgh, Pennsylvania. Apply two coats, each coat to have a dry film thickness of 7 to 9 mils.
- G. Manhole Liner: Provide corrosion resistant liner in only those manholes where so noted on the Drawings as having the liner. Liner shall meet the following requirements:

1. Materials: Semi-rigid thermosetting polyvinyl chloride (PVC) sheet having a service life equal to PVC sewer pipe. The liner shall assure such service life under severe sewer conditions, being resistant to H₂S, acids, alkalis, and salts which attach sewer systems.
2. Design: The PVC liner sheet shall be formed to fit the manhole interior contour. The sheets shall have ribs formed in the back side with the ribs of a design to be integrally locked into the precast concrete structure.
 - a. The liner shall extend sufficiently into the manhole section joint to completely cover the concrete when the sections are joined and sealed with preformed plastic sealing compounds.
 - b. The liner shall have a white or light color for light reflectance.
3. Acceptable Manufacturers:
 - a. A-Lock Products Inc., Dura Plate 100.
 - b. Ameron, T-Lock Amerplate.
 - c. Or equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C478 regarding repairable defects and defects subject to rejection by the Engineer.

3.02 PREPARATION

- A. Earthwork: Perform earthwork for manhole installation as specified in Section 31 23 33 and according to the following:
 1. Protection: During the earthwork operations, keep pipe and manhole interiors cleared of debris as construction progresses.
- B. Waterproof Coating Touch-Up: Touch-up chipped, cracked, or abraded surfaces and finished joints with two coats of the factory applied waterproof coating material.
 1. Bring coating materials for touch up and field coating to the job site in the original sealed and labeled containers of the manufacturer.
- C. Protective Coating Touch-Up: Touch-up chipped, cracked, or abraded surfaces and finished joints with two coats of the factory applied protective coating material.
 1. Bring coating materials for touch up and field coating to the job site in the original sealed and labeled containers of the manufacturer. The Contractor shall submit to the Engineer, immediately upon completion of the field applied coating, certification from the manufacturer indicating that the quantity of each coating purchased was sufficient to properly coat all surfaces.

3.03 MANHOLE CONSTRUCTION METHODS

- A. Construction Options: The Contractor has the option to construct either cast-in-place concrete manhole bases or to provide precast concrete manhole bases, except where indicated otherwise on the Drawings.
- B. Cast-In-Place Concrete Manhole Base Construction: Construct in accordance with design and dimensions indicated on Drawings. When necessary to construct wider or deeper manhole bases than indicated or specified, build such bases as required by the Engineer.
 - 1. Form and pour concrete in accordance with requirements of Section 03 30 00. Additional requirements as follows:
 - a. Vibrate poured concrete using mechanical vibrator of a type and design approved by Engineer. Use vibrators of type capable of transmitting vibration to concrete in frequencies of not less than five thousand impulses per minute.
 - b. Form and pour joint monolithically in manhole base top to match joint of adjoining precast riser section. Use template as obtained from precast concrete manhole component manufacturer of manhole components used in the Project.
 - 2. Install piping in cast-in-place manhole bases prior to pouring the concrete.
 - a. Apply Epoxy Bonding Compound in accordance with manufacturer's instructions to pipe at base connection prior to pouring the concrete.
 - b. Install PVC Waterstop on pipes entering and leaving manhole base prior to pouring concrete. Install PVC Waterstop in accordance with manufacturer's written instructions.
 - 3. Use Class A (4,000 psi) concrete as specified in Section 03 30 00, unless indicated otherwise on Drawings.
 - 4. Doghouse Style Base Installation: Set base as indicated on Drawings and fill pipe openings with bedding material.
 - 5. Coat bases in accordance with the requirements for precast manhole components.
- C. Precast Concrete Manhole Base Installation: Install precast base on a 6-inch deep compacted layer of aggregate meeting requirements of Pipe Bedding as specified in Section 31 23 33.
 - 1. Set pipe in the Prefabricated Pipe Opening Seals so that an equal annular space is created on the interior and exterior of the wall of the manhole base section.
 - 2. Following pipe installation through the seal, grout the annular space at the pipe connection, on both sides of the wall, to the spring line of the pipe. Tightly caulk sealing compound into annular spaces in a manner to completely fill the spaces and render the installation watertight. Finish the grout smooth and flush with face of manhole.
- D. Length of Pipe Connections into Manholes: Use pipes no longer than five feet in length when connecting into manholes through Prefabricated Pipe Opening Seals.

1. For other types of pipe connections into manholes, use pipes of such length that a pipe joint is provided at the outside edge of manhole base or wall as applicable. Also use pipes no longer than 6 feet in length for first pipe joined thereto.
- E. Concrete Channel Fill: Field pour and form concrete channel fill for each manhole base except in the case where precast bases are used, factory preformed channels may be provided.
1. Form inverts directly in concrete channel fill.
 2. Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
 3. Make changes in size and grade gradually.
 4. Make changes in direction of entering piping and branches to a true curve of as large a radius as manhole size will permit.
 5. In terminal manholes, install concrete channel fill with formed channel extending from downstream pipe opening directly across the base to future pipe opening on upstream side of the base.
 6. Make slopes gradual outside the invert channels.
 7. Use Class B (3,000 psi) concrete as specified in Section 03 30 00, unless indicated otherwise on Drawings.
 8. When precast bases with preformed channels are used, fill the annular space at the pipe connections, on both sides of the wall, to assure flow through the channel and bring grout up to the spring line of the pipe.
 - a. Use Non-Shrink Non-Metallic grout as specified in Section 03 60 00.
- F. Manhole Wall Installation: Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.
1. If rubber compression gaskets are used between sections, install gaskets and join sections in accordance with written instructions of manhole component manufacturer.
 2. If Preformed Plastic Sealing Compound is used between sections, install sealing compound in accordance with manufacturer's recommendations, and join sections in accordance with written instructions of manhole component manufacturer.
 - a. Prime joint surfaces if required by sealing compound manufacturer.
 - b. If sealing compound is installed in advance of section joining, leave exposed half of two piece protective wrapper in place until just prior to section joining.
 - c. Use sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
 - d. Arrange and pay for the sealing compound manufacturer's representative to be present for first installation of manhole sections to instruct workmen on proper installation methods of sealing compound and to be present while manhole sections are being installed.
 - e. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.

- f. Make pipe connections into manhole walls as specified for pipes connecting into manhole bases.
- G. Lifting Recess Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into recesses in such manner to render them completely water and air tight. Sealing of lifting recesses with grout not permitted.
- H. Manhole Frame and Cover Installation: Where required, make final adjustment of frame to elevation using Grade Rings. Set manhole frame and cover to conform to roadway grade and crown. Set top of manhole frame and cover 1/8-inch below finished paving elevation.
 - 1. Precast Concrete Grade Ring: Wet, but do not saturate the grade rings immediately before laying. Pre-set grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding the joint thickness. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh mortar in a manner to completely encase each. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Crown fresh mortar to produce squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess mortar prior to initial mortar set.
 - 2. Cast Iron Manhole Frame and Cover Anchorage: Anchor manhole frames in place on manhole top section, or on leveling units, after installing fresh mortar on bearing surface of manhole frame. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.
 - a. Anchor Bolt Length: Size bolts according to the following:
 - 1) Sufficient length to properly pass through leveling units, if any.
 - 2) Sufficient length to engage full depth of manhole top section inserts.
 - 3) Sufficient length to allow enough threaded end to pass through manhole frame to properly tighten nut and washer.
 - b. Tighten manhole frame bolts after mortar has cured.
 - c. Install manhole covers using the proper bolts as provided with the covers for the waterproof installations.
- I. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections.
 - 1. Use masonry units and waterproofed mortar laid up to prevent deterioration.
 - 2. Install such materials to meet exfiltration limits and to allow future removal without damage to manhole.
- J. Installation of Manhole Exterior (Infiltration Prevention) Seals: In general, install Manhole Manhole Chimney Seals in accordance with the manufacturer's installation instructions and the following:
 - 1. Field Verification: Field verify the external measurements of the manhole sections and the manhole frame and chimney areas prior to ordering the applicable seals.

2. Preparation: Clean the manhole frame (casting) and the concrete surfaces to the extent as required by the seal manufacturer. Additionally prepare the surfaces to be free from protruding defects.
 3. Specialty Installation Tools: Provide as required the specialty tools from the seals manufacturers for the installation of the two types of manhole seals.
 4. Acceptable Manufacturers:
 - a. Cretex Specialty Products
 - b. GPT Industries
 - c. Or Equal
- K. Drop Manholes: Construct in accordance with Type indicated in Details on the Drawings, or bound in Project Manual. Use the same type pipe and fittings in drop connection as used in the sewer line from which drop connection is made.

3.04 INTERFACING EXISTING SEWER

- A. Bypass Provisions: As work of this Section, maintain flow in the existing sewer both during construction operations and until concrete is cured, both in the case of cast-in-place work and newly formed invert channels.
1. Provide a fail-safe (and properly sized) temporary means and methods of continued wastewater system service. The means and methods are at the Contractor's discretion.
 2. Do not permit ground or surface water to enter the existing wastewater sewer facilities during the construction or the bypass work.
 3. Do not flush or drain water, or deposit debris from the new manhole construction, into the existing wastewater sewer facilities.
- B. Constructing Manholes on Existing Sewer: Where new manholes are constructed on existing sewers, the Authority not the Contractor shall have the option to use the specified cast-in-place manhole bases or precast manhole bases. In either case, make the appropriate connection of the new and existing sewer pipe to the new manhole.
1. Where the invert difference between the new and existing sewer is two feet or more, construct a drop manhole base. No separate or additional payment will be made for the vertical feet of drop connection required.
 2. Where the existing piping is damaged beyond the new manhole base as a result of work of constructing the new manhole, replace such damaged pipe with new material matching the existing. Use compatible joint materials or flexible pipe coupling. Repair to the first joint or to such point as agreed to by the Engineer.
 3. Connect new pipe to the specified new manhole bases, or new in-line structures.
 4. Where precast manhole bases are used, replace the existing sewer pipe with new to the first joint outside the manhole base.
 5. Where cast-in-place manhole bases are constructed, saw-cut the existing piping to be removed. Chipping or breaking pipe as a cutting method is not acceptable.
 6. Following the manhole base construction, install a watertight pipe plug until debris and accumulated water have been removed from the new manhole base and the new sewer facilities have passed the specified acceptance tests.

7. Maintain flow in existing sewer both during construction operations and until concrete is cured in both the case of the cast-in-place work and formed inverts.
8. Do not permit ground or surface water or debris from the new sewer piping or related construction into the existing sanitary sewer facilities.

3.05 ADDITIONS AND ALTERATIONS TO EXISTING MANHOLES

- A. Examination/Verification: Prior to manhole frame and cover adjustment to the proposed new grades, the Contractor shall verify the required height adjustment for the existing manhole frame and cover and determine the additional manhole components required.
 1. The determination of whether grade rings or a short wall section will be required is dependent on compliance with OSHA regarding entry to first manhole step distance limitations.
- B. Earthwork: Perform the required excavation necessary to conduct the manhole additions and alterations work. Perform the excavation by such means and methods as will not damage the existing materials.
 1. Salvage the existing topsoil within the excavation limits and stockpile for subsequent replacement following the completed work.
 2. Upon completion of the additions and alterations work, backfill the manhole using the as-excavated material placing the material in six inch compacted layers. Perform the final layer of material placement using as-excavated topsoil.
- C. Salvage/Preparation: Carefully remove the existing manhole frames and covers, and also the reusable precast concrete components, and stockpile for subsequent re-installation in the manhole frame and cover raising operations.
 1. Perform cleaning operations on the salvaged materials to remove mortar and concrete residues and to promote bonding with fresh materials upon re-installation.
 2. Remove and dispose of brick and mortar where such materials were used for manhole frame and cover adjustment-to-grade.
 3. Core bore holes in the existing manhole top sections where required for new manhole frame and cover anchor bolts installations.
- D. Installations: In general, the means and methods of performing manhole additions and alterations operations are the sole responsibility of the Contractor, but subject to the limitations as follows:
 1. Keep the manhole interior free of debris as the additions and alterations work is being performed.
 2. Perform cleaning and surface preparation of the existing manhole components, which are not being removed, to promote proper bonding of both re-installed and newly installed materials.
 3. Dispose of cleaning and construction debris and other materials in a lawful manner off site.
 4. Raising/Setting Manhole Frames and Covers: To make manhole frame and cover adjustments to meet the new grades, comply with the following:

- a. Where conditions require a new short wall section unit under the existing tapered section, install such new section as previously specified under Manhole Construction Methods, Manhole Wall Erection.
- b. Where conditions require the use of additional new precast concrete grade rings and waterproofed mortar, set grade rings as specified previously for Frame and Cover Installation.
- c. Following the manhole additions and alterations work as specified above, re-install the prepared cast iron manhole frame and cover as specified previously for Frame and Cover Installation. Apply anti-seize lubricant to cover tightening bolts.

3.06 FIELD QUALITY CONTROL

- A. General: Make a visual inspection of each manhole constructed to ensure compliance with installation requirements.
- B. General Requirements: Test each manhole constructed in the Project by one of the methods specified herein. Conduct tests in presence of, and to complete satisfaction of the Engineer. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until that manhole does test satisfactorily.
 1. Provide tools, materials, equipment and instruments necessary to conduct the manhole testing specified herein.
 - a. Vacuum Testing Equipment: Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from the manhole and to monitor vacuum.
 - 1) Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
 - 2) Vacuum testing equipment and associated testing apparatus are subject to Engineer's approval.
 - 3) Provide seal plate with vacuum piping connections for inserting in manhole frame.
 2. Prior to testing, clean manholes thoroughly and seal openings, both to the complete satisfaction of the Engineer. Seal openings using properly sized plugs.
 3. Perform testing with the cast iron frames and covers installed. Include the joint between the precast manhole component and the cast iron manhole frame in the test.
 4. The Contractor may elect to make a test for his own purposes prior to backfilling. However, conduct tests of the manholes for acceptance, only after the backfilling has been completed.
 5. If a manhole is constructed on an existing active sanitary sewer, where sewage flow must be maintained, the test will be waived.
- C. Vacuum Test Procedure: Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions and the following:
 1. Draw a vacuum of ten inches of mercury and close the valves.
 2. Consider manhole acceptable when vacuum does not drop below ten inches of mercury for the following manhole sizes and times:

- a. Four foot diameter - 60 seconds.
 - b. Five foot diameter - 75 seconds.
 - c. Six foot diameter - 90 seconds.
 - d. Seven foot diameter - 105 seconds.
- D. Repair and Retest: Determine source or sources of leaks in manholes failing acceptable limits.
- 1. Repair or replace defective materials and workmanship, as is the case, and conduct such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet test requirements.
 - 2. Materials and methods used to make manhole repairs shall meet with Engineer's approval prior to use.
 - 3. Make repairs, replacements and retests at no increase in Contract Price.

END OF SECTION

SECTION 33 31 19

GRAVITY WASTEWATER UTILITY PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of constructing the various types and sizes of piped wastewater sewers and appurtenances.
- B. Related Sections:
 - 1. Grouting: Section 03 60 00.
 - 2. Trenching and Backfilling: Section 31 23 33.
 - 3. Manholes and Structures: Section 33 05 13.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI B16.21, Nonmetallic Gaskets for Pipe Flanges.
 - 2. ANSI B18.2.1, Square and Hex Bolts and Screws, Including Askew head Bolts, Hex Cap Screws, and Lag Screws.
 - 3. ANSI B18.2.2, Square and Hex Nuts.
- B. American Society for Testing and Materials.
 - 1. ASTM A 48, Specification for Gray Iron Castings.
 - 2. ASTM A 74, Specification for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM A 285, Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate-Tensile Strength.
 - 4. ASTM A 536, Specification for Ductile Iron Castings.
 - 5. ASTM C 12, Recommended Practice For Installing Vitrified Clay Pipe Lines.
 - 6. ASTM C 76, Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 - 7. ASTM C 144, Specification for Aggregate for Masonry Mortar.
 - 8. ASTM C 150, Specification for Portland Cement.
 - 9. ASTM C 301, Method of Testing Vitrified Clay Pipe.
 - 10. ASTM C 361, Specification for Reinforced Concrete Low-Head Pressure Pipe.
 - 11. ASTM C 425, Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - 12. ASTM C 443, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 13. ASTM C 564, Specification for Rubber for Cast Iron Soil Pipe and Fittings.
 - 14. ASTM C 700, Method of Testing Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
 - 15. ASTM C 828, Recommended Practice for Low Pressure Air Test of Vitrified Clay Pipe Lines.
 - 16. ASTM C 923, Specification for Resilient Concrete Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

17. ASTM C 924, Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
18. ASTM D 1784, Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
19. ASTM D 2000, Standard Classification System for Rubber Products in Automotive Applications (SAE Recommended Practice J200).
20. ASTM D 2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
21. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
22. ASTM D 2680, Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
23. ASTM D 2751, Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
24. ASTM D 3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
25. ASTM D 3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
26. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
27. ASTM F 679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
28. ASTM F 789, Specification for Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.
29. ASTM F 794, Specification for Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
30. ASTM F 1803, Standard Specification for Poly(Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter.

C. American Water Works Association:

1. ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. ANSI/AWWA C110/A21.10, American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.
3. ANSI/AWWA C111/A21.11, American National Standard for Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
4. ANSI/AWWA C115/A21.15, American National Standard for Flanged Ductile-Iron Pipe With Threaded Fittings.
5. ANSI/AWWA C150/A21.50, American National Standard for Thickness Design of Ductile-Iron Pipe.
6. ANSI/AWWA C151/A21.51, American National Standard for Ductile-Iron Pipe Centrifugally Cast for Water or Other Liquids.
7. ANSI/AWWA C153/A21.53, American National Standard for Ductile-Iron Compact Fittings for Water Service.
8. ANSI/AWWA C207, Steel Pipe Flanges.
9. ANSI/AWWA C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.

10. ANSI/AWWA C302, Reinforced-Concrete Water Pipe-Noncylinder Type, Not Prestressed.
11. ANSI/AWWA C600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

D. Cast Iron Soil Pipe Institute, Cast Iron Soil Pipe and Fittings Handbook, CISPI 301.

E. Uni-Bell Plastic Pipe Association:

1. UNI-B-6, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.
2. UNI-B-9, Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide one type and class of pipe in continuous line of sewer between structures, unless otherwise indicated on the Drawings.
2. Provide pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Submit completely dimensioned shop drawings, catalog cuts and such other data as required to provide complete descriptive information for the following:

1. Sewer Pipe and Fittings
2. Piping Specialties
3. Service Connection Pipe and Fittings

B. Certificates: Submit certified records or reports of results of shop tests, with such records or reports containing a sworn statement that shop tests have been performed as specified.

1. Manufacturer's sworn certification stating that the pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.05 QUALITY ASSURANCE

A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Protection (DEP), comply with the following:

1. Use one type and class of pipe in continuous line of sewer between structures, unless otherwise indicated on the Drawings.
2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.
3. Provide a minimum depth of cover of five feet for pipe sewers. Where less cover is provided, protect the pipe with concrete encasement or by some other means acceptable to the Engineer.

B. Source Quality Control:

1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory tests of pipe materials listed in the following shall have been performed. Each pipe manufacturer is to have facilities to perform the listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Solid Wall Polyvinyl Chloride (PVC) Pipe	ASTM D 3034 or ASTM F 789 or ASTM F 679	As specified in ASTM D 3034 ASTM F 789 or ASTM F 679
Closed Profile Wall PVC Pipe	ASTM F 1803	As specified in ASTM F 1803
Ribbed Wall PVC Pipe	ASTM F 794	As specified in ASTM F 794
Ductile Iron Pipe	ANSI/AWWA C151/A21.51	As specified in ANSI/AWWA C151/A21.51

2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. These laboratory tests will be paid for as provided in the Bid Form from the fund stipulated for the purpose.
3. The Engineer reserves the right to accept certified test records or reports of previously conducted tests covering the above stated tests.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store pipe materials and the associated materials specified herein, in the manner recommended by the respective materials manufacturers so as to prevent damage and defects to their respective materials.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: In addition to the environmental requirements of the manufacturer's of the particular pipe products used, comply with the following:
 1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement (as required) have cured.
 2. Do not lay pipe in water or on bedding containing frost.
 3. Do not lay pipe when weather conditions are unsuitable for pipe laying work, as determined by the Engineer.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. Elastomeric Gaskets: For pipe joint gasket material, provide elastomeric gaskets that have been tested as suitable for continuous contact with domestic sewage.
- B. Solid Wall Polyvinyl Chloride (PVC) SDR Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation.
 - 1. Pipe, Solid Wall, Size 4 through 15 Inch Diameters: Type PSM SDR-35 conforming to ASTM D 3034 requirements, or Type PS-46 conforming to ASTM F 789 requirements for pipe sizes above 15 inch to 18 inch diameter.
 - 2. Pipe, Solid Wall, Size 18 through 27 Inch Diameters: Type PS-46 conforming to ASTM F 679 requirements.
 - 3. Fittings: Commercially manufactured molded fittings made from PVC compounds having a cell classification of 12454-B, 12454-C, or 13343-C as defined in Specification ASTM D 1784.
 - 4. Joints: Push-on style joint, with elastomeric gasket, conforming to ASTM D 3212 requirements for joint design; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal.
 - a. Incorporate the gasket locked in a groove as part of pipe bell design so as to prevent gasket displacement when pipes are joined.
- C. Closed Profile Wall Polyvinyl Chloride (PVC) Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation.
 - 1. Pipe, 21 through 48 Inch Diameters: Manufactured to a controlled inside diameter, with integral bell and elastomeric seal joints, and conforming to ASTM F 1803 requirements.
 - 2. PVC Compounds: Complying with the requirements for a minimum cell classification of 12454C or 12364C as defined by ASTM D1784.
 - 3. Fittings: Molded fittings conforming to ASTM F 679 or depending on the size, fabrications made by the pipe manufacturer, using closed profile pipe and meeting ASTM F 1803 or ASTM F 679 requirements, and formed by fusion heat welded mitered joints. Molded fittings and fabricated fittings made up by solvent cement mitered joints are not acceptable.
 - 4. Joints: Push-on style joint, with elastomeric gasket, conforming to ASTM D 3212 requirements for joint design; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal. Gaskets factory installed and chemically bonded to the pipe to prevent gasket displacement when pipes are joined.
- D. Ribbed Wall Polyvinyl Chloride (PVC) Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation.
 - 1. Pipe, 18 through 48 Inch Diameters: Manufactured to have a smooth interior with a solid cross-sectional ribbed exterior with the ribs perpendicular to the axis of the pipe, and conforming to ASTM F 794 requirements.

2. PVC Compounds: Complying with the requirements for a cell classification of 12454-B, 12454-C, or 13364-B as defined by ASTM D 1784.
 3. Fittings: Commercially manufactured molded fittings made from PVC compounds having a cell classification of 12454-B, 12454-C, or 13343-C as defined in Specification ASTM D 1784.
 4. Manhole Adaptor: Provide fittings specifically manufactured for ribbed pipe connection to manholes. Design fitting to change from ribbed wall to smooth wall for that portion of the fitting entering the manhole wall Prefabricated Pipe Opening Seal.
 5. Joints: Push-on style joint, with elastomeric gasket, conforming to ASTM D 3212 requirements for joint design; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal.
 - a. Incorporate the gasket locked in a groove as part of pipe bell design so as to prevent gasket displacement when pipes are joined.
- E. Ductile Iron Pipe (DIP): Conforming to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51 requirements and the following:
1. Wall Thickness Class, Buried Pipe: As indicated on Drawings.
 2. Wall Thickness Class, Exposed Pipe: Class 53 except as noted otherwise on Drawings.
 3. Fittings: Gray iron or ductile iron conforming to ANSI/AWWA C110/A21.10 or ductile iron compact fittings conforming to ANSI/AWWA C153/A21.53. Ductile iron or cast iron fittings joints are as indicated herein or on Drawings. Fittings larger than 48 inches shall conform to AWWA C100 Class B requirements.
 4. Rubber-Gasket Joints, Buried Pipe: Conforming to ANSI/AWWA C111/A21.11 requirements.
 - a. For buried pipe installation, provide push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.
 - b. For buried pipe installation, provide mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.
 - c. For buried pipe installation, provide push-on joints except where other types of joints are indicated on the Drawings or required by the Specifications.
 5. Flanged Joints, Exposed Pipe: Conforming to ANSI/AWWA C115/A21.15 requirements.
 - a. Unless indicated otherwise on the Drawings, use flanged joints for pipe and fittings installed inside of structures.
 - b. Gaskets: 1/16 inch thick cloth insertion rubber full face type conforming to ANSI B16.21 requirements.
 - c. Bolts: Conforming to ANSI B18.2.1 requirements.
 - d. Nuts: Conforming to ANSI B18.2.2 requirements.
 6. Pipe and Fittings Coating (Special Coating): Ductile iron pipe factory coated inside and out with 46H-413 Hi-Build Tnemec-Tar by Tnemec Company, Inc., or equal. Prepare pipe surfaces according to coating manufacturer's instructions and apply coating 18 to 20 mils minimum dry mil thickness.

2.02 SERVICE CONNECTION PIPE AND FITTINGS

- A. Solid Wall Polyvinyl Chloride (PVC) Pipe: As specified under Sewer Pipe and Fittings; six inch diameter.
- B. Ductile Iron Pipe (DIP): As specified under Sewer Pipe and Fittings; six inch diameter.
- C. Saddles: Provide tee saddles contoured for outside diameter of pipe, and incorporating ring gasket bell outlet. Saddles shall have a base casting conforming to ASTM A-48 Class 30 cast iron and PVC adapter conforming to ASTM D3034, SDR-35 with gasketed bell.
 - 1. Adapter is cemented permanently in place with two-part urethane adhesive.
 - 2. Base of saddle is dip-coated in a water based bituminous coating.
 - 3. Strap is 24 ga. x 2.5" wide Type 304 stainless steel.
 - 4. Strap pins are 0.75" diameter Type 303 stainless steel.
 - 5. T-bolts are 0.375" – 16 Type 304 stainless steel.
 - 6. Nuts and washers are Type 18-8 stainless steel.
 - 7. O-ring is ASTM C361-77 tubular polyisoprene.
 - 8. Acceptable manufacturer:
 - a. The General Engineering Company; Type PVC/U Model H.
 - b. Or equal.
- D. Compression-Fit PVC Hub: Provide Compression-Fit PVC Hubs (Inserta Tee) only for service connections into Closed Profile PVC pipe. Materials and construction as follows:
 - 1. PVC Hub: Manufactured from polyvinyl chloride (PVC) pipe, Type PSM SDR-35, conforming to ASTM D 3034 requirements. The hub is to conform to ASTM D 3212 requirements for push-on style pipe joint with elastomeric gasket; gasket conforming to ASTM F 477 requirements for material specifications, providing a watertight seal.
 - 2. Band-Screw Assembly: Stainless steel band and housing fabricated from AISI Type 301 stainless steel; tightening screw of AISI Type 305 stainless steel.
 - 3. Rubber Sleeve: A molded component of materials composition meeting the requirements of ASTM C 443.
 - 4. Acceptable Manufacturers:
 - a. Inserta Fittings Company; Inserta Tee.
 - b. Or equal.
- E. Tapping Sleeve: Two section type for bolting over pipe with flange face outlet, designed for field tap-machine opening.
 - 1. Sleeve Body: Carbon steel conforming to ASTM A 285, Grade C requirements; ANSI/AWWA C207 Class D, ANSI 150 pound drilling outlet; and fusion bonded inside and out epoxy coating to 12 mil average thickness.
 - 2. Bolts and Nuts: Extra strength alloy steel bolts with semi-finished hexagon nuts conforming to ANSI/AWWA C111/A21.11 requirements.
 - 3. Gasket: Grade 60 concave wedge rubber compound gasket for sewage service.

4. Acceptable Manufacturers:
 - a. Rockwell International Company; No. 622 Tapping Sleeve.
 - b. Or equal.
- F. Pipe Plugs: Designed for permanent installation and removable. Obtain plugs for various types of pipe used from the respective pipe manufacturer.
- G. Cleanout Cap Protection Casting: Gray iron casting confirming to ASTM A 48, Class No. 35; designed for AASHTO Highway Loading Class HS-20 and a product of the U.S.A.
 1. Finish: Cover bearing surface factory machined to prevent movement under traffic. Casting surfaces factory cleaned and coated with manufacturer's standard asphalt-base coating (non-tacky drying).
 2. Acceptable Manufacturers:
 - a. East Jordan Iron Works, Inc.; Model No. 1007-S.
 - b. Neenah Foundry Company.
 - c. Or equal.

2.03 PIPING SPECIALTIES

- A. Non-Shrink Non-Metallic Grout: As specified in Section 03 60 00.
- B. PVC Waterstop: Use PVC waterstop in making a grouted connection of piping to existing manholes or structures. Waterstop construction as follows:
 1. Gasket type waterstop composed of virgin polyvinyl chloride (PVC) material.
 2. Acceptable Manufacturers:
 - a. FERNCO Inc., CMA Concrete Manhole Adapter, Distributed by the General Engineering Company.
 - b. Or equal.
- C. Sleeve Type Pipe Seal: Use sleeve type pipe seal in making a core-drilled connection of piping to existing manholes or structures. Pipe seal construction as follows:
 1. In general, the pipe seal is to conform to the requirements of ASTM C 923 and incorporate a positive compression fit of the gasket to both the manhole and the pipe.
 2. Acceptable Manufacturers:
 - a. Press-Seal Gasket Corp., Concrete Products Supply Co.; PSX Seal.
 - b. Or equal.
- D. Modular, Mechanical Type Pipe Seal: Modular, mechanical type pipe seal used for core-drilled connection of piping to existing manholes. Seal component construction as follows:
 1. The seal shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 2. The elastomeric element of the seal shall be sized and selected in accordance with the seal manufacturer's recommendations. Elastomeric element shall conform to ASTM D2000 requirements for EPDM material.

3. The hardware provided in the seal shall be as recommended by the seal manufacturer for buried service such as will exist at the project site.
 4. Acceptable Manufacturers:
 - a. Thunderline Corporation; Link-Seal.
 - b. Or Equal.
- E. Couplings: Use reducing couplings for joining plain-end pipe of differing outer diameters.
1. Follower: Cast ductile iron conforming to ASTM A536 with fusion bonded epoxy finish conforming to AWWA C213.
 - a. Integral bolt head pocket for one wrench installation.
 2. Transition Sleeve: Cast ductile iron conforming to ASTM A536 with a fusion bonded epoxy finish.
 - a. Shall provide up to 2.75" range with single assembly.
 - b. Integral bolt head pocket for one wrench installation.
 - c. Shall have smooth inside taper for uniform gasket seating.
 3. Gaskets: Nitrile Buna-N conforming to ASTM D2000.
 4. Nuts/Bolts: 5/8"-11UNC High Strength Low Alloy Steel conforming to AWWA C111/A21.11.
 5. Acceptable Manufacturers:
 - a. Smith-Blair, Inc., OMNI™ Cast Reducing Coupling Model R441
 - b. Or Equal

2.04 CONTRACTOR OPTIONS IN PRODUCTS

- A. Sewer Pipe and Fitting Options: The Contractor is allowed the option to provide one type of pipe in the Project of the types listed hereinafter for a particular listed pipe size range.
1. Pipe Material Restriction: Use only the type of pipe selected to construct the pipe sewer mains for which pipe material options are allowed. In certain locations where indicated on the Drawings, only ductile iron pipe (DIP) will be allowed.
 2. Pipe Material Types:
 - a. Six through 15 inch diameter:
 - 1) Polyvinyl Chloride pipe (PVC), SDR-35 or PS-46.
 - 2) Ductile Iron pipe (DIP). 16-inch diameter allowed where 15-inch diameter is indicated on Drawings.
 - b. 18 through 27 inch diameter:
 - 1) Polyvinyl Chloride pipe (PVC): Solid Wall, PS-46 or Ribbed Wall.
 - 2) Ductile Iron pipe (DIP) 20-inch diameter DIP allowed where 21-inch diameter pipe is indicated on Drawings.
 - c. 21 through 48 inch diameter:
 - 1) Polyvinyl Chloride pipe (PVC): Solid Wall, PS-46 or Closed Profile.
 - 2) Ductile Iron pipe (DIP) 20-inch diameter DIP allowed where 21-inch diameter pipe is indicated on Drawings.
 - d. Sewer Main Connections for Service Connections (RCP and PCCP) Options:
 - 1) Cast Iron Saddles.
 - 2) PVC Saddles.

3) Precast Concrete Pipe Outlets.

- B. Pipe Connections to Existing Manholes or Structures Options: The option is allowed to construct one type of connection in the Project of the types listed herein, except where required otherwise on the Drawings.
 - 1. Core-drilled opening utilizing Sleeve Type Pipe Seal.
 - 2. Core-drilled opening utilizing Modular, Mechanical Type Pipe Seal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- B. Rejected Products: Remove rejected Products from the Project site and replace with new Products at no increase in Contract Price.
 - 1. Pipe already laid and later found defective will not be accepted and require its replacement at no increase in Contract Price.

3.02 PREPARATION

- A. General Requirements: Clean piping interior prior to laying pipe and following pipe laying and keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.
 - 1. Provide the protective means to prevent water and debris from washing into the pipe.
- B. Earthwork: Perform earthwork for gravity sewer installation as specified in Section 31 23 33.
 - 1. Bedding materials and concrete work for pipe bedding as specified in Section 31 23 33.
 - 2. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from rock removal operations.

3.03 CONSTRUCTION

- A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.
 - 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade. Lay tongue and groove pipe with groove end upgrade. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
 - 2. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.
 - 3. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously

- laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
4. Walking or working on the installed pipe line, except as necessary in tamping and backfilling, is not permitted until trench is backfilled one-foot deep over top of pipes.
 5. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
 6. Take up and replace with new, such in-place pipe sections found to be defective.
- B. Pipe Laying and Joining: Perform pipe laying and joining in strict accordance with manufacturer's installation instructions, reference standards as included, and such additional requirements as specified herein.
1. Arrange and pay for pipe manufacturer's representative to be present for first installation of pipe to instruct workmen on proper installation methods.
 2. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.
 3. Laying/Joining Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D 2321 requirements and for Class I bedding material as included therein.
 4. Laying/Joining Ductile Iron Pipe: Installation and joint assembly according to ANSI/AWWA C600, and as follows:
 - a. Pipe Cutting: Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.
 - b. Push-on Joints: To make ductile cast iron pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible. Make deflection, if required, only after the joint has been assembled properly.
 - c. Mechanical Joints: To make ductile iron pipe mechanical joint, position sealing gasket and gland for bolting and then enter the spigot into pipe bell end until joint line is visible. Tighten bolts evenly maintaining approximate distance between gland and face of flange at all points around the socket. Do not exceed pipe manufacturer's specifications for maximum torque applied to bolts.
 - d. Flanged Joints(for DIP): Faced true, fitted with gaskets, and drawn up square and tight to ensure full gasket flow and satisfactory seal.
- C. Service Connection Fittings Installation:
1. Wyes or Tees: Make connections to sewer using wye or tee fittings of same material and joint configuration as the sewer at planned point of branch connection.
 - a. Use commercially manufactured wye or tee fittings and one-eighth bends.
 - b. Set wye or tee branches at proper vertical angles as required to bring service connections to the proper depth.
 - c. Fittings locations determined by the Engineer with respect to service connections to existing house or building location.

2. Saddles: Make connections to sewers, which incorporate a saddle connection, by machine cutting a hole in the sewer of proper size to accommodate the saddle. Use a machine specifically designed for the purpose; no other means of making the hole permitted.
 - a. Install saddle in accordance with manufacturer's installation instructions.
 3. Compression-Fit PVC Hub: Use only for service connection into Closed Profile PVC pipe; install in accordance with manufacturer's installation instructions.
 4. Pipe Outlet: Connect service connection piping to outlet in manner specified for joining pipe.
 5. Tapping Sleeves: Make connections to sewers, which incorporate a tapping sleeve connection, by machine cutting a hole in the sewer of proper size to accommodate the tapping sleeve.
 - a. Install tapping sleeve in accordance with manufacturer's installation instructions.
 6. Plugs: Close free ends of branches and service connections with a carefully fitted plug. Provide type of plug used and method of installation per Engineer's approval. Perform Line Acceptance Tests on installed plugs.
- D. Drop Connections: Make drop connections where indicated on the Drawings, where drop in invert is two feet or more or as required by the Engineer. Use same pipe material used to construct the main from which the drop connection is made. Construct drop connection in accordance with design shown on Detail Drawing.
- E. Connections of Piping to Existing Manholes or Structures: The option is allowed to construct pipe connections to existing manholes or structures by one of the methods stated herein, except where indicated otherwise on the Drawings. A mixture of connection methods is not allowed.
1. Cut-in Opening Utilizing PVC Waterstop and Grout: Cut required opening or openings by such methods so as to prevent cracking and spalling concrete. Make openings of sufficient size to accommodate the pipe with PVC Waterstop installed and one inch of annular grout space. Grout annular space using Non-Shrink Non-Metallic Grout as specified in Section 03 60 00. Make connection watertight.
 2. Core-drilled Opening Utilizing Sleeve Type Pipe Seal: Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient size to accommodate the Pipe Seal.
 3. Core-drilled Opening Utilizing Modular, Mechanical Type Pipe Seal: Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient size to accommodate the Pipe Seal.
 4. Grouting The Connection: Following pipe installation through the seal, grout the annular space at the pipe connection, on both sides of the wall, to the spring line of the pipe. Finish the grout smooth and flush with face of manhole.
 5. New Invert Channel: Regardless of the connection to existing manhole option selected, form a new invert channel in the existing manhole base to properly conduct the flow through the existing manhole. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection.
 - a. Use Non-Shrink Non-Metallic Grout to form the new invert channel.

