# STRASBURG BOROUGH AUTHORITY

# SEWER SPECIFICATIONS

# AUGUST 2026

# SECTION 1 – GENERAL REQUIREMENTS

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Capacity, Design, & Construction Approval Process Policy.

B. Design considerations and requirements.

C. Easement requirements.

1.02 CAPACITY, DESIGN, & CONSTRUCTION APPROVAL PROCESS POLICY

A. DEVELOPER shall refer to "Strasburg Borough Authority Capacity, Design, & Construction Approval Process Policy" for information on the following items:

1. Minimum submission requirements for sewer capacity requests.

2. Initial plan submission requirements.

3. The comment response process and final design approval requirements.

4. Items required prior to acquiring construction permits.

5. Construction closeout procedures.

6. Dedicated facilities closeout procedures.

1.03 DESIGN CONSIDERATIONS AND REQUIREMENTS

A. Sanitary Sewer Services:

1. The AUTHORITY will allow one (1) sanitary sewer connection to the AUTHORITY system per established lot.

2. In the event that a new sanitary sewer service is desired on a lot with an existing sanitary sewer service, the existing sanitary sewer service shall be demolished in accordance with AUTHORITY regulations.

3. For pressure sanitary sewer services, the DEVELOPER shall provide the AUTHORITY's Engineer all requested background information deemed necessary to review and approve design.

4. Pressure sanitary sewer services shall require the lining of the next four (4) manholes downstream of the point of connection, or all manholes within 1,000 linear feet downstream of the point of connection, whichever is greater. For manhole lining requirements, refer to SECTION 6 – MANHOLES, Item 2.02H.

B. Sanitary Sewer Mains:

1. For new connections to the AUTHORITY system, DEVELOPER may be required to extend sanitary sewer mains within the public right-of-way to the furthest property lines or corners of the development under consideration. The location of such extensions shall be determined or approved by the AUTHORITY Engineer so as to comply with the AUTHORITY's long-range facilities planning.

2. Sizes, materials, and locations of sanitary sewer lines and manholes intended for dedication shall be determined or approved by the AUTHORITY Engineer so as to comply with the AUTHORITY's long-range facilities planning.

C. Low-Pressure Sanitary Sewer Mains:

1. Low-pressure sanitary sewer mains intended for dedication to the AUTHORITY shall be prohibited unless otherwise allowed by the AUTHORITY as a special exception.

2. In the event that low-pressure sanitary sewer is allowed as a special exception, the DEVELOPER shall provide the AUTHORITY Engineer all requested background information deemed necessary to review and approve design.

3. Sizes, materials, and locations of low-pressure sanitary sewer lines and manholes intended for dedication shall be approved by the AUTHORITY Engineer so as to comply with the AUTHORITY's long-range facilities planning.

D. Improvements in Flood-Prone- or High-Water-Table Areas:

1. Manholes in flood-prone or high-water-table areas shall be subject to additional requirements as compared to manholes in other areas. These requirements may include:

a. Clay dikes (refer to SECTION 3 – TRENCHING, BACKFILLING, AND COMPACTION for detailed information).

b. Watertight manhole frames and covers (refer to SECTION 6 – MANHOLES for detailed information).

c. Heat-shrinkable manhole seals (refer to SECTION 6 – MANHOLES for detailed information).

E. Commercial/Industrial Sanitary Sewer Connections:

1. Commercial/industrial sanitary sewer connections may require the installation of a sampling manhole. This is to be evaluated on a case-by-case basis by the AUTHORITY Engineer.

2. If waste streams are found to be highly concentrated or potentially harmful, the AUTHORITY has the ability to impose a requirement of pre-treatment of waste streams.

F. Pre-Treatment of Sanitary Sewer Connections

1. Grease interceptors shall be required for all proposed connections generating a high concentration of food waste.

2. Oil/water separators shall be required for all proposed connections utilizing floor drains in automotive applications or for applications using motorized equipment.

3. The AUTHORITY has the ability to require pre-treatment of proposed connections on a case-by-case basis and shall be provided all requested information in order to determine whether pre-treatment shall be required.

G. Sanitary Sewer Pumping Stations and Force Mains:

1. Private grinder pump stations and force mains shall be subject to the requirements of SECTION 5 – PIPE AND FITTINGS and SECTION 10 – GRINDER PUMP STATIONS.

2. Sanitary sewer pumping stations and force mains intended for dedication shall be allowed by special exception only by the AUTHORITY and shall be subject to the requirements of SECTION 5 – PIPE AND FITTINGS and SECTION 11 – WASTEWATER PUMPING STATIONS.

1.04 EASEMENTS

A. Sanitary Sewer Easements:

1. Easements shall be provided for sanitary sewer mains within private property that are intended for dedication to the AUTHORITY.

2. All easements shall be a minimum of 30 feet in width, centered on the sanitary sewer mains, unless otherwise allowed by the AUTHORITY.

3. Easements shall recite all details and rights to enter thereon for any purpose appropriate to the inspection, repair, or maintenance of the AUTHORITY system.

4. The AUTHORITY shall have free ingress, egress, and regress on, over, and through the easement at all times and seasons, with reasonable prior notice except in the case of an emergency, in order to inspect, monitor, maintain, reconstruct, enlarge, repair, remove, relocate, or related functions any sanitary sewer mains, manholes, connection fittings, or other appurtenances as the AUTHORITY deems necessary in its sole discretion.

5. No building, fence, lighting fixture, pond, swimming pool, driveway, parking lot, or other permanent structure shall be erected or located within the sanitary sewer easement. No vehicles, campers, trailers, boats, or other large equipment or facilities shall be stored within the easement on a long-term basis. No trees, shrubbery, or bushes shall be planted within the boundaries of the easement. In the event that the AUTHORITY is not able to access the easement due to any of the foregoing, the AUTHORITY shall have the right, but not the obligation, to remove such obstruction at the owner's expense.

6. Property owners shall not be due compensation from the AUTHORITY for damage to permanent structures, vehicles, or other large equipment, or loss of trees, shrubbery, or bushes resulting from work performed by the AUTHORITY that occurs to such items that are placed within the easement following execution of an easement agreement.

7. Property owners shall not alter the grade nor construct landscaping features within the easement that would impair access by the AUTHORITY.

B. Access Easements:

1. Access easements may be required to allow the AUTHORITY to access their facilities, and the AUTHORITY may require the inclusion of these easements on a case-by-case basis, where reasonable and deemed necessary.

2. Widths of easements are also to be determined on a case-by-case basis.

3. Easements shall recite all details and rights to enter thereon.

**END OF SECTION**

## SECTION 2 – CONSTRUCTION SUBMITTALS

### PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures.

B. Action on construction submittals.

C. Construction progress schedules.

D. Proposed products list.

E. Shop drawings.

F. Manufacturers' instructions.

1.02 SUBMITTAL PROCEDURES

A. For a complete list of items required prior to construction, refer to the "Strasburg Borough Authority Capacity, Design, & Construction Approval Process Policy."

B. When requested by AUTHORITY, submit three copies of complete schedule of all anticipated submittal dates.

C. Transmit each submittal to AUTHORITY in accordance with schedule.

D. Sequentially number the transmittals. Resubmittals to have original number with an alphabetic suffix.

E. Identify Project, subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

F. Apply Design Consultant's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the work. Submittals not containing Design Consultant's stamp shall be returned.

G. Schedule submittals to expedite the Project and deliver to AUTHORITY. Coordinate submission of related items.

H. Identify variations from Drawings and Product or system limitations which may be detrimental to successful performance of the completed Work.

I. Revise and resubmit submittals as required, clearly identify all changes made since previous submittal.

J. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 ACTION ON CONSTRUCTION SUBMITTALS

A. AUTHORITY's Action: Where action and return is required or requested, AUTHORITY will review each submittal, mark with the action taken and return within a reasonable time period. Where submittals must be held for coordination, Design Consultant will be so advised by AUTHORITY.

B. Submittals returned with "REVIEWED" action indicate that the information submitted was found to be in conformance with the design concept and in compliance with the requirements of the Drawings. DEVELOPER may proceed with performance of the work covered by the submittal.

C. Submittals returned with "REVIEWED AS NOTED" action indicates that the information submitted was found to be in conformance with the design concept and in compliance with the requirements of the Drawings, provided the noted clarifications or corrections are completed. Submission of a corrected submittal indicating the changes noted by AUTHORITY is not required. DEVELOPER may proceed with performance of the work covered by the submittal.

D. Submittals returned with "REVISE AND RESUBMIT" action indicate that: (1) information submitted is at least partially not in conformance with these Requirements, (2) information submitted is at least partially not in compliance with the Requirements, (3) submittal is incomplete and does not include all items required by the individual specification Sections, or (4) certifications or computations required by the individual specification Sections have not been included in the submittal. Submittal will be returned to Design Consultant noting the reasons for noncompliance. DEVELOPER shall not proceed with the performance of the work covered by submittal until corrected information is submitted and approved.

E. Submittals returned with "NOT APPROVED" action indicates that AUTHORITY interprets the information submitted to be not in conformance with the design concept or not in compliance with these Requirements. Performance of the work shall not proceed until submittal is revised, resubmitted and reviewed.

1.04 CONSTRUCTION PROGRESS SCHEDULES

A. If required by AUTHORITY, submit one copy of initial progress schedule to AUTHORITY for review and comment. Submit revisions when requested by the AUTHORITY, to reflect changes to the initially submitted schedule.

1.05 PROPOSED PRODUCTS LIST

A. If requested by AUTHORITY, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product. Submit number of copies DEVELOPER requires, one copy to be retained by AUTHORITY, and an electronic copy for review by the AUTHORITY ENGINEER.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.06 SHOP DRAWINGS

A. Submit the number of opaque reproductions which DEVELOPER requires, one copy which will be retained by AUTHORITY, and an electronic copy for review by the AUTHORITY ENGINEER. Each shop drawing must be marked with the name of the project and numbered consecutively.

B. All work which is related to shop drawing approval shall not be initiated until approved shop drawings have been received from AUTHORITY.

C. All work initiated by DEVELOPER prior to receipt of approved shop drawings shall be at the sole risk of DEVELOPER. Any and all rework, modifications or reinstallations necessitated by changes in the Work due to changes required by subsequently approved shop drawings will be done by DEVELOPER.

1.07 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

B. Identify conflicts between manufacturers' instructions and Drawings.

**END OF SECTION**

## SECTION 3 – TRENCHING, BACKFILLING AND COMPACTION

### PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Excavating trenches for utilities.

B. Backfilling and compaction.

1.02 RELATED WORK

A. Section 4 – Boring and Jacking.

B. Section 5 – Pipe and Fittings.

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 99, Standard Method of Test for Moisture-Density Relations of Soils Using a 5.5-lb. Rammer and a 12-inch Drop, most recent edition.

2. AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand Cone Method, most recent edition.

B. American Society for Testing and Materials:

1. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort, most recent edition.

2. ASTM D2167 – Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method, most recent edition.

3. ASTM D2321 – Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe, most recent edition.

4. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth), most recent edition.

C. Occupational Safety and Health Administration:

1. OSHA 29 CFR, Part 1926, Subpart P, Construction Standards for Excavation

D. Commonwealth of Pennsylvania Department of Transportation (PennDOT)

1. Publication 408 – Specifications

a. PDT Section 703 Aggregates.

E. State Code: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67. Transportation, Department of Transportation, Chapter 459, Occupancy of highways by Utilities, as supplemented or revised (Penn DOT Chapter 459).

F. State Publication: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 203, Work Zone Traffic Control (Penn DOT Chapter 203).

G. Strasburg Borough

1. Roadway Requirements

2. Blasting Requirements

H. Strasburg Township

1. Roadway Requirements

2. Blasting Requirements

1.04 DEFINITION

A. Definitions:

1. Subgrade: Trench bottom prepared as specified to receive pipe bedding, concrete cradle or concrete encasement of the bottom of excavations prepared to receive pipeline structures.

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

3. Final Restoration Elevation: Elevation of bottom of final restoration operation such as bottom of topsoil depth or paving Subgrade.

1.05 REGULATORY REQUIREMENTS

A. Work performed within State Highway rights-of-way shall be completed according to Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities and if applicable, the PennDOT Highway Occupancy Permit secured by DEVELOPER. Work within the State Highway rights-of-ways shall be subject to inspection by representatives of PennDOT.

B. Work performed within Borough rights-of-way shall be completed according to Strasburg Borough's requirements.

1.06 PROJECT CONDITIONS

A. Removal of Obstructions:

1. Remove, realign, or change the direction of above or below ground utilities and their appurtenant supports, if such is required in the opinion of AUTHORITY. Perform such work unless such work is done by the owner of the obstruction. However, uncover and sustain the obstruction at own expense prior to the final disposition of obstruction. Additional precautions concerning obstructions are as follows:

a. Do not interfere with persons, firms, corporations, or utilities employing protective measures, removing, changing, or replacing their property or structures, but allow said persons, firms, corporations or utilities to take such measures as they may consider necessary or advisable under the circumstances.

b. Break through and reconstruct, if necessary, the invert or arch of a sewer, culvert or conduit that may be encountered if the said structure is in such a position, in the judgment of AUTHORITY, as not to require its removal, realignment or complete reconstruction.

B. Environmental Requirements:

1. Do not perform trenching, backfilling or compacting when weather conditions or the condition of materials are such, in the opinion of AUTHORITY, that work cannot be performed satisfactorily.

2. Do not use frozen materials as backfill or wet materials containing moisture in excess of the amount 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 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 for surface drainage. No damming or ponding or water in gutters or other waterways will be permitted, except through approved pipes or properly constructed troughs. When so required, provide pipes or troughs of such sizes and lengths as required, and place the same as required.

Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.

6. Pumping: Keep excavations free from standing water. Build dams and other devices necessary for this purpose and provide and operate pumps of sufficient capacity for dewatering the excavations. Provide for the disposal of the water removed from excavations in such manner as not to cause injury to the public health, to public or private property, to the work of others, to the portion of the work completed or in progress or produce an Impediment to the use of streets, roads, and highways.

7. When it is necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials caused by hauling on roadways.

8. Provide effective dust control by sprinkling water, use of calcium chloride or other methods approved by AUTHORITY. Employ dust control when, where and in a manner required by AUTHORITY.

9. Do not dispose of water in trenches by draining through completed portions of the work.

C. Protection: Assume the risks attending and presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work for same, existing structures and property of whatever nature. Damages and expenses for direct or indirect injury to such structures or to any person or property by reason of them or by reason of injury to them; whether such structures are or are not shown on the Drawings, rests solely with DEVELOPER.

1. Outside Rights-of-Way: Take necessary precautions to protect trees, shrubs, lawns, and such landscaping from damage. Complete restoration work for damaged areas.

2. Pipe Supports: Adequately support underground pipes or conduits exposed as a result of excavations. Provide adequate support along their entire exposed length. Install such supports in such manner that backfilling may be performed without dislodging such pipes or conduits. Place and carefully compact Aggregate Backfill around the supports and leave such supports in place as a guard against breakage due to backfill settlement.

3. Temporary Protective Construction:

   a. Temporary Fence Barricade:

   b. Erect and maintain substantial temporary fences surrounding excavation to prevent unauthorized persons from entering such areas.

c. Barricades: Furnish and erect substantial barricades at crossings of trenches, or along trenches, to protect the traveling public.

d. Cover open excavation when work therein is suspended or left unattended, including the end of a workday. For such covers, use materials of sufficient strength and weight to prevent their removal by unauthorized persons.

e. Provide temporary paving around manhole frame/cover at a minimum of 5'.

f. Remove temporary protective construction at the completion of work.

D. Structure Supports: Where passing buildings or any structure which by their construction or position might bring a great pressure upon the trenches, the right reserved by AUTHORITY to require that such 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. Failure of AUTHORITY to recommend said protection shall not relieve DEVELOPER of his responsibility to protect structures near the construction.

E. Accommodation of Traffic: Do not obstruct streets, roads, and highways unless Strasburg Borough authorized in writing the complete closing of the street, road, or highway. Employ such measures as may be necessary, including flag persons, to keep the 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. No to obstruct fire hydrants.

F. Explosive and Blasting:

1. Blasting will be permitted only in areas permitted by Strasburg Borough or Strasburg Township and where the proximity of structures, underground facilities or public safety does not preclude the use of explosives. Blasting must comply with Borough or Township regulations.

2. The use of explosives shall be governed by the "Regulations for the Storage, Handling and the Use of Explosives" of the Pennsylvania Department of Labor and Industry and any other applicable federal, state, or local codes that may have jurisdiction.

3. All blasts shall be properly matted and securely covered. DEVELOPER shall be solely responsible for injury to persons or property located within or beyond the area or scope of the project that may result from use of explosives.

4. Blasting work shall be supervised by personnel licensed and experienced in this type of work.

5. Explosives shall be stored in state-approved magazine off the job site and shall be delivered to the site in vehicles clearly marked to indicate cargo.

6. Blasting within State Highway and railroad rights-of-way is not permitted unless authorized by PennDOT or the railroad. DEVELOPER shall be responsible for securing required permits.

7. Notify utilities having structures or other installations above or below ground in proximity to the trenching work prior to use of explosives. Such notice must be given sufficiently in advance to enable the utilities to take such steps as they may deem necessary to protect their property from injury. Such notice shall not relieve DEVELOPER of responsibility for damage resulting from his use of explosives. The right is reserved to direct that rock within five (5) feet of pipe, conduit or other structures encountered in the trench be removed by methods other than blasting.

8. Cease blasting operations when street paving adjacent to trench is damaged. Repair damaged street paving. Submit to AUTHORITY methods to be used in subsequent blasting. Do not proceed with blasting without written approval of AUTHORITY on methods to be used in subsequent blasting.

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

H. Responsibility for Condition of Excavation: Condition and results of excavation are solely the responsibility of DEVELOPER. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.

I. Excess Materials: No right of property in materials is granted to DEVELOPER for materials excavated on lands not owned by DEVELOPER. This provision does not relieve DEVELOPER of his responsibility to remove and dispose of surplus excavated materials.

J. Borrow Material: When the required quantity of backfill material exceeds the quantity of suitable on site material, provide borrow material. If borrow material is needed, notify AUTHORITY sufficiently in advance to permit AUTHORITY to verify such need and to view the proposed borrow pit to determine the material suitability. Borrow excavation will be subject to AUTHORITY approval whose written consent shall be obtained prior to its use. DEVELOPER shall be responsible for all sampling and testing required by AUTHORITY to determine suitability.

K. Change of Trench Location or Depth: AUTHORITY reserves the right to change the location of a trench from that indicated on the Drawings due to the presence of an obstruction, or for other causes.

L. Advance Trenching: Where existing utilities or other suspected underground obstructions as indicated on the Drawings are within close proximity of proposed pipelines, uncover and verify the exact location of utilities and other underground obstructions far enough in advance of pipe laying to allow any changes in pipe alignment or grade required to bypass the obstructions to avoid removing sections of pipe already installed. If any sections of installed pipe must be removed and reinstalled as a result of not verifying utilities or other underground obstructions far enough in advance, DEVELOPER shall remove and reinstall the pipe.

1.07 FIELD MEASUREMENTS

A. Verify that survey benchmark, control point, and intended elevations for the Work are shown on the Drawing.

**PART 2 – PRODUCTS**

2.01 FILL MATERIAL

A. Earth Backfill: On site excavated soil or soil-rock mixed materials free of topsoil, vegetation, lumber, metal, and refuse; and free of rock or similar hard objects larger than six inches in greatest dimensions. Rock to soil ratio shall not exceed one part rock to three parts soil.

B. Aggregate Backfill: PennDOT 2A Modified Aggregate conforming to PennDOT Publication 408, Section 703.

C. Pipe Bedding and initial Backfill:

1. Pipe Bedding: AASHTO No. 8 Coarse Aggregate conforming to PennDOT Publication 408, Section 703.2.

2. Initial Backfill: AASHTO No. 8 Coarse Aggregate conforming to PennDOT Publication 408, Section 703.2.

3. Concrete Cradle and Encasement: PennDOT Publication 408, Section 704, Type A, a 28-day minimum mix design compressive strength of 3,300 psi.

4. Clay Dike: Clay containing no more than 15% (by volume) stone no larger than two (2) inches in diameter.

D. Unsuitable Bearing Replacement: AASHTO No. 3 Coarse Aggregate conforming to PennDOT Publication 408, Section 703.2

E. Underground Warning Tape: Required for all pipes.

1. Printed polyethylene tape, three inches minimum width, color coded, one-inch minimum lettering, printed with name of utility burled below, and suitable for installation in all soil types.

2. Magnetic.

3. Provide for:

a. Sewage force main – green

b. Gravity sewer/lateral – green

**PART 3 – EXECUTION**

3.01 PREPARATION

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

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

C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities which are to remain.

3.02 EXCAVATING

A. Perform sheeting and shoring according to OSHA Standards.

B. Perform soil erosion and sedimentation control work according to Erosion and Sedimentation Control Plan approved by Lancaster County Soil Conservation Office.