- F. Reconnection of Existing Service Connections: Use wye or tee fittings or (cast iron tee saddles) (PVC wye or tee saddles) for connection to the sewer main. Use pipe if required as specified previously. Make connection to existing piping with flexible pipe couplings.
1. Service connection fittings as specified previously.
 2. Use commercially manufactured wye or tee fittings and one-eighth bends.
 3. Set wye or tee branches at proper vertical angles as required to bring service connections to the proper depth.
 4. Fittings locations determined by the Engineer with respect to existing service connection location.
 5. Cast Iron Saddles: Make connections to sewers, which incorporate a saddle connection, by machine cutting a hole in the sewer of proper size to accommodate the saddle. Use a machine specifically designed for the purpose; no other means of making the hole permitted.
 - a. Install saddle in accordance with manufacturer's installation instructions.
 6. PVC Saddles: Place saddle in position on pipe and mark guide for hole cut-in, using saddle as a template. Remove saddle from pipe and using hole guide mark, cut hole through pipe wall 1/2-inch outside the hole guide mark.
 - a. Install saddle in accordance with manufacturer's installation instructions.
 7. Pipe Outlet: Connect service connection piping to outlet in manner specified for joining pipe.
 8. Tapping Sleeves: Make connections to sewers, which incorporate a tapping sleeve connection, by machine cutting a hole in the sewer of proper size to accommodate the tapping sleeve.
 - a. Install tapping sleeve in accordance with manufacturer's installation instructions.
 9. Plugs: Close free ends of branches and service connections with a carefully fitted plug. Type of plug used and method of installation to Engineer's approval. Perform Line Acceptance Tests on installed plugs.
- G. Replacement of Damaged Sewer Segments: Remove existing damaged pipe to the limits indicated on the Drawings or as designated by the Engineer and replace with new pipe.
1. When the remaining pipe ends in a bell, remove the bell by cutting with a mechanical saw. Removing the bell or other pipe sections by hammering or chiseling is not permitted.
 2. Make connection of new pipe to remaining existing pipe using Flexible Pipe Couplings. Provide reducing Flexible Pipe Coupling where required to accommodate differing pipe materials.
- H. Storm Sewer Obstructions: When it is necessary to construct a pipe sewer beneath an existing or proposed storm sewer in a location where the vertical separation between the top of the pipe sewer piping and the bottom of the storm sewer piping is 18 inches or less, the pipe sewer piping shall be DIP.
- I. Stream Crossing: Construct stream crossing in accordance with the requirements of Section 01 57 13 and the following:

1. Pipe: Construct stream crossing using only Ductile Iron Pipe, concrete encased as specified in Section 31 23 33.

3.04 SERVICE CONNECTION CONSTRUCTION

- A. General Requirements: Build service connections (house or other service lines) to such points indicated on Drawings, or to such other points designated by the Engineer. Build service connections at such location as selected by the Engineer. Lay and join service connections in every respect as specified for Sewer Construction Methods except as follows:
 1. Line and Grade: Lay service connections true to line and grade furnished by Engineer, and unless otherwise required by Engineer, at a 90 degree angle to curb line.
 2. Test Tees: Install a six by six by six inch test tee on upper free end of service connections (test tee for Owner's use in testing house or building sewer lines connected to service connection). Provide test tees of same material as service connection. Close two outlets of test tee with Plugs. Type of plug used and method of installation subject to Engineer's approval. Perform Line Acceptance Tests on installed plugs.
 3. In general, where depth of sewer invert is 12-feet or more, or elsewhere as designated by the Engineer, install service connections to enter the sewer as shown on Drawings for Service Connection-Deep Sewer. Construct of same material used for service connections.
 4. Where DIP, RCP or PCCP is used for pipe sewer mains, use VC, PVC or ABS pipe for service connection piping. Provide suitable adaptor.
 5. Do not connect service connections to manholes unless the requirement is waived in writing by the Authority.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that each pipe line installed in the Project is tested to the Engineer's satisfaction.
 1. Provide tools, materials (including water), apparatus and instruments necessary for pipe line testing.
 2. Conduct tests in the presence of and to the satisfaction of the Engineer.
- B. Testing Equipment: Use air compressing apparatus equipped with a control panel with necessary piping, control valves and gauges to control air flow rate to piping test section, and to monitor air pressure within piping test section and air pressure within test section seal plugs.
 1. To prevent accidental overloading of piping test section, provide air compressing apparatus with an approved pressure relief device set to relieve at ten psi.
 2. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
 3. Air testing equipment and associated testing apparatus subject to Engineer's approval.

4. Provide GO-NO-GO Mandrel and incidental equipment for Deflection Test. Mandrel to conform to following requirements:
 - a. Cylindrical in shape with not less than nine arms spaced evenly around the mandrel.
 - b. Minimum contact length of mandrel arms with pipe wall not less than the nominal diameter of the pipe being tested.
 - c. Mandrel diameter 95 percent of inside pipe diameter.
- C. Cleaning Prior to Tests: Before tests are conducted, flush piping including sewers, branches and service connections until free of all forms of dirt and construction debris.
 1. Provide the water for the flush cleaning operation from the Contractor's source.
- D. Initial Section Test: To demonstrate acceptability of installed pipe materials and workmanship, construct and air test one sewer section from manhole to manhole using the pipe provided in the Contract. Pretesting such section prior to actual Initial Section Test not permitted.
 1. Conduct Initial Section Test in same manner as Line Acceptance Test specified in a following paragraph.
 2. Conduct the Initial Section Test for each size and type pipe material used in the Project prior to continued installation of same pipe.
 3. Provide pipe manufacturer's representation during laying, backfilling and testing of Initial Sections Tests.
 4. The Engineer has the option to order the same Initial Section Test for a section of sewer in each 3,000 lineal feet of sewer line of a particular size and material.
 5. Conduct same Initial Section Test for one manhole to manhole sewer section of each 3,000 lineal feet of sewer.
 6. Failure of an Initial Section Test will be sufficient cause for the Engineer to reject manufacturer and supplier of pipe regardless of cause of failure.
 7. Sewer sections successfully tested as Initial Section Test will be retested under Line Acceptance Test.
- E. Line Acceptance Test: After a section of sewer and its service connections is constructed between adjacent manholes, backfilled and successfully cleaned, perform a low pressure air Line Acceptance Test in accordance with the following and the Standards listed therein:
 1. Plug free ends of branches and service connections.
 2. Seal Sewer piping at upstream and downstream manholes with pneumatic type plugs. Test plug seal before actual use by testing plugs outside the trench in one length of pipe pressurized to maximum anticipated testing pressure. Plugs to hold without bracing and show no movement.
 3. Introduce low pressure air slowly into sealed sewer section until internal air pressure is four psig greater than the average ground water pressure acting on the pipe.
 4. Allow two minutes minimum for air temperature to stabilize, adding only required air to maintain pressure.
 5. After stabilization period (3.5 psig minimum in pipe) disconnect air supply and determine rate of air loss by measuring time interval required for 3.5 psig to

- decrease to 2.5 psig greater than the average groundwater pressure acting on the pipe.
6. To determine the groundwater pressure acting on the pipe being tested, divide the height in feet of the groundwater above the invert of the pipe by 2.3. Add the result to the previously specified test pressures (i.e., If maximum groundwater height is 11.5 feet above the pipe invert, the groundwater pressure is five psig. This increases the 3.5 psig and 2.5 psig to 8.5 psig and 7.5 psig, respectively.) Test pressure not to exceed ten psig regardless of height of groundwater over the pipe.
 7. Consider sewer line Acceptable when a 1.0 psig pressure drop does not occur within the test time specified in the AIR TEST TABLES immediately following this Section.
 8. Test Standards:
 - a. DIP, RCP, PCCP: Test according to ASTM C 924.
 - b. PVC Pipe, Solid Wall: Test according to UNI-B-6.
 - c. PVC Pipe, Profile Wall: Test according to UNI-B-6.
 9. For sections of sewer containing service connections which service existing buildings, perform Line Acceptance Test by testing one joint at a time.
 - a. Equipment: Use joint testing apparatus such as the Cherne Joint Tester, Cherne Industrial, Inc., Edina, Minnesota or equal.
 - b. Consider joint acceptable when the pressure loss is less than one pound in one minute immediately following air stabilization.
 - c. Use air pressure for testing joint as previously specified.
- F. Deflection Test: In addition to air tests and infiltration test, conduct deflection tests on PVC pipe. Test each PVC pipe sewer main installed.
1. Conduct deflection testing not less than 30 days after section of pipe sewer main and service connection between adjacent manholes is backfilled.
 2. Pull mandrel through pipe section manually; powered pulling devices not permitted.
 3. Consider sewer line section which mandrel cannot pass through, to have more than maximum allowable deflection of five percent.
- G. Infiltration Test: In addition to air tests and deflection test specified previously, conduct infiltration tests at such time and manner required by Engineer.
1. Infiltration rate of groundwater or other water into the sewer line, including manhole bases and walls, exceeding 100 gallons per inch diameter per mile of sewer per day during periods of high groundwater levels will be considered evidence of defective material or improper workmanship.
 2. Make repairs and replacements as required, if rate of infiltration exceeds allowable maximum rate.
 3. Regardless of whether the rate of leakage exceeds or is below the allowable maximum rate, repair leaks in pipe sewer lines.
- H. Repair and Retest: When section or sections of sewer fails to meet test requirements specified previously, determine source or sources of leakage, repair or replace defective material, and if as result of improper workmanship, correct such.

1. Take up and relay pipe sewer line section that has more than the maximum allowable deflection.
 2. Conduct additional tests required to demonstrate that sewer line meets specified tests requirements.
- I. Authority's Tests: The Authority reserves the right to retest at its expense, any piping throughout the duration of the Construction Period.
1. Make repairs as Work of this Contract to piping found defective by such Authority conducted tests.

END OF SECTION

AIR TEST TABLES

8" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
100	58	76	93	111	129	147	165	183	200	218	236	254	272	289	307	325	343	361	378	396
125	68	86	104	121	139	157	175	193	210	228	246	264	282	299	317	335	353	371	388	406
150	78	96	114	131	149	167	185	203	220	238	256	274	292	309	327	345	363	381	398	416
175	88	106	124	141	159	177	195	213	230	248	266	284	302	319	337	355	373	391	408	426
200	98	116	134	151	169	187	205	223	240	258	276	294	312	329	347	365	383	401	418	436
225	108	126	144	161	179	197	215	233	250	268	286	304	322	339	357	375	393	411	429	446
250	118	136	154	171	189	207	225	243	260	278	296	314	332	349	367	385	403	421	439	456
275	128	146	164	181	199	217	235	253	270	288	306	324	342	359	377	395	413	431	449	466
300	138	156	174	191	209	227	245	263	280	298	316	334	352	370	387	405	423	441	459	476
325	148	166	184	201	219	237	255	273	290	308	326	344	362	380	397	415	433	451	469	486
350	158	176	194	211	229	247	265	283	301	318	336	354	372	390	407	425	443	461	479	496
375	168	186	204	221	239	257	275	293	311	328	346	364	382	400	417	435	453	471	489	506
400	178	196	214	232	249	267	285	303	321	338	356	374	392	410	427	445	463	481	499	516
425	188	206	224	242	259	277	295	313	331	348	366	384	402	420	437	455	473	491	509	526
450	198	216	234	252	269	287	305	323	341	358	376	394	412	430	447	465	483	501	519	536
475	208	226	244	262	279	297	315	333	351	368	386	404	422	440	457	475	493	511	529	546
500	218	236	254	272	289	307	325	343	361	378	396	414	432	450	467	485	503	521	539	557
525	228	246	264	282	299	317	335	353	371	388	406	424	442	460	477	495	513	531	549	567
550	238	256	274	292	309	327	345	363	381	398	416	434	452	470	487	505	523	541	559	577
575	248	266	284	302	319	337	355	373	391	408	426	444	462	480	498	515	533	551	569	587

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

10" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	22	45	67	89	111	134	156	178	200	223	245	267	289	312	334	356	378	401	423	445
25	32	55	77	99	121	144	166	188	210	233	255	277	299	322	344	366	388	411	433	455
50	42	65	87	109	131	154	176	198	220	243	265	287	309	332	354	376	398	421	443	465
75	52	75	97	119	141	164	186	208	230	253	275	297	319	342	364	386	408	431	453	475
100	62	85	107	129	151	174	196	218	240	263	285	307	329	352	374	396	418	441	463	485
125	72	95	117	139	161	184	206	228	250	273	295	317	339	362	384	406	429	451	473	495
150	82	105	127	149	171	194	216	238	260	283	305	327	349	372	394	416	439	461	483	505
175	92	115	137	159	181	204	226	248	270	293	315	337	359	382	404	426	449	471	493	515
200	102	125	147	169	191	214	236	258	280	303	325	347	370	392	414	436	459	481	503	525
225	112	135	157	179	201	224	246	268	290	313	335	357	380	402	424	446	469	491	513	535
250	122	145	167	189	211	234	256	278	301	323	345	367	390	412	434	456	479	501	523	545
275	132	155	177	199	221	244	266	288	311	333	355	377	400	422	444	466	489	511	533	555
300	142	165	187	209	232	254	276	298	321	343	365	387	410	432	454	476	499	521	543	565
325	152	175	197	219	242	264	286	308	331	353	375	397	420	442	464	486	509	531	553	575
350	162	185	207	229	252	274	296	318	341	363	385	407	430	452	474	496	519	541	563	585
375	173	195	217	239	262	284	306	328	351	373	395	417	440	462	484	506	529	551	573	595
400	183	205	227	249	272	294	316	338	361	383	405	427	450	472	494	516	539	561	583	605
425	193	215	237	259	282	304	326	348	371	393	415	437	460	482	504	526	549	571	593	615
450	203	225	247	269	292	314	336	358	381	403	425	447	470	492	514	536	559	581	603	626
475	213	235	257	279	302	324	346	368	391	413	435	457	480	502	524	546	569	591	613	636
500	223	245	267	289	312	334	356	378	401	423	445	467	490	512	534	557	579	601	623	646
525	233	255	277	299	322	344	366	388	411	433	455	477	500	522	544	567	589	611	633	656
550	243	265	287	309	332	354	376	398	421	443	465	487	510	532	554	577	599	621	643	666
575	253	275	297	319	342	364	386	408	431	453	475	498	520	542	564	587	609	631	653	676

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

12" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	27	53	80	107	134	160	187	214	240	267	294	321	347	374	401	427	454	481	508	534
25	37	63	90	117	144	170	197	224	250	277	304	331	357	384	411	437	464	491	518	544
50	47	73	100	127	154	180	207	234	260	287	314	341	367	394	421	447	474	501	528	554
75	57	83	110	137	164	190	217	244	270	297	324	351	377	404	431	457	484	511	538	564
100	67	93	120	147	174	200	227	254	280	307	334	361	387	414	441	467	494	521	548	574
125	77	104	130	157	184	210	237	264	290	317	344	371	397	424	451	477	504	531	558	584
150	87	114	140	167	194	220	247	274	301	327	354	381	407	434	461	487	514	541	568	594
175	97	124	150	177	204	230	257	284	311	337	364	391	417	444	471	498	524	551	578	604
200	107	134	160	187	214	240	267	294	321	347	374	401	427	454	481	508	534	561	588	614
225	117	144	170	197	224	250	277	304	331	357	384	411	437	464	491	518	544	571	598	624
250	127	154	180	207	234	260	287	314	341	367	394	421	447	474	501	528	554	581	608	634
275	137	164	190	217	244	270	297	324	351	377	404	431	457	484	511	538	564	591	618	644
300	147	174	200	227	254	280	307	334	361	387	414	441	467	494	521	548	574	601	628	654
325	157	184	210	237	264	290	317	344	371	397	424	451	477	504	531	558	584	611	638	664
350	167	194	220	247	274	301	327	354	381	407	434	461	487	514	541	568	594	621	648	674
375	177	204	230	257	284	311	337	364	391	417	444	471	498	524	551	578	604	631	658	684
400	187	214	240	267	294	321	347	374	401	427	454	481	508	534	561	588	614	641	668	695
425	197	224	250	277	304	331	357	384	411	437	464	491	518	544	571	598	624	651	678	705
450	207	234	260	287	314	341	367	394	421	447	474	501	528	554	581	608	634	661	688	715
475	217	244	270	297	324	351	377	404	431	457	484	511	538	564	591	618	644	671	698	725
500	227	254	280	307	334	361	387	414	441	467	494	521	548	574	601	628	654	681	708	735
525	237	264	290	317	344	371	397	424	451	477	504	531	558	584	611	638	664	691	718	745
550	247	274	301	327	354	381	407	434	461	487	514	541	568	594	621	648	674	701	728	755
575	257	284	311	337	364	391	417	444	471	498	524	551	578	604	631	658	684	711	738	765

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

15" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	31	63	94	125	157	188	219	250	282	313	344	376	407	438	470	501	532	563	595	626
25	41	73	104	135	167	198	229	260	292	323	354	386	417	448	480	511	542	573	605	636
50	51	83	114	145	177	208	239	270	302	333	364	396	427	458	490	521	552	583	615	646
75	61	93	124	155	187	218	249	280	312	343	374	406	437	468	500	531	562	594	625	656
100	71	103	134	165	197	228	259	290	322	353	384	416	447	478	510	541	572	604	635	666
125	81	113	144	175	207	238	269	301	332	363	394	426	457	488	520	551	582	614	645	676
150	91	123	154	185	217	248	279	311	342	373	404	436	467	498	530	561	592	624	655	686
175	101	133	164	195	227	258	289	321	352	383	414	446	477	508	540	571	602	634	665	696
200	111	143	174	205	237	268	299	331	362	393	424	456	487	518	550	581	612	644	675	706
225	121	153	184	215	247	278	309	341	372	403	434	466	497	528	560	591	622	654	685	716
250	131	163	194	225	257	288	319	351	382	413	445	476	507	538	570	601	632	664	695	726
275	141	173	204	235	267	298	329	361	392	423	455	486	517	548	580	611	642	674	705	736
300	152	183	214	245	277	308	339	371	402	433	465	496	527	558	590	621	652	684	715	746
325	162	193	224	255	287	318	349	381	412	443	475	506	537	568	600	631	662	694	725	756
350	172	203	234	265	297	328	359	391	422	453	485	516	547	578	610	641	672	704	735	766
375	182	213	244	275	307	338	369	401	432	463	495	526	557	588	620	651	682	714	745	776
400	192	223	254	285	317	348	379	411	442	473	505	536	567	599	630	661	692	724	755	786
425	202	233	264	296	327	358	389	421	452	483	515	546	577	609	640	671	702	734	765	796
450	212	243	274	306	337	368	399	431	462	493	525	556	587	619	650	681	712	744	775	806
475	222	253	284	316	347	378	409	441	472	503	535	566	597	629	660	691	722	754	785	816
500	232	263	294	326	357	388	419	451	482	513	545	576	607	639	670	701	732	764	795	826
525	242	273	304	336	367	398	429	461	492	523	555	586	617	649	680	711	743	774	805	836
550	252	283	314	346	377	408	439	471	502	533	565	596	627	659	690	721	753	784	815	846
575	262	293	324	356	387	418	450	481	512	543	575	606	637	669	700	731	763	794	825	856

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

16" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	36	71	107	142	178	214	249	285	321	356	392	427	463	499	534	570	605	641	677	712
25	46	81	117	152	188	224	259	295	331	366	402	437	473	509	544	580	615	651	687	722
50	56	91	127	162	198	234	269	305	341	376	412	447	483	519	554	590	626	661	697	732
75	66	101	137	173	208	244	279	315	351	386	422	457	493	529	564	600	636	671	707	742
100	76	111	147	183	218	254	289	325	361	396	432	467	503	539	574	610	646	681	717	752
125	86	121	157	193	228	264	299	335	371	406	442	477	513	549	584	620	656	691	727	762
150	96	131	167	203	238	274	309	345	381	416	452	487	523	559	594	630	666	701	737	772
175	106	141	177	213	248	284	319	355	391	426	462	498	533	569	604	640	676	711	747	782
200	116	151	187	223	258	294	329	365	401	436	472	508	543	579	614	650	686	721	757	792
225	126	161	197	233	268	304	339	375	411	446	482	518	553	589	624	660	696	731	767	802
250	136	171	207	243	278	314	349	385	421	456	492	528	563	599	634	670	706	741	777	812
275	146	181	217	253	288	324	359	395	431	466	502	538	573	609	644	680	716	751	787	823
300	156	191	227	263	298	334	370	405	441	476	512	548	583	619	654	690	726	761	797	833
325	166	201	237	273	308	344	380	415	451	486	522	558	593	629	664	700	736	771	807	843
350	176	211	247	283	318	354	390	425	461	496	532	568	603	639	674	710	746	781	817	853
375	186	221	257	293	328	364	400	435	471	506	542	578	613	649	684	720	756	791	827	863
400	196	232	267	303	338	374	410	445	481	516	552	588	623	659	695	730	766	801	837	873
425	206	242	277	313	348	384	420	455	491	526	562	598	633	669	705	740	776	811	847	883
450	216	252	287	323	358	394	430	465	501	536	572	608	643	679	715	750	786	821	857	893
475	226	262	297	333	368	404	440	475	511	546	582	618	653	689	725	760	796	831	867	903
500	236	272	307	343	378	414	450	485	521	557	592	628	663	699	735	770	806	841	877	913
525	246	282	317	353	388	424	460	495	531	567	602	638	673	709	745	780	816	851	887	923
550	256	292	327	363	398	434	470	505	541	577	612	648	683	719	755	790	826	861	897	933
575	266	302	337	373	408	444	480	515	551	587	622	658	693	729	765	800	836	871	907	943

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

18" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	36	72	108	144	180	216	252	288	325	361	397	433	469	505	541	577	613	649	685	721
25	46	82	118	154	190	226	262	299	335	371	407	443	479	515	551	587	623	659	695	731
50	56	92	128	164	200	236	272	309	345	381	417	453	489	525	561	597	633	669	705	741
75	66	102	138	174	210	246	282	319	355	391	427	463	499	535	571	607	643	679	715	751
100	76	112	148	184	220	256	292	329	365	401	437	473	509	545	581	617	653	689	725	761
125	86	122	158	194	230	266	303	339	375	411	447	483	519	555	591	627	663	699	735	771
150	96	132	168	204	240	276	313	349	385	421	457	493	529	565	601	637	673	709	745	781
175	106	142	178	214	250	286	323	359	395	431	467	503	539	575	611	647	683	719	755	791
200	116	152	188	224	260	297	333	369	405	441	477	513	549	585	621	657	693	729	765	801
225	126	162	198	234	270	307	343	379	415	451	487	523	559	595	631	667	703	739	775	811
250	136	172	208	244	280	317	353	389	425	461	497	533	569	605	641	677	713	749	785	821
275	146	182	218	254	290	327	363	399	435	471	507	543	579	615	651	687	723	759	795	831
300	156	192	228	264	301	337	373	409	445	481	517	553	589	625	661	697	733	769	805	841
325	166	202	238	274	311	347	383	419	455	491	527	563	599	635	671	707	743	779	815	851
350	176	212	248	284	321	357	393	429	465	501	537	573	609	645	681	717	753	789	825	861
375	186	222	258	295	331	367	403	439	475	511	547	583	619	655	691	727	763	799	835	871
400	196	232	268	305	341	377	413	449	485	521	557	593	629	665	701	737	773	809	845	881
425	206	242	278	315	351	387	423	459	495	531	567	603	639	675	711	747	783	819	855	892
450	216	252	288	325	361	397	433	469	505	541	577	613	649	685	721	757	793	829	865	902
475	226	262	299	335	371	407	443	479	515	551	587	623	659	695	731	767	803	839	875	912
500	236	272	309	345	381	417	453	489	525	561	597	633	669	705	741	777	813	849	886	922
525	246	282	319	355	391	427	463	499	535	571	607	643	679	715	751	787	823	859	896	932
550	256	292	329	365	401	437	473	509	545	581	617	653	689	725	761	797	833	869	906	942
575	266	303	339	375	411	447	483	519	555	591	627	663	699	735	771	807	843	879	916	952

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

20" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	40	81	121	162	202	243	283	324	364	405	445	486	526	567	607	648	688	729	769	809
25	50	91	131	172	212	253	293	334	374	415	455	496	536	577	617	658	698	739	779	819
50	61	101	141	182	222	263	303	344	384	425	465	506	546	587	627	668	708	749	789	829
75	71	111	151	192	232	273	313	354	394	435	475	516	556	597	637	678	718	759	799	840
100	81	121	161	202	242	283	323	364	404	445	485	526	566	607	647	688	728	769	809	850
125	91	131	172	212	252	293	333	374	414	455	495	536	576	617	657	698	738	779	819	860
150	101	141	182	222	262	303	343	384	424	465	505	546	586	627	667	708	748	789	829	870
175	111	151	192	232	272	313	353	394	434	475	515	556	596	637	677	718	758	799	839	880
200	121	161	202	242	283	323	363	404	444	485	525	566	606	647	687	728	768	809	849	890
225	131	171	212	252	293	333	373	414	454	495	535	576	616	657	697	738	778	819	859	900
250	141	181	222	262	303	343	383	424	464	505	545	586	626	667	707	748	788	829	869	910
275	151	191	232	272	313	353	393	434	474	515	555	596	636	677	717	758	798	839	879	920
300	161	201	242	282	323	363	404	444	484	525	565	606	646	687	727	768	808	849	889	930
325	171	211	252	292	333	373	414	454	494	535	575	616	656	697	737	778	818	859	899	940
350	181	221	262	302	343	383	424	464	504	545	585	626	666	707	747	788	828	869	909	950
375	191	231	272	312	353	393	434	474	515	555	595	636	676	717	757	798	838	879	919	960
400	201	241	282	322	363	403	444	484	525	565	605	646	686	727	767	808	848	889	929	970
425	211	251	292	332	373	413	454	494	535	575	615	656	696	737	777	818	858	899	939	980
50	221	261	302	342	383	423	464	504	545	585	626	666	706	747	787	828	868	909	949	990
475	231	271	312	352	393	433	474	514	555	595	636	676	716	757	797	838	878	919	959	1000
500	241	281	322	362	403	443	484	524	565	605	646	686	726	767	807	848	888	929	969	1010
525	251	291	332	372	413	453	494	534	575	615	656	696	737	777	817	858	898	939	979	1020
550	261	301	342	382	423	463	504	544	585	625	666	706	747	787	827	868	908	949	989	1030
575	271	311	352	392	433	473	514	554	595	635	676	716	757	797	837	878	918	959	999	1040

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

AIR TEST TABLES

24" PIPE DIAMETERS

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR
PRESSURE TO DROP FROM 3 1/2 TO 2 1/2 PSIG
(POUNDS PER SQUARE INCH GAGE)

**	LENGTH OF MAIN LINE IN FEET																			
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
0	53	107	160	214	267	321	374	427	481	534	588	641	695	748	801	855	908	962	1015	1068
25	63	117	170	224	277	331	384	437	491	544	598	651	705	758	811	865	918	972	1025	1078
50	73	127	180	234	287	341	394	447	501	554	608	661	715	768	821	875	928	982	1035	1089
75	83	137	190	244	297	351	404	457	511	564	618	671	725	778	831	885	938	992	1045	1099
100	93	147	200	254	307	361	414	467	521	574	628	681	735	788	841	895	948	1002	1055	1109
125	104	157	210	264	317	371	424	477	531	584	638	691	745	798	851	905	958	1012	1065	1119
150	114	167	220	274	327	381	434	487	541	594	648	701	755	808	861	915	968	1022	1075	1129
175	124	177	230	284	337	391	444	498	551	604	658	711	765	818	871	925	978	1032	1085	1139
200	134	187	240	294	347	401	454	508	561	614	668	721	775	828	881	935	988	1042	1095	1149
225	144	197	250	304	357	411	464	518	571	624	678	731	785	838	892	945	998	1052	1105	1159
250	154	207	260	314	367	421	474	528	581	634	688	741	795	848	902	955	1008	1062	1115	1169
275	164	217	270	324	377	431	484	538	591	644	698	751	805	858	912	965	1018	1072	1125	1179
300	174	227	280	334	387	441	494	548	601	654	708	761	815	868	922	975	1028	1082	1135	1189
325	184	237	290	344	397	451	504	558	611	664	718	771	825	878	932	985	1038	1092	1145	1199
350	194	247	301	354	407	461	514	568	621	674	728	781	835	888	942	995	1048	1102	1155	1209
375	204	257	311	364	417	471	524	578	631	684	738	791	845	898	952	1005	1058	1112	1165	1219
400	214	267	321	374	427	481	534	588	641	695	748	801	855	908	962	1015	1068	1122	1175	1229
425	224	277	331	384	437	491	544	598	651	705	758	811	865	918	972	1025	1078	1132	1185	1239
450	234	287	341	394	447	501	554	608	661	715	768	821	875	928	982	1035	1089	1142	1195	1249
475	244	297	351	404	457	511	564	618	671	725	778	831	885	938	992	1045	1099	1152	1205	1259
500	254	307	361	414	467	521	574	628	681	735	788	841	895	948	1002	1055	1109	1162	1215	1269
525	264	317	371	424	477	531	584	638	691	745	798	851	905	958	1012	1065	1119	1172	1225	1279
550	274	327	381	434	487	541	594	648	701	755	808	861	915	968	1022	1075	1129	1182	1235	1289
575	284	337	391	444	498	551	604	658	711	765	818	871	925	978	1032	1085	1139	1192	1245	1299

** - LENGTH OF 6" DIAMETER LATERAL IN FEET

SECTION 33 32 16.13

GRINDER PUMP UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: This Section specifies both simplex and duplex grinder pump units with tank, internal piping, and operating controls. All non-residential uses will require a duplex grinder pump unit unless waived by the Authority.
- B. Related Sections:
 - 1. Cast-In-Place Concrete: Section 03 30 00.
 - 2. Trenching and Backfilling: Section 31 23 33.
 - 2. Manholes and Structures: Section 33 05 13.
 - 3. Low Pressure Wastewater Utility Piping: Section 33 33 19.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI B2.1, Pipe Threads.
 - 2. ANSI B16.3, Malleable-Iron Screwed Fittings, 150 and 300 lb.
 - 3. ANSI C2, National Electrical Safety Code.
- B. American Society for Testing and Materials:
 - 1. ASTM A 48, Specification for Gray Iron Castings.
 - 2. ASTM A 536, Specification for Ductile Iron Castings.
 - 3. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
 - 5. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
 - 6. ASTM C 581, Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
 - 7. ASTM C 582, Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
 - 8. ASTM D 1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 9. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.
 - 10. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).
 - 11. ASTM D 2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 12. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

13. ASTM D 3299, Specification for Filament-Wound Glass Fiber Reinforced Polyester Chemical-Resistant Tanks.
14. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. Federal Specifications:

1. Fed. Spec. WW-C-581D, Conduit, Metal, Rigid and Coupling Elbow and Nipple, Electrical Conduit, Zinc-Coated.

D. Institute of Electrical and Electronics Engineers.

E. National Bureau of Standards: Product Standard PS 15-69, Custom Molded Reinforced Polyester Chemical Resistant Process Equipment.

F. National Electrical Code (NEC).

G. National Electric Manufacturer's Association (NEMA) Standards of Construction.

H. National Fire Protection Association (NFPA): NFPA 70; National Electrical Code, and current amendments.

I. Underwriters' Laboratories (UL) Listings and Approvals on specified Products.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval completely dimensioned shop drawings and catalog cuts or other data as required to provide a complete description of the following:

1. Submit shop drawings certified for construction by the manufacturer which includes location of electrical connections; wiring diagrams; anchor bolt layout; details indicating construction and materials of construction; diameter of shafting; dimensions and rated horsepower of all motors; gear and bearing ratings; service factors and weights of principal parts and completely assembled equipment.
2. Submit evidence of Underwriters' Laboratories (UL) Listings and Approvals on the electrical control panel and grinder pump.
2. Submit details of the Anti-Flotation Anchor indicating the size and weight required.

B. Certificates: Submit certified records or reports of results of shop test for each unit. Such records or report shall contain a sworn statement that shop tests have been made as specified.

1. Submit manufacturer's sworn certification that components and products will be manufactured in accordance with specified reference standards for components.

C. Operation and Maintenance Manuals: Within four weeks following the receipt of approved shop drawings, submit to the Engineer for review and approval, five copies of manuals prepared by the manufacturer/supplier, or the Contractor. The submission and

approval of each set of manuals will be considered to be an integral part of furnishing and installation of the respective equipment or system. Incomplete or inadequate manuals will be returned to the Contractor for correction and resubmission.

1. Include the following elements in each manual:
 - a. Erection or installation instructions.
 - b. Start-up procedures.
 - c. Recommended and alternative procedures.
 - d. Schedule of preventive maintenance requirements.
 - e. Detailed maintenance procedures.
 - f. Schedule of lubrication requirements.
 - g. Data sheet listing pertinent equipment or system information, as well as the addresses and telephone numbers of the nearest sales and service representatives.
 - h. Provide a list of the manufacturer recommended spare parts.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualification: Consideration will be given only to manufacturers or fabricators meeting the following qualifications:
 1. Three years minimum experience producing Units of equal quality to the type specified herein.
 2. Three years minimum experience of in-service, satisfactorily operating Units of the type specified herein.
 3. Manufactured grinder pump units shall have been tested to certify capability to perform, as specified herein, in either individual or low pressure sewer system applications.
 4. Historical and certified data substantiating the above qualifications available to the Engineer upon request.
- B. Design Criteria: Units shall meet accepted standards for plumbing equipment for use in or near structures, and shall operate free from noise, odor or health hazards.
 1. Grinder: The grinder shall have capability to reduce the components in normal domestic sewage, including a reasonable amount of foreign objects, such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4 inch diameter discharge piping.
 - a. The grinder position shall be such that solids are fed in an upflow direction.
 2. Pump: Centrifugal design and progressive cavity, capable of delivering 11 GPM against a normal rated total dynamic head of 92 feet. Pump of such design to allow for removal from tank, without use of tools, to the immediate area outside of tank with electrical and control connections intact.
 3. Pump and motor to have the capability of running dry for extended periods of time without damage to motor or seals.
 4. Motor: 1 Horsepower minimum.
 5. Tank: Provide completely watertight tank, of 60 gallon capacity minimum, and designed to withstand the minimum depth of bury earthload at the proposed tank

location. In the case of FRP tank, the tank manufacturer shall calculate the anti-flotation anchor and provide an appropriate design for the anchor.

- a. Provide a 7 foot deep tank.
 6. Inlet Size: 4-inch diameter, minimum.
 7. Discharge Size: 1-1/4-inch diameter.
- C. Requirements of Regulatory Agencies: Comply with construction code requirements of State, County, and such other political subdivision specifications as may exceed the requirements of the codes, standards and approving bodies referenced throughout these Specifications.
1. Provide electrical control panels and grinder pump units constructed in accordance with the requirements of the Underwriters Laboratory, or other nationally recognized certification agency, and labeled accordingly.
 2. Units shall comply with the applicable requirements of the Pennsylvania Department of Environmental Protection and the National Sanitation Foundation.
- D. Source Quality Control:
1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test each unit. The manufacturer shall have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.
 - a. Submit the proposed types of tests in the Shop Drawing submittal.
 - b. Test to assure watertightness of the Unit for the proposed installation depth.
 - c. Test pump output in gallons per minute at 15 psi and 35 psi.
 - d. Test amperage and wattage of electrical consumption.
 2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on Units that have been shop tested. When the Engineer so orders, furnish labor, materials, and equipment necessary packaging, and shipping the grinder pump unit to the Test Laboratory.
 3. Provide certification that the units have been tested successfully for watertightness.
 4. Single Source Responsibility: To ensure single source responsibility and part supply, provide the pump components, tank, internal piping system and electrical controls from one grinder pump manufacturer.
- E. Authority's Representative Inspections: A representative of the Authority will be present during Grinder Pump Unit initial installation and testing operations. To accommodate the Authority's representative concerning the Inspections stated herein, the Contractor shall observe the following:
1. Notice: Give the Authority a minimum of 72 hours notice for an inspection. Call Phone No. 610-539-6161 between the 7:00 a.m. and 3:30 p.m. prevailing time Monday through Friday. Schedule inspection appointments with the Authority only between the hours of 8:00 a.m. and 3:00 p.m. prevailing time Monday through Friday.
 - a. No weekend or holiday inspection appointments allowed.

2. Initial Unit Installation and Inspection: To serve as the minimum acceptable conditions of installation throughout the Project, install the first unit in the Project to demonstrate the stages of installation stated in the following sentences. The Authority's representative shall inspect each of the following stages of installation:
 - a. Bedding and concrete construction.
 - b. Pipe connections to the Unit and watertightness of the complete Unit.
 - c. Proper electrical work operation of the Unit.
 - d. Proper backfilling procedures.

1.05 DELIVERY, STORAGE AND HANDLING

- A. To prevent damage and defects, transport, store and handle the units and Products specified herein in a manner recommended by the respective manufacturers.

1.06 SITE CONDITIONS

- A. Environmental Requirements: In no instance set units on subgrade containing frost or on unacceptable subgrade which condition has been determined unacceptable by the Engineer.
- B. Electrical Interface: Install or mount those electrical components or apparatus as furnished by the Product manufacturers of those Products specified herein.
 1. Property owner will be responsible for permanent power wiring, including final connections of such to the electrical components or apparatus of the grinder pump units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 1. Barnes Pumps, Inc.
 2. Hydromatic.
 3. Myers.
 4. Environment One.
 5. Or Equal.

2.02 GRINDER PUMP UNIT

- A. General Requirements: Provide prefabricated, completely assembled Unit, suitable for conveying domestic sewage and for underground installation with the necessary accessories as specified herein and as required for a completely operational unit. Unit shall have one (Simplex) or two (Duplex) grinder pumps, as indicated on the Drawings.
 1. Unit shall have the sewage grinder pump(s) and other necessary accessories as specified herein, which include sewage grinder pump(s), mercury switch level

controls, discharge piping, with hydraulically sealed discharge flange(s), pump mounting plate and bottom rail supports, upper rail supports, pump guide rails and lifting chain or cable.

2. Unit shall include FRP tank and discharge piping with hydraulically sealed discharge flange.
3. Unit shall have a control panel, control panel enclosure, alarm devices and electrical wiring.
4. Where exposed to wastewater, provide materials that have inherent corrosion protection (i.e., cast iron, fiberglass, stainless steel, PVC).
5. Duplex installations shall permit the independent removal of each grinder pump from the sump basin for maintenance or inspection, and the return of the pump to service without draining or entering the sump basin.

B. Pump: Component construction as follows:

1. Casing: Pump casing, oil casing and motor casing of ASTM A 48 cast iron. Pump casing construction of single volute type, ribbed to prevent excessive deflection and hydrostatically tested to twice the design. Volute sized at all points to pass solids which can pass through the impeller and internally finished to provide smooth, unobstructed flow.
2. Impeller: Non-clogging type of ASTM A 536 ductile iron or bronze; statically, dynamically and hydraulically balanced.
3. Pump Shaft: Stainless steel of sufficient strength and size to safely transmit the maximum torque developed by the drive unit.
4. Hydraulically Sealed Discharge Flange: The hydraulically sealed discharge flange shall allow the pump to be removed periodically and shall result in a watertight seal when the pump is replaced. Fittings of threaded style, 150 lb. galvanized malleable iron conforming to ANSI B 16.3.

C. Grinder: Mounted immediately below pumping elements and constructed so as to eliminate clogging and jamming under normal operating conditions including starting. Unit shall create sufficient vortex action to scour tank free of deposits or sludge banks which would impair the operation of the pump. Components and construction as follows:

1. Direct drive with single, one piece motor shaft.
2. Abrader: AISI Type 316 stainless steel.
3. Cutter Bar: AISI Type 410 stainless steel, Rockwell hardness C-35.
4. Wear Plate: Stainless steel with micrometer adjustment for high head requirements and eliminating the need for shims.
5. Pump and grinder assembly balanced to operate without objectionable noise or vibration over the entire range of recommended operating pressures.

D. Motor: One Hp. minimum, of 240 volt, single phase, 60 Hertz, 1,750 RPM, totally submersible design, constructed with open winding and designed to operate in clean dielectric oil for cooling winding. Air cooled stators and grease packed bearings not acceptable.