C. General:

1. Excavation shall be performed to the lines and grades indicated on the Drawings or directed by AUTHORITY.

2. Perform excavation and backfilling using machinery except where hand excavation and backfilling is required or is necessary to protect existing structures, utilities, or other private or public properties.

3. Begin excavation in trenches for sewer lines at the control point having the lower invert and proceed upward.

4. Saw cut existing pavement. Remove pavement according to Strasburg Borough requirements.

5. Remove rock to Subgrade at least twenty-five (25) feet in advance of pipe laying.

6. Do not interfere with 45 degree bearing splay of foundations.

D. Subgrade Preparation:

1. Do not excavate below depths indicated or specified except where unsuitable material is encountered at Subgrade.

2. Remove unsuitable material found below Subgrade to a depth determined by AUTHORITY and backfill with suitable material or as directed by AUTHORITY to required Subgrade.

3. Remove rocks or other hard matter protruding through trench bottom at Subgrade which could damage pipe or impede consistent backfilling or compaction. Backfill with AASHTO No. 8 Coarse Aggregate to required Subgrade. Compact in four (4) inch lifts.

4. Remove rock below Subgrade if shattered due to excessive drilling impact or splitting operations and in the opinion of AUTHORITY it is unfit for foundations. Backfill to Subgrade with Concrete or other material acceptable to AUTHORITY.

E. Excavated Material Storage:

1. In field/agricultural areas, separate and stockpile in designated area, the top 18” of in situ topsoil to be replaced upon installation of bedding and backfill.

2. Separate and stockpile in designated area, excavated materials suitable for use as backfill. Remove from the site excess materials, and excavated materials not suitable for backfill.

3. In no case shall excavated materials be stockpiled outside of the construction easements or the permanent right-of-way if construction easements are not in place.

4. In streets, roads, and highways or in any other locations where working space is limited, remove the excavated materials from the first 100 feet of any opening, when required by AUTHORITY, as soon as such is excavated; store and return same for backfilling when required. In no case will DEVELOPER be allowed to cast excavated material beyond the curb or right-of-way lines on sidewalks or lawns.

5. At all times keep excavated materials at least five (5) feet back from edge of trench to facilitate access.

F. Trench Width:

1. From Subgrade elevation to an elevation at least twelve (12) inches above the top of the outside barrel of the pipe, excavate trench banks to vertical lines and not less than the minimum or more than the maximum widths specified in Table A. If sheeting is required, the Table A dimensions apply to the inside face of sheeting.

Table A

| Minimum Trench Width (outside diameter of pipe at the barrel plus) | Maximum Trench Width (outside diameter of pipe at the barrel plus) |
|---|---|
| 12 inches | 16 inches |

2. Refer to PennDOT requirements for trench width within the PennDOT rights-of-way.

3. From a point twelve (12) inches above at the top of the outside barrel of the pipe, maintain trench banks as follows:

a. Vertical as possible for trenches in paved or unpaved roadways, with a maximum of forty (40) inches.

b. In open areas, trenches may be sloped at angles required to make trench stand; however, in no case shall angle exceed one-half horizontal to one vertical.

c. Top of trench shall not exceed limits of right-of-way or construction easement if such is in place.

d. Maintain trenches such that there is no conflict with State or OSHA regulations.

G. Length of Open Trench:

1. Complete trench excavation at least twenty-five (25) feet but not more than one hundred (100) feet in advance of pipe laying and keep trenches free from obstructions, except that at the end of a workday or at the discontinuance of work, the pipe laying may be completed to within five (5) feet of the end of the open trench.

2. DEVELOPER shall limit all trench openings to a distance commensurate with all rules of safety.

3. If the work is stopped either totally or partially, DEVELOPER shall refill the trench and temporarily repave over the same. The trench shall not be opened until he is ready to proceed with the construction of the pipeline.

4. AUTHORITY reserves the right to request trench refilling over completed pipe if in AUTHORITY's judgment such action is necessary.

3.03 PIPE BEDDING

A. Place Pipe Bedding and Initial Backfill as specified herein unless indicated otherwise on the Drawing. Place material in trench for full width. Place on each side of pipe and fittings simultaneously.

B. Pipe Bedding: Carefully place on undisturbed Subgrade or compacted Subgrade as approved by AUTHORITY, Pipe Bedding material from six (6) inches below outside of pipe barrel to pipe springline. Work Pipe Bedding material by hand under pipe haunching to provide adequate side support. Place in three (3) inch layers (uncompacted).

C. Initial Backfill: From pipe springline to twelve (12) inches above outside of pipe barrel carefully place initial Backfill in four (4) inch layers (uncompacted). Place carefully so as not to disturb pipe.

3.04 BACKFILL

A. Backfill trenches to contours and elevations indicated on the Drawing.

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

C. Do not use frozen backfill materials or place backfill on frozen subgrades or trench subgrades.

D. Perform backfilling by methods which will result in thorough compaction of backfill material.

E. Backfill to Final Restoration Elevation: Backfill from one (1) foot above the top of pipe to Finished Restoration Elevation using backfill materials specified below. Consolidate backfill materials evenly from center to side of trench to prevent arching.

1. Within the Right-Of-Way Limits of Existing State Highways: Backfill material as specified below unless stated otherwise in the approved PennDOT Highway Occupancy Permit.

a. Paved Areas: Aggregate Backfill compacted in four (4) inch layers to the bottom of the temporary or permanent paving.

b. Unpaved Shoulders: Aggregate Backfill compacted in four (4) inch layers to existing grade.

c. Unpaved Areas: Aggregate Backfill compacted in four (4) inch layers to bottom of topsoil. Replace topsoil to approximate depth of existing as final refill operation and crown to such height as required by AUTHORITY. Maintain crowned surface to the satisfaction of AUTHORITY, during the warranty period.

2. Existing and Proposed Borough Roadways and Private Driveways: Aggregate backfill compacted in four (4) inch layers to bottom of temporary or permanent paving.

3. Unpaved Shoulders of Proposed and existing Borough Streets: Backfill compacted in six (6) inch layers to a point six (6) inches below the adjacent existing surface. Refill the remaining six (6) inches with compacted Aggregate Backfill.

4. Unimproved Streets: Aggregate Backfill compacted in eight (8) inch layers to within six (6) inches of existing grade. Refill the remaining six (6) inches with compacted PennDOT 2A Aggregate.

5. Stone Driveways: Backfill compacted in eight (8) inch layers to within six (6) inches of existing grade. Refill the remaining six (6) inches with compacted PennDOT 2A Aggregate.

F. If there is a deficiency of backfill material, provide borrow material as required.

3.05 COMPACTION

A. Solidly tamp each layer of bedding material to compact to a density of 90%. Solidly tamp each layer of backfill around the pipeline and above pipeline using proper tamping tools made specifically for this purpose. Compact each layer to the densities specified using ASTM D698 Standard Proctor Test Methods determined at maximum density at optimum moisture content as determined by AASHTO T 99.

1. Within the Right-of-Way limits of existing State Highways and Borough Roadways.

a. Paved Areas: 100%

b. Unpaved Areas: 90% (Up to bottom elevation of final restoration material)

2. Other Areas

a. Paved Areas: 95%

b. Stone Driveways: 95%

c. Lawns, Fields: 90% (Up to bottom elevation of final restoration material)

B. Do not use rolling equipment or heavy tampers to consulate backfill until at least two (2) feet of backfill is placed over the top of the pipe.

C. The use of HYDRA-HAMMER for compacting backfill in trenches is prohibited.

D. The use of puddling or jetting for compacting backfill in trenches is prohibited.

E. Compaction Tests: During the course of backfilling and compacting, AUTHORITY may at various locations and depths of trenches request that DEVELOPER make field tests to verify that specified compactions are being achieved. Perform field density tests according to AASHTO T 191.

F. If compaction tests indicate that Work does not meet specified requirements, remove Work, replace, compact and retest.

3.06 STREAM CROSSINGS

A. Excavate trenches in stream crossings to the depth shown on the Drawing or otherwise required by AUTHORITY.

B. Material excavated may be used as backfill unless specifically prohibited by any governing agency having jurisdiction.

C. Make all necessary provisions for cofferdaming, dewatering and removal of excess excavated material.

D. Maintain the flow in the stream at all times.

E. 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.

F. Install concrete encasement to a minimum of ten (10) feet back from the top edges of the stream banks.

G. Construct stream crossing according to permit issued for the crossing.

3.07 CLEAN-UP AND MAINTENANCE

A. General: During construction, the surfaces of all areas including, but not limited to, roads, streets and driveways shall be maintained on a daily basis to produce a safe, desirable and convenient condition. Streets shall be swept and flushed after

backfilling and recleaned as dust, mud, stones, and debris caused by the Work, or related to the Work again accumulates.

B. Remove surplus excavated materials, rubbish, and other construction debris from the site after backfilling is completed.

C. Construction site shall be left clean at end of each working day to satisfaction of AUTHORITY.

**END OF SECTION**

# SECTION 4 – BORING AND JACKING

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Construction of bored or jacked crossings.

1.02 RELATED WORK

A. Section 5 – Pipe and Fittings

1.03 REFERENCES

A. American Society for Testing and Materials:

1. ASTM A53, Pipe, Street, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

2. ASTM A 153; Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. Commonwealth of Pennsylvania Department of Transportation (PennDOT)

1. Publication 408 – Specifications

a. PDT Section 703 Aggregates.

C. State Code: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67. Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities, as supplemented or revised (PennDOT Chapter 459).

D. State Publication: Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 203, Work Zone Traffic Control (PennDOT Chapter 203).

1.04 REGULATORY AGENCY REQUIREMENTS

A. DEVELOPER shall be responsible for complying with requirements of owner of crossing or right-of-way or entity having jurisdiction. Work shall not commence until the proper notice to proceed has been issued by said owner or entity.

B. DEVELOPER shall be responsible for making application and obtaining all permits required to complete work from owner of crossing or right-of-way or entity having jurisdiction. DEVELOPER shall contact AUTHORITY for additional requirements if permit is required to be in the AUTHORITYS name.

C. Work performed within PennDOT right-of-ways shall comply with Pennsylvania Code, Title 67, Chapter 459 – Occupancy of Highways by Utilities and PennDOT Publication 408.

D. Work performed within Amtrak rights-of-way shall comply with applicable Amtrak requirements for pipeline installations.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport, handle and store materials and Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects.

1.06 PROJECT CONDITIONS

A. DEVELOPER shall keep boring pits dewatered at all times. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site. When dewatering, close observation shall be maintained to detect any settlement or displacement of roadway embankment.