1. Motor shaft of stainless steel and designed for extremely difficult pumping service.

- Motor shaft and housing sealed with two mechanical shaft seals with an oil chamber between the seals. The seals shall have carbon and ceramic seal faces.
2. Motors shall comply with Standards of IEEE and NEMA in all respects except where requirements exceed these Standards.

- E. Lifting Accessories: Provide stainless steel guide rails, supports, chains and shackles for raising and lowering the pumping equipment.

2.03 PIPING

- A. Discharge Piping and Fittings: Schedule 80 PVC manufactured from Class 12454-B Rigid PVC Compounds with a hydrostatic design stress of 13.8 MPa (2000 psi designated as PVC 1120) and conforming to ASTM D 1785; NPT couplings, pipe and fittings.
 1. Size: 1-1/4-inch diameter on the Simplex Unit and 1-1/2-inch diameter on the Duplex Unit.
 2. Material Option: Discharge pipe may be SDR 21 PVC (Pressure Class 200 psi.) conforming to ASTM D 2241 or High Density Polyethylene (HDPE) Pressure Piping.
 - a. Pipe Joints: Push-on or compression type, joint performance conforming to ASTM D 3139, with rubber gasket suitable for domestic sewage service and conforming to ASTM F 477.
- B. Valves: Include a check valve, gate valve and hydraulically sealed discharge flange in pump discharge piping.
 1. General Requirements: Provide valves of the same type by the same manufacturer; suitable for the intended service. Markings factory cast on the bonnet or body of each valve shall indicate manufacturer's name or mark, year of valve casting, size of valve, directional flow arrow and designation of working water pressure.
 - a. Valve pressure-temperature ratings of not less than the design criteria applicable to system components.
 - b. Valves shall open to the left (counterclockwise). Provide extension stems with bronze bushed stem guides where required. Provide a top support and one intermediate support unless the unsupported stem length exceeds four feet, in which case provide an additional support every two feet of valve stem length.
 - c. Valve ends indicated on the Drawings, and unless indicated otherwise, shall be threaded in accordance with ANSI B2.1.
 2. Check Valve: Ball check valve designed for a minimum water working pressure of 150 pounds per square inch and factory tested to double that pressure before shipment. Check valve bodies to provide excess area through the valves to assure full delivery of line capacity. Include with each Unit one separate 1-1/4-inch check valve for installation in the discharge line between the Grinder Pump and the sewer main.
 - a. Double union type manufactured from PVC 12454-B conforming to ASTM

D 1784 with Vitron O ring seals. Valve to be as specified with the exception of the joint.

3. Gate Valve: Provide valves of designed working water pressure at 200 psi., of solid bronze construction with tapered split wedge disc. Physical properties of brass pressure containing parts shall conform to ASTM B 62.
 - a. Valves of rising stem pipe. Valve stuffing box of such design that valve can be packed under pressure when in fully open position.
 - b. Stems fabricated of ASTM B 371, Alloy A (rolled silicon brass), ASTM B 584 Copper Alloy No. 876 (silicon bronze + silicon brass), or other material equally resistant to dezincification.
- C. Spare Parts: Provide manufacturer recommended and Engineer approved spare parts items and quantity of each.

2.04 PUMP CONTROLS

- A. Controls, Simplex Pump: Provide three mercury switches; one for pump start, one for pump stop, and one to signal high-level sump alarm. Operation as follows:
 1. On sump level rise, lower mercury switch shall first be energized, then upper level switch shall next energize and start pump.
 2. With pump operating, sump level shall lower to low switch turn-off setting and pump shall stop.
 3. If level continues to rise when pump is operating, alarm switch shall energize. Level switches adjustable for level setting, from the surface.
- B. Controls, Duplex Pumps: Provide four mercury switches; one for lead pump start, one for lag pump start, one for both pumps stop and one to signal high-level sump alarm. Operation as follows:
 1. On sump level rise, lower mercury switch shall first be energized, then upper level switch shall next energize and start lead pump. With lead pump operating, sump level will lower to low switch turn-off setting and pump shall stop.
 2. Alternating relay shall index on stopping of pump so that lag pump shall start on next operation.
 3. If sump level continues to rise when lead pump is operating, override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low level switch turns off both pumps.
 - a. If level continues to rise when both pumps are operating, alarm switch shall energize.
 4. If one pump should fail for any reason, the second pump shall operate on the override control, and if level rises above override control, signal alarm switch shall energize.
 - a. Level switches adjustable for level setting, from the surface.
- C. Control Components: Provide the following items which are common to either Simplex or Duplex control systems:
 1. Power Cord: Provide SO type construction electric power cord, suitable for continuous submersion in sewage, to power the pump. Cord sealed by use of a

- cord grip, with individual conductors additionally sealed into the cord cap assembly with epoxy sealing compound. Cord cap sealed into the motor housing with a Buna-N O-ring, providing a completely watertight electrical connection.
2. Sealed Float-Type Mercury Switches: For corrosion and shock resistance the mercury tube switches are factory sealed in a solid polypropylene float, with internal weight. The float power and support wire shall have a heavy Neoprene jacket.
 - a. Provide an intrinsically safe UL approved relay to be wired to each float type mercury switch.
 - b. Support the float switches by the cord that is connected to the junction box. Provide a junction box to be drilled and tapped for the four 3/4-inch diameter conduits for wiring to Pump Control Panel. Provide junction box labeled for Explosion-Proof application and conforming to the requirements under Article 500 of NEC for Class 1, Division 1, Group D, Hazardous Location.
 3. Thermal Overload Sensors: Include in the pumping system sensors to determine thermal overload and hydraulic seal failure conditions in addition to high sump level.
 4. Control Panel: NEMA 3R Enclosure with baked gray enamel finish or fiberglass, fully enclosed with panel hardware mounted on a separate inside plate organized to facilitate maintenance and repair. Panel factory equipped with an oxidation inhibitor and wall mounting brackets. Panel so designed to be wall or post mounted. Enclosure equipped with locking hardware and provided with weather-resistant padlock. Unnecessary punch-outs not permitted. Enclosure to contain the following:
 - a. Provide a circuit breaker for total panel and individual breakers for pumps and alarms so that alarms remain energized when pump breaker is tripped.
 - b. (Simplex) Hardware includes start and run capacitors, start relay, circuit breaker (quick-make/quick-break action on manual operation) with bi-metallic ambient compensated overload relay with heaters to protect both start and run windings, H-O-A switch and indicator lights. Provide individual circuit breaker for alarm system.
 - c. (Simplex) Provide terminal strip for float control wires and a 120 volt AC control circuit.
 - d. (Duplex) Hardware includes two sets of start and run capacitors, start relay, circuit breaker (quick-make/quick-break on manual operation) with bi-metallic ambient compensated overload relay with heaters to protect both start and run windings, H-O-A switch and indicator lights.
 - e. (Duplex) Provide one alternating relay and terminal strip for float control wires.
 - f. Visible and Audible Alarms:
 - 1) Visible red lights indicating overflow, thermal overload and hydraulic seal failure conditions.
 - 2) Audible alarm indicating overflow conditions with manual On/Off switch on exterior of enclosure. Red overflow light to remain on when alarm silenced.
 - 3) (Duplex) Pump running lights.

- g. Provide electrical surge protection device as part of the unit package.

2.05 TANK

- A. FRP Tank: Tank construction of fiberglass reinforced polyester construction conforming to ASTM C 582 and C 581 Standards with a minimum wall thickness of 1/4-inch.
 - 1. Materials:
 - a. Tank Resin: Polyester; Atlac 382.
 - b. Tank Cover: Flush design, fiberglass reinforced polyester construction of same type as tank, with slip resistant surface. Cover bolted to tank and equipped with padlock feature. Bolts and padlock of corrosion-resistant construction.
 - c. Connections: Watertight and suitable for attaching PVC pipe; 4-inch diameter inlet and 1-1/4-inch diameter discharge with plugs or caps.
 - 2. Manufacturing Standards: Tank manufactured according to ASTM D 3299 Standards for filament wound tanks, or NBS PS 15-69 Standards for contact molded tanks.
- B. Anti-Flotation Anchor: Provide precast or field cast concrete anchor in accordance with tank manufacturer's recommendations. The tank manufacturer shall provide the design and size of the anchor as specified previously under Design Criteria.
- C. Precast Concrete Manhole Tank: Conforming to the requirements of Section 33 05 13.

2.06 MISCELLANEOUS MATERIAL

- A. Bedding and Backfill: As specified in Section 31 23 33.
- B. Cast-In-Place Concrete: As specified in Section 03 30 00.
- C. Pipe Connections: Make pipe connections according to the requirements of Section 33 33 19.
- D. Preservative Treated Post (Control Panel Mounting Option): Nominal dimension 6 x 6, surfaced four sides (grade stamp S4S) and grade stamped indicating product compliance with PS-20-70 according to the American Softwood Lumber Standard, and preservative treated as follows:
 - 1. Preservative treatment by the pressure impregnation process for Ground Contact in accordance with the American Wood Preserver's Association AWPAC P-5.
 - 2. Preservative injected into the wood at 0.60 pounds per cubic foot of wood. Preservative density determined by assay in accordance with AWPAC Standard C-1.
- E. Underground Cable, Type UF: Multi-conductor cable with each conductor of annealed uncoated copper and individual color coded PVC insulation. Conductors assembled flat

with grounding wire and encased in gray sunlight resistant PVC approval imprinted jacket. Standards compliance as follows:

1. UL listed as Type NMC Cable per Standard 719 for Nonmetallic-Sheathed Cables.
2. UL listed as sunlight resistant Type UF cable per Standard 493 for underground Feeder and Branch-Circuit Cables.
3. Conforming to National Electrical Code, Article 339.
4. ROMEX and BX Cable not permitted for use in this Project.
5. Warning Tape: Printed polyethylene, magnetic tape of three inches width minimum, color coded red and labeled in one inch lettering with the word electric.

F. Wire and Cable Connections (Exposed Locations):

1. Wire Nuts: Preinsulated UL Listed hand or tool installed solderless connectors of the spring-lock type or compression type for making splices of solid COPPER wire.
2. Split Bolt Connectors or Compression Type Connectors: UL Listed connectors for making parallel or butt splices of stranded COPPER wire. Use companion preformed plastic insulating covers or tape insulation conforming to NEC requirements.
3. Screw-Lock Connectors: UL Listed connectors for making terminal connections or solid COPPER wire. Contractor option to use UL Listed crimp type ring tongue connectors.

G. Waterproof Splice Kit (Buried and Waterproof Locations): Molded rubber composition and designed to create a watertight seal on the cable jacket as well as the splice.

1. Acceptable Manufacturers:
 - a. Elastimold Division Amerace-Esna Corp.; Fused and Single & Multi-Conductor Connector Kits.
 - b. Joy Manufacturing Company.
 - c. Or equal.

H. Rigid Metal Conduits: Fabricated of mild steel piping, galvanized or sherardized inside and outside, and protected against corrosion by a dichromate rinse or a zinc chromate coating. Each conduit shall bear the UL label, be defect free, furnished in 10 ft. lengths minimum, and of the following type:

1. Rigid Metal Conduit and Fittings: Products meeting requirements of NEC Article 346 for materials and uses, and Fed. Spec. WW-C-581D.

I. Rigid PVC Conduit: High impact PVC (polyvinyl chloride) Conduit and Fittings conforming to NEMA Spec. TC-2, 90 C, UL rated and Labeled and made from compounds conforming to ASTM D 1784. Additionally, PVC conduit shall have material strengths of 5,500 psi tensile, 11,000 psi flexural and 8,600 psi compression; all at 78 degrees F.

1. Provide schedule 40 conduit and fittings, except where required by NEC use schedule 80.

J. Grounding Materials: Provide materials conforming to UL requirements for such use as

NEC Article 250. Basic materials as follows:

1. Ground Rods: 3/4-inch by ten foot copperweld type.
2. Ground Conductors: Code gauge stranded copper unless otherwise indicated.
3. Ground Clamps: Multi-bolt type, (Clamps for pipe, lugs for bars) saddle clamp or compression type for wire.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Examine units for defects that will adversely affect installation or cause latent defects in completed work. Inform Engineer of defects. Do not proceed with installation until defects have been corrected.
 1. Verify other construction work is complete to the extent that substrates on which electrical apparatus is to be installed is ready to receive same.
- B. Manufacturer Instructions: Refer to manufacturer's installation instruction manual for familiarization before proceeding with installation of units.
 1. Verify direction of motor rotation in equipment before making final connections to electrically operated equipment.

3.02 PREPARATION

- A. Field Measurement: The Drawings are generally indicative of the Work, but are not an exact representation of each condition involved. Therefore, set units, piping, etc. to suit actual field measurements. No extra compensation will be made for Work due to differences between indicated and actual dimensions.
 1. Where proposed changes to the Engineer's design are necessitated by field conditions or other causes, submit detail drawings of proposed changes to the Engineer for approval.
- B. Keep pipe and unit interiors cleared of debris as construction progresses.
- C. Earthwork: Perform earthwork for unit installation as specified in Section 31 23 33 and according to the following:
 1. Make excavations for units to a nearly vertical plane and not to exceed the nominal dimensions of the concrete anchor outside diameter.
 2. If rock excavation is required, take rock out to limits specified previously.
 3. If surface pavement of any type is encountered, vehicle or pedestrian ways, cut such pavement to a rectangular shape as opposed to circular shape of unit. Make limits of cut not to exceed one-foot beyond excavation limit as specified previously.

3.03 INSTALLATION

- A. General Requirements: Install units in strict accordance with manufacturer's instruction and installation manual, and at locations and in accordance with Details indicated on the Drawings.
 - 1. Install a check valve between the unit and the main sewer piping in accordance with the Detail Drawings.
 - 2. Install units on a six inch deep compacted layer of aggregate meeting requirements of Pipe Zone Bedding. Install Pipe Zone Bedding material as backfill up to highest pipe connection.
- B. Anti-Flotation Anchor Installation, Fiberglass Tank: Form and pour concrete anchors in accordance with requirements of Section 03 30 00. Use Class B (3,000 psi) concrete.
 - 1. Prefabricated anchors, as qualified previously in this Section, are acceptable.
- C. Underground Electrical System: Install underground electric cable in accordance with Article 300-5 of the NEC, in accordance with previous requirements of this Section, and the following requirements exceeding NEC:
 - 1. Earthwork: Perform earthwork for buried electric cable as specified for piping under Section 31 23 33.
 - 2. Provide two feet minimum cover over cable unless indicated otherwise on the Drawings.
 - 3. Make electrical cable penetrations through the tank absolutely watertight.
- D. Electrical System Grounding: Perform grounding of electrical system and metal enclosures in accordance with Article 250 of the NEC.
 - 1. In addition to grounding and bonding requirements of NEC as referenced in the preceding paragraph, the following shall also apply:
 - a. Use approved grounding connectors only. Clean the surfaces involved in the made-grounds before connecting and finish the installation with touch-up painting or other protective coating to prevent corrosion.
- E. Control Panel Installation: Fasten control panel and cable to exterior of the building or post (for post mounted) using fasteners suitable for anchoring into the particular type of surface, and fasten in accordance with current accepted trade practices. Only screw-type corrosion-resistant fasteners are acceptable.
 - 1. Install control panel four feet above existing grade, measured to the bottom of the panel.
 - 2. If post mount installation, provide post of sufficient length to permit three feet of embedment in ground and the four foot clearance requirement stated above.

3.04 FIELD QUALITY CONTROL

- A. General Requirements: Upon completion of installation of the grinder pump units, including but not limited to control panel mounting, electrical work installation and connections, pressure service lateral installation, and unit backfilling, each being performed in a manner satisfactory to the Engineer, advise the unit manufacturer that the units have been installed and are ready to be inspected and tested.
1. In cooperation with the unit manufacturer, determine a mutually acceptable schedule for inspection and testing of installed units.
 2. Conduct the Performance Test specified herein prior to the property owner's electrical wiring and plumbing connections to the grinder pump units.
 3. Conduct tests as specified herein so that each unit installed in the Project is tested to the unit manufacturer's and Engineer's satisfaction. Provide the Authority with documentation of such manufacturer's acceptance test in the form of a letter to the Authority attesting to this test requirement.
 4. Provide tools, materials, water, temporary power, apparatus, and instruments necessary for unit testing. Conduct the specified tests in the presence of and to the satisfaction of the unit manufacturer and the Engineer.
- B. Performance Test: Demonstrate (with the Personnel of the Authority observing), to the satisfaction of the Engineer, the mechanical performance of each unit when operated in accordance with the design intent indicated by the Drawings and described in this Section of the Specifications.
1. Connect 120V temporary power source to the alarm circuit at the control panel.
 2. Fill the tank with sufficient water to test the high level audible and visual alarms at the control panel.
 3. Connect 24V temporary power source to the power circuit at the control panel and run the unit through a minimum of three operation cycles to check pump operation and shut-off.
 4. If the demonstrations are satisfactory to the Engineer, the test will be considered concluded. If deficiencies are found, they shall be corrected as follows and the test repeated until the Engineer determines that the unit has performed satisfactorily.
 - a. Unit manufacturer shall correct pump, internal piping and control panel deficiencies.
 - b. Installer shall correct installation deficiencies.
- C. Fiberglass Tank Watertightness Test: Perform both an exfiltration and an infiltration test of each unit in the Project. Test procedures as follows:
1. Fill the completely installed units above the highest tank wall penetration (including electrical) with clear water. Allow a one hour stabilization period and then commence a three consecutive day exfiltration test.
 2. Measure and record the water level, with the Engineer observing, both at the beginning and end of the test period.
 3. An acceptable exfiltration test will be when no water leakage in the closed unit is detectable by the measurements.
 4. Conduct an infiltration test of the completely installed units over a three

- consecutive day time period with the Engineer observing.
5. An acceptable infiltration test will be when no water enters the closed unit.
- D. Manhole Tank Watertightness Test: Perform precast manhole test as specified in Section 33 05 13.
- E. Electrical Systems Test: Unless waived in writing by the Engineer, perform tests and trials in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, furnish to the Engineer sworn statements, in duplicate, of the tests made and the results thereof.
1. Inspection: Have the work inspected by an authorized inspection agency, and such other agencies having jurisdiction, for compliance with National Electrical Code and obtain certificates of approval, acceptance, and compliance with code regulations. Work shall not be deemed complete until such certifications have been delivered to the Authority.
 2. Testing: Test materials, supplies and parts and assemblies thereof, entering into the Work, in conformity with the best currently approved method for the particular type and class of work.
 - a. Render the entire installation free from short circuits and improper grounds. Test feeders cable disconnected from the power source. Then test the entire power circuit and the panel with the pumping equipment operating. In no case, shall the insulation resistance be less than one hundred thousand ohms.
 - b. Perform initial electrical system tests using meggers, ammeters, voltmeters, insulation resistance testers, and high-pot testers prior to placing electrical systems into complete operation.
 - 1) Use meggers with an adjustable 2.5/5.0 KV range which will permit reading of 0.05 to 100,000 Megohms. The minimum testing voltage obtained by adding 1,000 volts to twice the rated voltage of the cable, device, apparatus or equipment. In no case shall the insulation resistance be less than one Megohm. However, the recommended insulation resistance measurements of each test shall conform to IEEE and ANSI Standards.
 - c. Correct failures in a manner satisfactory to the Engineer or his authorized representative.

END OF SECTION

SECTION 33 33 19

LOW PRESSURE WASTEWATER UTILITY PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of constructing the piped low pressure wastewater sewers and appurtenance.
- B. Related Sections:
 - 1. Cast-In-Place Concrete: Section 03 30 00.
 - 2. Trenching and Backfilling: Section 31 23 33.
 - 3. Manholes and Structures: Section 33 05 13.
 - 4. Gravity Wastewater Utility Piping: Section 33 31 19.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
 - 2. ANSI A21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
 - 3. ANSI A21.15, Flanged Cast-Iron and Ductile-Iron pipe with Threaded Flanges.
 - 4. ANSI A21.50, Thickness Design of Ductile-Iron Pipe.
 - 5. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
 - 6. ANSI A21.53, Ductile-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - 7. ANSI B 1.1, Unified Inch Screw Threads.
 - 8. ANSI B2.1, USAS-Pipe Threads (except Dryseal).
 - 9. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - 10. ANSI B16.21, Nonmetallic Gaskets for Pipe Flanges.
 - 11. ANSI B18.2.1, Square and Hex Bolts and Screws, Including Askew head Bolts, Hex Cap Screws, and Lag Screws.
 - 12. ANSI B18.2.2, Square and Hex Nuts.
- B. American Society for Testing and Materials.
 - 1. ASTM A36; Specification for Structural Steel.
 - 2. ASTM A47, Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A48, Specification for Gray Iron Castings.
 - 4. ASTM A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A126; Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

6. ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
7. ASTM A183, Specification for Carbon Steel Track Bolts and Nuts.
8. ASTM A240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
9. ASTM A283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
10. ASTM A307; Specification for Carbon Steel Externally Threaded Standard Fasteners.
11. ASTM A320, Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
12. ASTM A536, Specification for Ductile Iron Castings.
13. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
14. ASTM B140 Specification for Copper-Zinc-Lead (Leaded Red Brass or Hardware Bronze) Rod, Bar, and Shapes.
15. ASTM B371, Specification for Copper-Zinc-Silicon Alloy Rod.
16. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
17. ASTM C534, Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
18. ASTM D1599, Standard Test Method for Short-Term Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
19. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
20. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.
21. ASTM D2000, Standard Classification System for Rubber Products in Automotive Applications.
22. ASTM D2241, Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR-Series).
23. ASTM D2466, Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
24. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
25. ASTM D2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
26. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
27. ASTM D3350, Specification for Polyethylene Plastic Pipe and Fittings Materials.
28. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.
29. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
30. ASTM SB800

C. American Water Works Association:

1. AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
3. AWWA C600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
4. AWWA C800, Threads for Underground Service Line Fittings (with Appendix on Collected Standards for Service Line Materials).

D. Federal Specifications:

1. Fed. Spec. FF-S-325, Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry) Group II (Shield, Expansion Bolt Anchor) Type 4 (Wedge Expansion Anchors) Class 1 (One-Piece Steel Expander with Cone Taper Integral with Stud).

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit completely dimensioned shop drawings, catalog cuts or other data as required to provide a complete descriptive information for the following:
1. Pipe and Fittings.
 2. Piping Specialties.
 3. Sewage Valve.
 4. Valves.
 5. Air Release and Cleanout Chambers
- B. Certificates: Submit certified records or reports of results of shop tests, with such records or reports containing a sworn statement that shop tests have been made as specified. Sworn certifications shall bear the seal of a Registered Professional Engineer.
1. Provide manufacturer's sworn certification stating that the pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.04 QUALITY ASSURANCE

- A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Protection (DEP), comply with the following:
1. Use only one type of class of pipe in any continuous sewer between structures, unless otherwise indicated on the Drawings.
 2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.
- B. Source Quality Control:
1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory tests of pipe materials listed in the following, shall have been performed. Each pipe manufacturer must have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number

of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
a. High Density Polyethylene Pipe	ASTM D3350	As specified in ASTM D3350
b. Polyvinyl Chloride Pipe	ASTM D2241	As specified in ASTM D2241.
c. Polyvinyl Chloride Pipe	ASTM D1785	As specified in ASTM D1785.
d. Ductile Iron Pipe	ANSI A21.51	As specified in ANSI A21.51.
2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. These laboratory tests will be paid for as provided in the Proposal Form from the fund stipulated for the purpose.		
3. The Engineer reserves the right to accept certified test records or reports of previously conducted tests covering the above stated tests.		

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, and store pipe materials and the associated materials specified herein in the manner recommended by the respective materials manufacturers so as to prevent damage and defects to their respective materials.

1.06 SITE CONDITIONS

- A. Environmental Requirements:
1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.
 2. Do not lay pipe in water or on bedding containing frost.
 3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. High Density Polyethylene (HDPE) Low Pressure Piping: 1-1/2 Through 4 Inch Diameter: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Provide HDPE pipe and fittings manufactured in accordance with AWWA C901 and AWWA C906. Materials used

for manufacturing of polyethylene pipe and fittings shall be PE 3408 High Density Polyethylene (HDPE) meeting ASTM D3350 cell classification of 34544C.

- B. Elastomeric Gaskets: For pipe joint gasket material, provide elastomeric gaskets that have been tested as suitable for continuous contact with domestic sewage.
- C. Polyvinyl Chloride (PVC) SDR Pipe, 1 1/2 Through 3 Inch Diameter, Buried Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Pipe design and material requirements shall conform to ASTM D2241, SDR-21 for 200 psi pressure. PVC material shall conform to ASTM D1784 requirements for Cell Classification 12454B.
 - 1. Pipe Joints: Push-on or compression type, rubber gasket, conforming to ASTM D3139 and ASTM F477 requirements; rubber gasket that have been tested as suitable for continuous contact with domestic sewage.
 - 2. Pipe Fittings: Manufactured in one piece of injection molded PVC compound meeting ASTM D1784 requirements.
 - a. Fittings shall be Class 200 and conform to requirements of DR 21.
 - b. Fittings shall withstand a minimum of 630 psi quick burst pressure at 73 degrees F. when tested in accordance with ASTM D1599 requirements.
 - c. Bells shall be gasketed joint conforming to ASTM D3139 with gaskets conforming to ASTM F477 requirements.
 - d. Acceptable Manufacturer: The Harrington Corporation or equal.
 - 3. Retainers for PVC Pipe: Manufactured from 60-42-10 ductile iron conforming to ASTM A536 requirements, including the glands and tie bolts. The retainers shall have a sufficient number of tie bolts to restrain the working and test pressures established by the retainer manufacturer.
 - a. The glands shall have serrations on the inside diameter sufficient to hold against both the working and test pressures.
 - b. Acceptable Manufacturer: EBAA Iron Sales, Inc. or equal.
 - 4. Restraints for PVC fittings: Manufactured from 60-42-10 ductile iron conforming to ASTM A536 requirements, including the bell ring, restraint ring and tie bolts.
 - a. A split ring shall be utilized behind the bell of the fitting outlets. A serrated ring shall be used to grip the pipe and a sufficient number of bolts shall connect the bell ring and the serrated gripping ring. The combination shall restrain continuously against a working pressure rating of 150 psi.
 - b. Acceptable Manufacturer:
 - 1) EBAA Iron Sales, Inc.
 - 2) Or equal.
- D. Polyvinyl Chloride (PVC) SCH-40 Pipe and Fittings, Exposed Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Pipe design and material requirements shall conform to ASTM D1785 Schedule 40, pressure Class 160, and manufactured from Class 1245-B Rigid PVC Compounds with a hydrostatic design stress of 13.8 MPa (2000 psi) designated as PVC 1120.
 - 1. Socket-Type Joints: Socket-Type conforming to ASTM D2564. Solvent cement for joint making shall conform ASTM D2564.

2. Flanges: PVC Schedule 40 150-lb. flanges manufactured from Rigid PVC Compounds conforming to ASTM D1784.
 - a. Gaskets: Soft rubber full face flat type.
 - b. Bolts: Steel conforming to ASTM A307.
 3. Socket Type Fittings: ASTM D2466 manufactured from Class 12454-B Rigid PVC Compound.
 4. Provide adapters, nipples, caps, etc., as required.
- E. Ductile Iron Pipe (DIP): Conforming to ANSI A21.50 and ANSI A21.53 requirements.
1. Wall Thickness Class, Buried Pipe: As indicated on Drawings.
 2. Wall Thickness Class, Exposed Pipe: Class 53 except as noted otherwise on Drawings.
 3. Fittings: Gray iron or ductile iron conforming to ANSI A21.10 requirements, rated for 250 psi working pressure.
 4. Rubber-Gasket Joints, Buried Pipe: Conforming to ANSI A21.11 requirements. For buried pipe installation, provide either push-on joints except where other types of joints are indicated on the Drawings or required by the Specifications.
 5. Restrained Joints: Conforming to requirements of ANSI A21.11 and designed for a working pressure equal to connected pipe rating. Provide joints for pipe and fittings similar to the following:
 - a. American Cast Iron Pipe Company; Lok-Fast or Lok-Set.
 - b. Clow Corporation; Super-Lock.
 - c. United States Pipe and Foundry Company; TRFLEX.
 - d. Or equal.
 6. Flanged Joints, Exposed Pipe: Conforming to ANSI A21.15 requirements. Unless indicated otherwise on the Drawings, use flanged joints for pipe and fittings installed inside of structures.
 - a. Gaskets: 1/16 in. thick cloth insertion rubber full face type conforming to ANSI B16.21 requirements.
 - b. Bolts: Conforming to ANSI B18.2.1 requirements.
 - c. Nuts: Conforming to ANSI B18.2.2 requirements.
 7. Retainer Glands: Designed for pipe joint retaining through the use of a follower gland and set screw anchoring devices which impart multiple wedging action against the pipe. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of two to one. Material components as follows:
 - a. Gland: Manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall match ANSI A21.11 and ANSI A21.53.
 - b. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist off nut bolt to insure the proper actuating of the restraining device. The twist off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.
 - c. Joint Deflection: Retainer Gland joint deflection shall be limited to a two degree maximum. Joint deflection shall be applied before the set screws are torqued.

- d. Acceptable Manufacturers:
 - 1) EBAA Iron, Inc.; Megalug 1100 Series.
 - 2) Or equal.
- F. Flanged Adapters: Fabricated from high strength steel (Style 128), or cast iron (Style 127), and designed for joining DIP plain-end pipe to flanged fittings, valves, and flanged end equipment.
 - 1. The compression-end of the adapter shall have the Dresser-Coupling type pack utilizing a Grade 27 wedge gasket for positive, watertight sealing. The flanged-end shall match the flange of the proposed fitting, valve or equipment connection.
 - 2. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 128 and 127.
 - b. Rockwell-International.
 - c. R. H. Baker & Co., Inc.
 - d. Or equal.

2.02 PIPING SPECIALTIES

- A. Valve Boxes: Cast iron extension roadway type, three-piece construction, and of screw adjustment design.
 - 1. Boxes shall have 4 1/4-inch minimum shaft diameter and lock cover marked SEWER.
 - 2. Boxes hot coated inside and out with a tar or asphalt compound.
 - 3. Provide box compatible with valve for operating clearances.
- B. Flexible Insulation For Piping: Insulation manufactured by closed cell, 5 to 6 pounds cubic feet density foamed plastic with thermal conductivity of 0.26 BTUH per sq. ft. per degree per inch at 70 degrees F. mean temperature, water vapor transmission rating of less than 0.1 perms. per inch, and a self-extinguishing fire-rating; ASTM E84. Insulation manufactured to meet requirements of ASTM C534. Use insulation manufacturer's companion joint making/sealing adhesive to make permanent insulation joints.
 - 1. Flexible Insulation For Fittings: Insulate fittings and valve bodies with sleeves of same insulation thickness used on adjacent piping and having an inside diameter large enough to fit over the insulation on adjacent piping.
 - 2. Acceptable Manufacturers:
 - a. Manville Products Corp.; Aerotube II, 1/2-inch thickness.
 - b. Owens-Corning Fiberglas.
 - c. Armstrong Industry Products Division.
 - d. Or equal.
- C. Curb Stop and Box: Designed to conform to Standard AWWA C800.
 - 1. All bronze construction, inverted key stop.
 - 2. Extension type arch pattern base of two-piece cast iron construction coated inside and out with tar base enamel and topped with cast iron lid secured by bronze bolt. Provide box compatible with T-wrench and stop. Provide cover marked SEWER.

- D. Flexible Pipe Coupling: Coupling shall consist of a steel middle ring or sleeve, two steel or malleable iron flange or follower rings, two wedge shaped resilient gaskets and sufficient number of track-head bolts and nuts.
1. Middle Ring or Sleeve: Steel construction conforming to ASTM A283, (Grade A) requirements, fabricated in a true circular section and free of surface defect.
 2. Follower Rings or Flanges: Steel construction conforming to ASTM A47 (Grade 32510) requirements, fabricated in a true circular section and free of surface defect, and tested and sized after welding by cold expanding a minimum of one percent.
 3. Bolts and Nuts: Steel bolt conforming to ASTM A183 requirements, double radius head or buttonhead track type with rolled threads, conforming to ANSI B1.1 requirements; and steel nuts conforming to ANSI B 18.2.2 requirements, American Standard Heavy Dimension Series.
 4. Gaskets: Resilient wedge-shaped of synthetic base compound designed for raw sewage and sludge service.
 5. Shop Paint: Middle and follower rings shop painted with primer compatible with specified field coat for piping where coupling is located.
 6. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 38 or 138.
 - b. Rockwell-International.
 - c. R. H. Baker & Co., Inc.
 - d. Or equal.
- E. Stainless Steel Pipe Supports: Fabricate pipe supports and pipe straps for exposed piping using AISI Type 304 stainless steel conforming to ASTM A167. Individual pipe support and pipe strap designs are as indicated on the Drawings.
1. Anchors and Fasteners: Provide drilled-in type expansion anchors incorporating a one-piece stud (bolt) with integral expansion wedges, nut and washer as a UL Listed assembly and meeting physical requirements of Federal Specification FF-S-325, Group II, Type 4, Class 1. Stud of AISI Type 303 or Type 304 stainless and nut and washer of AISI Type 316 stainless.
 2. Standard Bolts, Nuts and Washers: AISI Type 304 stainless steel conforming to ASTM A320.
- F. Modular, Mechanical Type Pipe Seal (LINK-SEAL): Modular, mechanical type pipe seal used for core-drilled connection of piping to existing manholes. Seal component construction as follows:
1. The seal shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 2. The elastomeric element of the seal shall be sized and selected in accordance with the seal manufacturer's recommendations. Elastomeric element shall conform to ASTM D2000 requirements for EPDM material.
 3. The hardware provided in the seal shall be as recommended by the seal manufacturer for buried service such as will exist at the project site.
 4. Acceptable Manufacturers:
 - a. Thunderline Corporation; Link-Seal.

b. Or equal.

G. Cast-In-Place Concrete Products: As specified in Section 03 30 00.

1. Use Class B (3,000 psi.) quality concrete, unless indicated otherwise on the Drawings.

2.03 SEWAGE VALVE

A. Sewage Air Release Valve: Valve design shall automatically release air, gas or vapor under pressure during system operation. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:

1. Valve Body and Cover: Cast iron, conforming to ASTM A48, Class 35 requirements.
2. Inlet Size: 2-inches, NPT.
3. Outlet Size: 1/2-inch, NPT.
4. Maximum Working Pressure: 75 psi.
5. Vent Orifice: 5/16-inch.
6. Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.
7. Orifice Button: Stainless steel and Buna-N, Nitrile Rubber conforming to ASTM SB800 requirements.
8. Mechanism Lever Pins and Float: High strength stainless steel, conforming to ASTM A240 requirements.
9. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of a 2-inch shut-off valve at bottom inlet, a 1-inch blow-off valve near the bottom of the valve body, quick disconnect couplings and 1/2-inch shut-off valve at top of valve, and a section of rubber hose with quick disconnect coupling.
10. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 Series.
 - b. Or equal.

B. Sewage Air and Vacuum Valve: Valve design shall automatically exhaust large quantities of air during the filling of a system and shall allow air to re-enter the system during draining or when a vacuum occurs. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:

1. Valve Body and Cover: Cast iron, conforming to ASTM A48, Class 35 requirements.
2. Inlet Size: 2-inches.
3. Discharge Orifice: 2-inches.
4. Float Stem and Guide: Bronze, conforming to ASTM B584 requirements.
5. Floats: Stainless Steel, conforming to ASTM A240 requirements.
6. Orifice Seat: Buna-N, Nitrile Rubber, conforming to ASTM SB800 requirements.
7. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of an inlet shut-off valve, a 1-inch blow-off valve near the bottom of the valve body, quick disconnect couplings and a 1/2-inch shut-off valve at the top of valve, and a section of rubber hose with quick disconnect coupling.

8. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 300 Series.
 - b. Or equal.
- C. Sewage Combination Air Valves: Consisting of an air release valve and an air and vacuum valve factory piped into a compact assembly. The combination assembly shall automatically release air, gas or vapor under system operating pressure and shall also allow air to re-enter the system during draining or when a vacuum occurs. Combination valve designs shall feature long bodies and float stem components so that the operating mechanisms are kept free from contact with sewage during operation. Valve construction as follows:
 1. Valve Bodies and Covers: Cast iron, conforming to ASTM A48, Class 35 requirements.
 2. Inlet Sizes: 2-inches.
 3. Air Release Outlet Size: 1/2-inch, NPT.
 4. Vacuum Discharge/Outlet Size: 2-inches.
 5. Air Release Valve Maximum Working Pressure: 75 psi.
 6. Air Release Valve Vent Orifice: 5/16-inch.
 7. Air Release Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless steel.
 8. Air Release Valve Orifice Button: Stainless Steel and Buna-N, Nitrile Rubber conforming to ASTM SB800 requirements.
 9. Air Release Valve Mechanism Lever Pins and Float: High strength stainless steel, conforming to ASTM A240 requirements.
 10. Air and Vacuum Valve Float Stem and Guide: Bronze, conforming to ASTM B584 requirements.
 11. Air and Vacuum Valve Floats: Stainless Steel, conforming to ASTM A240 requirements.
 12. Air and Vacuum Valve Orifice Seat: Buna-N, Nitrile Rubber, conforming to ASTM SB800 requirements.
 13. Backflushing and Cleaning Accessories: Factory assembled to the combination valves and consisting of two inlet shut-off valves, two blow-off valves, two clear water inlet valves, section of rubber hose and quick disconnect couplings.
 14. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 or 49/300 Series.
 - b. Or equal.
- D. Valve Support work: Provide steel support as indicated on the Standard Details.
 1. Miscellaneous Metals: Steel conforming to requirements of ASTM A36 and galvanize finished according to ASTM A123.
 2. Drilled-In Expansion Anchors and Fasteners: UL Listed stainless steel anchor and fastener incorporating a one-piece stud (bolt) with integral expansion wedges, nut and washer, and meeting physical requirements of Federal Specification FF-S-325, Group II, Type 4, Class 1. Stud of Type 303 or 304 stainless and nut and washer of Type 316 stainless.
 3. Standard Bolts, Nuts and Washers: Type 304 stainless steel conforming to ASTM A320.

2.04 VALVES

- A. General Requirements: Provide valves of the same type by same manufacturer; suitable for the intended service. Markings shall be cast on the bonnet or body of the valve indicating manufacturer's name or mark, the year the valve casting was made, the size of the valve, directional flow arrow and designation of working water pressure.
 - 1. Valve pressure-temperature ratings of valve shall be not less than the design criteria applicable to the system components.
 - 2. Valves shall open to the left (counterclockwise). Valve shall be operated by handwheel or operating nut as indicated on the Drawings. Operating wheel shall have cast thereon an arrow indicating the direction of opening.
 - 3. Provide extension stems with bronze bushed stem guides where required.
 - 4. Valve ends as indicated on the Drawings and unless indicated otherwise shall conform to the following:
 - a. Flanged: Conforming to ANSI B16.1.
 - b. Screw End: Threaded in accordance with ANSI B2.1.
- B. Gate Valves: Provide valves designed for working water pressure of 200 psi., and having rising stem operation except when installed underground, or where indicated otherwise on Drawings. Valves shall contain stuffing box of such design that allow repacking under pressure when valve is in fully open position.
 - 1. Valves Smaller Than 3-inches In Diameter: Provide valves of solid bronze construction with tapered split wedge disc.
 - a. Physical properties of brass pressure containing parts shall conform to ASTM B62.
 - b. Stems fabricated of Alloy A (rolled silicon brass) conforming to ASTM B371, or Copper Alloy No. 876 (silicon bronze + silicon brass) conforming to ASTM B584, or other material equally resistant to dezincification.
 - 2. Hose End Type: Bronze construction, tapered solid wedge disc, nonrising stem, female inlet and outlet having American Standard Taper Pipe thread. (Provide quick disconnect couplings in polypropylene material as manufactured by Plastic Piping Systems.)
 - a. Acceptable Manufacturers:
 - 1) Crane Company; No. 451 with cap and chain.
 - 2) NIBCO Inc.
 - 3) Wm. Powell Company.
 - 4) Or equal.
- C. Plug Valves (Straightway Type): Designed for a minimum working water pressure of 175 psi for valves through 12 in.
 - 1. Provide non-lubricated eccentric type plug valve with valve bodies of cast iron conforming to ASTM A126 Grade B, or valve bodies of semi-steel with coated plug suitable for wastewater and corrosion resistant seats.
 - 2. Provide valves with port areas sized at least 80 percent of full pipe area.
 - 3. Provide T-wrench for operation.
 - 4. Acceptable Manufacturers:

- a. DeZurik; Series 100 Eccentric Valves.
 - b. Henry Pratt Company.
 - c. Homestead Industries, Inc.
 - d. Dresser Industries, Inc.
 - e. Or equal.
- D. Bronze Ball Valves: Valve body of solid bronze material conforming to ASTM B584, and having a straight-through flow passage.
 - 1. Seats and O-rings of Buna-N.
 - 2. Valves of quarter-turn operation with a T-handle or round handle suitable for use in confined spaces, and which will allow sufficient clearance whether valve is in open or closed position.
 - 3. Threaded end valves available in sized 1/4 inch through 2 inch shall be rated 200 psi.
 - 4. Ball and Stem: Brass chrome finish conforming to ASTM B140.
 - 5. Acceptable Manufacturers:
 - a. Crane Co.
 - b. Or equal.
- E. PVC Ball Check Valve: Provide ball check valve designed for a minimum water working pressure of 150 pounds per square inch and factory tested to double that pressure prior to shipment.
 - 1. Construction: Double union type with the valve body shaped to provide excess area through the valve to assure full delivery of the pipe line size capacity.
 - 2. Materials: Polyvinyl chloride PVC 12454-B conforming to ASTM D1784 with sealing O-rings of Viton.
 - 3. Acceptable Manufacturers:
 - a. NIBCO Inc.; True-Union Ball Check.
 - b. Or equal.

2.05 PRECAST CONCRETE CHAMBERS

- A. Terminal Cleanout Chambers, In-Line Chambers, Junction Cleanout Chambers, and Air Release Chambers: In general, the materials and construction shall conform to precast concrete manhole requirements specified in Section 33 05 13, with the following additional requirements:
 - 1. Manhole covers (lids) do not require cover hold-down bolts on air release chambers.
 - 2. Sump Frame and Grate: Cast iron conforming to ASTM A48.
- B. Cleanout Chambers: Provide chambers composed of sections of reinforced concrete Class III pipe, aggregate base, and frame and cover. Dimensions are as indicated on the Detail Drawings.
 - 1. Frames and Covers: Cast iron conforming to ASTM A48. The word SEWER cast on cover. Provide frames and covers similar to Neenah R-5900-C.

- C. Piping In Chambers: Provide ductile iron pipe and ductile iron or cast iron fittings within chambers except where other type of pipe is indicated on the drawing detail.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- B. Rejected Products: Remove rejected pipe from the Project site and replace with new Products at no increase in Contract Price.
 - 1. Pipe already laid and later found defective will not be accepted and shall require replacement at no increase in Contract Price.

3.02 PREPARATION

- A. As specified in Section 33 31 19.
- B. General Requirements: Clean piping interior prior to laying pipe and following pipe laying and keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.
 - 1. Provide the protective means to prevent water and debris from washing into the pipe.
- C. Earthwork: Perform earthwork for sewer installation as specified in Section 31 23 33.
 - 1. Bedding materials and concrete work for pipe bedding as specified in Section 31 23 33.
 - 2. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from rock removal operations.

3.03 CONSTRUCTION

- A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.
 - 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
 - 2. Unless indicated otherwise, install piping with not less than four feet of cover.
 - 3. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.
 - 4. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.

5. Walking or working on the installed pipe line, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.
 6. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
- B. Pipe Laying and Joining: Perform pipe laying and joining in strict accordance with manufacturer's installation instructions, reference standards as included, and such additional requirements as specified herein.
1. Arrange and pay for pipe manufacturer's representative to be present for first installation of pipe to instruct workmen on proper installation methods.
 2. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.
 3. Threaded Joints: Cut pipe ends square, deburr and ream to size of original bore. Cut threads to American Standard tapered pipe threads, free of oil and cuttings. Use an approved joint tape or joint paste to aid in joint lubrication and sealing. After fabrication, paint exposed threads with red lead paint.
 4. Laying/Joining Specified Types of Plastic Pipe: Perform installation and joint assembly according to ASTM D2774 for Class I bedding material.
 - a. Push-on Joints. To make PVC pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible.
 - b. Solvent-Weld Joints: Use chemical solvent welding components to join PVC pipe. Use the type of solvents specified in manufacturer's printed recommendations.
 - c. Joint Restraints: Install joint restraints at changes in direction of pipe runs and at terminal ends of pipe runs in accordance with the following table:

PVC PIPE RESTRAINED JOINT DIMENSIONS (In feet of straight pipe for each leg)	
Fitting	1-1/2 inch through 4 inch Diameter. Pipe
Plug	25
Tee	25
Lateral	25
90 deg.	25
45 deg.	15
22 1/2 deg.	15
11 1/4 deg.	15

5. Laying/Joining Ductile Iron Pipe: Installation and joint assembly according to AWWA C600, and as follows:
 - a. Pipe Cutting: Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.
 - b. Push-on Joints. To make ductile cast iron pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and

- fully enter joint until joint line is visible. Make deflection, if required, only after the joint has been assembled properly.
- c. Mechanical Joints: To make ductile iron pipe mechanical joint, position sealing gasket and gland for bolting and then enter the spigot into pipe bell end until joint line is visible. Tighten bolts evenly maintaining approximate distance between gland and face of flange at all points around the socket. Do not exceed pipe manufacturer's specifications for maximum torque applied to bolts.
6. Flanged Joints: To make ductile iron pipe flanged joint, face flanges true and fit with gaskets, and draw flanges up square and tight to insure full gasket flow and satisfactory seal.
- a. Concrete Thrust Blocks: Provide concrete thrust blocks for each fitting, and at those locations where horizontal and vertical deflections are made in the joints of the force mains. Use Class B concrete. Provide thrust blocks of the design indicated on the Detail Drawing.
 - b. Joint Restraints: Install on buried DIP at changes in direction of pipe runs, and at terminal ends of pipe runs in accordance with the following table:

DUCTILE IRON PIPE RESTRAINED JOINT DIMENSIONS (In feet of straight pipe for each leg)		
Fitting	6 Inch Dia. Pipe	8 Inch Dia. Pipe
Plug	25	25
Tee	25	25
Lateral	25	25
90 deg.	25	25
45 deg.	15	15
22 1/2 deg.	15	15
11 1/4 deg.	15	15

- C. Pipe Connections to Existing Manholes: Make pipe connections to existing manholes in accordance with the appropriate requirements as follows:
 1. Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient size to accommodate the pipe and the Pipe Seal (LINK-SEAL). Install the Pipe Seal in accordance with the manufacturer's installation instructions. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection.
 2. Run the exposed pipe (Drop Connection) within the manhole using SCH-40 PVC Pipe with Solvent Weld Socket Type joints. Run piping within the manhole as indicated on the Drawings.
 3. Anchor the exposed pipe in place within the manhole as indicated on the Drawings using Exposed Pipe Support Work. Embed the Drilled-In Expansion Anchors to four and one-half bolt diameters.

3.04 PRECAST CONCRETE CHAMBER INSTALLATIONS

- A. As specified in Section 33 05 13 for precast manholes and as shown on the Drawings.

- B. Flexible Insulation Installation: Install flexible insulation on piping within chambers. Install insulation on clean, dry pipe surfaces. Perform cleaning required for removal of construction debris and dirt from the piping.
 - 1. Installation: Install flexible insulation on piping according to manufacturer's instructions, using specific adhesive to seal both longitudinal and butt joints. Insulate in-line appurtenances to the same thickness as adjoining insulation. Install insulation in 1/2-inch thickness.
 - 2. Weatherizing Installation: Weatherize flexible insulation using those protective and moisture impervious materials as recommended by the insulation manufacturer.

3.05 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that each pressure wastewater sewer installed in the Project is tested to the Engineer's satisfaction.
 - 1. The Contractor may elect to make a leakage test prior to backfilling the trenches, for his own purposes. However, the leakage tests of pressure wastewater sewers, or sections thereof, for acceptance shall be conducted after the backfilling of the trenches has been completed.
 - 2. Provide tools, materials (including water), apparatus and instruments necessary for pressure wastewater sewer testing.
 - 3. When the length of the pressure wastewater sewer exceeds 1000 feet, test the sewer in sections, the length of each section to be determined by the Engineer.
 - 4. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.
- B. Testing Equipment: Use testing apparatus equipped with a control panel with necessary piping, control valves and gauges to control pressure within piping test section and to monitor pressures throughout the test.
 - 1. To prevent accidental overloading of piping test section, provide testing apparatus with an approved pressure relief device set to relieve at ten psig.
 - 2. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
 - 3. Testing equipment and associated testing apparatus subject to Engineer's approval.
- C. Cleaning Prior to Tests: Before tests are conducted, flush piping with clean water until free of all forms of dirt and construction debris.
 - 1. The water for the flush cleaning operation shall be from the Contractor's source.
- D. Line Acceptance Test: After the pressure wastewater sewers, or section thereof, is constructed, backfilled, and successfully cleaned, perform a hydrostatic Line Acceptance Test as follows:
 - 1. Seal pressure wastewater sewer at downstream end with a suitable pipe plug.
 - 2. Fill pressure wastewater sewer with clear water.
 - 3. Raise hydrostatic pressure to one and one-half times the operating pressure; measured at the low point of the particular section of sewer being tested.

4. A preliminary test period will be permitted for the removal or absorption of air from the sewer before measuring the leakage.
 5. Maintain test pressure for a period of not less than four hours.
 6. Consider pressure wastewater sewers acceptable when measured leakage does not exceed ten gallons per day per mile per inch of pipe diameter.
- E. Repair and Retest: When the pressure wastewater sewer, or sections thereof, fails to meet test requirements specified previously, determine source or sources of leakage and repair or replace defective material, and if a result of improper workmanship, correct such.
1. Conduct such additional tests required to demonstrate that pressure wastewater sewers meet specified test requirements.
- F. Authority's Tests: The Authority reserves the right to retest, at his expense, piping throughout the duration of the Construction Period.
1. Make repairs as Work of this Section to piping found defective by such Authority conducted tests.

END OF SECTION

SECTION 33 34 16

WASTEWATER UTILITY FORCE MAINS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The work specified in this Section consists of constructing the piped wastewater force mains and appurtenances.
- B. The Authority's Engineer shall design pump stations for the Authority. The Authority's Engineer shall work in tandem with the Developer.
- C. Related Sections:
 - 1. Cast-In-Place Concrete: Section 03 30 00.
 - 2. Grouts: Section 03 60 00.
 - 3. Trenching and Backfilling: Section 31 23 33.
 - 4. Manholes and Structures: Section 33 05 13.
 - 5. Gravity Wastewater Utility Piping: Section 33 31 19.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
 - 2. ANSI A21.11, Rubber Gasket joints for Cast Iron and Ductile Pressure Pipe and Fittings.
 - 3. ANSI A21.15, Flanged Cast Iron and Ductile-Iron Pipe with Threaded Flanges.
 - 4. ANSI A21.50, Thickness Design of Ductile-Iron Pipe.
 - 5. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
 - 6. ANSI A21.53, Ductile-Iron Compact Fittings, 3 in. through 12 in. for Water and Other Liquids.
 - 7. ANSI B1.1, Unified Inch Screw Threads.
 - 8. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - 9. ANSI B16.21, Nonmetallic Gaskets for Pipe Flanges.
 - 10. ANSI B18.2.1, Square and Hex Bolts and Screws, Including Askew head Bolts, Hex Cap Screws, and Lag Screws.
 - 11. ANSI B18.2.2, Square and Hex Nuts.
- B. American Society for Testing and Materials.
 - 1. ASTM A 47, Specification for Malleable Iron Castings.
 - 2. ASTM A 48, Specification for Gray Iron Castings.
 - 3. ASTM A 167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
 - 4. ASTM A 183, Specification for Carbon Steel Track Bolts and Nuts.

5. ASTM A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels.
6. ASTM A 283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality.
7. ASTM A 320, Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
8. ASTM A 536, Specification for Ductile Iron Castings.
9. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
10. ASTM B 85, Specification for Aluminum-Alloy Die Castings.
11. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.
12. ASTM B 438, Specification for Copper-Base Sintered Bearings (Oil-Impregnated).
13. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.
14. ASTM C 76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
15. ASTM C 923, Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.
16. ASTM D 1248, Specification for Polyethylene Plastics Molding and Extrusion Materials.
17. ASTM D 1598, Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
18. ASTM D 1599, Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
19. ASTM D 1784, Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride)(CPVC) Compounds.
20. ASTM D 2000, Standard Classification System for Rubber Products.
21. ASTM D 2241, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
22. ASTM D 2774, Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Pipe.
23. ASTM D 2837, Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
24. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
25. ASTM D 3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
26. ASTM D 3350, Polyethylene Plastic Pipe and Fittings Materials, Spec. for.
27. ASTM F 714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
28. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association:

1. ANSI/AWWA C110/A21.10, American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.

2. ANSI/AWWA C111/A21.11, American National Standard for Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
3. ANSI/AWWA C115/A21.15, American National Standard for Flanged Ductile-Iron Pipe With Threaded Fittings.
4. ANSI/AWWA C150/A21.50, American National Standard for the Thickness Design of Ductile-Iron Pipe.
5. ANSI/AWWA C151/A21.51, American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
6. ANSI/AWWA C153/A21.53, American National Standard for Ductile-Iron Compact Fittings for Water Service.
7. ANSI/AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service-Sizes 4 in. Through 144 in.
8. ANSI/AWWA C500, Gate Valves - 3 In. through 48 In. for Water and Other Liquids.
9. ANSI/AWWA C509, Resilient-Seated Gate Valves, 3 Through 12 NPS, for Water and Sewage Systems.
10. ANSI/AWWA C550, Protective Interior Coatings for Valves and Hydrants.
11. ANSI/AWWA C600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
12. ANSI/AWWA C900, Polyvinyl chloride (PVC) Pressure Pipe, 4-inch Through 12-inch, for Water.

D. U.S. Commercial Standard Specification CS 226-59.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit completely dimensioned shop drawings, catalog cuts and such other data as required to provide complete descriptive information for the following:
 1. Force Main Pipe and Fittings
 2. Piping Specialties
 3. Sewage Valve
 4. Gate Valves
 5. Air Release and Cleanout Chambers
- B. Certificates: Submit certified records or reports of results of shop tests, with such records or reports containing a sworn statement that shop tests have been made as specified.
 1. Sworn certifications shall bear the seal of a Registered Professional Engineer.
 2. Provide manufacturer's sworn certification stating that the pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.04 QUALITY ASSURANCE

- A. Design Criteria: In addition to the design requirements of the Pennsylvania Department of Environmental Protection (DEP), comply with the following:

1. Use only one type and class of pipe in any continuous force main between structures, unless otherwise indicated on the Drawings.
2. Use pipe and fittings designed to withstand imposed trench loadings and prevailing site conditions at the various locations.

B. Source Quality Control:

1. Shop Tests: In accordance with Article 1.06 of the General Instructions, factory test pipe materials listed in the following table, shall have been performed. Each pipe manufacturer shall have facilities to perform listed tests. The Engineer reserves the right to require the manufacturer to perform such additional number of tests as the Engineer may deem necessary to establish the quality of the material offered for use.

MATERIAL	TEST METHOD	NUMBER OF TESTS
Ductile Iron Pipe	ANSI/AWWA C151/A21.51	As specified in ANSI/AWWA C151/A21.51
Polyvinyl Chloride Pipe	ASTM D2241	As specified in ASTM D2241
Polyvinyl Chloride Pipe	AWWA C900	As specified in AWWA C900
Polyethylene Pipe	ASTM D1598	As specified in ASTM D1598

2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. These laboratory tests will be paid for as provided in the Bid Form from the fund stipulated for the purpose.
3. The Engineer reserves the right to accept certified test records or reports of previously conducted tests covering the above stated tests.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store pipe materials and precast reinforced concrete manhole components and the associated materials specified herein, in a manner recommended by the respective manufacturers to prevent damage and defects.

1.06 SITE CONDITIONS

A. Environmental Requirements:

1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.
2. Under no circumstances lay pipe in water or on bedding containing frost.
3. Do not lay pipe when weather conditions are unsuitable for pipe laying work, as determined by the Engineer.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. Elastomeric Gaskets: For pipe joint gasket material, provide elastomeric gaskets that have been tested as suitable for continuous contact with domestic sewage.
- B. Ductile Iron Pipe (DIP): Conforming to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51 requirements for 350 psi working pressure (to 20 inch diameter).
 - 1. Wall Thickness Class, Buried Pipe: As indicated on Drawings.
 - 2. Wall Thickness Class, Exposed Pipe: Class 53 except as noted otherwise on Drawings.
 - 3. Fittings: Gray iron or ductile iron conforming to ANSI/AWWA C110/A21.10 requirements, rated for 250 psi working pressure.
 - 4. Rubber-Gasket Joints, Buried Pipe: Conforming to ANSI/AWWA C111/A21.11 requirements.
 - a. For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.
 - 5. Restrained Joints: Conforming to requirements of ANSI/AWWA C111/A21.11 and designed for a working pressure equal to connected pipe rating. Provide joints for pipe and fittings similar to the following:
 - a. American Cast Iron Pipe Company; Lok-Fast or Lok-Set.
 - b. Clow Corporation; Super-Lock.
 - c. United States Pipe and Foundry Company; TRFLEX.
 - d. Or equal.
 - 6. Flanged Joints, Exposed Pipe: Conforming to ANSI/AWWA C115/A21.15 requirements. Unless indicated otherwise on the Drawings, use flanged joints for pipe and fittings installed inside of structures.
 - a. Gaskets: 1/16 in. thick cloth insertion rubber full face type conforming to ANSI B16.21 requirements.
 - b. Bolts: Conforming to ANSI B18.2.1 requirements.
 - c. Nuts: Conforming to ANSI B18.2.2 requirements.
 - 7. Retainer Glands: Designed for pipe joint retaining through the use of a follower gland and set screw anchoring devices which impart multiple wedging action against the pipe. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of two to one. Material components as follows:
 - a. Gland: Manufactured of ductile iron conforming to ASTM A536 requirements. Gland dimensions shall match ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53.
 - b. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist off nut bolt to insure the proper actuating of the restraining device. The twist off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.

- c. Joint Deflection: Retainer Gland joint deflection shall be limited to a two degree maximum. Joint deflection shall be applied before the set screws are torqued.
 - d. Acceptable Manufacturers:
 - 1) EBAA Iron, Inc.; Megalug 1100 Series.
 - 2) Or equal.
 - 8. Pipe and Fitting Lining: Manufacturer's standard cement-mortar lining in accordance with ANSI/AWWA C104/A21.4, single thickness. Lining shall include an asphaltic seal coat to prevent moisture loss in cement-mortar curing sequence.
 - 9. Pipe and Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with ANSI/AWWA C151/A21.51, applied to the outside of pipe and fittings.
 - 10. Pipe and Fittings Coating (Special Coating): Factory coated inside and out with 46H-413 Hi-Build Tneme-Tar by Tnemec Company, Inc., or equal. Prepare pipe surfaces according to coating manufacturer's instructions and apply coating 18 to 20 mils minimum dry mil thickness.
- C. Flanged Adapters: Fabricated from high strength steel (Style 128), or cast iron (Style 127), and designed for joining DIP plain-end pipe to flanged fittings, valves, and flanged end equipment.
- 1. The compression-end of the adapter shall have the Dresser-Coupling type pack utilizing a Grade 27 wedge gasket for positive, watertight sealing. The flanged-end shall match the flange of the proposed fitting, valve or equipment connection.
 - 2. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 128 and 127.
 - b. Rockwell-International.
 - c. R. H. Baker & Co., Inc.
 - d. Or equal.
- D. Polyvinyl Chloride (PVC), 4 Through 8 Inch Diameter Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and AWWA conformance designation. Pipe design and material requirements shall conform to AWWA C900 requirements for DR 18, 150 psi pressure class.
- 1. PVC Pipe Joints: Push-on or compression type, rubber gasket, conforming to ASTM D3139 and ASTM F477 requirements.
 - 2. Fittings: Gray iron or ductile iron conforming to ANSI/AWWA C110/A21.10 requirements, rated for 250 psi working pressure.
 - a. Fitting Joints: Rubber-gasket push-on or mechanical type conforming to ANSI/AWWA C111/A21.11 requirements.
 - b. Fitting Coating: Manufacturer's standard asphaltic coating, approximately one mil thick in accordance with ANSI/AWWA C151/A21.51.
 - 3. Retainers for PVC Pipe: Manufactured from 60-42-10 ductile iron conforming to ASTM A536 requirements, including the glands and tie bolts. The retainers shall have a sufficient number of tie bolts to restrain the working and test pressures established by the retainer manufacturer.

- a. The glands shall have serrations on the inside diameter sufficient to hold against both the working and test pressures.
 - b. Acceptable Manufacturer: EBAA Iron Sales, Inc. or equal.
 - 4. Restraints for PVC fittings: Manufactured from 60-42-10 ductile iron conforming to ASTM A536 requirements, including the bell ring, restraint ring and tie bolts.
 - a. A split ring shall be utilized behind the bell of the fitting outlets. A serrated ring shall be used to grip the pipe and a sufficient number of bolts shall connect the bell ring and the serrated gripping ring. The combination shall restrain continuously against a working pressure rating of 150 psi.
 - b. Acceptable Manufacturer:
 - 1) EBAA Iron Sales, Inc.
 - 2) Or equal.
- E. Polyvinyl Chloride (PVC) 1 ½ Through 3 Inch Diameter Pipe: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Pipe design and material requirements shall conform to ASTM D2241, SDR-21 for 200 psi pressure. PVC material shall conform to ASTM D1784 requirements for Cell Classification 12454B.
- 1. Pipe Joints: Push-on or compression type, rubber gasket, conforming to ASTM D3139 and ASTM F477 requirements; rubber gasket that have been tested as suitable for continuous contact with domestic sewage.
 - 2. Pipe Fittings: Manufactured in one piece of injection molded PVC compound meeting ASTM D1784 requirements.
 - a. Fittings shall be Class 200 and conform to requirements of DR 21.
 - b. Fittings shall withstand a minimum of 630 psi quick burst pressure at 73 degrees F. when tested in accordance with ASTM D1599 requirements.
 - c. Bells shall be gasketed joint conforming to ASTM D3139 with gaskets conforming to ASTM F477 requirements.
 - d. Acceptable Manufacturer:
 - 1) The Harrington Corporation.
 - 2) Or equal.
 - 3. Retainers for PVC Pipe: Manufactured from 60-42-10 ductile iron conforming to ASTM A536 requirements, including the glands and tie bolts. The retainers shall have a sufficient number of tie bolts to restrain the working and test pressures established by the retainer manufacturer.
 - a. The glands shall have serrations on the inside diameter sufficient to hold against both the working and test pressures.
 - b. Acceptable Manufacturer:
 - 1) EBAA Iron Sales, Inc.
 - 2) Or equal.
 - 4. Restraints for PVC fittings: Manufactured from 60-42-10 ductile iron conforming to ASTM A536 requirements, including the bell ring, restraint ring and tie bolts.
 - a. A split ring shall be utilized behind the bell of the fitting outlets. A serrated ring shall be used to grip the pipe and a sufficient number of bolts shall connect the bell ring and the serrated gripping ring. The combination shall restrain continuously against a working pressure rating of 150 psi.
 - b. Acceptable Manufacturer:

- 1) EBAA Iron Sales, Inc.
 - 2) Or equal.
- F. Polyethylene (PE) Pipe and Fittings: Provide pipe which is permanently marked with manufacturer's trademark, size and ASTM conformance designation. Pipe design shall conform to ASTM F714 for SDR 17 performance requirements.
1. Pipe Construction: The polyethylene material shall have a PE 3408 designation and shall conform to ASTM D1248 requirements for a Type III, Class C, Category 5, Grade P34 material. Pipe material shall also have a cell classification of 345434C as defined in ASTM D3350, and have a hydrostatic design value basis of 1,600 psi when tested in accordance with ASTM D2837.
 2. Fittings: Molded from polyethylene compound equal to the compound used in the PE pipe construction. Fabricated fittings shall conform to ASTM D3261, SDR 17 requirements and shall be pressure rated to match the system piping in which they are installed.
 3. Joining: Both pipe and fittings joined to one another by thermal butt fusion, saddle fusion, or socket fusion in accordance with procedures developed by the pipe manufacturer.
 4. Flanged Joints: PE pipe and fittings joined to other materials by means of flanged connections composed of PE flange (fusion joined to pipe) and type 316 stainless steel back-up rings rated for the same pressure service as the pipe.

2.02 PIPING SPECIALTIES

- A. PVC Waterstop: Use PVC waterstop in making a grouted connection of piping to existing manholes or structures. Waterstop construction as follows:
1. Gasket type waterstop composed of virgin polyvinyl chloride (PVC) material which meets the performance requirements of U.S. Commercial Standard Specification CS 226-59.
 2. Acceptable Manufacturers:
 - a. FERNCO Inc., CMA Concrete Manhole Adapter, Distributed by the General Engineering Company.
 - b. Or equal.
- B. Sleeve Type Pipe Seal: Use sleeve type pipe seal in making a core-drilled connection of piping to existing manholes or structures. Pipe seal construction as follows:
1. In general, the pipe seal shall conform to the requirements of ASTM C923 and shall incorporate a positive compression fit of the gasket to both the manhole and the pipe.
 2. Acceptable Manufacturers:
 - a. Press-Seal Gasket Corp., Concrete Products Supply Co.; PSX Seal.
 - b. Or equal.
- C. Modular, Mechanical Type Pipe Seal: Use modular, mechanical type pipe seal in making a core-drilled connection of piping to existing manholes or structures. Pipe seal construction as follows:

1. The seal shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
 2. The elastomeric element of the seal shall be sized and selected in accordance with the seal manufacturer's recommendations. Elastomeric element shall conform to ASTM D2000 requirements for EPDM material.
 3. The hardware provided in the seal shall be as recommended by the seal manufacturer for buried service such as will exist at the project site.
 4. Acceptable Manufacturers:
 - a. Thunderline Corporation; Link-Seal.
 - b. Or equal.
- D. Wall Sleeves: Cast gray iron or ductile iron conforming to ANSI/AWWA C110/A21.10 requirements, rated for 250 psi working pressure, and provided with intermediate anchoring flange in center of sleeve.
1. Joints: Joint requirements shall match that of the connected piping except where indicated otherwise on the Drawings.
 2. Acceptable Manufacturers:
 - a. McWane Incorporated
 - b. American Cast Iron Pipe Co.
 - c. U.S. Pipe and Foundry Co.
 - d. Or equal.
- E. Flexible Pipe Coupling: Coupling shall consist of a steel middle ring or sleeve, two steel or malleable iron flange or follower rings, two wedge shaped resilient gaskets and sufficient number of track-head bolts and nuts.
1. Middle Ring or Sleeve: Steel construction conforming to ASTM A283, (Grade A) requirements, fabricated in a true circular section and free of surface defect.
 2. Follower Rings or Flanges: Steel construction conforming to ASTM A47 (Grade 32510) requirements, fabricated in a true circular section and free of surface defect, and tested and sized after welding by cold expanding a minimum of one percent.
 3. Bolts and Nuts: Steel bolt conforming to ASTM A183 requirements, double radius head or buttonhead track type with rolled threads, conforming to ANSI B1.1 requirements; and steel nuts conforming to ANSI B 18.2.2 requirements, American Standard Heavy Dimension Series.
 4. Gaskets: Resilient wedge-shaped of synthetic base compound designed for raw sewage and sludge service.
 5. Shop Paint: Middle and follower rings shop painted with primer compatible with specified field coat for piping where coupling is located.
 6. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Style 38 or 138.
 - b. Rockwell-International.
 - c. R. H. Baker & Co., Inc.
 - d. Or equal.

- F. Repair Clamp: Single band full circle style repair clamp constructed of materials specified in the following:
1. Lugs: Malleable cast iron conforming to ASTM A47 (Grade 32510) requirements, or ductile cast iron conforming to ASTM A536 (Grade 60-40-18) requirements and designed with mutually supporting sliding fingers.
 2. Band: One piece stainless steel type 304, with bridge plate recessed flush and bonded into the gasket.
 3. Gasket: Specially compounded new rubber material suitable for use with salt solutions, mild acids, and bases as well as domestic sewage contact. Gasket designed to overlap and shall have a fine grid molded integrally and tapered ends.
 4. Hardware: Manufacturer's standard corrosion resistant malleable iron bolts and nuts conforming to ANSI/AWWA C111/A21.11 standards.
 5. Acceptable Manufacturers:
 - a. Dresser Manufacturing Division of Dresser Industries, Inc.; Style 360.
 - b. Rockwell International.
 - c. Or equal.
- G. Stainless Steel Pipe Supports: Fabricate pipe supports and pipe straps for exposed piping using Type 304 stainless steel conforming to ASTM A167. Individual pipe support and pipe strap designs are as indicated on the Drawings.
1. Anchors and Fasteners: Provide drilled-in type expansion anchors incorporating a one-piece stud (bolt) with integral expansion wedges, nut and washer as a UL Listed assembly and meeting physical requirements of Federal Specification FF-S-325, Group II, Type 4, Class 1. Stud of Type 303 or 304 stainless and nut and washer of Type 316 stainless.
 2. Standard Bolts, Nuts and Washers: Type 304 stainless steel conforming to ASTM A320.
- H. Cast-In-Place Concrete Products: As specified in Section 03 30 00.
1. Use Class B (3,000 psi) concrete materials unless indicated otherwise on the Drawings.

2.03 VALVES

- A. Sewage Air Release Valve: Valve design shall automatically release air, gas or vapor under pressure during system operation. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:
1. Valve Body and Cover: Cast iron, conforming to ASTM A48, Class 35 requirements.
 2. Inlet Size: 2-inches, NPT.
 3. Outlet Size: 1/2-inch, NPT.
 4. Maximum Working Pressure: 75 psi.
 5. Vent Orifice: 5/16-inch.
 6. Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.
 7. Orifice Button: Stainless steel and Buna-N, Nitrile Rubber conforming to ASTM SB 800 requirements.

8. Mechanism Lever Pins and Float: High strength stainless steel, conforming to ASTM A240 requirements.
 9. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of a 2-inch shut-off valve at bottom inlet, a 1-inch blow-off valve near the bottom of the valve body, quick disconnect couplings and ½-inch shut-off valve at top of valve, and a section of rubber hose with quick disconnect coupling.
 10. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 Series.
 - b. Or equal.
- B. Sewage Air and Vacuum Valve: Valve design shall automatically exhaust large quantities of air during the filling of a system and shall allow air to re-enter the system during draining or when a vacuum occurs. Valve design shall feature long body and float stem components so that the operating mechanism is kept free from contact with sewage during operation. Valve construction as follows:
1. Valve Body and Cover: Cast iron, conforming to ASTM A48, Class 35 requirements.
 2. Inlet Size: 2-inches.
 3. Discharge Orifice: 2-inches.
 4. Float Stem and Guide: Bronze, conforming to ASTM B584 requirements.
 5. Floats: Stainless Steel, conforming to ASTM A240 requirements.
 6. Orifice Seat: Buna-N, Nitrile Rubber conforming to ASTM SB 800 requirements.
 7. Backflushing and Cleaning Accessories: Factory assembled to the valve and consisting of an inlet shut-off valve, a 1-inch blow-off valve near the bottom of the valve body, quick disconnect couplings and a ½-inch shut-off valve at the top of valve, and a section of rubber hose with quick disconnect coupling.
 8. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 300 Series.
 - b. Or equal.
- C. Sewage Combination Air Valves: Consisting of an air release valve and an air and vacuum valve factory piped into a compact assembly. The combination assembly shall automatically release air, gas or vapor under system operating pressure and shall also allow air to re-enter the system during draining or when a vacuum occurs. Combination valve designs shall feature long bodies and float stem components so that the operating mechanisms are kept free from contact with sewage during operation. Valve construction as follows:
1. Valve Bodies and Covers: Cast iron, conforming to ASTM A48, Class 35 requirements.
 2. Inlet Sizes: 2-inches.
 3. Air Release Outlet Size: 1/2-inch, NPT.
 4. Vacuum Discharge/Outlet Size: 2-inches.
 5. Air Release Valve Maximum Working Pressure: 75 psi.
 6. Air Release Valve Vent Orifice: 5/16-inch.
 7. Air Release Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless steel.

8. Air Release Valve Orifice Button: Stainless Steel and Buna-N, Nitrile Rubber conforming to ASTM SB 800 requirements.
 9. Air Release Valve Mechanism Lever Pins and Float: High strength stainless steel, conforming to ASTM A240 requirements.
 10. Air and Vacuum Valve Float Stem and Guide: Bronze, conforming to ASTM B584 requirements.
 11. Air and Vacuum Valve Floats: Stainless Steel, conforming to ASTM A240 requirements.
 12. Air and Vacuum Valve Orifice Seat: Buna-N, Nitrile Rubber conforming to ASTM SB 800 requirements.
 13. Backflushing and Cleaning Accessories: Factory assembled to the combination valves and consisting of two inlet shut-off valves, two blow-off valves, two clear water inlet valves, section of rubber hose and quick disconnect couplings.
 14. Acceptable Manufacturers:
 - a. Val-Matic Valve And Manufacturing Corp.; Model No. 48 or 49/300 Series.
 - b. Or equal.
- D. Hose End Gate Valve: Class 125 bronze gate valve having screw-in bonnet, non-rising stem, tapered solid wedge, and rated 200 psi non-shock cold water, oil or gas. Valve body shall indicate ratings and manufacturer identification. Design of valve stuffing box of such that repacking under pressure is possible. Valve construction requirements as follows:
1. Ends: Female standard pipe size to national standard hose.
 2. Handwheel: Aluminum alloy conforming to ASTM B85 requirements, with zinc plated steel nut and aluminum identification plate (opening direction indicated).
 3. Valve Stem: Silicon bronze alloy conforming to ASTM B371 requirements.
 4. Packing Nut/Packing Gland: Sintered bronze conforming to ASTM B438 Grade I Type II requirements.
 5. Packing: TFE impregnated asbestos.
 6. Stuffing Box, Bonnet, Valve Body, Wedge and Hose Cap: Bronze conforming to ASTM B62 requirements.
 7. Hose Cap Gasket: Rubber.
 8. Safety Chain: Brass.
 9. Acceptable Manufacturers:
 - a. NIBCO, Inc.; Cat. No. T-113-HC.
 - b. Crane Company.
 - c. Wm. Powell Company.
 - d. Or equal.
- E. Iron Body Gate Valve: Designed for working water pressure of 200 psi for valves 12-inch in diameter and smaller. Valve construction requirements as follows:
1. General Requirements:
 - a. Markings factory cast on the bonnet or body of each valve indicating manufacturer's name or mark, year of valve casting, size of valve, directional flow arrow and designation of working water pressure.

- b. Valves shall open to the left (counterclockwise). Valves operated by nut, handwheel, or otherwise as indicated on the Drawings. Operating nuts or wheels shall have cast thereon an arrow indicating the direction of opening.
 - c. Valve ends as indicated on the Drawings and unless indicated otherwise shall conform to the following:
 - 1) Flanged: Conforming to ANSI B16.1 requirements.
 - 2) Mechanical: Conforming to ANSI/AWWA C111/A21.11 requirements.
 - d. Valves of rising stem type except when installed underground; or otherwise indicated on Drawings.
 - e. Valve stuffing box of such design that valve can be packed under pressure when in fully open position.
 - 2. Design Working Water Pressure: 200 psi for valves 12 inches diameter and smaller, and 150 psi (high pressure) for valves 14 inches diameters and larger.
 - 3. Design Working Water Pressure: 200 psi for valves 12 inches diameter and smaller, and 100 psi (medium pressure) for valves 14 inches diameters and larger.
 - 4. Valves 3-inches Through 12-inches in Diameter: Iron body, outside screw and yoke design, bronze mounted, with resilient-seated wedge conforming to requirements of AWWA C509.
 - a. Resilient Seat: Composed of SBR or Urethane Rubber bonded to cast iron wedge.
 - b. Stem Seals: O-ring type.
 - c. Finish Coatings: Exterior asphalt varnish or epoxy coated and interior ferrous metal parts epoxy coated, according to AWWA C550.
 - 5. Acceptable Manufacturers:
 - a. Clow Corporation.
 - b. American Darling Valve.
 - c. Kennedy Valve.
 - d. Or equal.
- F. Tapping Valve: Provide valve of same basic construction as Iron Body Gate Valve with exceptions as follows:
- 1. Valve provided with oversized seat rings to accommodate tapping machine.
 - 2. Valve provided with raised male face on flanged end for bolting to tapping sleeve.
 - 3. Valve provided with mechanical or push-on joint with slotted holes for bolting to tapping machine.
 - 4. Tapping Sleeve: AWWA approved construction, of split sleeve design, having mechanical joint ends, and designed for 250 psi working pressure.
- G. Tapping Sleeve: Provide 18-inch size, AWWA approved construction, split type sleeve, designed for 250 psi working pressure.
- 1. Body: Carbon steel conforming to ASTM A283, Grade C.
 - 2. Flanges: AWWA C207 Class D; ANSI 150 pound drilling.
 - 3. Gasket: Grade 60 Concave Wedge Gasket; gasket compounded to resist oil, natural gas, acids, alkalies, most (aliphatic) hydrocarbon fluids, water and many chemicals. Designed for operating temperatures up to 2123 degrees F.
 - 4. Bolts and Nuts: ANSI/AWWA C111/A21.11, Type 304 stainless steel.