**PART 2 – PRODUCTS**

2.01 STEEL CASING PIPE

A. Unless required otherwise by owner of crossing or right-of-way or by entity having jurisdiction, the following specifications shall be adhered to:

B. Steel Pipe: ASTM A 53, or ASTM A 139, Grade B

1. 35,000 psi minimum yield strength

2. Full circumference welded joints

3. Asphalt coated

4. Minimum Wall Thickness: .375 inch

5. The steel casing pipe diameter shall be at least six (6) inches larger than the outside diameter of the pipe bell.

2.02 CARRIER PIPE AND FITTINGS

A. As specified in Section 5 – Pipe and Fittings unless required otherwise by owner of crossing or right-of-way or by entity having jurisdiction.

2.03 MISCELLANEOUS MATERIALS

A. Casing Spacers: Use casing spacers to center and support carrier pipe inside casing pipe. Provide spacers by Cascade Waterworks Mfg. Co. Model CCS.

1. Shell: 2-piece bolt on style, stainless steel, 14-gauge minimum thickness.

2. Liner: Shell shall be lined with a ribbed PVC extrusion with retaining section that overlaps the edge of the shell and prevents slippage.

3. Runners: Ultra high molecular weight (UHMW) polymer and shall be attached to risers. Runners shall have low coefficient of friction, high resistance to abrasion and sliding wear and low deflection under compression.

4. Hardware: 304 stainless steel.

B. End Seals: Provide end seals to wrap around casing and carrier pipes following installation to provide barrier to backfill and seepage. Seals shall be fabricated of 1/8" thick minimum synthetic rubber. Secure end seals to casing using 304 stainless steel straps with worm mechanism for tightening. End seals shall be by Cascade Waterworks Mfg. Co. Model CCES.

C. Grout (Sand/Cement)

1. Portland Cement: ASTM C 150 Type II.

2. Sand: ASTM C 33, fine aggregate.

3. Water: Potable.

4. Grout Quality: Mixture of one part Portland Cement, three parts fine aggregate and water.

D. Sand: ASTM C 33, fine aggregate.

**PART 3 – EXECUTION**

3.01 PREPARATION

A. Trenching: Excavate approach cased crossings, pits and trenches using methods specified in Section 3 – Trenching, Backfilling and Compaction.

B. Brace and Shore trenches to comply with OSHA requirements.

3.02 BORING

A. Push the pipe into the fill with a boring auger rotating within the pipe to remove the soil. When augers, or similar devices are used for pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The auger and cutting head arrangements shall be removable from within the pipe in the event an obstruction is encountered.

B. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than one-half inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material.

C. The use of water or other liquids to facilitate casing emplacement and soil removal is prohibited.

D. Any method which employs simultaneous boring and jacking or drilling and jacking for pipes over eight (8) inches in diameter which does not have the above approved arrangement will not be permitted. For pipes eight (8) inches and less in diameter, auguring or boring without this arrangement may be considered for use only as approved by AUTHORITY.

3.03 JACKING

A. Jacking shall be conducted without hand mining ahead of the pipe and without the use of any type of boring, auguring, or drilling equipment.

B. Bracing and backstops shall be so designed and jacks of sufficient rating used to that the jacking can be progressed without stoppage except for adding lengths of pipe.

C. Accurately place guide timbers on line and grade.

D. The vertical face of the excavation shall be supported as necessary to prevent sloughing.

E. Use poling boards and bulkheads as required if subgrade conditions in the heading are unstable.

F. Jacking and excavation within the pipe shall proceed simultaneously with the ground being cut no more than two (2) inches above subgrade at the bottom.

G. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.

H. If voids develop or if jacked hole diameter is more than one (1) inch greater than the outside diameter of the encasing conduit place grout to fill voids in manner approved by the regulatory agencies.

I. Check conduit alignment in a manner and at times required by AUTHORITY. Check alignment and grade at least once per shift as the work progresses.

J. Completely bulkhead heading at interruptions in jacking operation.

K. Completely weld joints around the circumference between sections of steel pipe encasing.

3.04 INSTALLATION AND TESTING OF CARRIER PIPE

A. Install carrier pipe one pipe length at a time. Push carrier pipe through steel casing pipe using casing spacers.

B. Assemble pipe joints with retainer glands or restrained joint before pushing.

C. Test carrier pipe as specified in Section 4 – Pipe and Fittings.

3.05 CLOSING CASING PIPE

A. After carrier pipe has been installed inside casing pipe and successfully tested, fill casing pipe with sand meeting PennDOT Form 408, Section 703, Specification for Type A Fine Aggregate.

B. After filling with sand, close ends of casing pipe and end seals per manufacturer's recommendations.

**END OF SECTION**

# SECTION 5 – PIPE AND FITTINGS

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer pipe, force mains, fittings, and related appurtenances.

1.02 RELATED SECTIONS

A. Section 3 – Trenching, Backfilling and Compaction

B. Section 4 – Boring and Jacking

C. Section 6 – Manholes

D. Section 7 – Cast-In-Place Concrete

1.03 REFERENCES

A. American National Standards Institute

1. ANSI A 21.10, Cast-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.

2. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.

3. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.

4. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

B. American Society for Testing and Materials

1. ASTM A 307, Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Strength.

2. ASTM B 763, Copper Alloy Sand Castings for Valve Applications

3. ASTM D 1784, Rigid Poly, (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

4. ASTM D 1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80 and 120.

5. ASTM D 2467, Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

6. ASTM D 2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

7. ASTM D 3034, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

8. ASTM D 3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastromeric Seals.

9. ASTM F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

10. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

C. American Water Works Association

1. AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings.

2. AWWA C110, Ductile-Iron and Gray-Iron Fittings.

3. AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C150, Thickness Design of Ductile-Iron Pipe.

5. AWWA C151, Ductile-Iron Pipe Centrifugally Cast.

6. AWWA C153, Ductile-Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch.

7. AWWA C600, Installation of Ductile Iron Mains and their Appurtenances.

1.04 SUBMITTALS

A. Make submissions required by Section 2 – Construction Submittals.

1.05 QUALITY ASSURANCE

A. Design Criteria:

1. Use only one type and class of pipe in any continuous line of sewer between structures, unless otherwise indicated on the Drawings.

2. Use pipe and fittings designed to withstand imposed trench loadings and conditions at the various locations.

B. Laboratory Tests:

1. The AUTHORITY 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.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport, handle and store pipe materials and other Products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

1.07 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, as determined by AUTHORITY, for pipe laying work.

**PART 2 – PRODUCTS**

2.01 PIPE AND FITTINGS

A. Size:

1. All pipe diameters referenced or noted shall be nominal diameters.

B. Ductile Iron, Epoxy-Lined (DIEL) Class 52 Sewer Piping (for dedicated force mains):

1. Manufacturers:

a. McWane

b. U.S. Pipe

2. Pipe: ANSI/AWWA C151/A21.51.

3. Wall Thickness Class: AWWA C150, Class 52 for buried pipe and Class 53 for flanged pipe.

4. Fittings: Ductile iron, ANSI/AWWA C153/A21.53 and ANSI/AWWA C110/A21.10. Mechanical joints shall conform to ANSI/AWWA C111/A21.11. Working pressure rated at 350 psi.

5. Joints:

   a. Burled Joints

      1) Push-on: ANSI/AWWA C111/A21.11.

      2) Mechanical: ANSI/AWWA C111/A21.11.

   b. Exposed/Interior Joints

      1) Flanged: ANSI A21.15 with ANSI B16.21 1/16-inch-thick cloth insertion rubber face gaskets. ANSI B18.2 nuts and bolts.

6. Pipe Lining: Ductile Iron pipe and fittings shall be coated inside in accordance with the following:

   a. Sanitary Sewage Pipe and Fittings: Lining shall be Protecto 401 ceramic epoxy lining or equal and shall meet all quality requirements of ANSI A21.16 and AWWA C116. Lining thickness through 12-inch, shall not be less than 0.125 inches and over 12 inches shall not be less than 0.1875 inches and seal coated per ANSI/AWWA C116/A21.16.

7. Pipe and Fittings Coating: ANSI/AWWA C151/A21.51, factory coated inside and out with bituminous paint, minimum 1 mil dry thickness.

C. Polyvinyl Chloride Pipe (PVC) – SDR 35:

1. Manufacturers:

   a. NAPCO

   b. JM Eagle

2. Pipe: Type PSM SDR-35, ASTM D 3034 (4”-15”), or Type PS-46, ASTM F 789 (4”-18”).

3. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.

4. Joints: ASTM D3212 push-on joint with ASTM F477 elastomeric gasket. Gasket shall be locked in groove of bell to prevent displacement when pipes are jointed.

D. Polyvinyl Chloride Pipe (PVC) – SDR 26:

1. Manufacturers:

   a. NAPCO

   b. JM Eagle

2. Pipe: Type PSM SDR-26, ASTM D 3034 (4”-15”), or Type PS-46, ASTM F 789 (4”-18”).

3. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.

4. Joints: ASTM D3212 push-on joint with ASTM F477 elastomeric gasket. Gasket shall be locked in groove of bell to prevent displacement when pipes are jointed.

E. Polyvinyl Chloride Pipe (PVC) – SDR21 (for low pressure sewers and gravity sanitary sewers with depths 10-15 feet below finished grade):

1. Manufacturers

   a. NAPCO

   b. JM Eagle

2. Pipe: Type PSM SDR-21, ASTM D 3034 (4”-15”), or Type PS-46, ASTM F 789 (4”-18”).

3. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.

4. Joints: ASTM D3212 push-on joint with ASTM F477 elastomeric gasket. Gasket shall be locked in groove of bell to prevent displacement when pipes are jointed.

5. Thrust blocks and anchors at every direction change in pressure pipes, in accordance with manufacturer directions.

F. Ductile Iron, Epoxy-Lined (DIEL) Class 50 Sewer Piping (for gravity sanitary sewers with depths exceeding 15 feet):

1. Manufacturers:

   a. McWane

   b. U.S. Pipe

2. Pipe: ANSI/AWWA C151/A21.51.

3. Wall Thickness Class: AWWA C150, Class 50 for buried pipe.

4. Fittings: Ductile iron, ANSI/AWWA C153/A21.53 and ANSI/AWWA C110/A21.10. Mechanical joints shall conform to ANSI/AWWA C111/A21.11. Working pressure rated at 350 psi.

5. Joints:

   a. Burled Joints

      1) Push-on: ANSI/AWWA C111/A21.11.

      2) Mechanical: ANSI/AWWA C111/A21.11.

   b. Exposed/Interior Joints

      1) Flanged: ANSI A21.15 with ANSI B16.21 1/16-inch-thick cloth insertion rubber face gaskets. ANSI B18.2 nuts and bolts.