5. Finish: Manufacturer's standard fusion bonded epoxy, coated to 12 mills dry film thickness.
 6. Acceptable Manufacturers:
 - a. Rockwell International.
 - b. Or equal.
- H. Valve Boxes: Cast iron extension roadway type, three-piece construction, and of screw adjustment design.
1. Boxes shall have 4 1/4-inch minimum shaft diameter and cover marked SEWER.
 2. Boxes hot coated inside and out with a tar or asphalt compound.
 3. Box design shall be capable of receiving increment cast iron rings to raise the box in the future.
- I. Inserting Valve: Inserting (control) valves, and the materials, machines, and related equipment necessary to insert control gate valves in fluid pipe lines while under pressure.
1. Inserting Valves: Double disc parallel seat type employing a compound side wedging mechanism and shall meet all requirements of the AWWA C500 Gate Valve Specification, and latest revisions thereto.
 2. Manufacturer's Field Supervisor: Inserting valves shall require the services of the valve manufacturer's field supervisor. His services are a chargeable amount which charges will not be paid for separately or additionally to the Contract Price. Such charges will be considered incidental to the Work.
 3. Acceptable Manufacturers:
 - a. United States Pipe and Foundry Company; SMITH INSERTING VALVES.
 - b. IPSCO.
 - c. Kerr Engineering Service.
 - d. Or equal.

2.04 PRECAST CONCRETE CHAMBERS

- A. Air Release and Cleanout Chambers: As specified in Section 33 05 13 for precast concrete manhole components.
1. Sump Frame and Grate: Light duty cast iron construction, conforming to ASTM A48 requirements.

2.05 CONTRACTOR OPTIONS IN PRODUCTS

- A. Force Main Pipe and Fitting Options: The Contractor is allowed the option to provide DIP or PVC pipe to construct the force mains for the Project. However, the Bidder shall state in writing in the space provided in the Bid Form which particular type of pipe is proposed. Use only the type of pipe selected to construct the force mains for which the pipe material option is allowed.
1. Through 3 inch diameter:
 - a. Ductile Iron Pipe.
 - b. Polyvinyl Chloride Pipe.
 - c. Polyethylene Pipe.

2. 4 inch through 8 inch diameter:
 - a. Ductile Iron Pipe.
 - b. Polyvinyl Chloride Pipe.
 - c. Polyethylene Pipe.
- B. Required Pipe Material Exception: Provide only ductile iron pipe and ductile iron or cast iron fittings within the air release and cleanout chambers.
- C. Thrust Restraint Option: The option is allowed to provide concrete thrust blocks or restrained joints at changes of directions of ductile iron pipe.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Field Inspection: Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- B. Rejected Products: Remove rejected Products from the Project site and replace with new Products at no increase in Contract Price.
 1. Pipe already laid and later found defective will not be accepted and shall require replacement at no increase in Contract Price.

3.02 PREPARATION

- A. General Requirements: Clean piping interior prior to laying pipe and following pipe laying, and keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.
 1. Provide the protective means to prevent water and debris from washing into the pipe.
- B. Earthwork: Perform earthwork for force main installation as specified in Section 31 23 33.
 1. Bedding materials and concrete work for pipe bedding as specified in Section 31 23 33.
 2. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from rock removal operations.

3.03 CONSTRUCTION

- A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.
 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
 2. Unless indicated otherwise, piping shall be installed with not less than four feet of cover.

3. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.
4. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
5. Walking or working on the installed force main, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.
6. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying. Replacement at Contractor's expense.
7. Concrete Thrust Blocks: Provide concrete thrust blocks for each fitting, and at those locations where horizontal and vertical deflections are made in the joints of the force mains. Use Class B concrete materials. Provide thrust blocks of the design indicated on the Detail Drawing.

B. Pipe Laying and Joining: Perform pipe laying and joining in strict accordance with manufacturer's installation instructions, reference standards as included, and such additional requirements as specified herein.

1. Arrange and pay for pipe manufacturer's representative to be present for first installation of pipe to instruct workmen on proper installation methods.
2. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.
3. Laying/Joining Ductile Iron Pipe: Installation and joint assembly according to AWWA C600, and as follows:
 - a. Pipe Cutting: Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.
 - b. Push-on Joints: To make ductile cast iron pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible. Make deflection, if required, only after the joint has been assembled properly.
 - c. Mechanical Joints: To make ductile iron pipe mechanical joint, position sealing gasket and gland for bolting and then enter the spigot into pipe bell end until joint line is visible. Tighten bolts evenly maintaining approximate distance between gland and face of flange at all points around the socket. Do not exceed pipe manufacturer's specifications for maximum torque applied to bolts.
 - d. Flanged Joints: For DIP shall be faced true, fitted with gaskets, and drawn up square and tight to ensure full gasket flow and satisfactory seal.
4. Joint Restraints: Install on buried DIP at changes in direction of pipe runs, and at terminal ends of pipe runs in accordance with the following table:

DUCTILE IRON PIPE RESTRAINED JOINT DIMENSIONS (In feet of straight pipe for each leg)				
Fitting Type	4 Inch Diameter Pipe	6 Inch Diameter Pipe	8 Inch Diameter Pipe	≥ 10 Inch Diameter Pipe
Plug	25	25	25	25
Tee	25	25	25	25
Lateral	25	25	25	25
90 Degree	25	25	25	25
45 Degree	15	15	15	15
22-1/2 Degree	15	15	15	15
11-1/4 Degree	15	15	15	15

5. Laying/Joining Specified Types of Plastic Pipe: Perform installation and joint assembly according to ASTM D2774 for Class I bedding material.
 - a. Push-on Joints. To make PVC pipe push-on joints, properly seat sealing gasket, evenly and sufficiently lubricate the spigot end of pipe, and fully enter joint until joint line is visible.
 - b. Joint Restraints: Install joint restraints at changes in direction of pipe runs and at terminal ends of pipe runs in accordance with the following table:

PVC PIPE RESTRAINED JOINT DIMENSIONS (In feet of straight pipe for each leg)	
Fitting Type	4 Inch and 6 Inch Diameter Pipe
Plug	25
Tee	25
Lateral	25
90 Degree	25
45 Degree	15
22-1/2 Degree	15
11-1/4 Degree	15

- C. Connections of Piping to Existing Manholes or Structures: The option is allowed to construct pipe connections to existing manholes or structures by one of the methods stated herein, except where indicated otherwise on the Drawings. A mixture of connection methods is not allowed.
 1. Cut-in Opening Utilizing PVC Waterstop and Grout: Cut required opening or openings by such methods so as to prevent cracking and spalling concrete. Make openings of sufficient size to accommodate the pipe with PVC Waterstop installed and one inch of annular grout space. Grout annular space using Non-Shrink Non-Metallic Grout as specified in Section 03 60 00. Make connection watertight.

2. Core-drilled Opening Utilizing Sleeve Type Pipe Seal: Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient size to accommodate the Pipe Seal.
 3. Core-drilled Opening Utilizing Modular, Mechanical Type Pipe Seal: Core-drill the required opening or openings using the proper equipment for the work. Make openings of sufficient size to accommodate the Pipe Seal.
 4. New Invert Channel: Regardless of the connection to existing manhole option selected, form a new invert channel in the existing manhole base to properly conduct the flow through the existing manhole. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection.
 5. Drop Connections: Make drop connections as indicated on the Drawings, where drop in invert is two feet or more or as required by the Engineer.
- D. Inserting Valve Installation: Perform installation of the valves in accordance with the installation instructions/training by and under the direct supervision of the valve manufacturer's field supervisor.
1. Preparation: Perform the required preparatory work prior to the arrival of the field supervisor, including the necessary excavation, excavation support work, valve foundation work, pipeline stabilizing and bracing work, and providing on-site the equipment and machinery required to place the valve and parts, and to operate the inserting machine.
 2. Installation: The Contractor's crew shall perform the valve installation with the valve manufacturer's field supervisor providing "hands-on" guidance on how to assemble the valve and how to operate the inserting equipment. Nothing contained in these Contract Documents shall imply the valve manufacturer's field supervisor as being party to this Contract.
- E. Setting Valves and Boxes:
1. Unless otherwise directed by the Engineer, set valves and boxes truly vertical.
 2. Set valve and boxes neatly to grade and in such a way that the box does not transfer shock or stress to the valve. Exercise care to center the box over the wrench nut of the valve.

3.04 PRECAST CONCRETE CHAMBER CONSTRUCTION

- A. Air Release and Cleanout Chamber Installations: As specified in Section 33 05 13 for precast concrete manholes and as indicated on the Drawings.

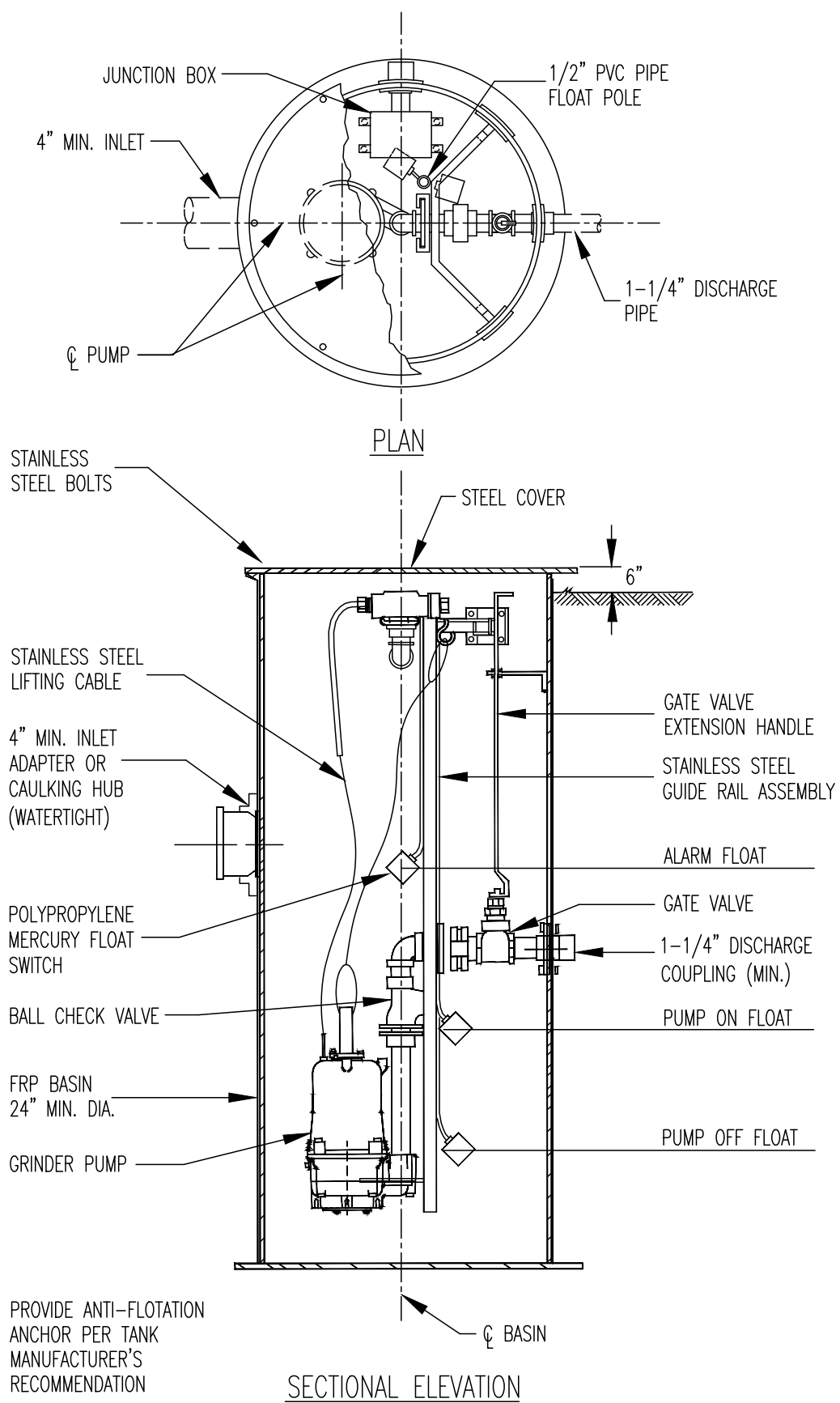
3.05 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that each force main installed in the Project is tested to the Engineer's satisfaction.
1. The Contractor may elect to make a leakage test prior to backfilling the trenches, for its own purposes. However, the leakage tests of the force mains or sections thereof for acceptance, shall be conducted after the backfilling of the trenches has been completed.

2. Provide tools, materials (including water), apparatus and instruments necessary for force main testing.
 3. When the length of the force main exceeds 1000 feet, test the force main in sections, the length of each section to be determined by the Engineer.
 4. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.
- B. Testing Equipment: Use testing apparatus equipped with a control panel with necessary piping, control valves and gauges to control pressures within the piping test section, and to monitor pressures throughout the test.
1. To prevent accidental overloading of piping test section, provide testing apparatus with an approved pressure relief device set to relieve at 150 psig.
 2. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
 - a. Testing equipment and associated testing apparatus subject to Engineer's approval.
- C. Cleaning Prior to Tests: Before tests are conducted, flush piping with clean water until free of all forms of dirt and construction debris.
1. The water for the flush cleaning operation shall be from the Contractor's source.
- D. Line Acceptance Test: After a force main or section thereof is constructed, backfilled, and successfully cleaned, perform a hydrostatic Line Acceptance Test as follows:
1. Seal force main at downstream end with a suitable pipe plug.
 2. Fill force main with clear water.
 3. Raise hydrostatic pressure to 100 psi or one and one-half times the working pressure; measured at the low point of the particular section of main being tested.
 4. A preliminary test period for the removal or absorption of air from the lines before measuring the leakage will be permitted.
 5. Maintain test pressure for a period of not less than four hours.
 6. Consider force main Acceptable when measured leakage does not exceed ten gallons per day per mile per inch of pipe diameter.
- E. Repair and Retest: When force main or sections of force main fails to meet test requirements specified previously, determine source or sources of leakage and repair or replace defective material, and if a result of improper workmanship, correct such.
1. Conduct such additional tests required to demonstrate that force main meets specified test requirements.
- F. Authority's Tests: The Authority reserves the right to retest at its expense, any piping throughout the duration of the Construction Period.
1. Make repairs as Work of this Section to piping found defective by such Authority conducted tests.

END OF SECTION

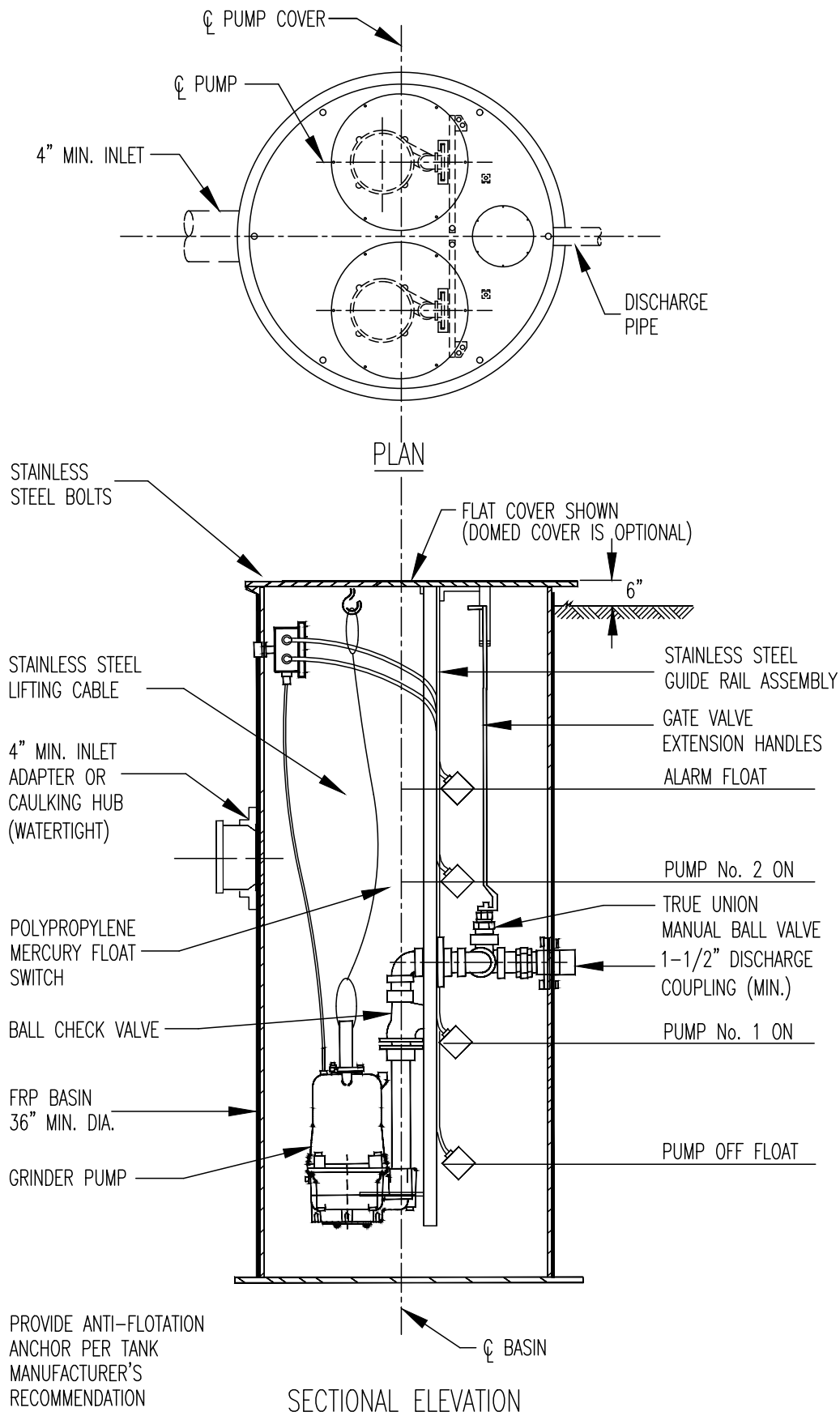
SEWER DETAIL
DRAWINGS



SIMPLEX GRINDER PUMP

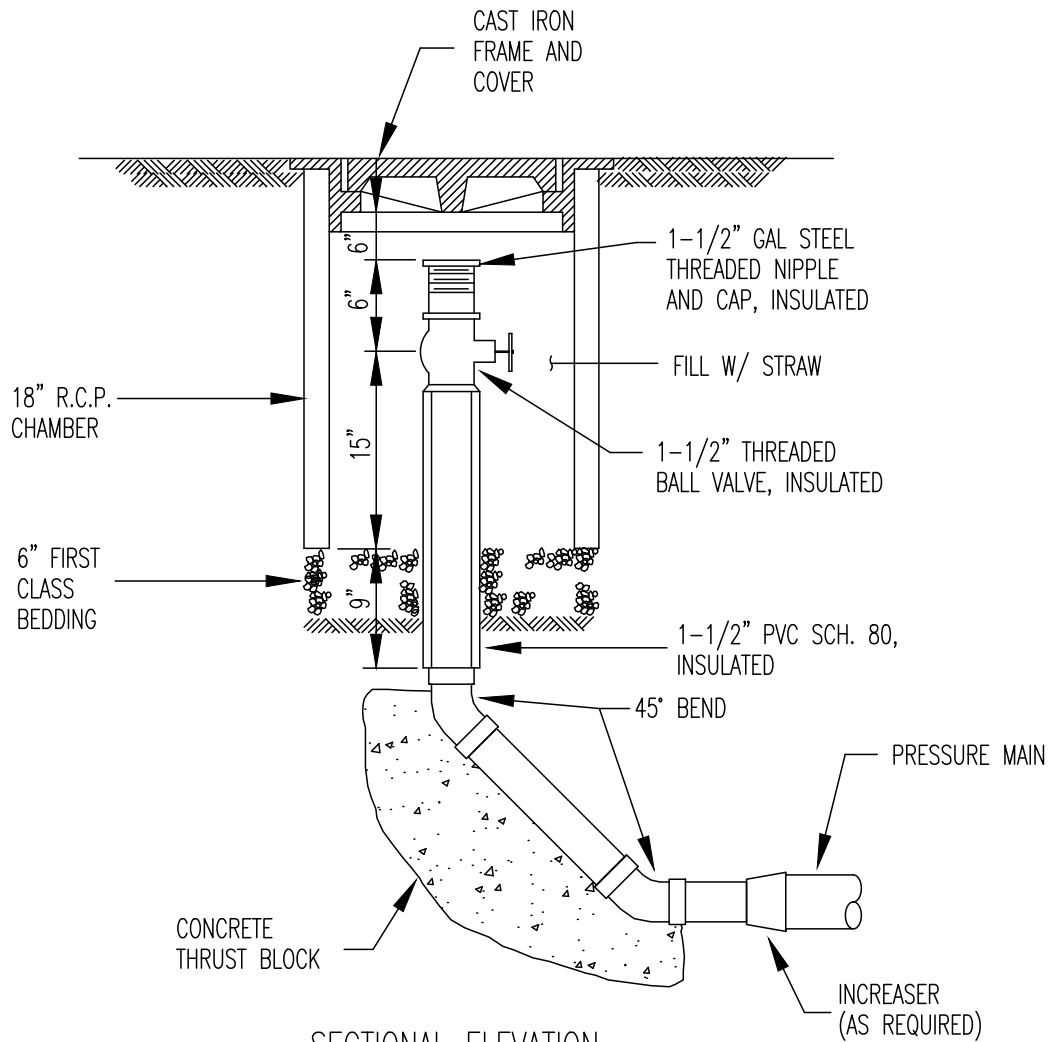
GANNETT FLEMING

DWG. No. A-35876



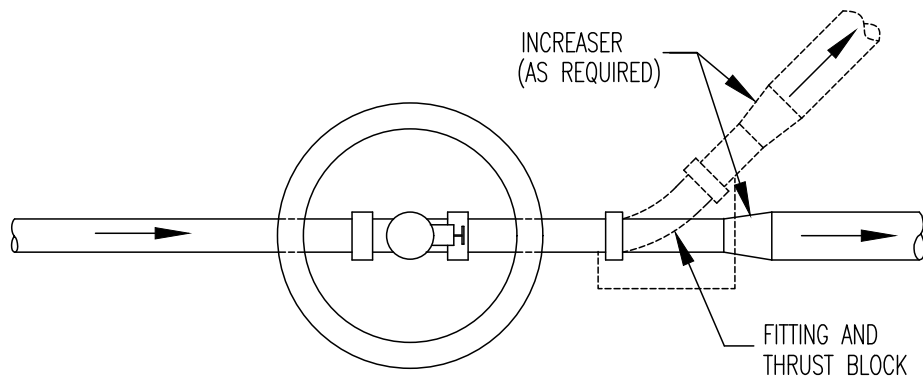
DUPLEX GRINDER PUMP

GANNETT FLEMING

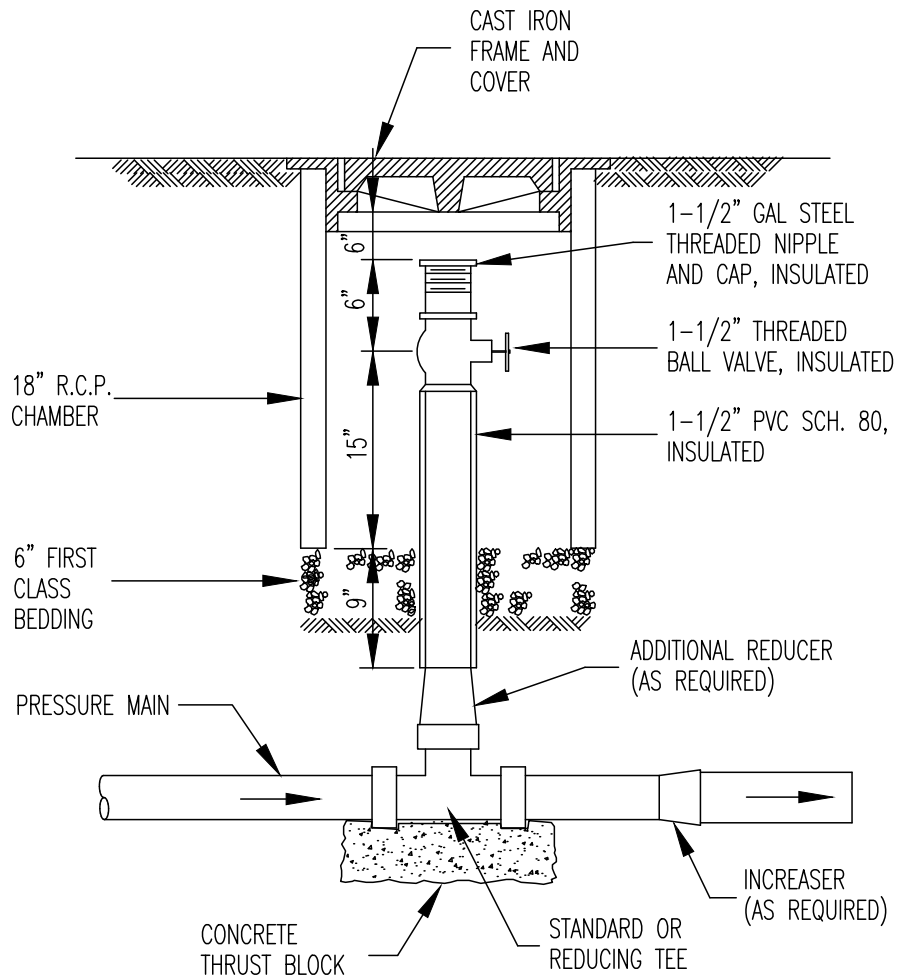


SECTIONAL ELEVATION

TERMINAL CLEANOUT PRESSURE
WASTEWATER SEWER

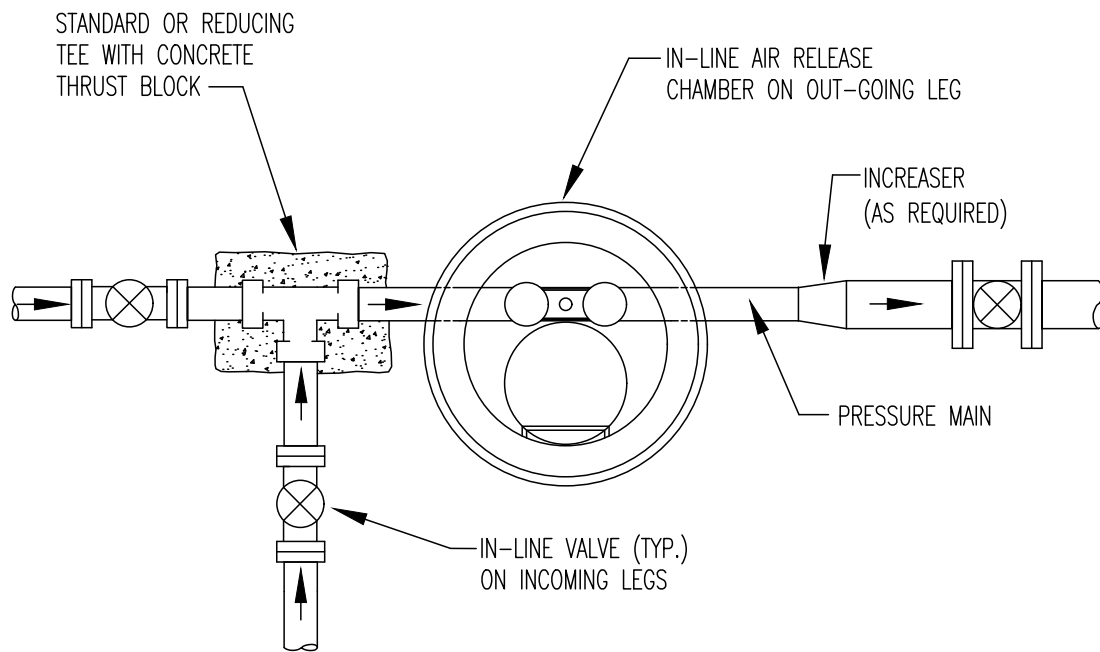


PLAN

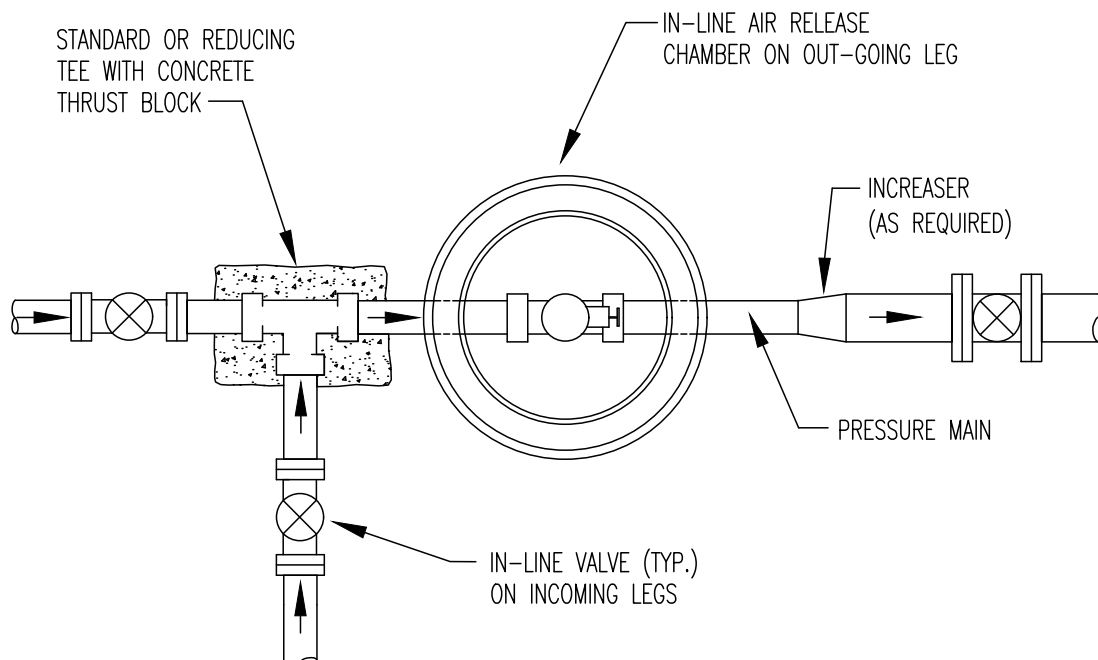


SECTIONAL ELEVATION

IN-LINE CLEANOUT
PRESSURE WASTEWATER SEWER



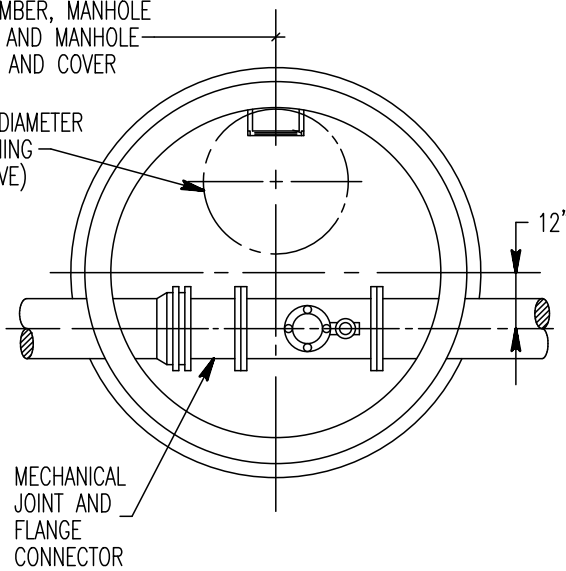
PLAN
AIR RELEASE JUNCTION CHAMBER



PLAN
AIR RELEASE JUNCTION
CLEANOUT PRESSURE
WASTEWATER SEWER

CHAMBER, MANHOLE
STEPS AND MANHOLE
FRAME AND COVER

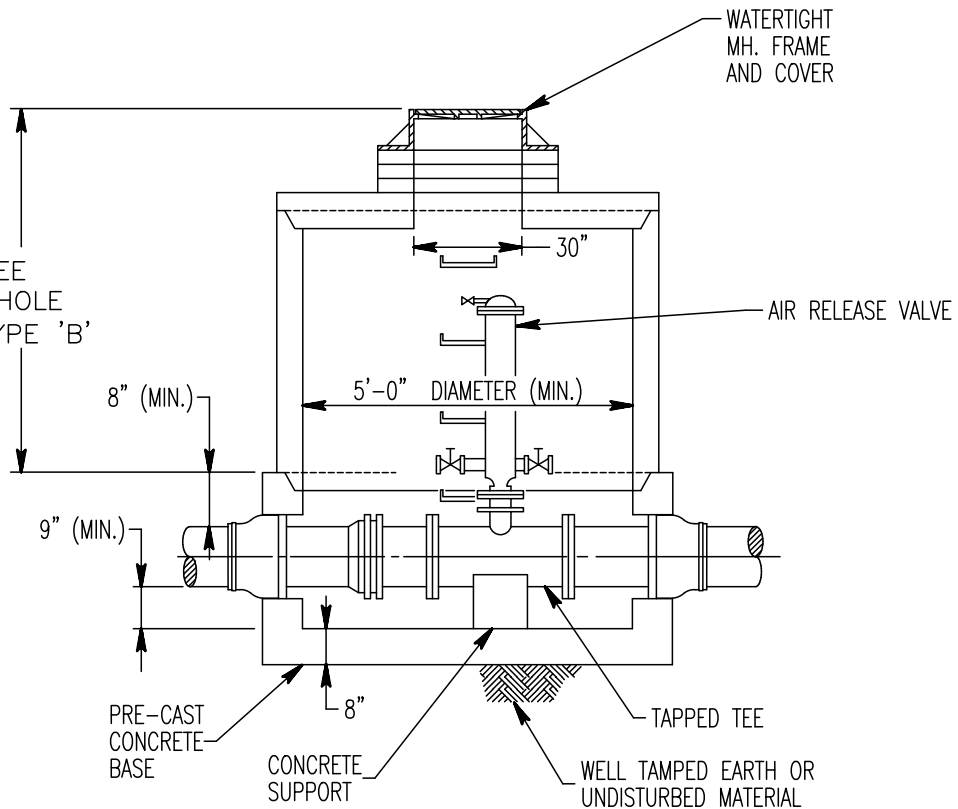
30" DIAMETER
OPENING
(ABOVE)



SECTIONAL PLAN

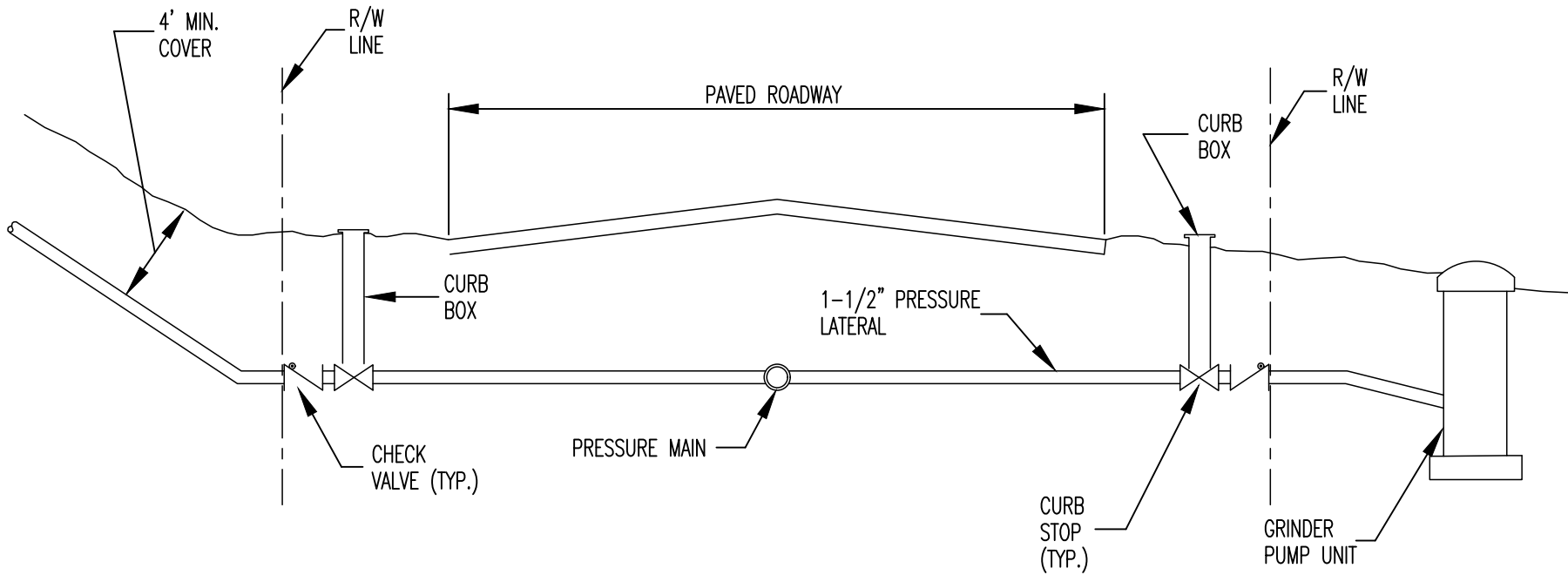
FOR DETAILED
CONSTRUCTION
INFORMATION SEE
STANDARD MANHOLE
TYPE 'A' OR TYPE 'B'
DETAIL

(M-4)