6. Pipe Lining: Ductile Iron pipe and fittings shall be coated inside in accordance with the following:

   a. Sanitary Sewage Pipe and Fittings: Lining shall be Protecto 401 ceramic epoxy lining or equal and shall meet all quality requirements of ANSI A21.16 and AWWA C116. Lining thickness through 12-inch, shall not be less than 0.125 inches and over 12 inches shall not be less than 0.1875 inches and seal coated per ANSI/AWWA C116/A21.16.

7. Pipe and Fittings Coating: ANSI/AWWA C151/A21.51, factory coated inside and out with bituminous paint, minimum 1 mil dry thickness.

2.02 VALVES AND APPURTENANCES

A. Plug Valves (4 inches and larger):

1. Manufacturers

   a. DeZurik, Series 100

   b. Clow

2. General: Non lubricated eccentric type valves with resilient faced plugs rated for 175 psi working pressure. End connections shall be ANSI 125/150 lb standard.

3. Valve Body: ASTM A 126 Class B cast iron with 1/8-inch welded overlay seat of not less than 90% nickel. Seat area shall be raised with raised surface completely covered with weld to insure that plug face contacts only nickel.

4. Plug: ASTM A 126 Class B cast iron resilient faced with neoprene or hycar, suitable for use with sewage. The interference between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with the valve in-line under pressure.

5. Valve Shaft Seals: Multiple V-ring type, externally adjustable and repackable without removing bonnet or actuator from valve while under pressure.

6. Furnish buried valves with 2-inch square operating nut and tee handle of sufficient length to properly operate valve.

B. Gate Valves

1. Manufacturers

   a. American Flow Control, Series 2500

   b. Mueller

2. General: AWWA C 509 resilient seat wedge type designed for 150 psi operating pressure.

   a. Buried: Non-rising stem

   b. Interior: Outside stem and yoke

3. Valve Body: ASTM A 126, Class B cast iron.

4. Resilient Wedge: ASTM A 536 ductile iron crated with nitrite rubber.

5. Stem: ASTM B 763 bronze with two (2) upper and one (1) lower nitrite rubber o-ring seals.

6. End Connections:

   a. Buried service: mechanical joint.

   b. Interior: ANSI 125/150 lb. flanged.

7. Provide square operating nut and valve box for buried service.

8. Interior and Exterior Coating: AWWA C 550 fusion bonded epoxy coating, 8 mils minimum.

C. Air Release Valves:

1. Manufacturer: Crispin, Model US 10.

2. Use valves of appropriate size at high points vent air which may accumulate. Valve shall be designed for 150 psig working pressure.

3. Construction: Cast iron body and cover, stainless steel floats and parts.

D. Valve Boxes

1. Manufacturers

a. Tyler Pipe, 6850 series

b. Bingham & Taylor, I5B series, screw type.

2. All valves buried in the ground shall be provided with cast iron valve boxes of the Two Piece or Buffalo Type. The valve boxes shall have an adjustable two section screw-type telescoping column and a separate base. The valve box column shall have an inside diameter of 5¼ inches. Valve boxes shall be furnished with a cover. Mark covers to read "SEWER". The valve boxes shall be hot coated inside and out with a tar or asphalt compound. For deep installations, provide screw-type extensions as required, designed for use with the valve box furnished. Set top of stem between 1-2 feet below grade.

2.03 PIPE COUPLINGS

A. Flexible Pipe Coupling (for gravity sewers only):

1. Manufacturers

a. Fernco Joint Sealer Company

b. Indiana Seal Company

2. Clamped design with virgin PVC coupling and two (2) type 305 stainless steel bands.

B. Steel Pipe Couplings (for pressure sewers):

1. Manufacturers

a. Dresser, Style 38

b. Smith-Blair, Style 411

2. Coupling shall consist of a middle ring, two (2) follower rings, two (2) gaskets and a sufficient number of bolts and nuts.

a. Middle Ring: ASTM A513 or ASTM A635 steel.

b. Followers: ASME SA 36.

c. Gasket: Resilient wedge-shaped suitable for use with raw sewage and sludge.

d. Bolts: AWWA C111/ANSI A21.11.

2.04 SADDLES

A. GENECO Sealtite Saddle.

2.05 THRUST RESTRAINT

A. DEVELOPER has option of either of the means specified below. Length of restraint specified by AUTHORITY.

1. Concrete Thrust Blocks and Tie Rods: Details as shown on drawings. Concrete shall be as specified in Section 8 – Cast-In-Place Concrete, 3,000 psi compressive strength (at 28 days). Tie rods shall be constructed of suitable metal. Metal harness of tie rods shall be galvanized or otherwise rust proofed and shall be painted with bituminous coating after installation.

2. Megalug Retainer Glands: Mechanical joint restraint consisting of follower gland which when actuated imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. ASTM A 536-84 ductile iron follower gland of dimensions such that it can be used with AWWA C153 mechanical joints. Restraining devices shall be of ductile iron, heat treated to a minimum hardness of 370 BHN. Twist-off nuts shall be used to insure proper actuating of the restraint device. Restraint device shall have a 250 psi minimum working pressure with 2:1 minimum safety factor. Megalug retainer gland equivalent to EBAA Iron, Inc.

2.08 PIPING SPECIALTIES AND APPURTENANCES

A. Hub Adapter Connection (for connections to lined rigid pipes)

1. Manufacturers

a. Advanced Drainage System (Inserta Tee Fatboy Hub Adapter product)

2. PVC hubs shall be constructed of a heavy-duty PVC material.

3. Rubber sleeve and gasket (where applicable) shall meet the requirements of ASTM F477.

4. Stainless steel band shall a clamping assembly made from minimum 301 grade steel.

B. Casing Pipe (for bored crossings)

1. Casing Pipe: ASTM A53 seamless steel, full circumference welded joints and of DIAMETER AS SHOWN ON Drawings unless required otherwise by governing agency having authoritative jurisdiction.

2. Casing Spacers: Use casing spacers to center and support carrier pipe inside casing pipe. Provide spacers by Cascade Waterworks Mfg. Co. Model CCS or equal.

a. Shell: 2-piece bolt on style, stainless steel, 14-gauge minimum thickness.

b. Liner: Shell shall be lined with a ribbed PVC extrusion with retaining section that overlaps the edge of the shell and prevents slippage.

c. Runners: Ultra high molecular weight (UHMW) polymer and shall be attached to risers. Runners shall have low coefficient of friction, high resistance to abrasion and sliding wear and low deflection under compression.

d. Hardware: T 304 stainless steel.

3. End Seals: Provide end seals to wrap around casing and carrier pipes following installation to provide barrier to backfill and seepage. Seals shall be fabricated of 1/8" thick minimum synthetic rubber. Secure end seals to casing using 304 stainless steel straps with worm mechanism for tightening. End seals shall be by Cascade Waterworks Mfg. Co. Model CCES.

C. Sewer Vent and Cleanout Protection

1. Unit shall have a cast iron body and Lid suitable for traffic loadings.

2. Dimensions:

a. Diameter – 15 inches (minimum)

3. Shaft shall have continuous extension on the bottom circumference.

4. Lid shall have the word “sewer” or the letter “s” cast on the top.

**PART 3 – EXECUTION**

3.01 EXAMINATION

A. Carefully examine each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.

B. Remove rejected pipe from the Project.

3.02 PREPARATION

A. Clean piping interior and mating surfaces of bell, spigot, and gasket before laying. Maintain clean until completed work is accepted.

B. Touch-up chipped, cracked, or abraded surfaces and finished joints with two coats of the particular coating material.

C. Perform trenching for sewer pipe and place pipe bedding as specified in Section 2 – Trenching, Backfilling and Compacting.

D. Dig bell holes sufficiently large to permit proper joint making and to ensure pipe is firmly bedded full length of its barrel.

E. Excavate trenches in rock at least twenty-five (25) feet in advance of pipe laying. Protect pipe ends if blasting is allowed.

3.03 LAYING PIPE

A. General Requirements:

1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade.

2. Bed pipe using materials specified in Section 2 – Trenching, Backfilling and Compaction. Gravity sewer pipe bedding must conform to AASHTO-99 to a density of 90% proctor.

3. Exercise care to ensure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipeline.

4. Center spigot end in bell or socket end of previously laid pipe, shove tight and secure.

5. No wedging or blocking permitted in laying pipe unless by written permission of AUTHORITY.

6. 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.

7. Walking or working on completed pipeline, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.

8. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.

9. Take up and replace with new, such in-place pipe sections found to be defective.

10. Take necessary precautions to prevent newly laid pipe from floating as a result water accumulation in the trench, or the collapse of the pipeline from any cause. Restore or replace pipe as necessary.

11. At the close of each day's work, and at such other times when pipe is not being laid, protect open end of pipe with a tight fitting stopper.

12. Cut pipe using only equipment specifically designed for that purpose such as an abrasive wheel, rotary wheel cutter, a guillotine pipe saw or a milling wheel saw. The use of chisels or hand saws will not be permitted. Grind smooth cut ends and rough edges. Bevel slightly, cut end for push-on connections.

13. Where cutting of pipe is necessary, minimum laying length shall be five (5) feet.

B. Specific Requirements:

1. Install ductile iron pipe, and fittings, and assemble joints according to AWWA C600.

2. Install PVC pipe and fittings and assemble joints according to ASTM D2855.

C. Joints

1. Make pipe and fitting joints according to pipe manufacturer's specifications and to specifications previously specified for pipe.

2. Make joints watertight. Immediately repair detected leaks and defects. Methods of repair subject to AUTHORITY'S approval.

D. Alignment and Grade:

1. Lay and maintain all pipe at the required lines and grades as shown on the Drawings. Place fittings and valves at the required locations with joints centered, spigots forced home, and all valve stems plumb. Do not deviate from the required line and grade, except with the approval of AUTHORITY.

2. Deflect pipe joints where indicated on the drawings. Deflections shall not exceed pipe manufacturer's recommended maximum allowable deflection.

3. Do not change grade or alignment without AUTHORITY'S approval.

E. Drop Connections: Make drop connections where indicated on the Drawings, where drop in invert is two feet or more or as required by AUTHORITY. Construct drop connection using the same pipe material used to construct the main. Construct drop connection in accordance with design shown on Standards Detail Drawings.

F. Connections to Existing Manholes or Structures: As specified in Section 5 – Manholes.

3.04 THRUST RESTRAINTS

A. General: Provide thrust restraint at all plugs, caps, tees, and bends (both horizontal and vertical) on pipelines 4 inches and larger.

B. Concrete Reaction Backing: Place concrete reaction backing between undisturbed solid ground and the fitting to be anchored. The backing unless otherwise shown or directed, shall be located as to contain the resultant thrust force and so that the pipe and fitting joints will be accessible for repair.

C. Install megalug retainer gland according to manufacturer's instructions.

D. Temporary Thrust Restraint: Provide temporary thrust restraint at temporary caps or plugs. Submit details of temporary restraint to AUTHORITY for approval.

3.05 EMERGENCY REPAIRS

A. CONTRACTOR shall be responsible for utilizing great care and superior Judgment when working on and around AUTHORITY'S system(s). CONTRACTOR shall provide emergency repair service (at no cost to AUTHORITY) when a main break or leak results from CONTRACTOR'S actions. Emergency repair could include isolation of the affected main,

excavation, clamping, possible disinfection, site restoration and other actions necessary to restore satisfactory service to the customers. CONTRACTOR shall notify AUTHORITY immediately when incidents and/or accidents occur that adversely affect service to AUTHORITY'S customers. AUTHORITY shall provide guidance towards resolving such situations, including approval of the emergency work and approval of any emergency main appurtenances, including but not limited to, repair saddles and clamps.

3.06 FIELD QUALITY CONTROL:

A. General Requirements: Conduct tests specified herein so that each pipeline installed in the Project is tested to AUTHORITY'S satisfaction.

1. Conduct tests in the presence of and to the satisfaction of AUTHORITY.

3.07 GRAVITY LINE TESTS

A. Alignment: After the sewer mains have been laid and backfilled, a light will be flashed between manholes or manhole locations to determine whether the alignment of the sewer is true and whether any pipe has been displaced, broken or otherwise damaged subsequent to laying. This test will again be conducted before final acceptance of the sewer. Each section (manhole to manhole) of sewer shall show a good light circle throughout its length and any and all defects shall be corrected by DEVELOPER, to the satisfaction of AUTHORITY, before the work shall proceed and before acceptance of and/or payment therefore shall be made.

B. Leakage Tests:

1. Air Testing: DEVELOPER shall test each section of sewer between manholes and all laterals to the limit of this contract using low pressure air. Testing shall not be performed, until all backfilling has been completed. DEVELOPER may, at his option, test the section of sewer for his own purposes, prior to completion of backfilling; however, the requirements of this subsection shall not be deemed to be completed until the lines have been tested after the backfilling has been completed and trench settlement has been minimized.

2. This test will be made by plugging all branch fittings and ends of lateral stubs to withstand internal pressure. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately braced when required.

3. Air shall slowly supply the plugged pipeline until the internal air pressure reaches 4.0 pounds per square inch (PSI) greater than the average back pressure of any groundwater that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

4. The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 to 2.5 PSI.

5. The line shall be considered acceptable if the amount of time is not less than the following formula:

T = 0.0850DK/Q, where

K = 0.000419DL, but not less than 1.0
Q = rate of loss of 0.003 CFM per square foot of internal surface
D = Pipe diameter, inches
L = Length of pipe being tested, feet

MINIMUM HOLDING TIME REQUIRED FOR PRESSURE TO DROP FROM 3.5 TO 2.5 PSIG FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.003

| Pipe Diameter (inches) | Minimum Time (min:sec) | Length for Minimum Time (feet) | Time for Longer Length (seconds) | Specific Time for Length | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 100 feet | 150 feet | 200 feet | 250 feet | 300 feet | 350 feet | 400 feet | 450 feet |
| 4 | 1:53 | 597 | 0.190 L | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 |
| 6 | 2:50 | 398 | 0.427 L | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:51 | 3:12 |
| 8 | 3:47 | 298 | 0.760 L | 3:47 | 3:47 | 3:47 | 3:47 | 3:48 | 4:26 | 5:04 | 5:42 |
| 10 | 4:43 | 239 | 1.187 L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 | 8:54 |
| 12 | 5:40 | 199 | 1.709 L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:48 | 11:24 | 12:50 |
| 15 | 7:05 | 159 | 2.671 L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 | 20:02 |
| 18 | 8:30 | 133 | 3.846 L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 | 28:51 |
| 21 | 9:55 | 114 | 5.235 L | 9:55 | 13:05 | 17:27 | 21:49 | 26:11 | 30:32 | 34:54 | 39:16 |
| 24 | 11:20 | 99 | 6.837 L | 11:24 | 17:57 | 22:48 | 28:30 | 34:11 | 39:53 | 45:35 | 51:17 |
| 27 | 12:45 | 88 | 8.653 L | 14:25 | 21:38 | 28:51 | 36:04 | 43:16 | 50:30 | 57:42 | 64:54 |
| 30 | 14:10 | 80 | 10.683 L | 17:48 | 26:43 | 35:37 | 44:31 | 53:25 | 62:19 | 71:13 | 80:07 |
| 33 | 15:35 | 72 | 12.926 L | 21:53 | 32:19 | 43:56 | 53:52 | 64:38 | 75:24 | 86:10 | 96:57 |
| 36 | 17:00 | 66 | 15.384 L | 25:59 | 38:28 | 51:17 | 64:06 | 76:55 | 89:44 | 102:34 | 115:23 |
| 39 | 18:25 | 61 | 18.054 L | 30:57 | 45:09 | 60:11 | 75:14 | 90:16 | 105:19 | 120:22 | 135:24 |

6. If the above rates of leakage are exceeded, DEVELOPER shall determine source of leakage and make all necessary corrections and retest.

7. DEVELOPER shall submit to AUTHORITY for approval the detailed test procedure and list of test equipment he proposes to use prior to testing.

C. Infiltration:

1. After the air testing described in the preceding paragraph has been completed by DEVELOPER, regardless of any indications of the test results made by AUTHORITY, AUTHORITY reserves the right to perform field investigations, prior to final written acceptance of each sewer run by AUTHORITY and/or during the maintenance period

required to establish the leakage of groundwater into the sewer and laterals constructed.

2. Should the leakage exceed 100 gallons per day per inch diameter per mile of pipe for any section, DEVELOPER shall, at the direction of AUTHORITY, perform any additional testing or corrective work required to reduce the infiltration in each manhole run from those lines installed by DEVELOPER to less than 100 gallons per day per inch diameter per mile of pipe. This leakage applies to each manhole run separately and should not be construed to mean total leakage in the total system. The scope of this corrective work shall include, but not be limited to, cleaning, televising and testing the sewer and laterals to the limits installed by DEVELOPER, to include testing and grouting of joints, excavation and replacement of faulty or damaged portions of the work, and all final restoration.

## 3.08 PRESSURE LINE TESTING

A. Alignment Test for Pressure Lines:

1. Prior to backfilling of pressure lines, the joint alignment shall be inspected to assure the maximum deflection present in each joint does not exceed the manufacturer's recommendations.

2. Assure lines which are a portion of a pump discharge system shall be inspected to assure the line is installed at a constant or increasing grade so as to eliminate the possibility for air accumulation at an intermediate high point.

3. Any and all defects shall be corrected by DEVELOPER to the satisfaction of AUTHORITY prior to backfilling. This shall be completed before the work shall proceed and before acceptance.

B. Leakage Test Requirements (applicable to Force Mains and Water Mains):

1. This test will be made by plugging a section of the main (as determined by the Engineer) and all branch fittings to withstand internal pressure.

2. The Contractor shall slowly fill each valved section of main with water and apply the test pressure, based on the elevation of the lowest point of the line or section under test, corrected to the elevation of the test gauge by means of a pump connected to the pipe in a manner satisfactory to the Engineer.

3. Expel air completely from the pipe and valves before applying the specified test pressure. If permanent air vents are not located within the section being tested, install corporation cocks at such points so that the air

can be expelled as the line is filled with water. After all air has been expelled, close the corporation cocks and apply the test pressure. At the conclusion of the test, remove the corporation cocks and plug the openings, or leave in place at the discretion of the Engineer.

4. The main shall be hydrostatically tested at a pressure 1.5 times the normal working pressure with a minimum pressure of 150 PSI. The test pressure shall be held for a period of at least two (2) hours during which time the test pressure shall not vary more than 5 PSI.

5. The Contractor shall conduct a leakage test concurrently with the Hydrostatic Pressure Test. Leakage shall be defined as the quantity of water that must be supplied into the newly constructed force main, or any valved section thereof, to maintain the pressure within 5 PSI of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

   Acceptance shall be determined on the basis of allowable leakage as specified below.

ALLOWABLE LEAKAGE PER 1,000 FEET OF MAIN (GPH)

| Average Test Pressure PSI | Nominal Pipe Diameter - Inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 20 |
| 250 | | 0.71 | 0.95 | 1.19 | 1.42 | 1.66 | 1.90 | 2.37 |
| 225 | | 0.68 | 0.90 | 1.13 | 1.35 | 1.58 | 1.80 | 2.25 |
| 200 | | 0.64 | 0.85 | 1.06 | 1.28 | 1.48 | 1.70 | 2.12 |
| 175 | | 0.60 | 0.80 | 0.99 | 1.19 | 1.39 | 1.59 | 1.98 |
| 150 | | 0.56 | 0.74 | 0.92 | 1.10 | 1.29 | 1.47 | 1.84 |
| 125 | | 0.50 | 0.67 | 0.84 | 1.01 | 1.18 | 1.34 | 1.68 |
| 100 | | 0.45 | 0.60 | 0.75 | 0.90 | 1.05 | 1.20 | 1.50 |

C. Time for Making Test:

1. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.

2. AUTHORITY shall be present during the operating of valves required to fill mains for pressure and leakage test.

3. DEVELOPER shall advise AUTHORITY of any pressure test and leakage test at least 48 hours in advance. No testing will be authorized unless air temperature is 35F or higher.

4. The pressure and leakage tests shall be witnessed by AUTHORITY.

5. DEVELOPER shall furnish laboratory calibrated test gauges and measuring devices for the leakage test.

6. The section under test shall be brought back to test pressure at one-half hour intervals during the testing. AUTHORITY will record both the makeup water amount and pressure at each one-half hour repressurization.

3.09 ACCEPTANCE: Observation of successful testing of sewers, force mains or water mains by AUTHORITY does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the AUTHORITY, at its sole discretion, may consider acceptance or beneficial use of the facilities.

**END OF SECTION**

# SECTION 6 – MANHOLES

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer manholes and related appurtenances.

1.02 RELATED SECTIONS

A. Section 7 – Cast-in-place concrete

B. Section 8 – Grout

1.03 REFERENCES

A. American Society for Testing and Materials

1. ASTM A48, Gray Iron Castings
2. ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes
3. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
4. ASTM C361, Reinforced Concrete Low-Head Pressure Pipe
5. ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
6. ASTM C478, Precast Reinforced Concrete Manhole Sections
7. ASTM C923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
8. ASTM D4101 Polypropylene Injection and Extrusion Materials
9. ASTM D2240, Test Method for Rubber Property-Durometer Hardness
10. ASTM A307, Carbon steel externally threaded standard, spec. for
11. ASTM C270, mortar for unit masonry spec. for

B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Requirements.