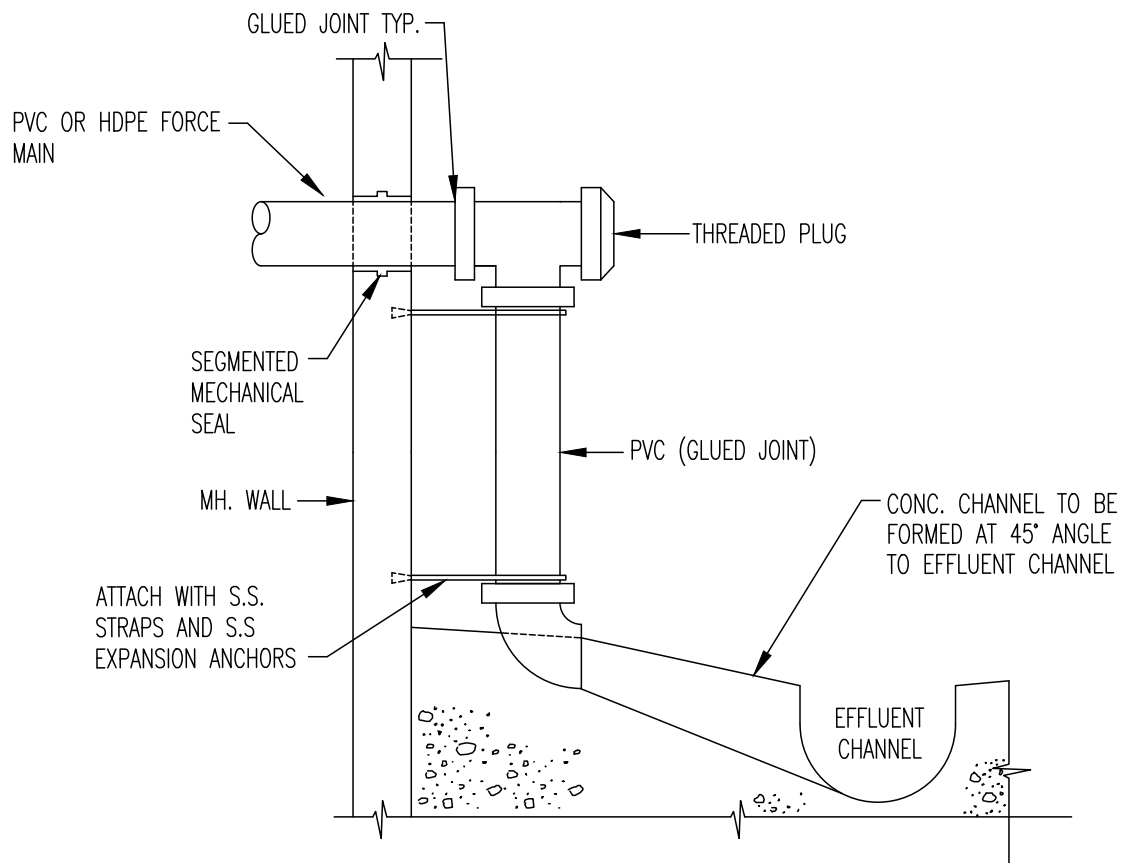


SECTIONAL ELEVATION

AIR RELEASE CHAMBER



PRESSURE LATERAL



LOW PRESSURE DROP CONNECTION

MISC2.dgn

MICRO-STATION

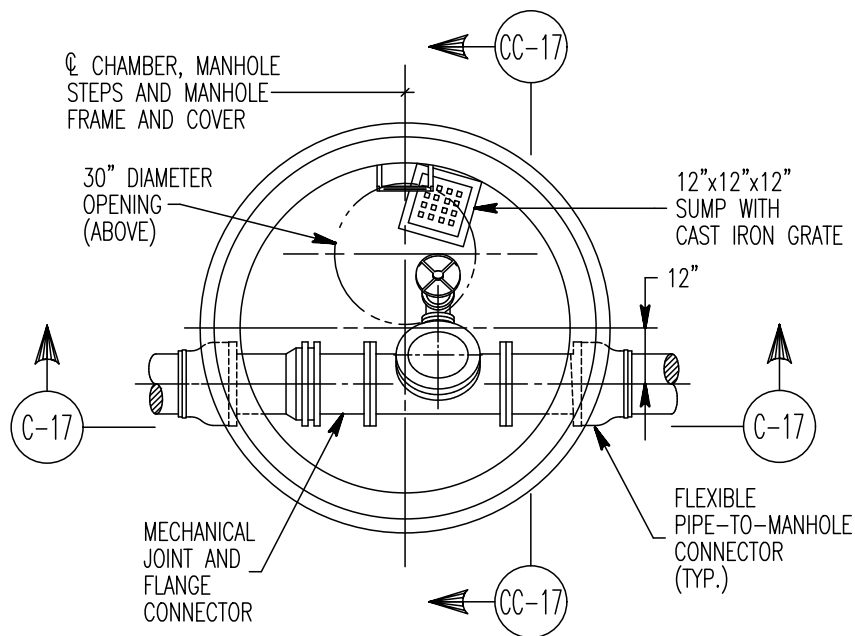
EMBANK

GANNETT FLEMING

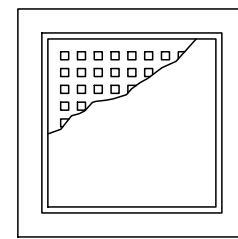
REV. SEPTEMBER 2017

10

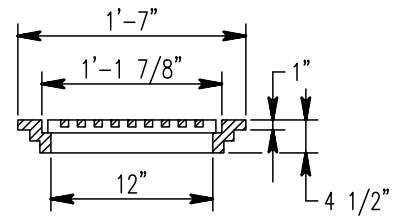
DWG. No. A-36175



SECTIONAL PLAN

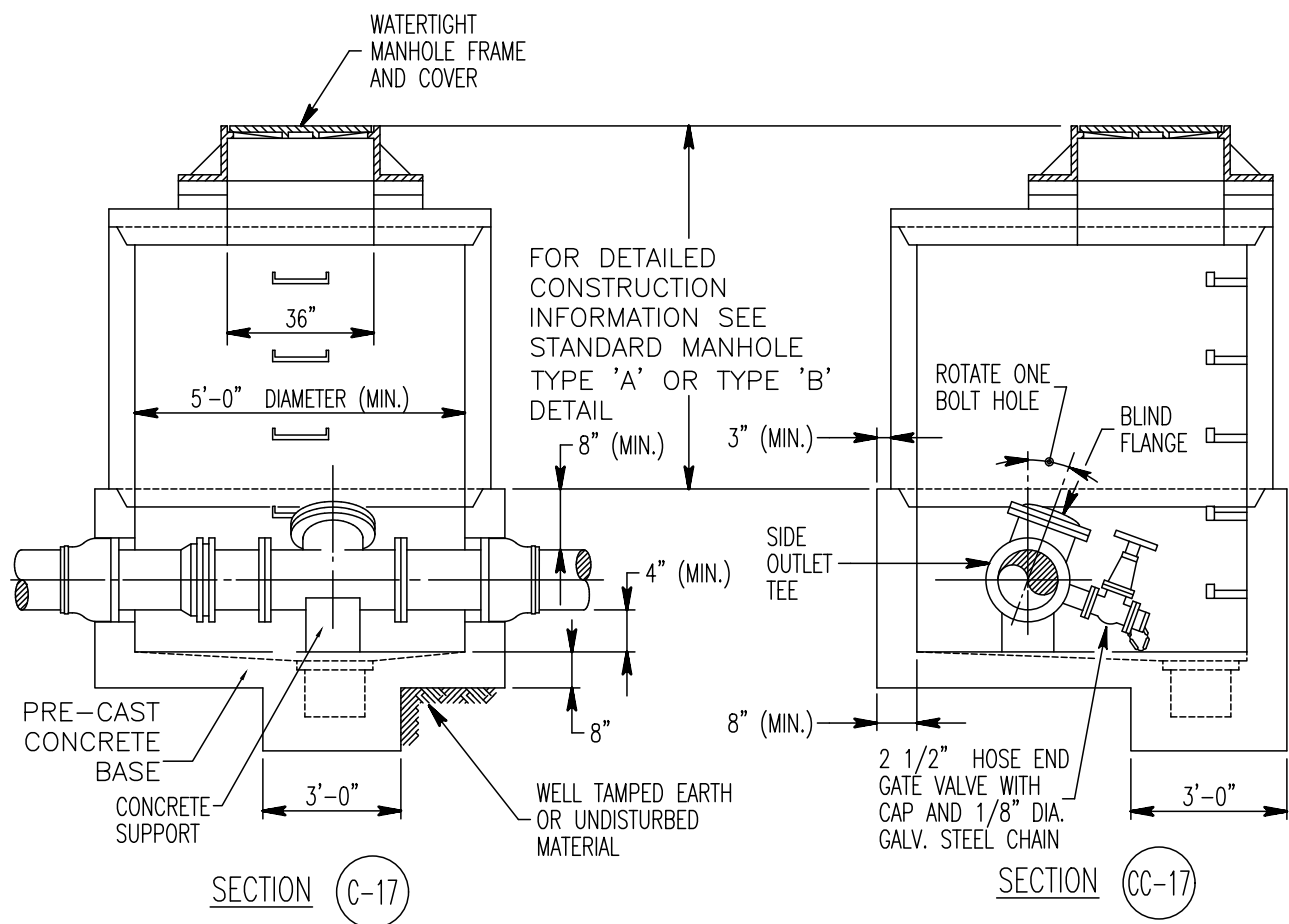


PLAN



SECTIONAL ELEVATION

SUMP FRAME AND GRATE



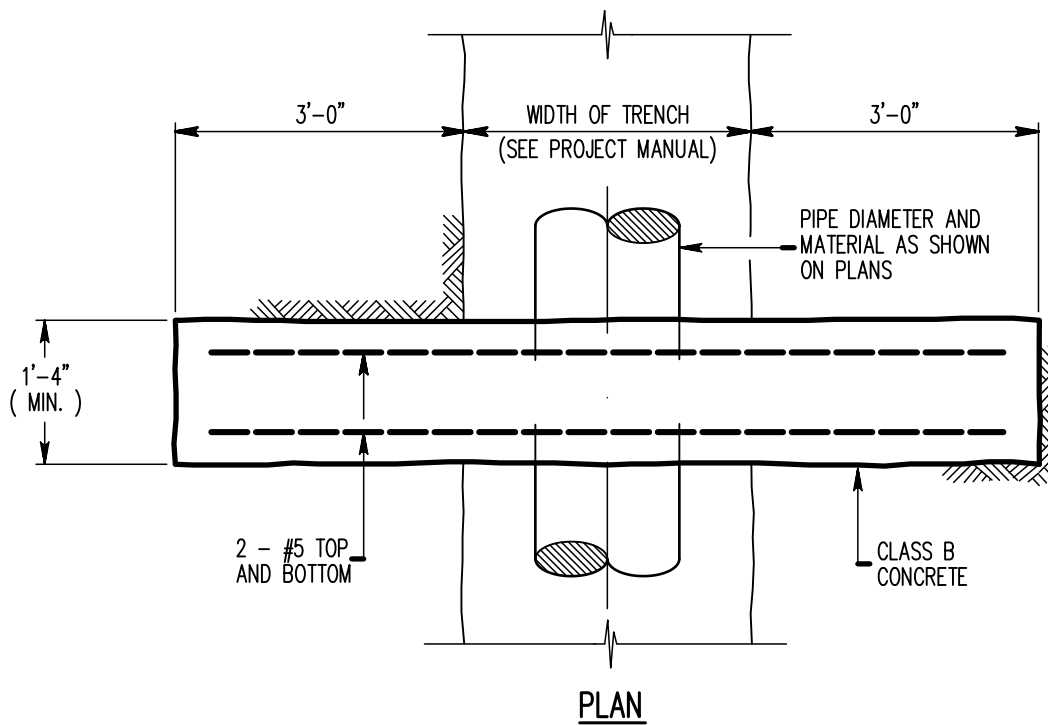
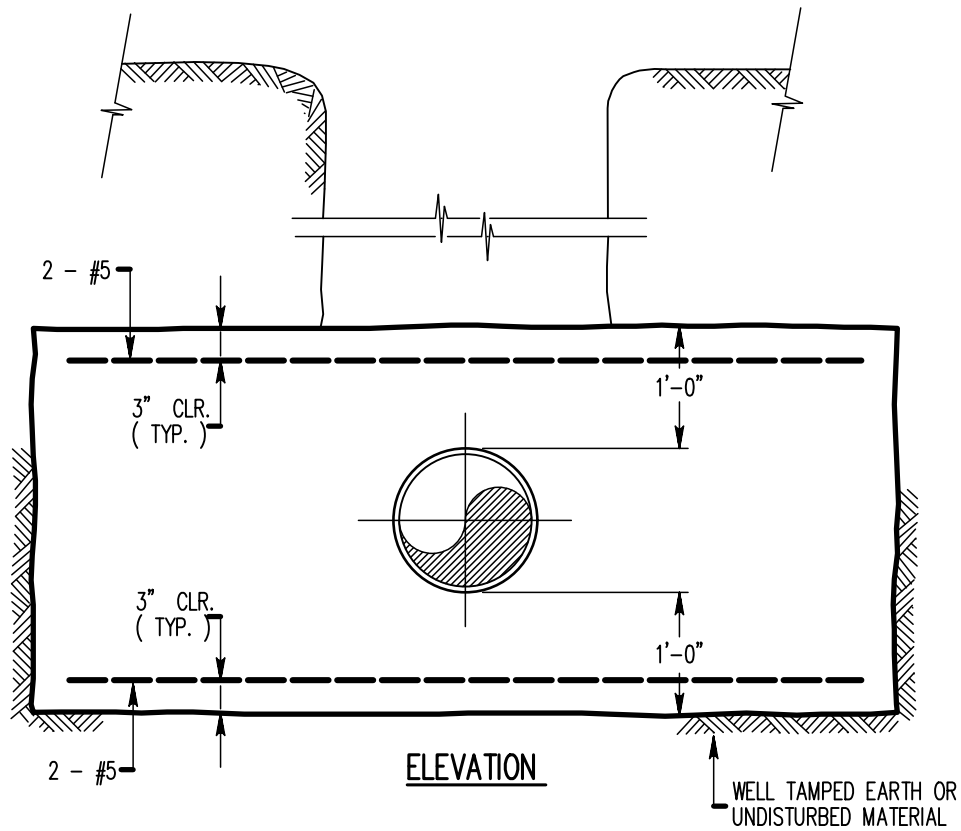
CLEANOUT CHAMBER

GANNETT FLEMING

MISC3.dgn

MICRO-STATION

CONVANC



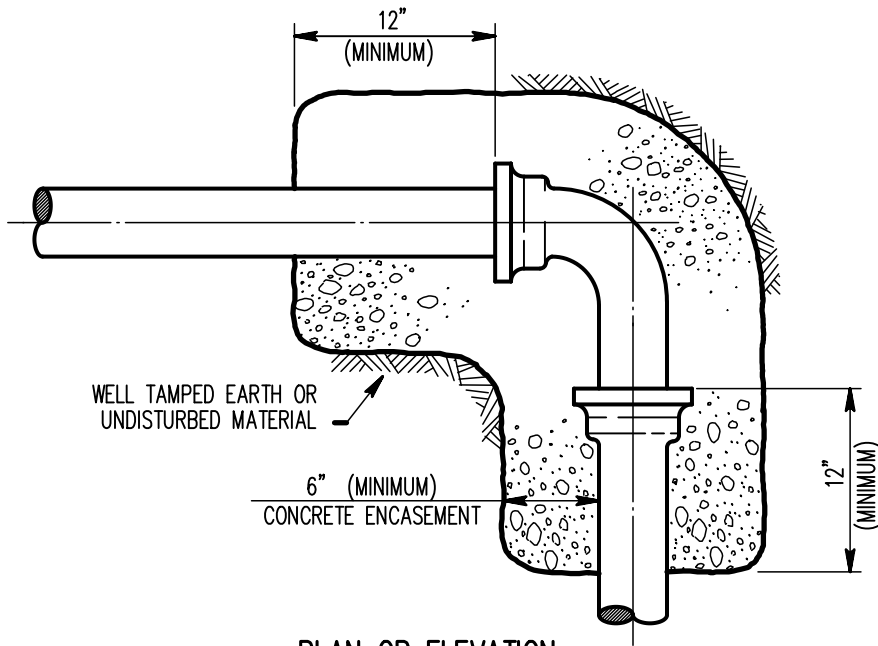
CONCRETE ANCHOR

GANNETT FLEMING

REV. MARCH 1993

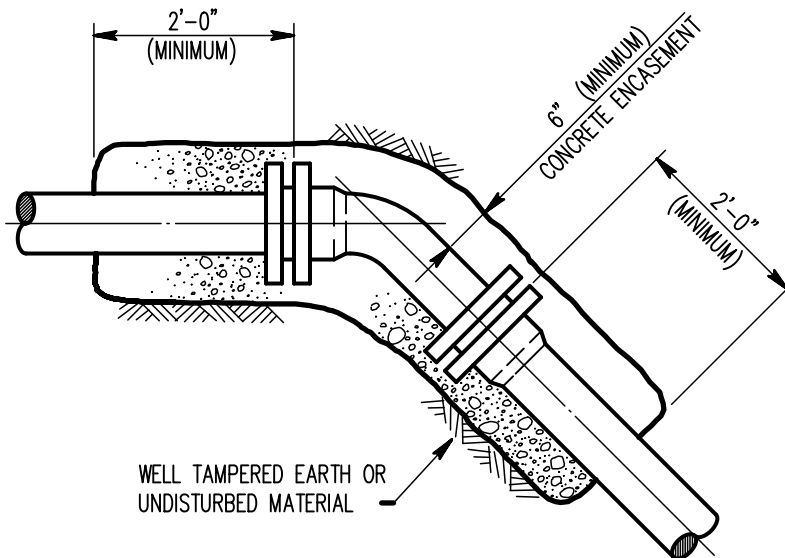
18

DWG. No. A-28778



PLAN OR ELEVATION

TYPICAL GRAVITY LINE FITTINGS NOTED



PLAN OR ELEVATION

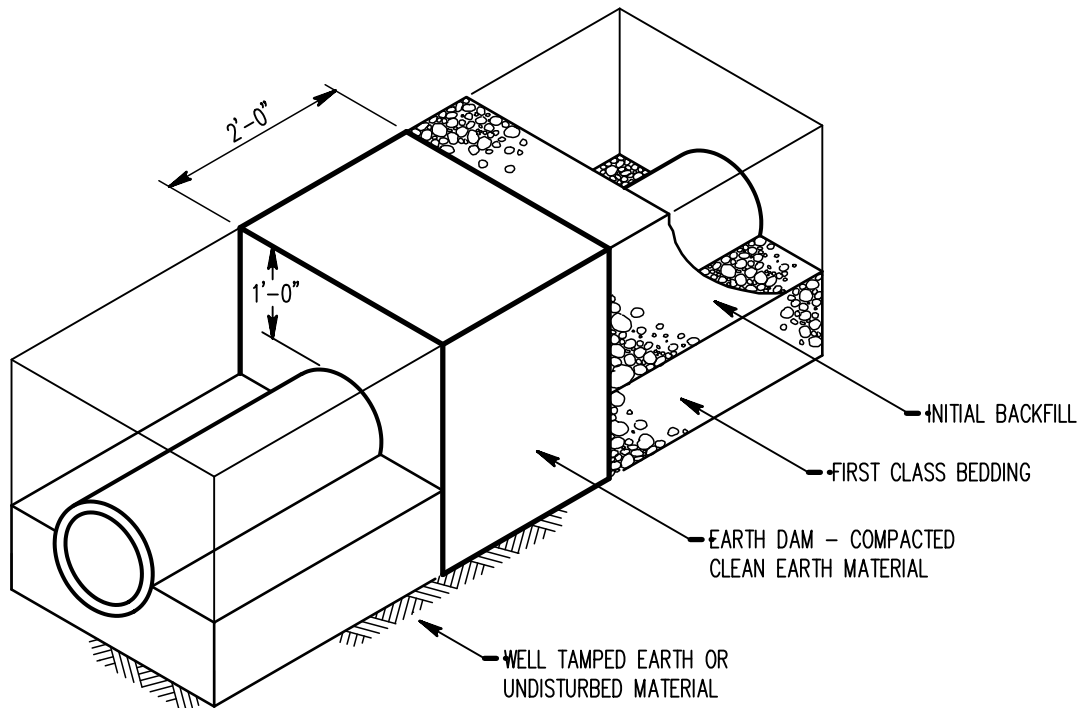
TYPICAL ALL PRESSURE LINE FITTINGS

CONCRETE THRUST BLOCKS

MISC3.dgn

MICRO-STATION

THRBLK



ISOMETRIC VIEW

EARTH DAM

MISC3.dgn

MICRO-STATION

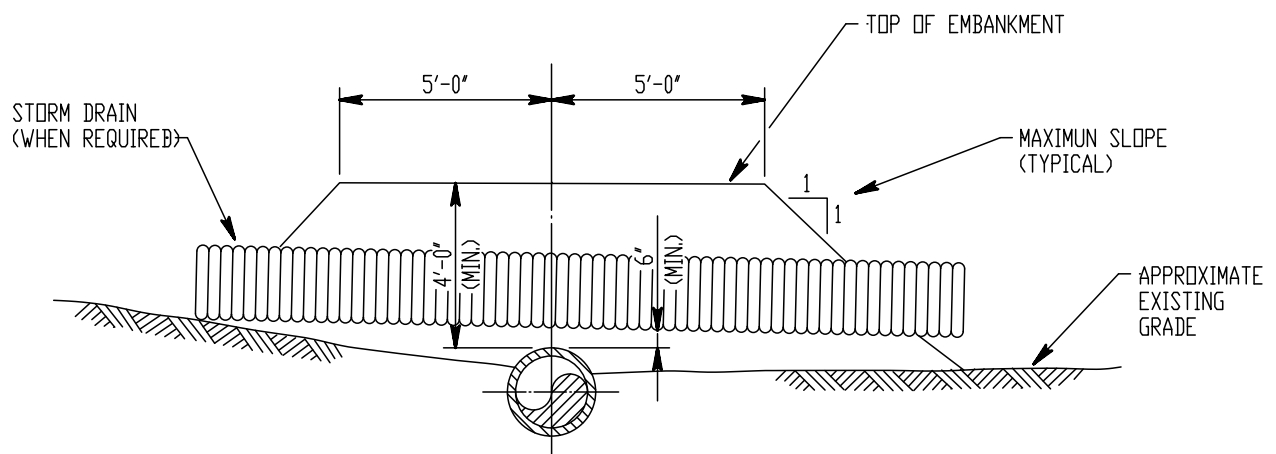
ERTHDM

GANNETT FLEMING

REV. JULY 1989

33

DWG. No. A-28777



SECTIONAL ELEVATION

EMBANKMENT

MISC2.dgn

MICRO-STATION

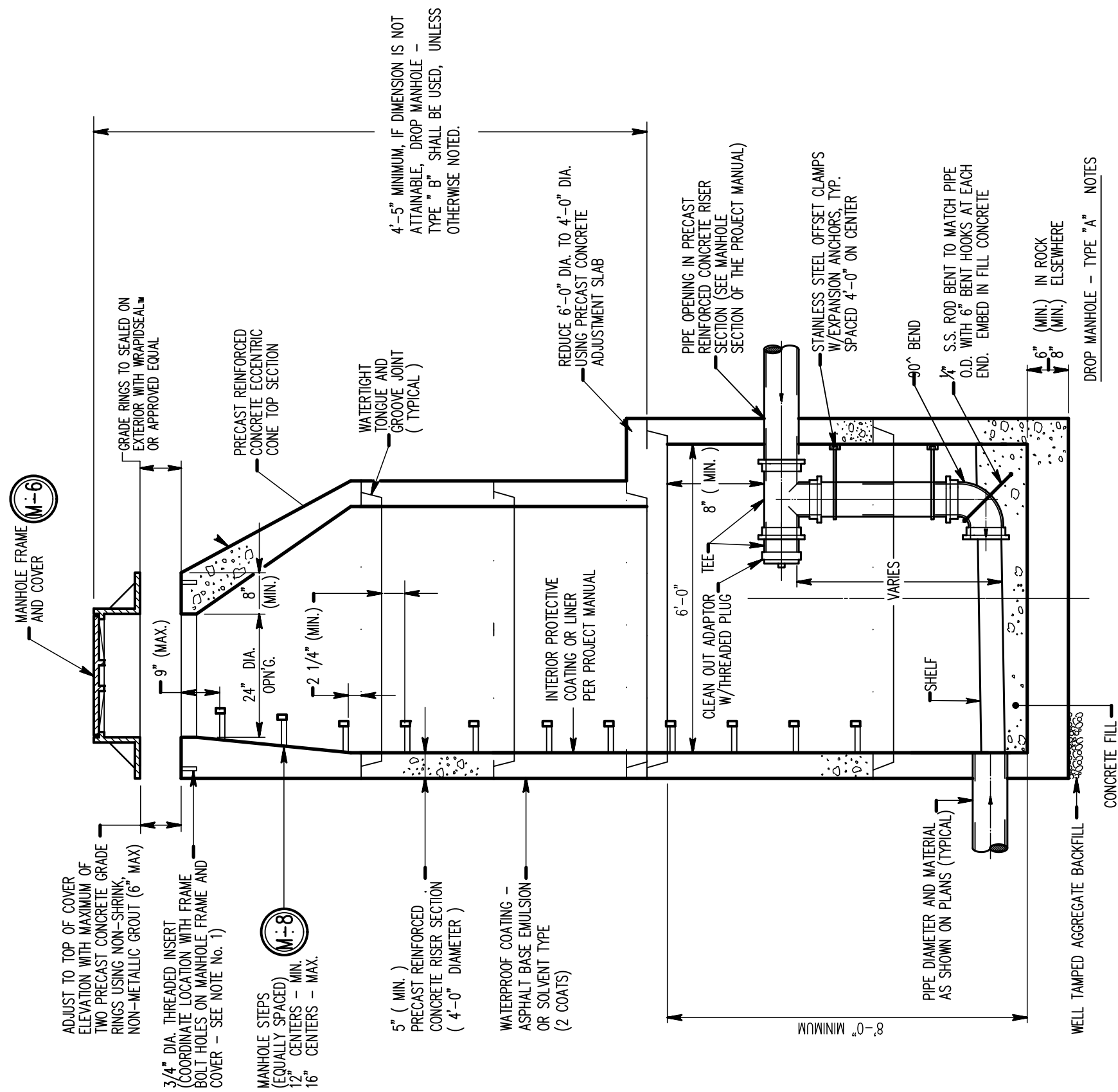
EMBANK

GANNETT FLEMING

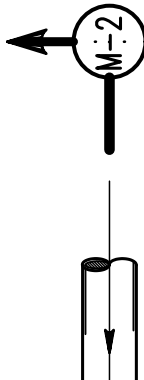
REV. AUGUST 1990

34

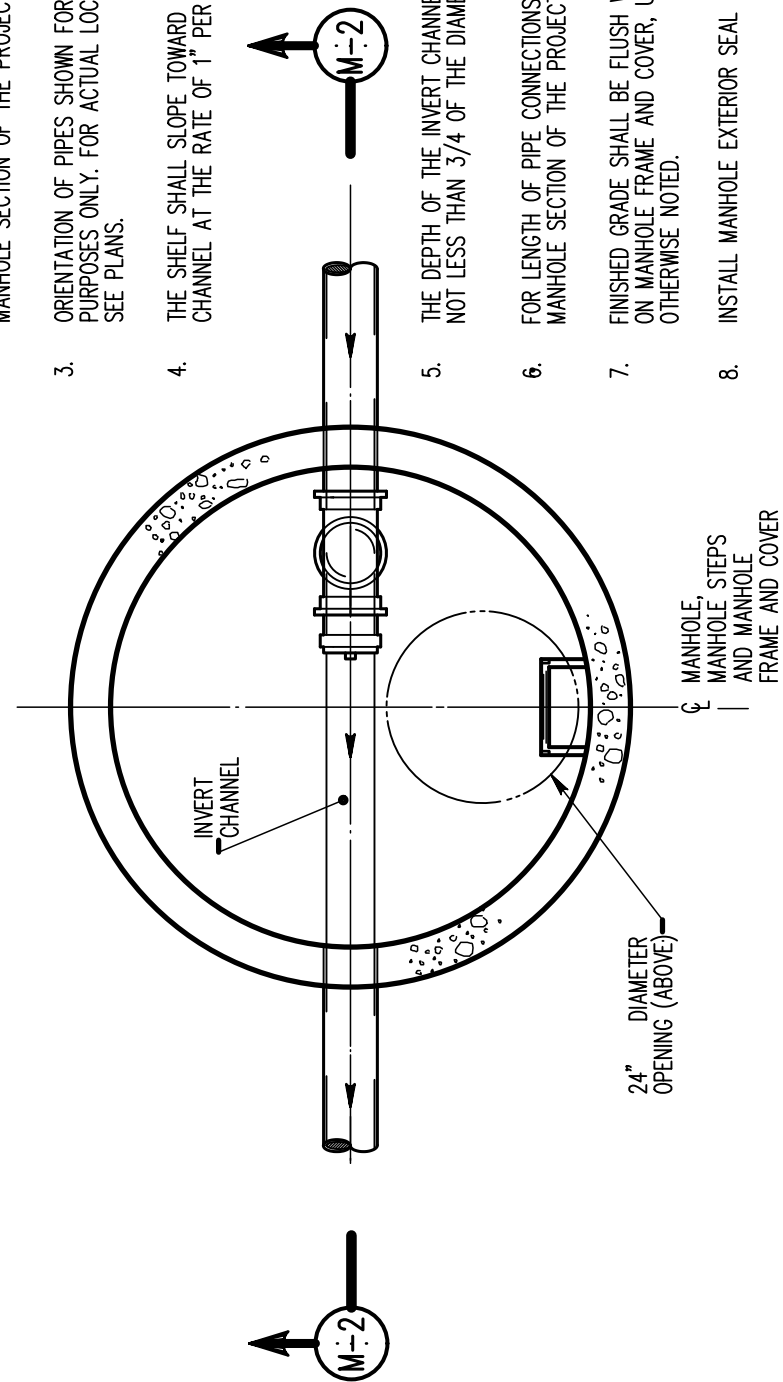
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DROP MANHOLE - TYPE "A" NOTES

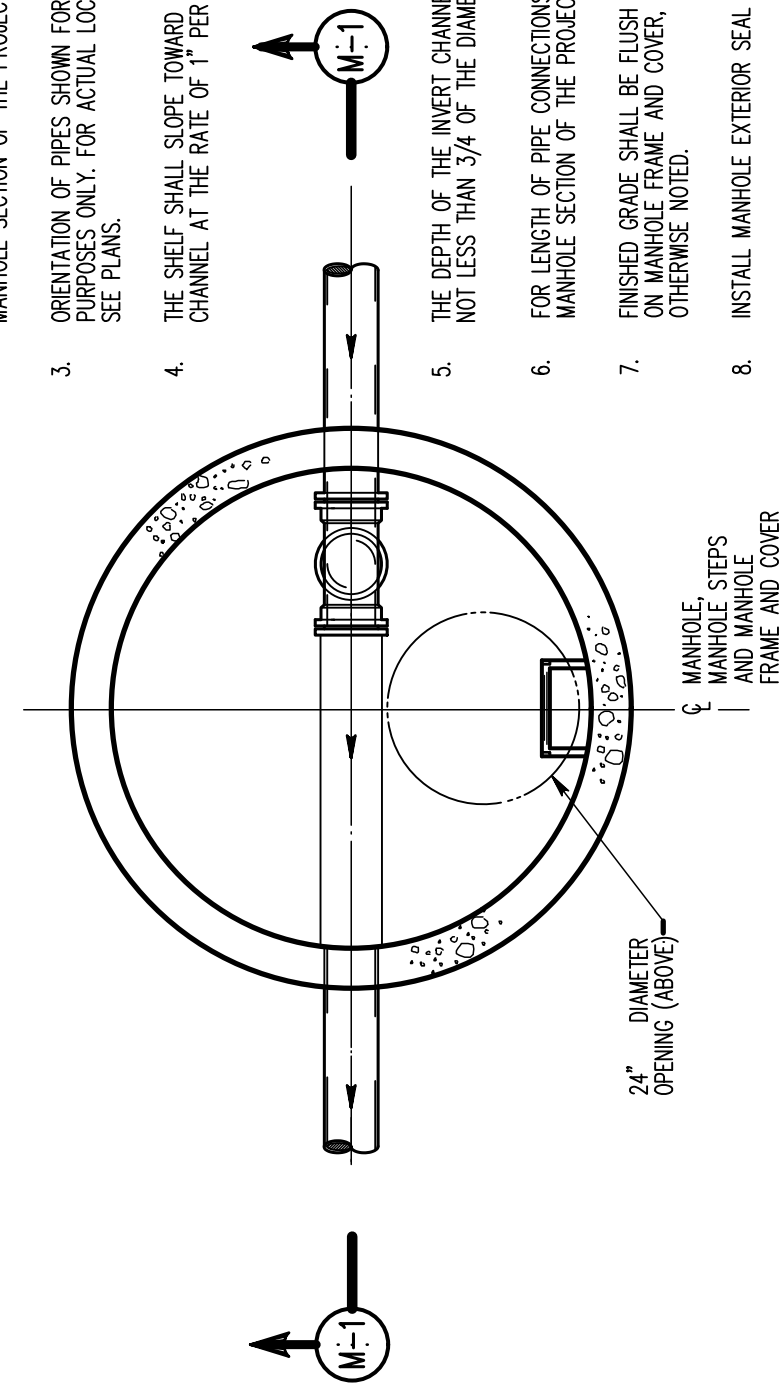
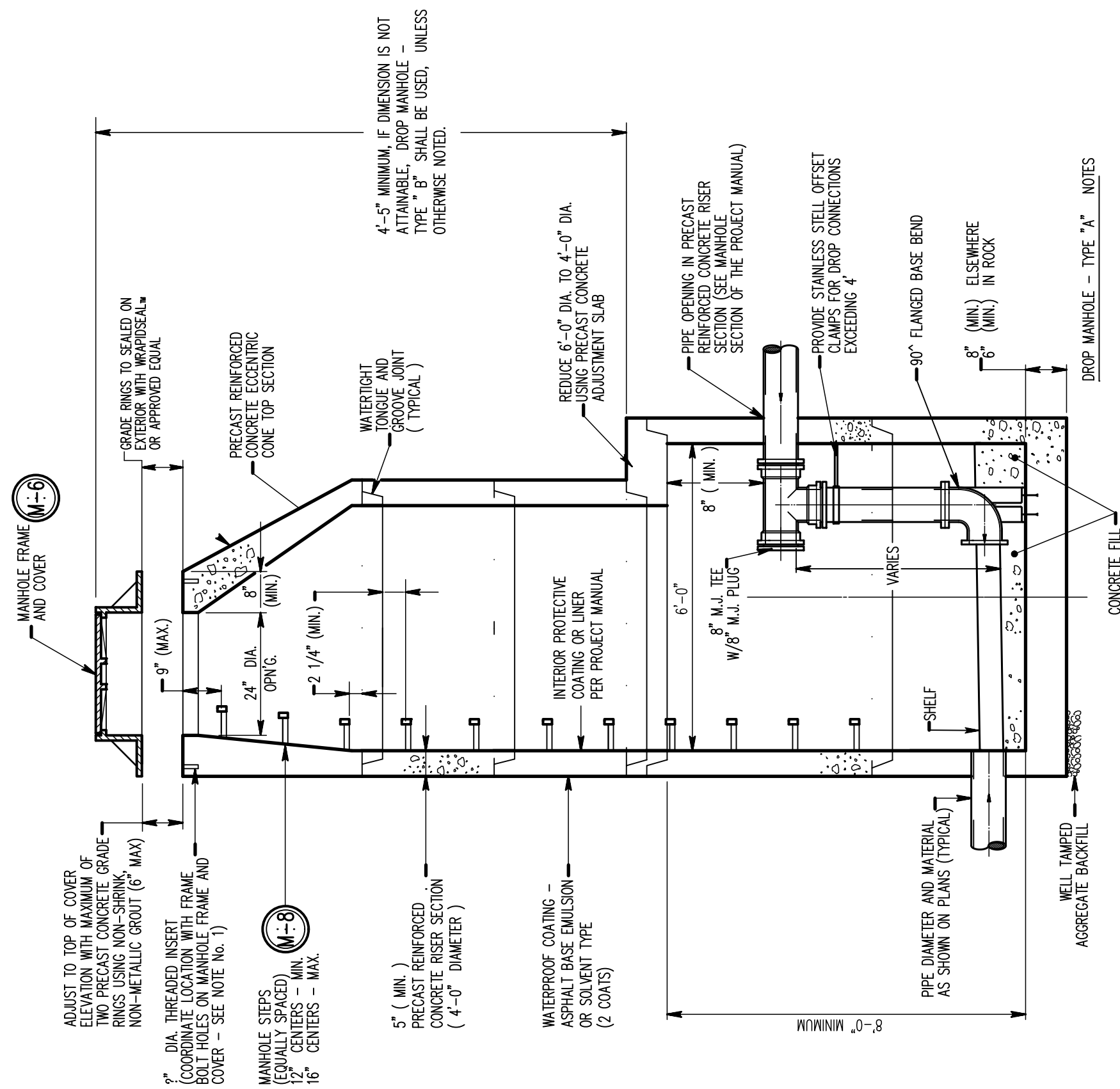
1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH FOUR 3/4" BOLTS AND FLAT WASHERS. ON ALL EXISTING MANHOLES FOUR 3/4" BOLTS AND FLAT WASHERS TO BE USED IN NEW CONSTRUCTION.
 2. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
 3. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
 4. THE SLOPE SHALL BE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM).
- 

The diagram illustrates a pipe installation detail. A horizontal pipe is shown in cross-section, with an arrow pointing from the pipe towards a vertical structure labeled 'M-2'. This structure represents the invert channel. The arrow indicates the direction of flow or slope towards the channel.
5. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE.
 6. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
 7. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER ON MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED.
 8. INSTALL MANHOLE EXTERIOR SEAL



SECTIONAL PLAN THRU BASE

P.V.C PIPE
DROP MANHOLE - TYPE "A"

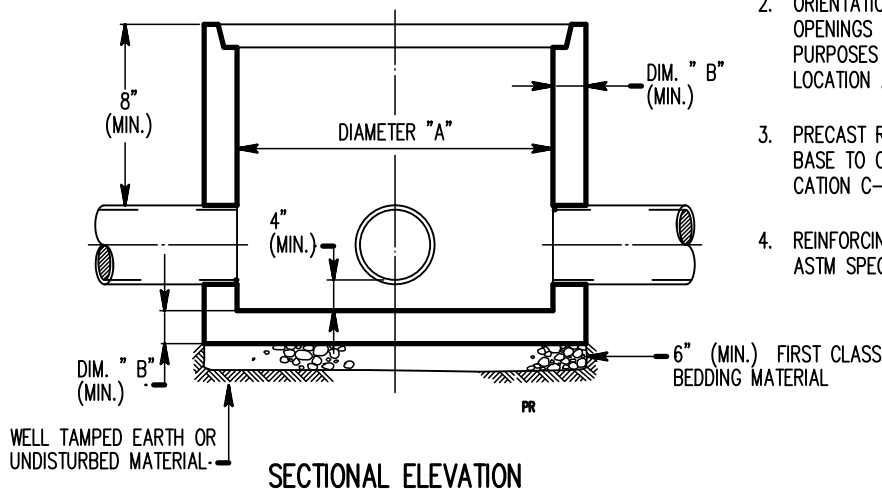


SECTIONAL PLAN THRU BASE

DUCTILE IRON PIPE
DROP MANHOLE - TYPE "A"

MISC5.dgn
MICRO-STATION
PREMHB

PRECAST REINFORCED CONCRETE MANHOLE BASE SCHEDULE OF DIMENSIONS	
DIA. "A"	DIM. "B"
4'-0"	5"
5'-0"	6"
6'-0"	7"
7'-0"	8"
8'-0"	9"
10'-0"	10"

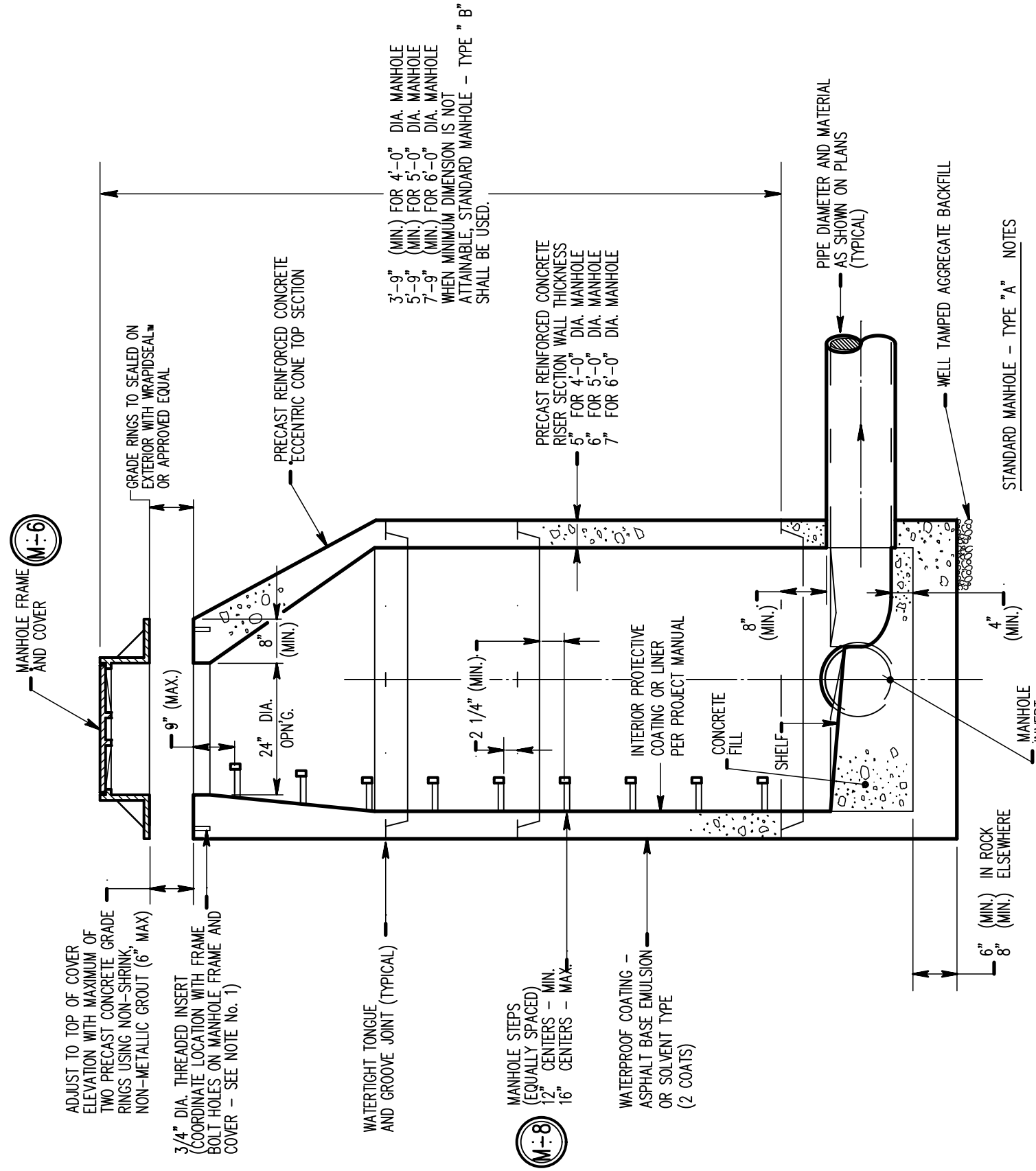


PRECAST REINFORCED CONCRETE MANHOLE BASE NOTES

1. FOR PIPE OPENINGS THRU PRECAST REINFORCED CONCRETE MANHOLE WALLS, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
2. ORIENTATION AND DIAMETER OF PIPE OPENINGS SHOWN FOR ILLUSTRATION PURPOSES ONLY. SEE PLANS FOR LOCATION AND DIAMETER.
3. PRECAST REINFORCED CONCRETE MANHOLE BASE TO CONFORM TO ASTM SPECIFICATION C-478.
4. REINFORCING STEEL TO CONFORM TO ASTM SPECIFICATION A-185.