C. American Water Works Association:

1. AWWA C 302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.

D. Commonwealth of Pennsylvania Department of Transportation (PennDOT), Specifications Publication 408.

1.04 DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast reinforced concrete manhole components and other Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects. Through-wall lifting holes not permitted in manhole component construction.

B. Store precast reinforced concrete manhole components in accordance with manufacturer's recommendations to prevent joint damage and contamination. Exercise such care in storage of other specified Products as recommended by the respective manufacturers.

1.05 PROJECT CONDITIONS

A. Environmental Requirements:

1. In no instance set or construct manhole basses on subgrade containing frost.

2. To improve workability of preformed plastic sealing compound during cold weather, store such at temperature above 70 degrees F or artificially warm compound in a manner satisfactory to AUTHORITY.

**PART 2 – PRODUCTS**

2.01 BASIC MATERIALS

A. Cast-In-Place Concrete Products: From work, Reinforcement, and Cast-In-Place Concrete conforming to requirements of Section 7 – Cast-In-Place Concrete.

B. Epoxy Bonding Compound:

1. Manufacturers:

a. Five Star Products

2. Multi-purpose, high-modulus, high-strength 2-component, solvent free, moisture insensitive, epoxy bonding/grouting adhesive.

C. Non-Shrink Non-Metallic Grout

1. Manufacturers

b. Master Builders, Inc., Masterflow 928

c. U.S. Grout Corporation, Five Star Products

2. Ready mix, ASTM C1107 high precision, natural aggregate grout

D. Manhole Steps:

1. Reinforced Plastic Step: Composed of a 1/2-inch Grade 60, ASTM A615 deformed steel reinforcing bar completely encapsulated in Grade 49108, ASTM D2146 polypropylene copolymer compound, Type II; M.A. Industries, Inc., Type PS2-PF or PS2-PFS.

2. Manhole step dimensions shall meet requirements of OSHA Standard 1910.27 for fixed ladders.

E. Manhole Frame and Cover:

1. Manufacturers:

a. US Foundry

b. Neenah Foundry Company

2. General: Gray iron castings conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class HS-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.

a. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Casting surfaces shotblast cleaned and coated with asphalt paint, non-tacky drying.

b. Identification: Cast the letters “SEWER” integrally in center of cover in 2-inch raised letters.

c. Frame Hold-down Bolts: Type 316 stainless steel, ASTM A276 bolts and washers.

d. Cover Gasket: One piece O-ring gasket factory installed in a machined rectangular or dovetail groove in the cover bearing surface.

1) Gasket material of neoprene composition having good abrasion resistance, low compression set, Type D 40 durometer hardness determined in accordance with ASTM D 2240 and suited for use in sanitary sewer manholes.

2) Gluing of gasket is not permitted.

e. Tensile Test Bar: Size B, cast separately, but poured from same iron as castings they represent.

F. Watertight Manhole Frame and Cover: Gray Iron castings conforming to preciously specified requirements for Manhole Frame and Cover except that cover shall contain four (4) hold-down bolts.

1. Manufacturers:

a. Modena Foundry, Pattern No. 541-WT

b. Washington Street Brass and Iron

c. Neenah Foundry Company

2. Cover Hold-down Bolts: 2-inch diameter minimum type 316 stainless steel, ASTM A276 bolts and washers: or manufacturer's standard bronze bolts and washers. Drill and tap frame to accept cover hold down bolts.

3. Threaded Sleeves: Manhole factory fitted with stainless steel or bronze threaded sleeve to accept cover bolts.

G. Preformed Plastic Sealing Compound:

1. Manufacturers:

a. Henry Company, Inc.; RAM-NEK. Model No. RN101

b. Henry Company, Inc.; RUB'R-NEK.

c. Hamilton Kent Manufacturing Company; KENT-SEAL NO. 2.

H. Heat-Shrinkable Manhole Seal: Wrapidseal as manufactured by Canusa-CPS, or equal.

I. Rubber Compression Gasket: Composition conforming to ASTM C 361 of ASTM C 443.

J. Expandable Sleeve Type Pipe Opening Seal: ASTM C923, consisting of a power sleeve, gasket and two (2) take-up clamps. Sleeve is mechanically expanded to

compress gasket against receptacle hold in manhole wall. Provide seal equivalent to Press Seal Gasket Corp. PSX Positive Seal Gasketing System.

1. Power Sleeve: Type 304 stainless steel, 85,000 psi yield strength.

2. Gasket: Compound Polyisoprene suitable for use with raw sewage.

3. Take-Up Clamps: Type 304 stainless steel with stainless steel screw.

K. Manhole Adapters: Gasket type water stops composed of elastomeric polyvinyl chloride (PVC) such as manufactured by Fernco Joint Sealer Co.; CMA Concrete Manhole Adapter.

L. Exteriors Coatings:

1. Manufacturers

a. Conseal CS-102B

2. Apply two (2) coats to outer surface of entire manhole to waterproof manhole.

M. Manhole-Cover Inserts:

1. Description: Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.

2. All standard frames and covers shall also include a high-density polyethylene manhole insert meeting the requirements of ASTM D-1248, Class A, Category 5, with a finish thickness of 1/8-inch as manufactured by Parson Environmental Products, Inc. All manhole inserts shall utilize a relief valve manufactured of polypropylene ethylene compound and shall be corrosion and wear resistant, and capable of releasing gas pressure at approximately 1 pound per square inch. Manhole inserts shall have a closed cell neoprene or cross-linked polyethylene gasket installed upon the insert rim by the manufacturer. The Contractor shall provide exact measurements to ensure that the manhole inserts are manufactured to fit the manhole frame rim upon which the manhole cover rests. Manhole inserts shall also include a corrosion resistant nylon strap installed for easy removal and re-installation into the manhole frame.

N. Manhole Protection Post:

1. 6” steel pipe, painted safety yellow, sized to extend 5’-0” above grade and a minimum of 3’-0” below grade.

2. Post shall be placed in a 3,000-psi (minimum) concrete foundation surrounding the pipe on all sides by 6".

3. Pipe shall be completely filled with 3,000-psi (minimum) concrete, and concrete shall be added until the shape is convex at the top to shed water.

2.02 PRECAST REINFORCED CONCRETE MANHOLE COMPONENTS

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

1. Concrete: Composition and compressive strength conforming to ASTM C478 except use Type II sulfate resistant Portland cement in manhole components and increase compressive strength to 4500 psi (at 28 days) in precast bases.

2. Casting and Curing: Wet cast and steam curing process in accordance with 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 Standard Detail drawings.

4. Manhole Component Seals: Manhole component joints factory formed for self-centering concrete to concrete bearing employing either a Rubber Compression Gasket or Preformed Plastic Sealing Compound.

5. Manhole Component Design: Base, tapered and straight riser section, and top section dimensions and diameters, not consistent with ASTM C 478, are as indicated on Standard Detail drawings.

6. Lifting Holes and Lugs: Through-wall holes shall not be permitted in manhole component construction.

7. PennDOT Compliance: In addition to above specifications, manholes for installation within PennDOT rights-of-way shall also conform to PennDOT Publication 408 specifications.

B. Precast Bases and Riser Sections: Design, materials and construction as specified previously.

C. Pipe Openings: Custom preformed during manufacturing in each base and riser section requiring such, to accommodate type of pipe and pipe opening seal provided.

D. Pipe Opening Seals: Option to install one of the following:

1. Resilient Gasket Type Pipe Opening Seal:

a. Manufacturers:

1) A Lok Products Corporation; A LOK Manhole Pipe Seal.

2) Press Seal Gasket Corporation; PSX.

b. Cast integrally with manhole component conforming to requirements to requirements specified in ASTM C 923.

E. Precast Top Sections: Designs as shown on Standard Detail Drawings of materials as specified preciously herein this Section except additional and differing requirements as follows:

1. Hold Down Bolt Inserts: Factory cast in top section no less than two s-inch diameter threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Threaded inserts of 3-inch depth. Both insert types designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.

2. Flat Slab Tops: Thickness indicated on Drawings. Tops factory formed to properly accept and support required manhole frame and cover and formed to join riser section in a matching joint.

3. Eccentric Cone Tops: Manufactured to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.

F. Precast Grade Rings: Leveling and adjusting units of 1-1/2” thickness of materials and constructions as specified previously. Factory cast grade rings with hold down bolt holes matching location of same in manhole frame. Design much provide for full bearing of manhole frame.

G. Polyurethane Resin-Based Manhole Coating:

1. Air release manholes and manholes to which force mains of low-pressure lines discharge to and the next four (4) manholes downstream, or all manholes within the next 1,000 linear feet downstream, whichever is greater, shall be coated as described below.

a. Polyurethane resin-based manhole coating shall be SprayWall by Sprayroq, Inc. or pre-approved equal. The liner, when installed, shall provide a continuous, impermeable lining which will shield the precast concrete manhole against deterioration caused by

corrosive material. A NACE Certified Coating Inspector shall be provided by the DEVELOPER to observe surface preparation, application, and materials handling procedures to ensure adherence to the SprayWall specifications.

b. Existing manholes shall be repaired to fill voids and bugholes and structurally reinforce and/or rebuild surfaces. The following materials may be used to repair existing manhole:

1) 100% solids, solvent-free grout specifically formulated for approved topcoating compatibility. The grout manufacturer shall provide instructions for trowel or spray application and for approved topcoating procedures.

2) Factory blended, rapid setting, high early strength, non-shrink cementitious or epoxy repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be compatible for approved topcoating. Such repair mortars should not be used unless their manufacturer provides information as to its suitability for topcoating with the approved topcoating. Project specific submittals should be provided including application, cure time and surface preparation procedures which permit optimum bond strength with the approved coating.