PRECAST REINFORCED CONCRETE MANHOLE BASES

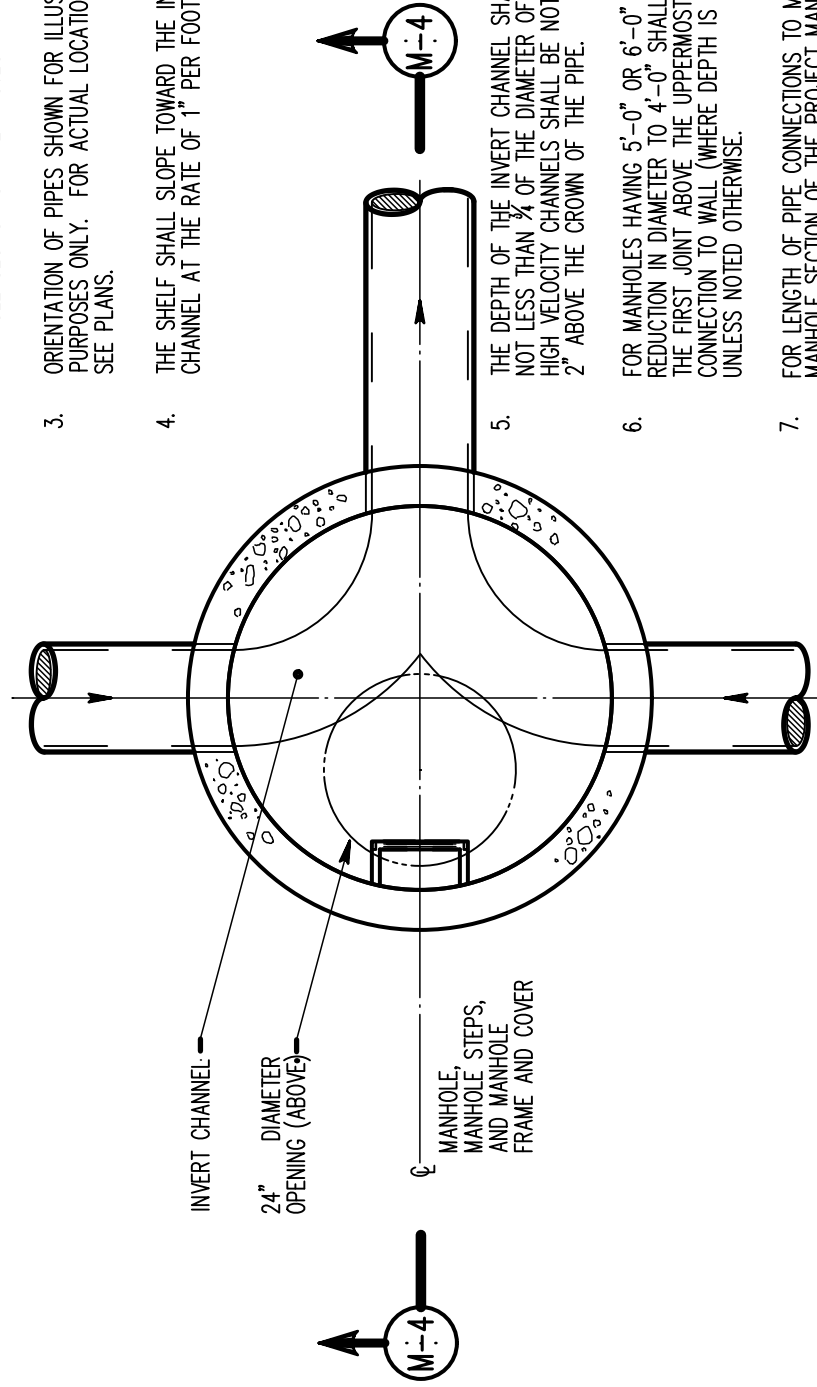




1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH FOUR 3/4" BOLTS AND FLAT WASHERS. ON ALL EXISTING MANHOLES FOUR 3/4" BOLTS AND FLAT WASHERS TO BE USED IN NEW CONSTRUCTION.

SECTION M-4

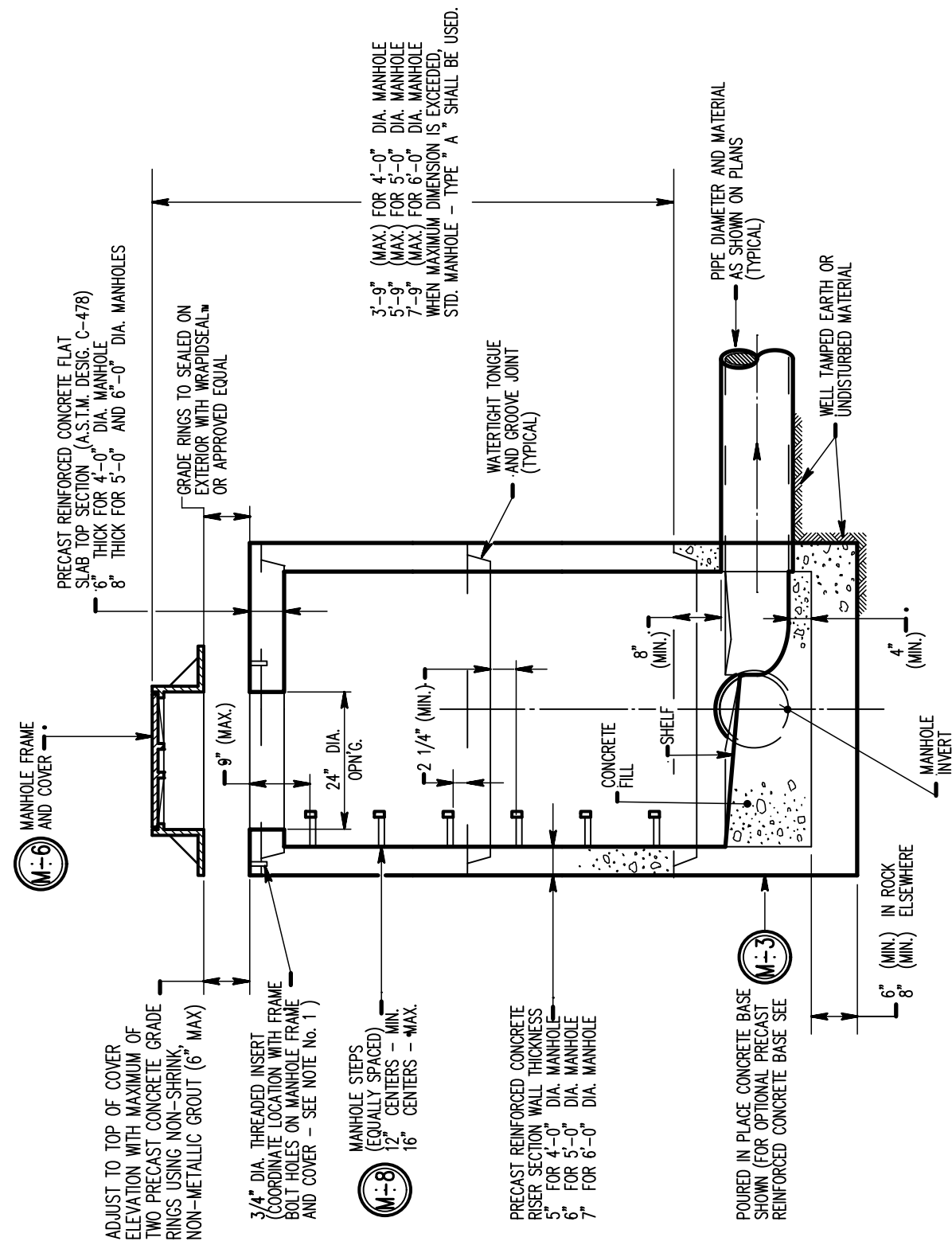
2. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
3. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.
4. THE SHELFF SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM).



5. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 1/4 OF THE DIAMETER OF THE PIPE. HIGH VELOCITY CHANNELS SHALL BE NOT LESS THAN 2" ABOVE THE CROWN OF THE PIPE.
6. FOR MANHOLES HAVING 5'-0" OR 6'-0" DIAMETER BASE, REDUCTION IN DIAMETER TO 4'-0" SHALL START AT THE FIRST JOINT ABOVE THE UPPERMOST PIPE CONNECTION TO WALL (WHERE DEPTH IS SUFFICIENT) UNLESS NOTED OTHERWISE.
7. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.
8. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER ON MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED.
9. INSTALL MANHOLE EXTERIOR SEAL

PLAN BELOW ECCENTRIC CONE TOP SECTION

STANDARD MANHOLE - TYPE "A"



STANDARD MANHOLE - TYPE "B" NOTES

SECTION (M-5)

1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH FOUR 3/4" BOLTS AND FLAT WASHERS. ON ALL EXISTING MANHOLES FOUR 3/4" BOLTS AND FLAT WASHERS TO BE USED IN NEW CONSTRUCTION.

2. FOR PIPE CONNECTION TO CONCRETE BASE, SEE MANHOLE SECTION OF THE PROJECT MANUAL.

3. ORIENTATION OF PIPES SHOWN FOR ILLUSTRATION PURPOSES ONLY. FOR ACTUAL LOCATIONS SEE PLANS.

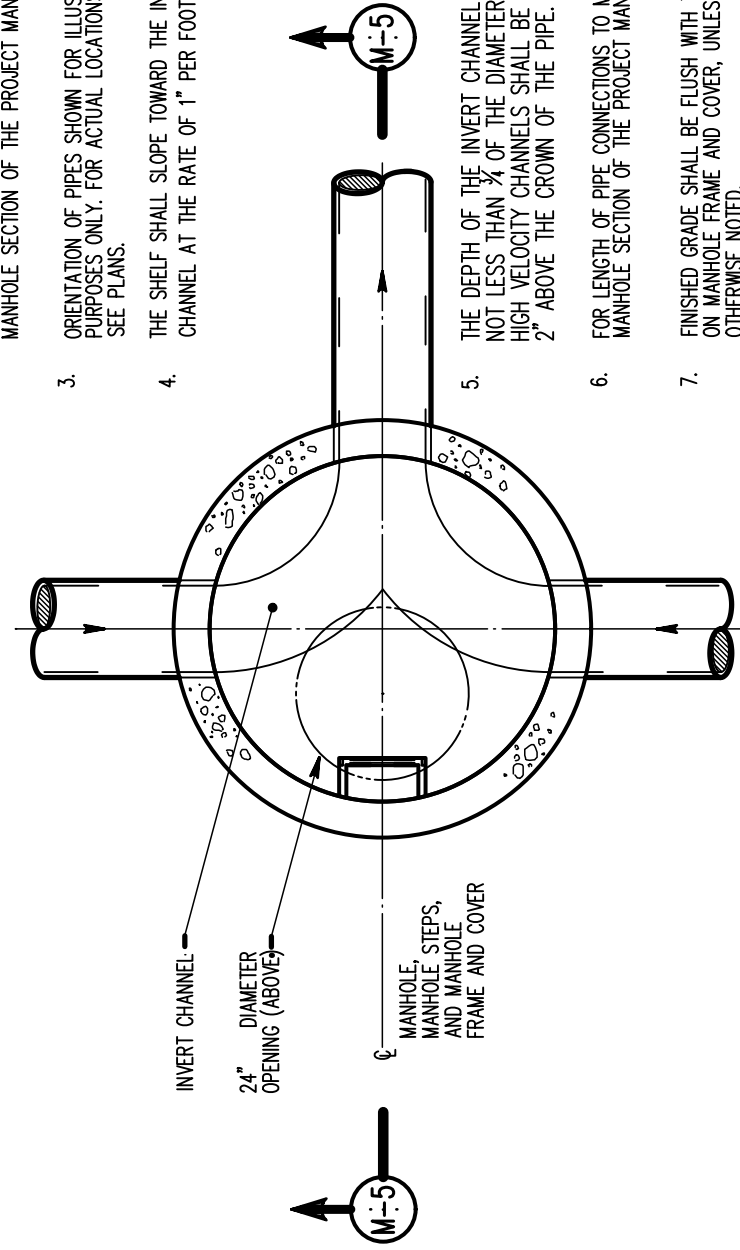
4. THE SHELVE SHALL SLOPE TOWARD THE INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MINIMUM).

5. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 1/4 OF THE DIAMETER OF THE PIPE. HIGH VELOCITY CHANNELS SHALL BE NOT LESS THAN 2" ABOVE THE CROWN OF THE PIPE.

6. FOR LENGTH OF PIPE CONNECTIONS TO MANHOLES, SEE MANHOLE SECTION OF THE PROJECT MANUAL.

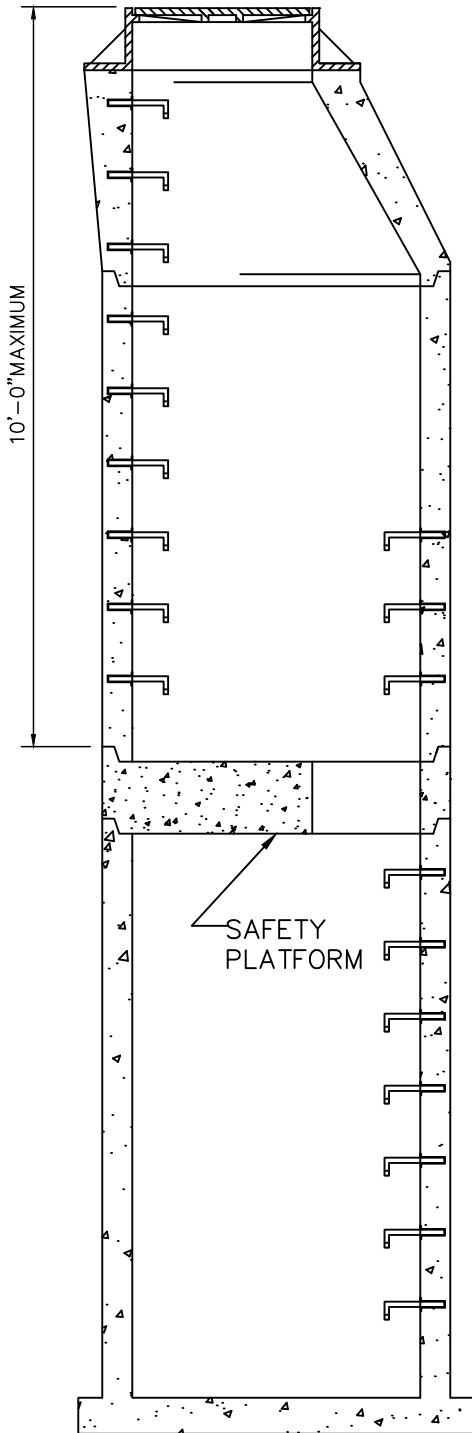
7. FINISHED GRADE SHALL BE FLUSH WITH TOP OF COVER ON MANHOLE FRAME AND COVER, UNLESS OTHERWISE NOTED.

8. INSTALL MANHOLE EXTERIOR SEAL

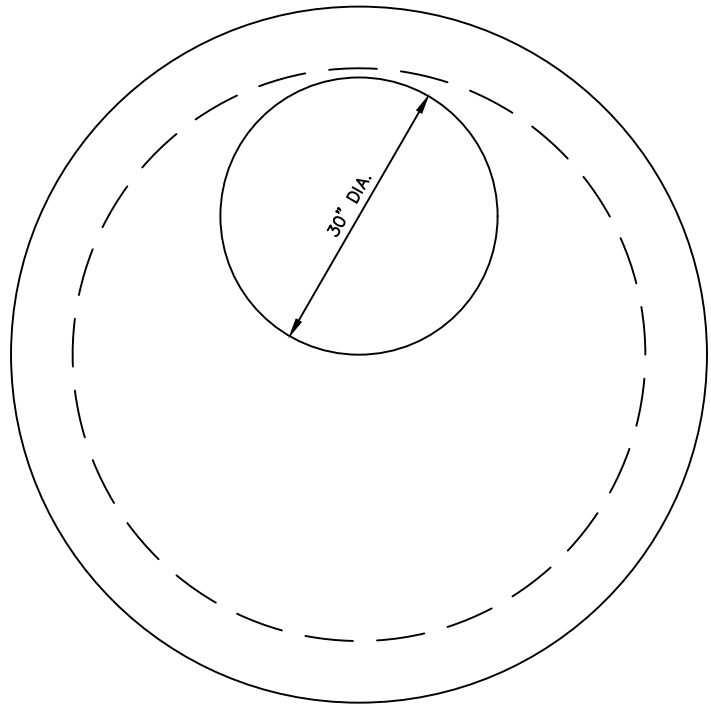


PLAN BELOW FLAT SLAB TOP SECTION

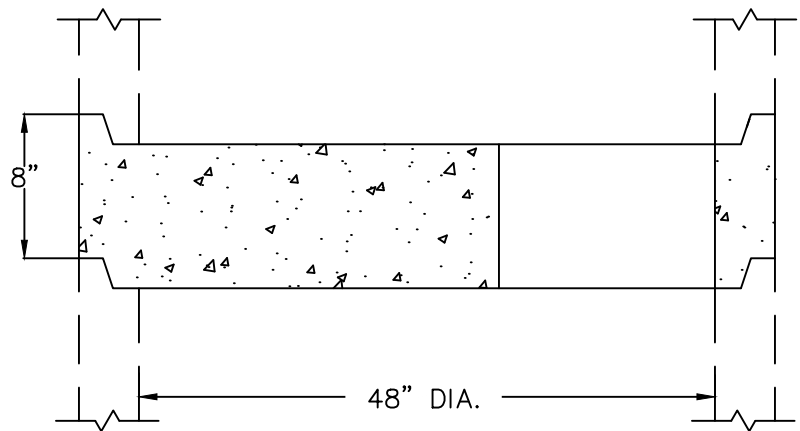
STANDARD MANHOLE - TYPE "B" (M-5)



MANHOLE CROSS-SECTION
NOT TO SCALE

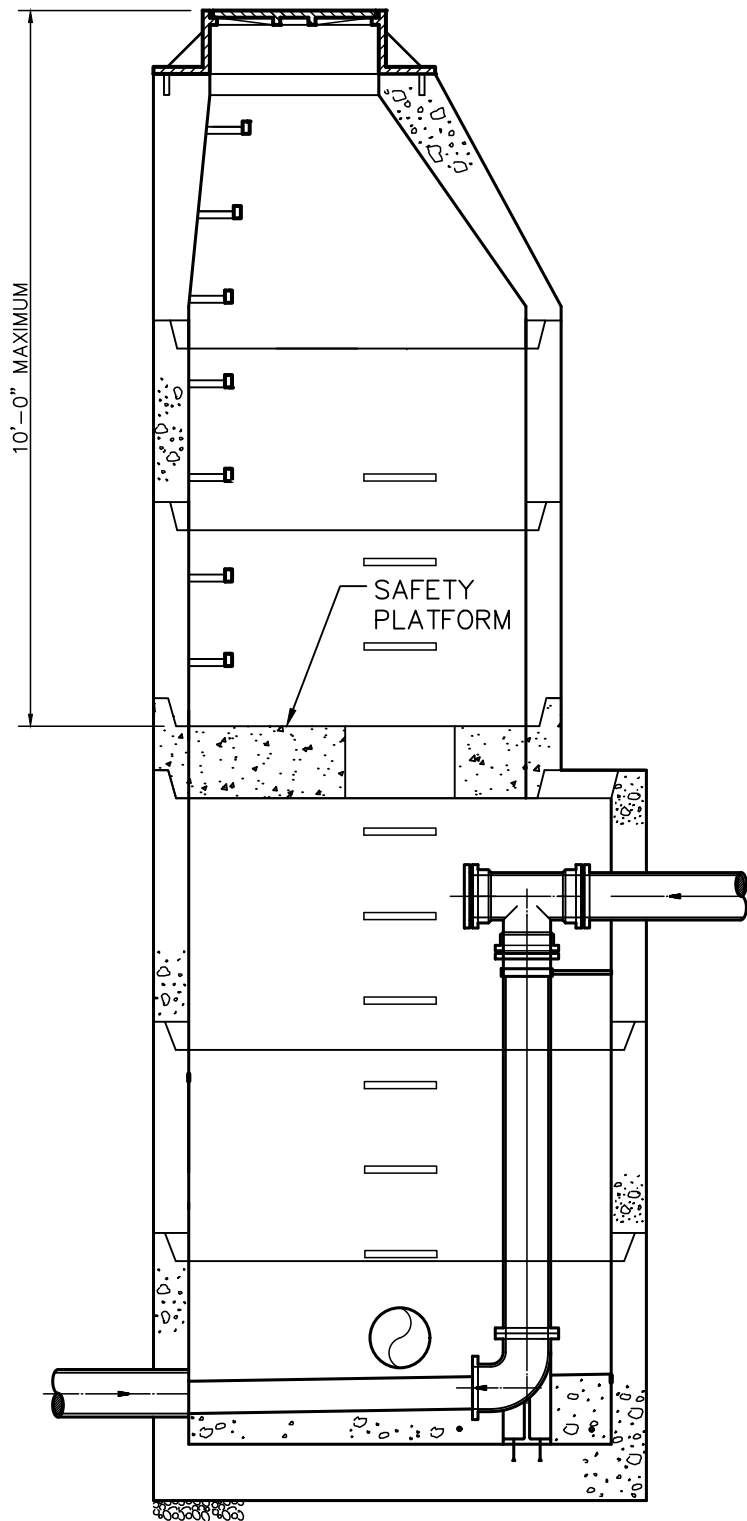


PLAN VIEW
NOT TO SCALE

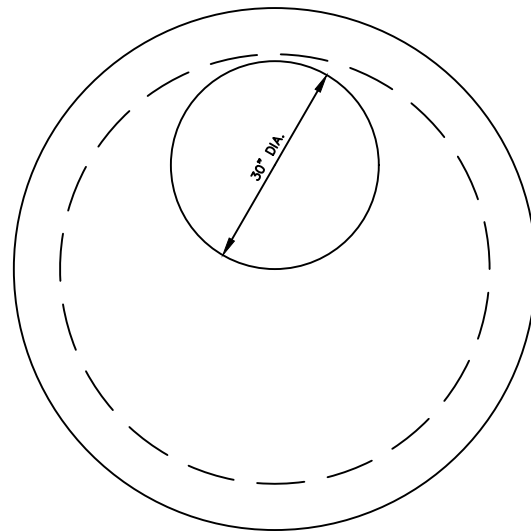


SAFETY PLATFORM DETAIL
NOT TO SCALE

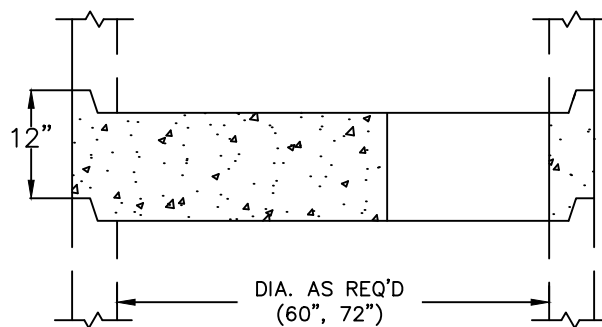
SAFETY PLATFORM DETAIL



MANHOLE CROSS-SECTION
NOT TO SCALE

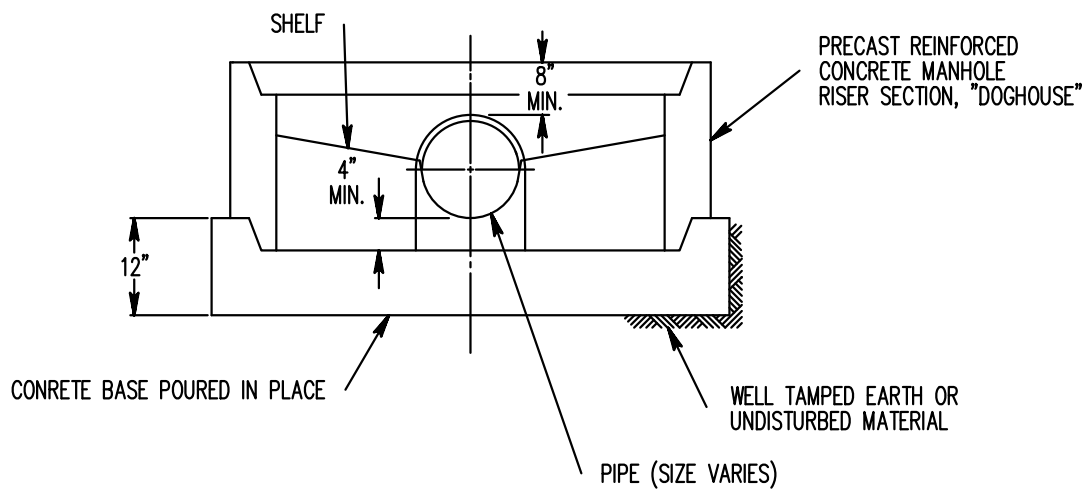


SAFETY PLATFORM PLAN VIEW
NOT TO SCALE

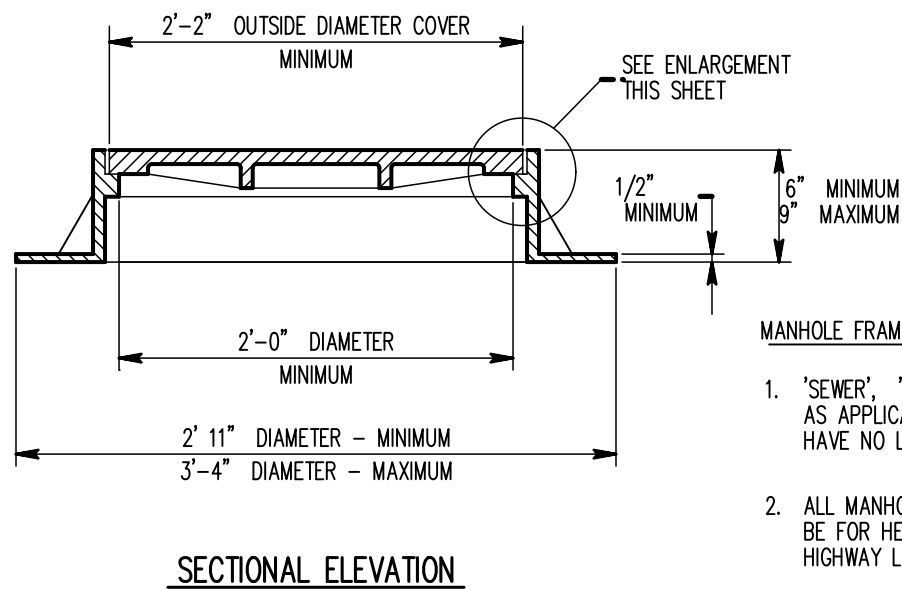
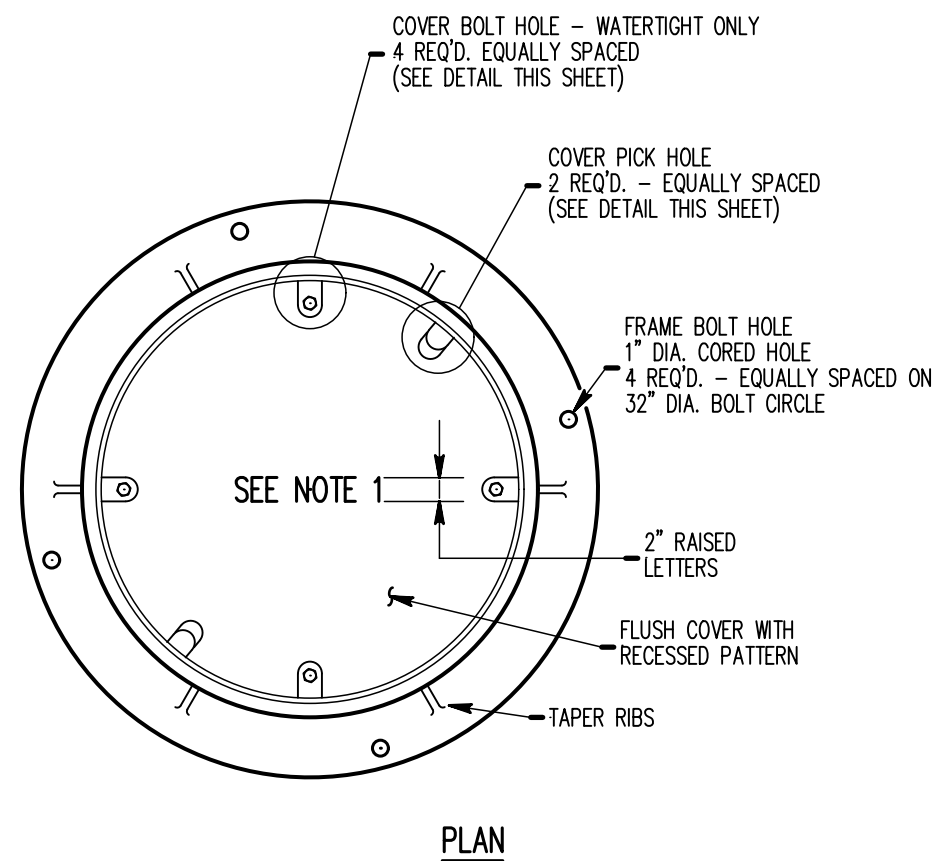


SAFETY PLATFORM DETAIL
NOT TO SCALE

DROP MANHOLE SAFETY PLATFORM DETAIL NOT TO SCALE



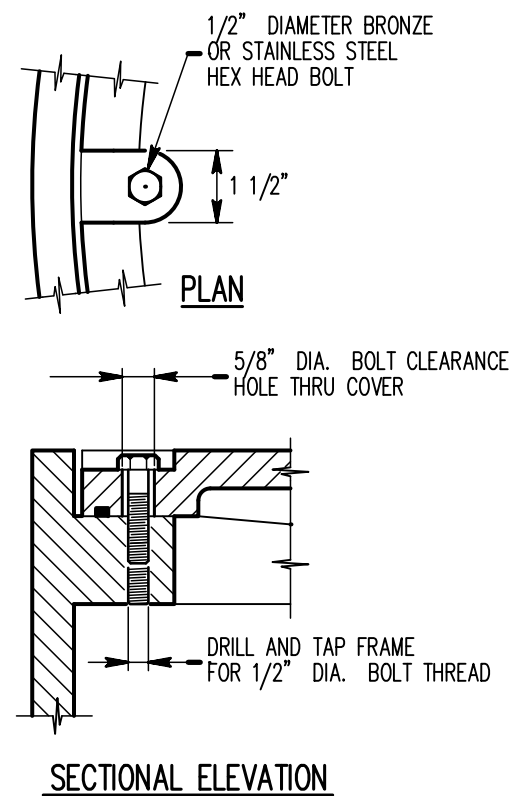
SECTIONAL ELEVATION
"DOGHOUSE" MANHOLE SECTION AND BASE



MANHOLE FRAME AND COVER NOTES

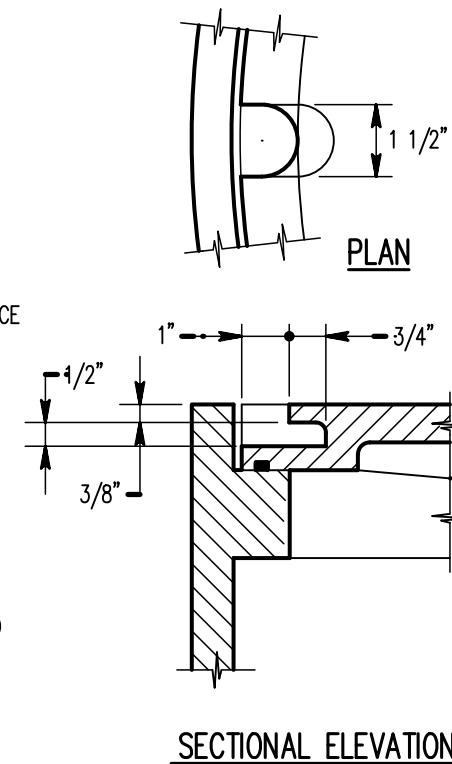
1. 'SEWER', 'ELECTRIC' OR 'TELEPHONE'
AS APPLICABLE. ALL OTHERS SHALL
HAVE NO LETTERING.
2. ALL MANHOLE FRAMES AND COVERS SHALL
BE FOR HEAVY DUTY TRAFFIC, AASHTO
HIGHWAY LOADING CLASS HS-20.

**STANDARD AND WATERTIGHT
MANHOLE FRAME AND COVER** (M-6)

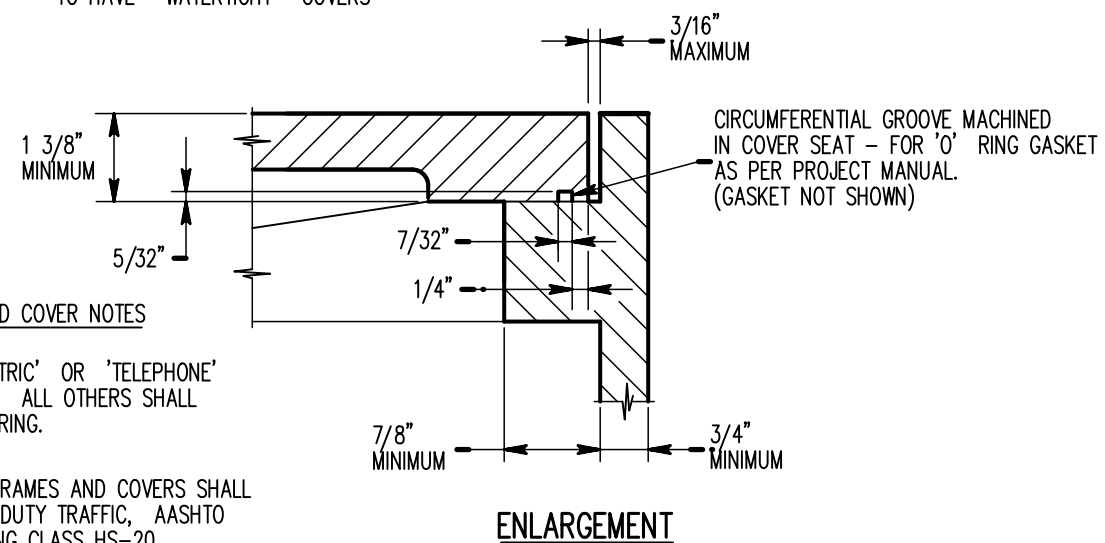


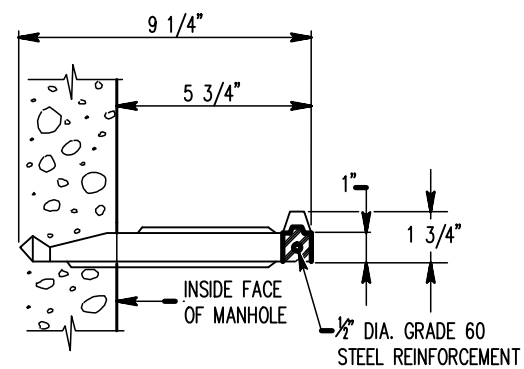
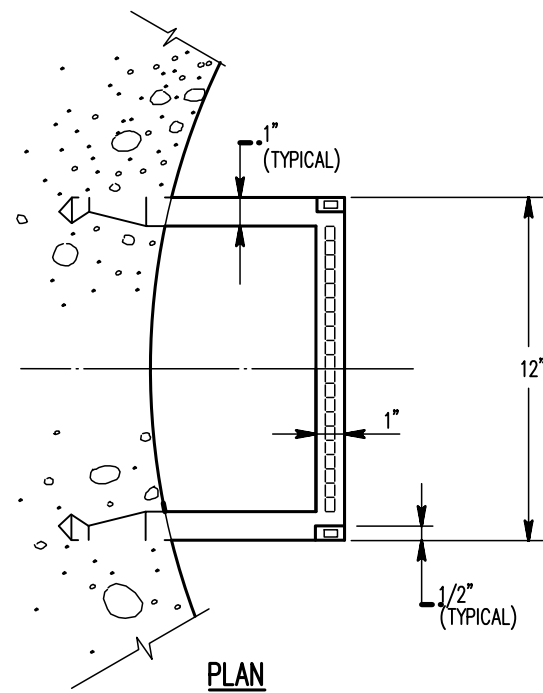
COVER BOLT HOLE

REQUIRED ONLY ON MANHOLES DESIGNATED
TO HAVE "WATERTIGHT" COVERS

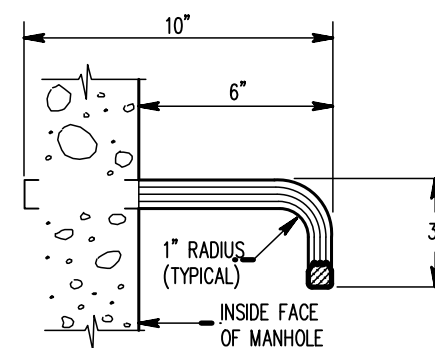
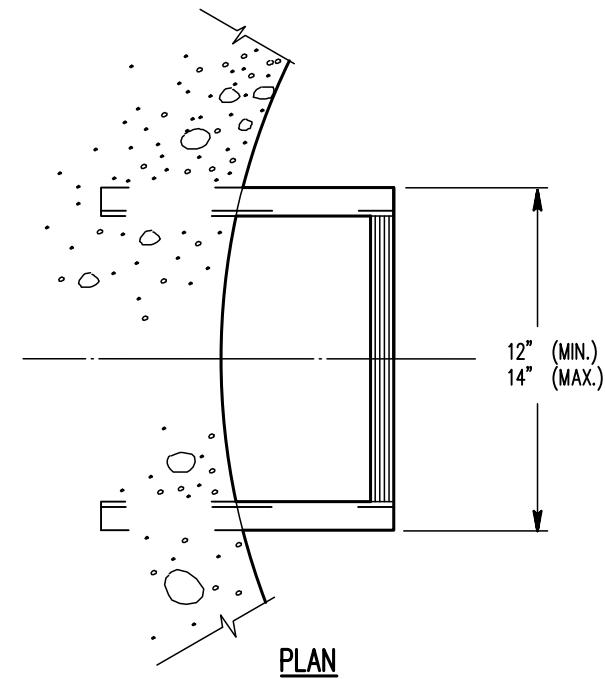


COVER PICK HOLE

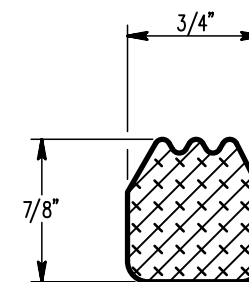




REINFORCED PLASTIC



ALUMINUM
ALLOY 6061-T6

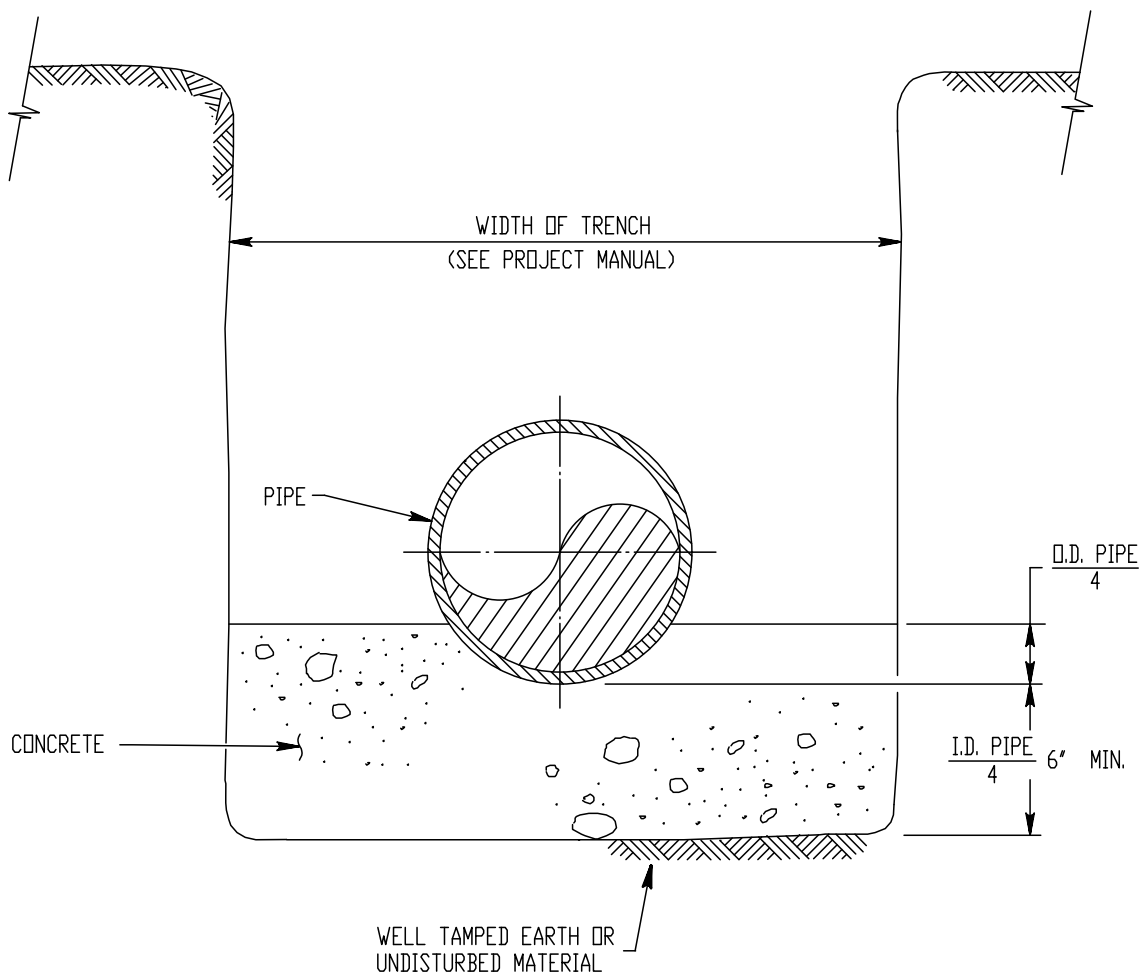


TYPICAL SECTION THRU
ALUMINUM MANHOLE STEP

MANHOLE STEPS NOTES:

1. PROVIDE A HEAVY COAT OF BITUMINOUS PAINT ON ALUMINUM SURFACES IN CONTACT WITH CONCRETE.
2. CIRCULAR WALLS SHOWN. MANHOLE STEPS FOR FLAT WALLS ARE SIMILAR.
3. DIMENSIONS SHOWN ARE MINIMUM UNLESS OTHERWISE SHOWN.

MANHOLE STEPS (M-8)



SECTIONAL ELEVATION

CONCRETE CRADLE

PIPE BEDDING

MISC2.dgn

MICRO-STATION

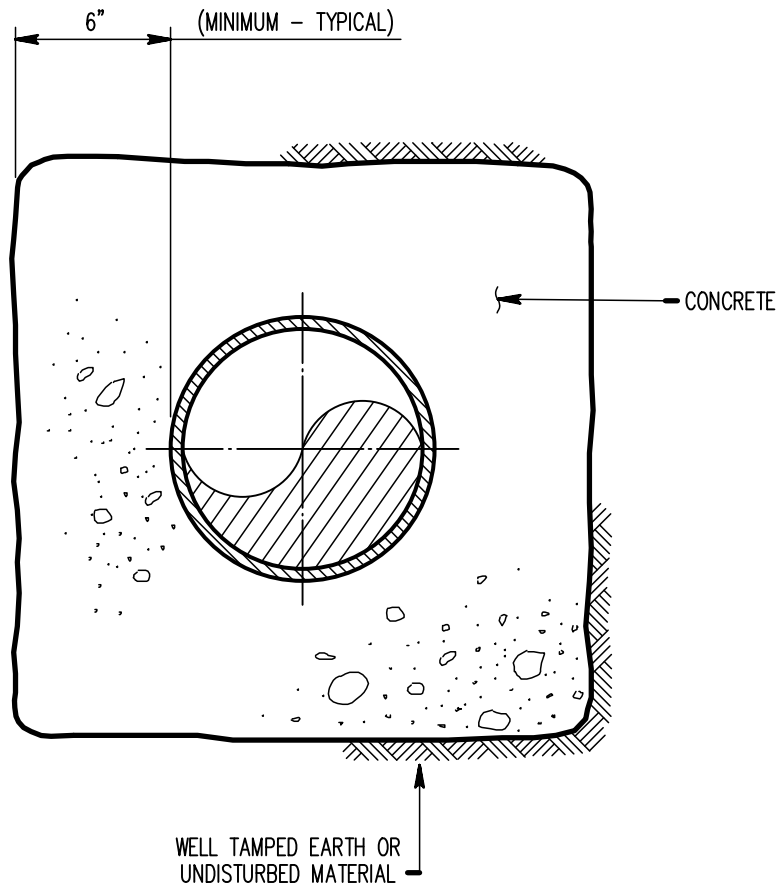
CONCRL

GANNETT FLEMING

REV. SEPTEMBER 2017

73

DWG. No. A-27017



SECTIONAL ELEVATION

CONCRETE ENCASEMENT

MISC2.dgn

MICRO-STATION

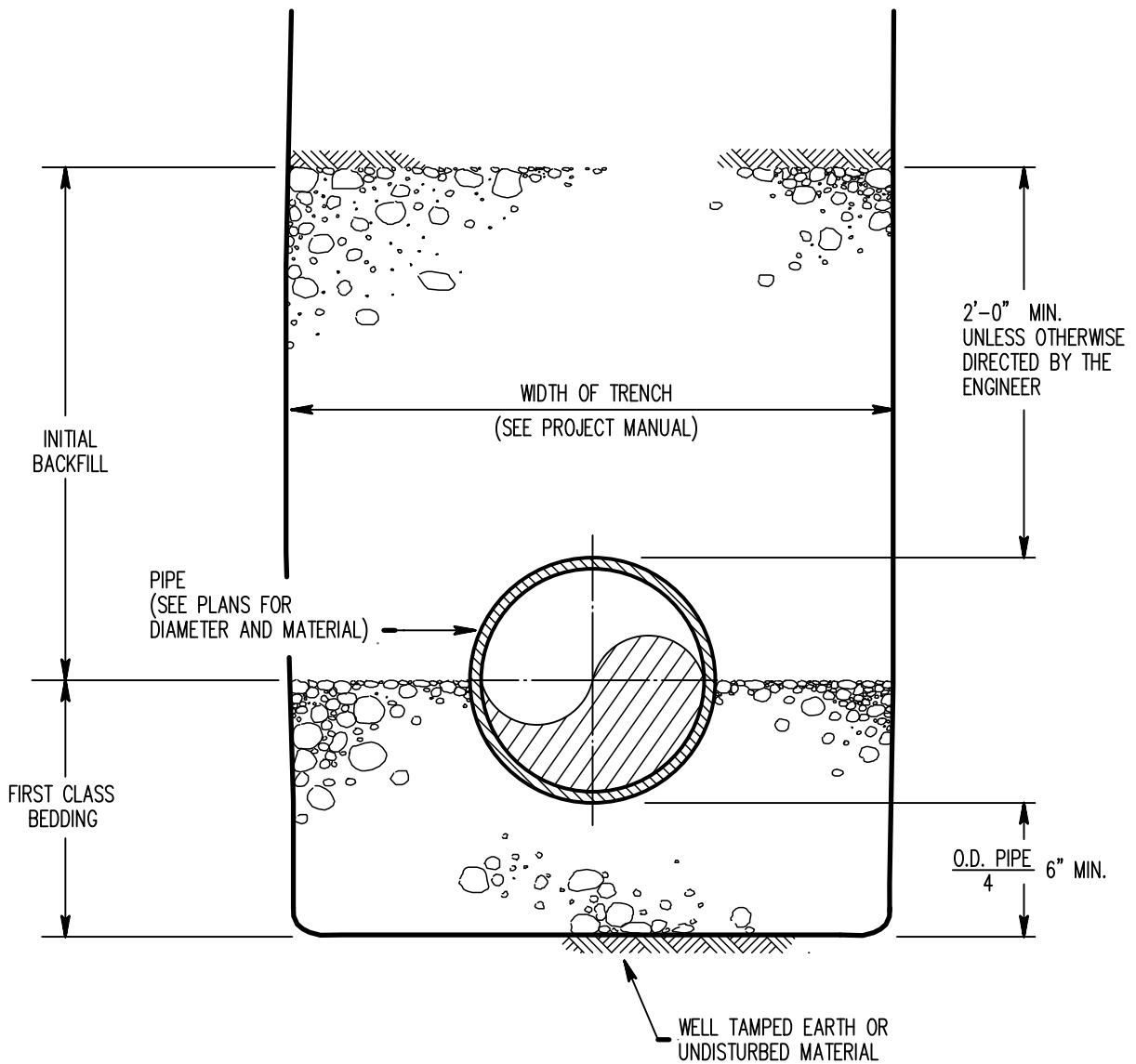
CONENC

GANNETT FLEMING

REV. JULY 1989

74

DWG. No. A-27019



SECTIONAL ELEVATION

FIRST CLASS BEDDING
AND INITIAL BACKFILL

PIPE BEDDING

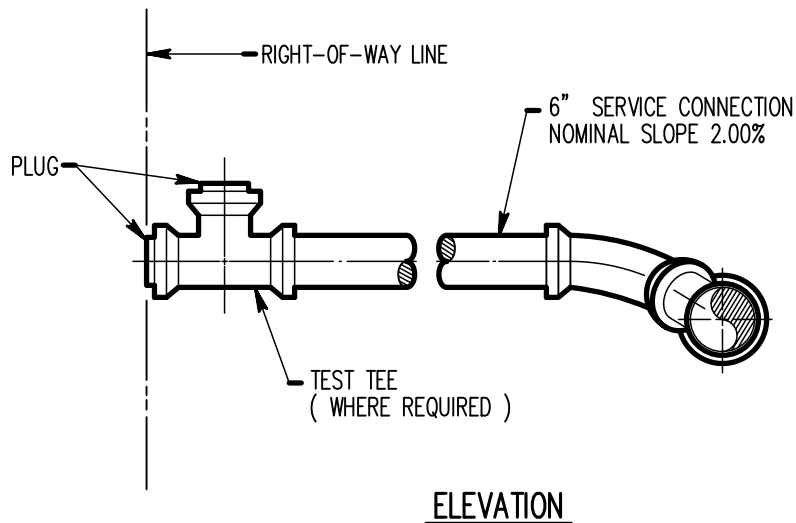
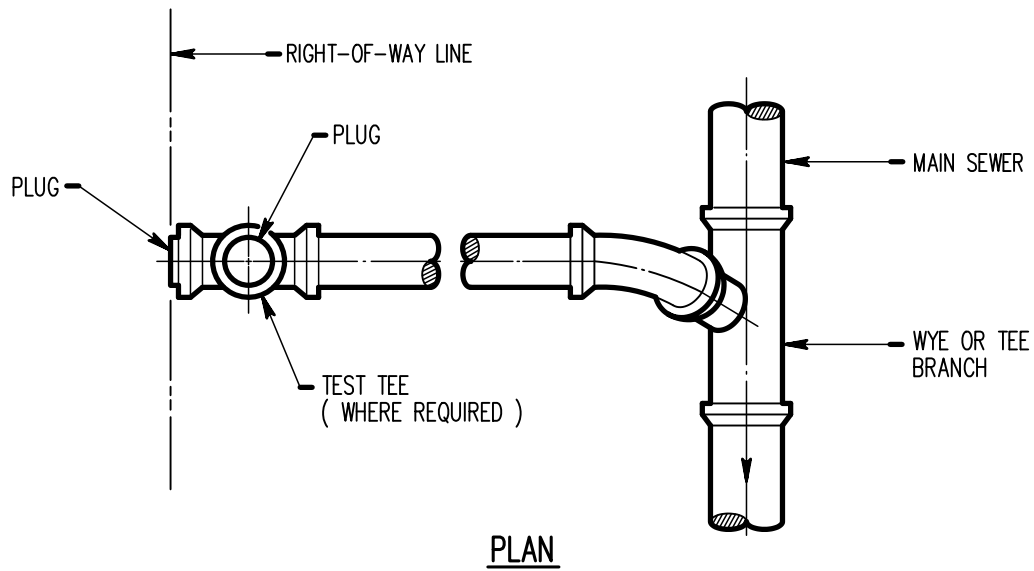
MISC2.dgn

MICRO-STATION

FCIBD

SERVICE CONNECTION SHALLOW SEWER NOTE

WHERE TEST TEE IS NOT REQUIRED, SERVICE CONNECTION SHALL BE EXTENDED TO THE RIGHT-OF-WAY LINE AND PLUGGED.

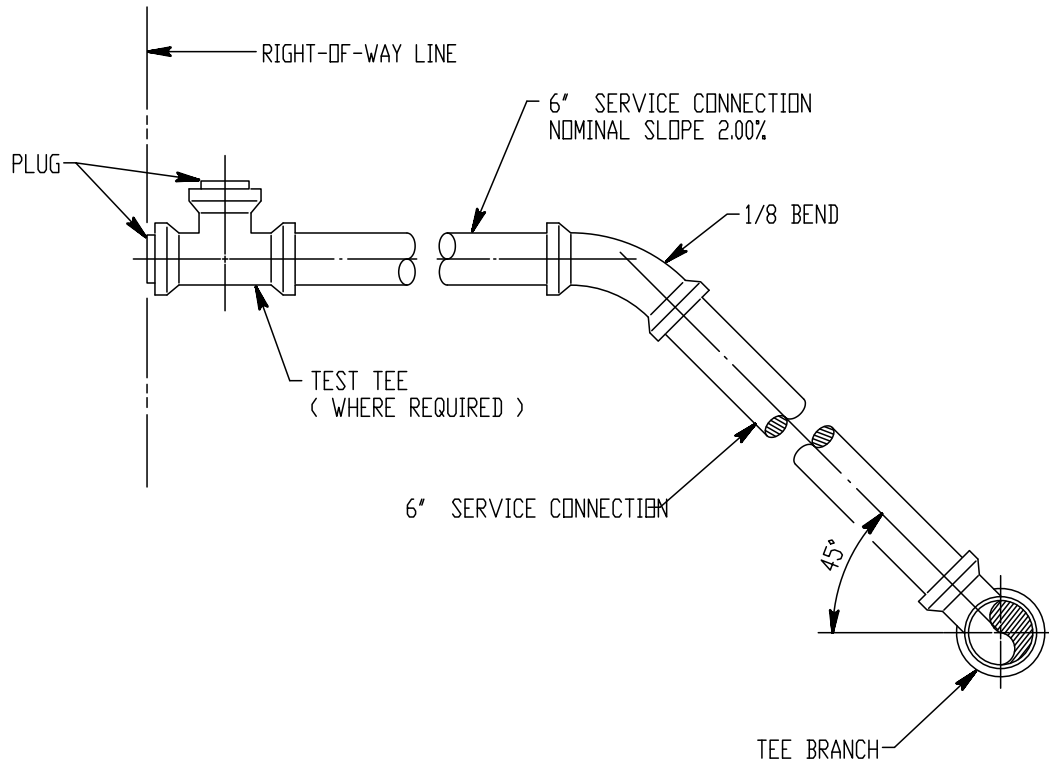


SERVICE CONNECTION
SHALLOW SEWER

GANNETT FLEMING

SERVICE CONNECTION DEEP SEWER NOTE

WHERE TEST TEE IS NOT REQUIRED, SERVICE CONNECTION
SHALL BE EXTENDED TO THE RIGHT-OF-WAY LINE AND PLUGGED.



ELEVATION

SERVICE CONNECTION
DEEP SEWER

MISC4.dgn

MICRO-STATION

SCANDS

GANNETT FLEMING

REV. AUGUST 1991

93

DWG. No. A-31498

CHAMBER, MANHOLE
STEPS AND MANHOLE
FRAME AND COVER

24" DIAMETER
OPENING
(ABOVE)

MANHOLE STEPS

12"

MECHANICAL
JOINT AND
FLANGE
CONNECTOR

FLEXIBLE
PIPE-TO-MANHOLE
CONNECTOR
(TYP.)

SECTIONAL PLAN

WATERTIGHT
MANHOLE FRAME
AND COVER

FOR DETAILED CONSTRUCTION
INFORMATION SEE STANDARD
MANHOLE TYPE 'A' OR TYPE 'B'

8" (MIN.)

4" (MIN.)

POURED IN
PLACE
CONCRETE
BASE

CONCRETE
SUPPORT

8"

TAPPED TEE

WELL TAMPED EARTH OR
UNDISTURBED MATERIAL

AIR RELEASE VALVE

VACUUM VALVE
(WHEN REQUIRED)

5'-0" DIAMETER (MIN.)

24"

SECTIONAL ELEVATION

AIR RELEASE CHAMBER

MISC7.dgn

MICRO-STATION

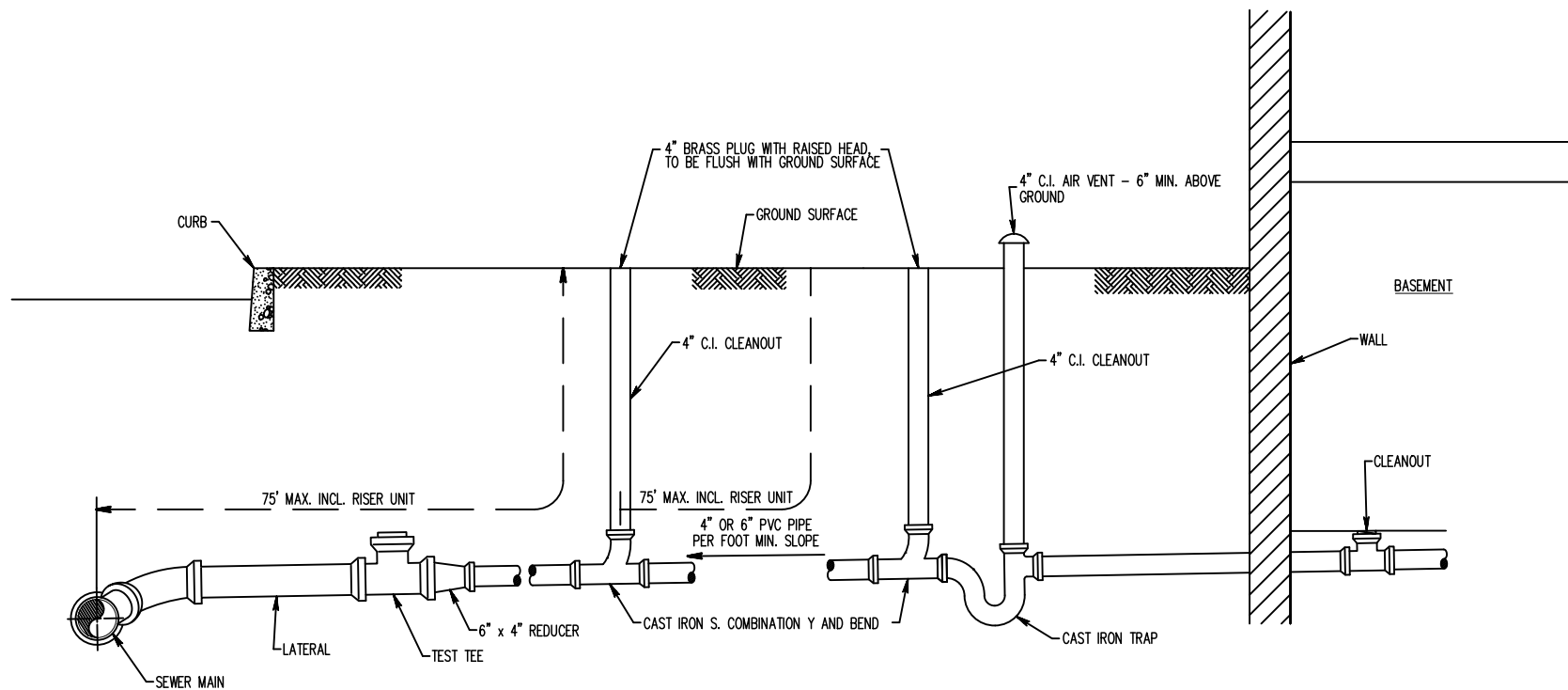
ARCH

GANNETT FLEMING

REV. FEBRUARY 1994

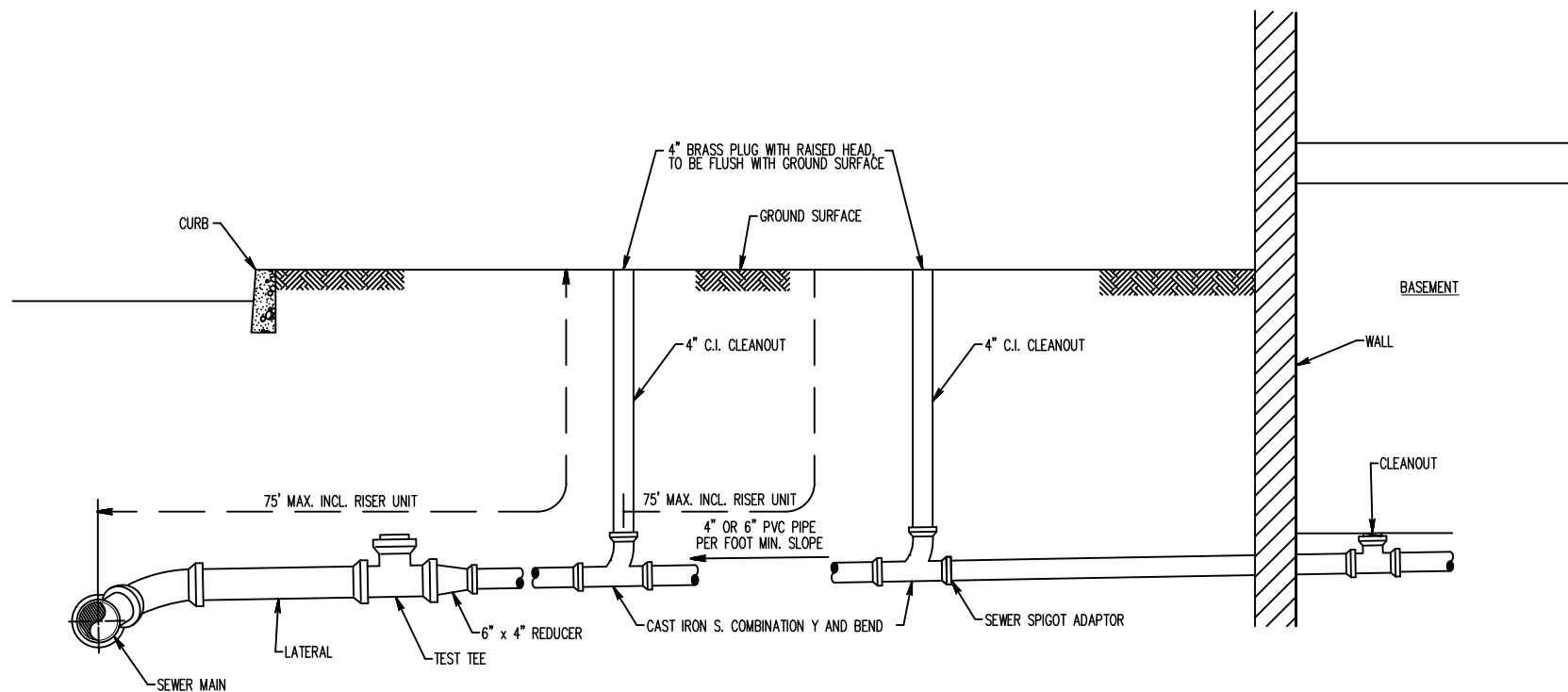
121

DWG. No. A-34280



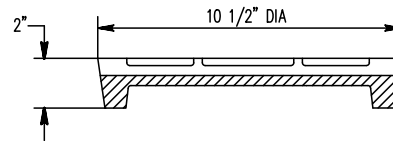
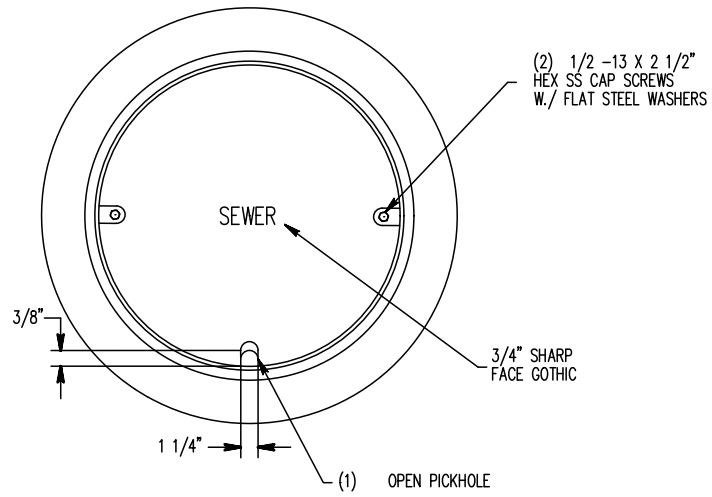
SANITARY SEWER LATERAL – EXISTING BUILDING

NOTE:
IF VENT IS LOCATED IN PAVED AREA REFER
TO "CLEANOUT BOX"

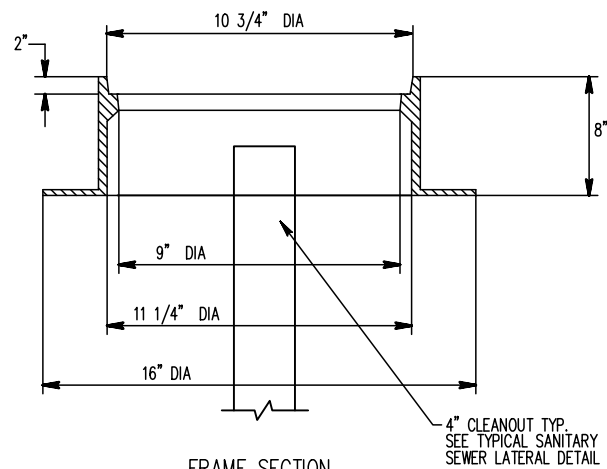


SANITARY SEWER LATERAL – NEW BUILDING

NOTE:
IF VENT IS LOCATED IN PAVED AREA REFER
TO "CLEANOUT BOX"



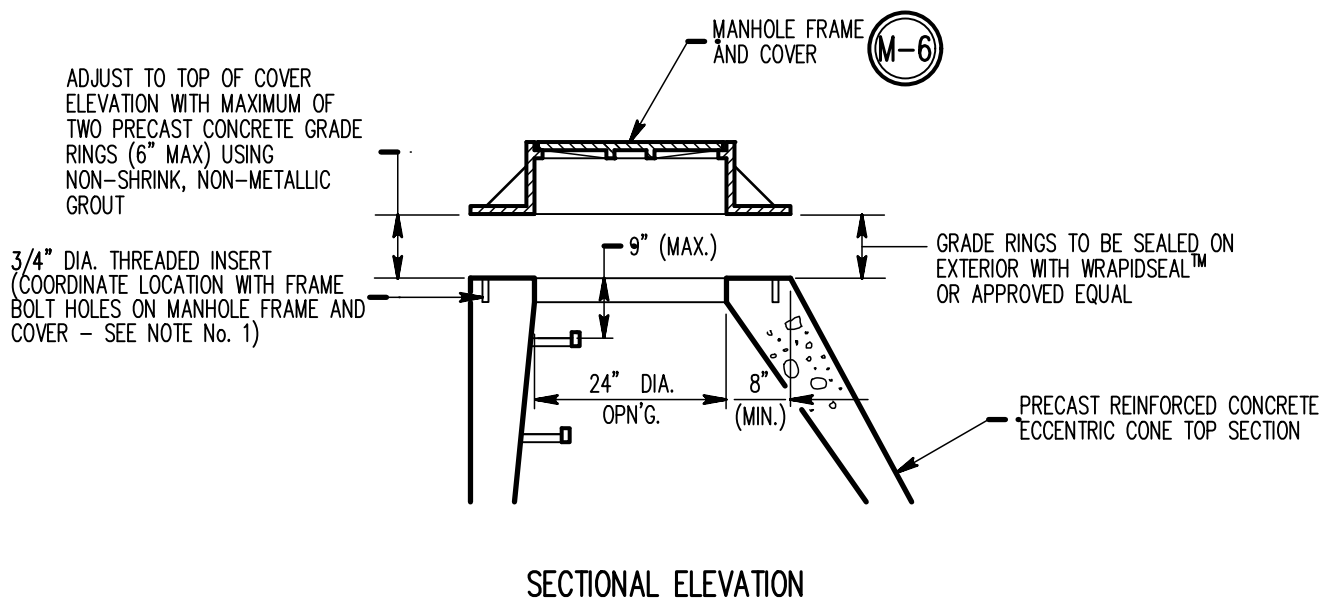
COVER SECTION



FRAME SECTION

CLEANOUT BOX

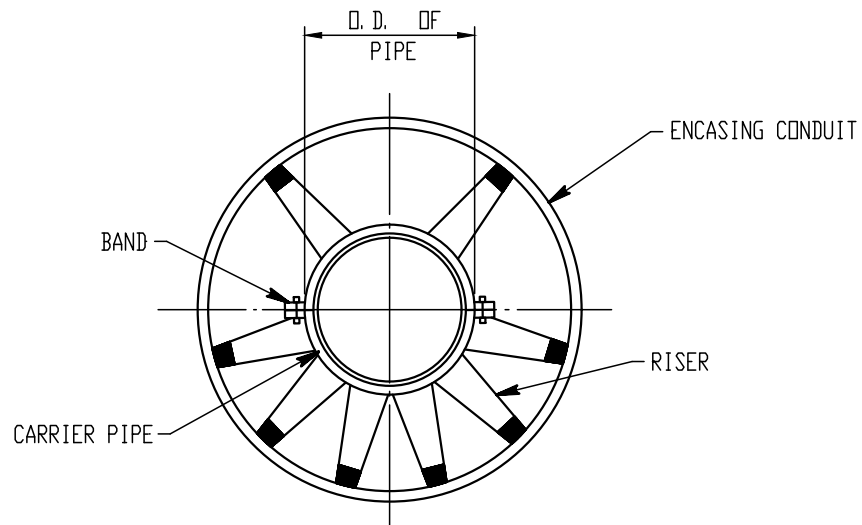
NOTE:
EJ MODEL 1565Z 1565A ASSEMBLY OR EQUAL



MANHOLE CASTING ADJUSTMENT DETAIL FOR PAVING CONTRACTS

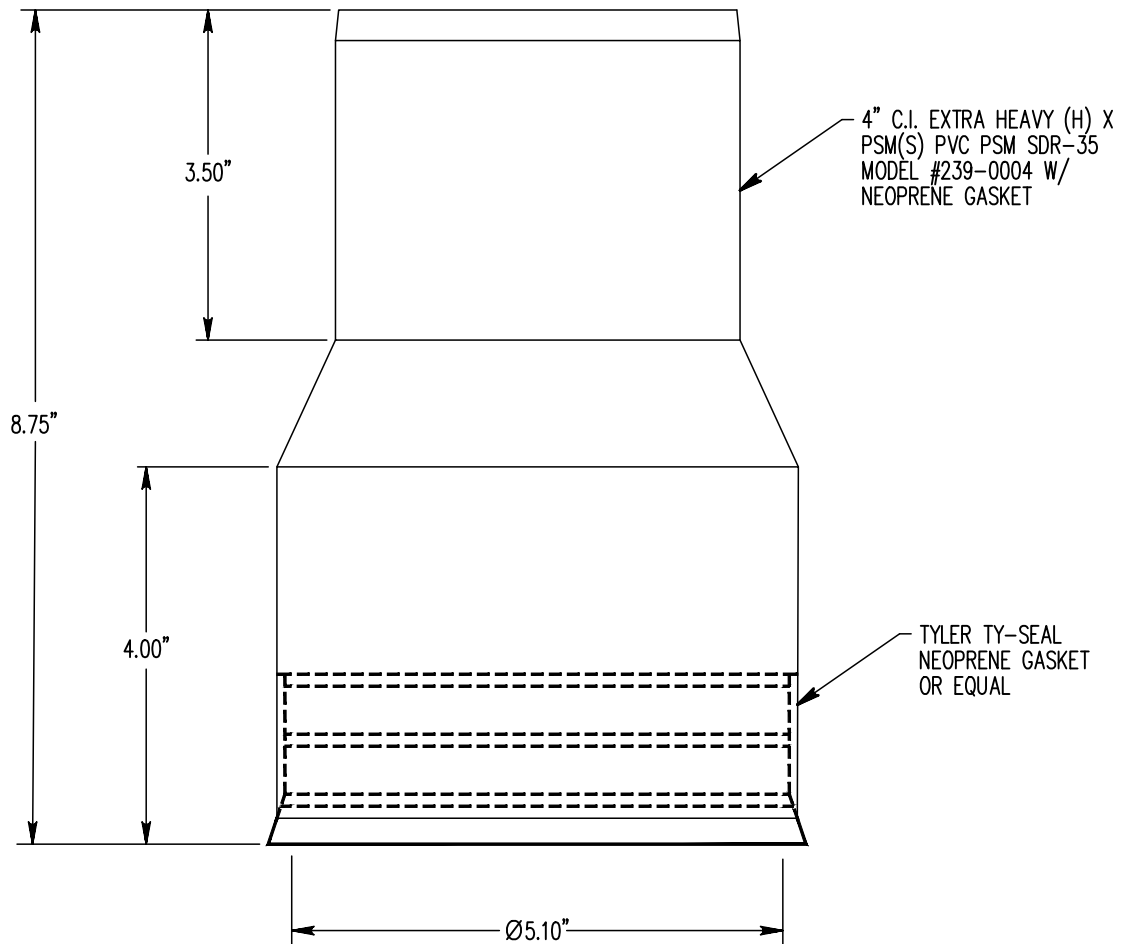
MANHOLE CASTING ADJUSTMENT DETAIL FOR PAVING CONTRACTS - NOTES

1. MANHOLE FRAME TO BE BOLTED IN PLACE WITH TWO 3/4" BOLTS AND FLAT WASHERS ON ALL EXISTING MANHOLES. FOUR 3/4" BOLTS AND FLAT WASHERS TO BE USED IN NEW CONSTRUCTION
2. INSTALL MANHOLE EXTERIOR SEAL



SECTIONAL ELEVATION

ENCASING CONDUIT



SEWER SPIGOT ADAPTER