3) In the case of excessive infiltration, a hydraulic cement or plug may be used to stop the flow of the infiltration. Approved manufacturers include Strong or approved equal. The hydraulic cement shall be compatible with the spray applied resin coating.

c. The resin-based material shall be used to form the spray structurally enhanced monolithic liner covering all interior surfaces of the structure, including benches and inverts of manholes. The finished liner shall be 100% Solids polyurethane and conform to the minimum physical requirements listed in the most current SprayWall specifications. The physical requirements must be verified by an independent, certified, third party testing laboratory within the last five years. The results of this verification shall be submitted to the AUTHORITY Engineer.

d. When the wall of the resin based liner is to be structurally designed to withstand the hydraulic load generated by the groundwater table the long term (50yr) value of the flexural modulus of elasticity will be utilized to calculate the thickness of the structural liner. The initial flexural modulus of elasticity (short term) of the submitted

resin material will be utilized with a long term deformation percentage. No adhesion to the substrate is assumed in structural calculations. The value of the long term flexural modulus of the proposed product will be certified by an independent, certified, third party testing lab, independent of the Manufacturer and shall be submitted to the AUTHORITY Engineer.

e. When groundwater loading is not an issue and only a corrosion barrier is required, the rehabilitation lining shall be installed to the thickness necessary to qualify as a monolithic (void free) liner. The roughness of the substrate will dictate the thickness needed to create the monolithic liner and eliminate any opportunity for voids in the lining. The minimum value for coating thickness for corrosion protection for non-structural rehabilitation shall be 125 mils and structural rehabilitation shall be a minimum of 250 mils or the design thickness determined by the proper design protocol.

f. The liner shall be installed in accordance with the specific instructions of the manufacturer.

g. Prior to application to a new manhole, this manhole shall be fully installed and shall have passed all required testing.

h. DEVELOPER shall provide a warranty statement from the manufacturer for a warranty against defects in materials and workmanship for a period of three (3) years following the installation of the liner.

2.03 DEVELOPER OPTIONS IN PRODUCTS

A. Manhole Construction Options: Permitted option to construct one type of manhole in the Project of types listed herein, except where required otherwise on Drawings.

1. All-precast reinforced concrete manhole components.

2. Precast reinforced concrete grade rings used as frame and cover leveling units in either of above manhole construction.

**PART 3 – EXECUTION**

3.01 EXAMINATION

A. Inspect precast reinforced concrete manhole components in accordance with requirements of ASTM C 478 regarding repairable defects and defects subject to rejection by AUTHORITY.

B. All material found during the progress of the Work, either before of after installation, to have cracks, flaws or other defects will be rejected by AUTHORITY. All defective materials furnished by DEVELOPER shall be promptly removed from the site.

3.02 PREPARATION

A. Keep pipe and manhole interiors cleared of debris as construction progresses.

B. Earthwork: Perform earthwork as previously specified in Section 2- Trenching, Backfilling and Compacting.

3.03 MANHOLE INSTALLATION

A. Cast-In-Place Concrete Manhole Base: Construct in accordance with design and dimensions indicated of Drawings. When necessary to construct wider or deeper manhole bases the indicated or specified, build such bases as required by AUTHORITY.

1. Form and pour concrete in accordance with requirements of Section 7 – Cast-In-Place Concrete. Additional requirements as follows:

a. Vibrate poured concrete using mechanical vibrator of a type and design approved by AUTHORITY. 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.

2. Install sewer pipe 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 Manhole Adapter on pipes entering and leaving manhole base prior to pouring concrete. Install Manhole Adapter according to manufacturer's written instructions.

B. Precast Concrete Bases:

1. Install precast bases on aggregate subbase. Materials and thickness as shown on the Standard Detail drawings.

2. When pipe opening seal materials create an annular space on interior and exterior of manhole wall pipe openings after pipe connection is made, fill such annular spaces with preformed plastic sealing compound.

    a. Tightly caulk sealing compound into annular spaces in a manner to completely fill the spaces and render the installation watertight.

    b. Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

C. Length of Pipe Connections into Manholes:

1. Use full pipe section when connecting into manholes through resilient gasket type pipe opening seals.

D. Concrete Channel Fill: Field pour concrete channel fill for each manhole base.

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 annually.

4. Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.

5. Make slopes gradual outside the invert channels.

6. Use 3000 psi Type II concrete as specified in Section 7 – Cast-In-Place Concrete, unless indicated otherwise on Drawings.

E. Manhole Wall Erection: 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. Install sealing compound in accordance with manufacturer's recommendations and join sections also in accordance with written instructions of manhole component manufacturer.

    a. Prime joint surfaces if required by preformed 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 preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.

d. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70 EF or artificially warm compound in a manner satisfactory to AUTHORITY.

e. During warm weather stiffen Preformed Plastic Sealing Compound by placing under cold water or by other means as recommended by the compound manufacturer.

f. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.

g. Make pipe connections into manhole walls as specified previously for pipes connecting into manhole bases.

h. Remove all excessive plastic sealing compound after all manhole sections have been set.

F. Lifting Recess Sealing: Seal with properly designed tapered rubber plugs. Drive plugs into recesses in such manner to render them completely water and airtight. Sealing of lifting recesses with grout not permitted.

G. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using Precast Grade Rings.

1. Set Precast Grade Rings in Non-shrink Non-Metallic Grout. Grout thickness should not exceed ¾-inch maximum and 3/8-inch minimum. Wet, but do not saturate Precast Grade Rings immediately before laying.

2. Parge the inside and outside of the grade rings to a minimum thickness of ½ inch using Non-shrink Non-Metallic Grout.

3. Bolt manhole frames only following grout curing period. Install manhole frames on ½-inch thick Preformed Plastic Sealing Compound on bearing surface of manhole frame. Remove excess sealing compound as it is squeezed out after manhole frame is bolted in place.

4. Use bolts of sufficient length to properly pass-through leveling units, if any, engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after grout has cured.

5. Upon completion of frame installation, install manhole insert by placing in frame prior to setting the cover.

H. Waterproofing: Coat entire outer surface of all manhole components including parged grade rings with two (2) coats of Bitumastic Coating.

I. Inside Drop Manholes: Shall be allowed by special exception only. Shall be installed wherever the pipe invert into a manhole is greater than 2'-0" higher than the channel invert. Construct in accordance with Standard Detail Drawing. Use same type pipe and fittings in drop connections as used in sewer line from which drop connection is made.

J. Inside Splash Manholes: Shall be allowed by special exception only. Shall be installed wherever the pipe invert into a manhole is greater than or equal to 6" but less than 2'-0" higher than the channel invert. Construct in accordance with Standard Detail Drawing. Use non-shrink grout to form the precast channel.

K. Plugging Pipe Openings: Plug pipe openings in manholes where such openings are required for future pipe connections. Use manufactured units specifically designed for the purpose. Plugs shall be designed to allow for future removal without damage to manhole.

3.04 PIPE CONNECTIONS TO EXISTING MANHOLES

A. Make connection to existing manhole by core drilling pipe opening in wall at invert elevation to match existing unless directed otherwise by AUTHORITY.

B. Remove existing bench as needed to make new connection. Reconstruct bench and form new flow channel after new pipe has been inserted.

C. Seal pipe to wall opening using either the Expandable Sleeve Type or Modular Mechanical Type Pipe Opening Seal.

3.05 CONSTRUCTION OF NEW MANHOLES OVER EXISTING SEWER MAINS

A. Where new manholes are to be constructed on existing sewer mains, DEVELOPER shall install an insertion manhole. Construct according to Standard Detail drawing and as follows:

1. Replace broken or damaged pipe resulting from Work with new pipe. New pipe shall be of materials as previously specified. Use couplings compatible with new and existing pipe for making final connections.

2. Connect new pipe to new manhole bases using materials and methods previously specified. Form smooth channel to conduct flow into main channel.

3. Maintain flow of existing sewer via bypass pumping during construction. Flow through manhole may resume when manhole has passed initial vacuum testing and all connections are complete.

4. Saw cut existing pipe to be removed. Chipping or breaking pipe with a hammer shall not be permitted.

5. Final vacuum testing is required following final paving, and the construction shall not be considered complete until testing is completed.

3.06 FIELD QUALITY CONTROL

A. General: Test each manhole constructed by one of the methods specified herein. If the manhole is constructed on an existing sewer where flow must be maintained, the test may be waived, at the sole discretion of AUTHORITY.

1. Conduct tests in presence of and to complete satisfaction of AUTHORITY.

2. Should a manhole not satisfactorily pass testing, AUTHORITY may direct DEVELOPER to discontinue manhole construction in the Project until such manhole does test satisfactorily.

3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.

4. Prior to testing manholes, thoroughly clean such and seal openings, both to complete satisfaction of AUTHORITY. Seal openings using properly sized plugs.

5. Perform testing with frames installed. The joint between the manhole and the manhole frame shall be included in the test.

6. DEVELOPER may elect to make a test prior to backfilling and paving for their own purposes; however, the tests of the manholes for acceptable, shall be conducted after the backfilling and paving has been completed.

B. Vacuum Testing.

1. Manholes, vaults, and similar structures constructed may be tested by the Vacuum Test. This test shall be performed in accordance with ASTM C 1244.

2. Testing prior to backfilling is highly recommended (but not required) to facilitate corrective measures in case of test failure.

3. Testing is required following final paving to ensure the manhole has not been damaged nor shifted during the paving process.

4. The Contractor shall plug all pipe openings, taking care to securely brace the plugs and inflate the compression band to 40 psi to bring about a seal between the vacuum tester base and the manhole frame.

5. A vacuum to 10 inches of mercury (10" Hg) shall be drawn and the valve closed.

6. Manholes and similar structures shall be considered acceptable if the vacuum remains at 10" Hg or drops to 9" Hg in a time greater than 1 minute.

C. Exfiltration Test Procedure:

1. If results of vacuum testing are in question or if requested by AUTHORITY, DEVELOPER shall conduct exfiltration test as described below.

2. Water Test Procedure will not be permitted when the air temperature is expected to fall below 35_F, or as directed by AUTHORITY.

3. Completely fill manhole with water. The AUTHORITY will charge for water used for testing based either on a minimum amount or an actual meter reading.

4. Allow water filled manhole to stand twelve hours prior to testing to allow absorbing in materials.

5. At commencement of test, fill manhole to top of manhole frame.

6. During a consecutive four-hour period keep an accurate record of the amount of water to be added because of exfiltration.

7. Consider manhole acceptable when exfiltration rate does not exceed a rate of 0.0189 gallons a day per inch of manhole diameter per vertical foot of manhole.

D. Repair and Retest:

1. Determine source or sources of leaks in manholes failing acceptable limits.

2. 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.

3. Materials and methods used to make manhole repairs must meet with AUTHORITY's approval prior to use.

E. Visual Inspection:

1. A visual inspection of all manhole repairs and rehabilitation shall be performed by the Engineer. The Contractor shall provide labor and materials required for inspection. There shall be no signs of infiltration, spalling, loss of adhesion, cracks, or any other defects in the Contractor's work.

2. Acceptance is also dependent satisfactory results of field compressive strength testing, if performed.

3. All manholes that have been rehabilitated in accordance with Section 332002 shall be re-inspected prior to Final Acceptance, but no less than 12 weeks after Conditional Acceptance. The Engineer shall schedule this re-inspection with the Contractor, providing a minimum of 2 weeks' notice.

4. Re-inspection shall include a visual confirmation that no infiltration, spalling, loss of adhesion, cracks or any other defects have formed in the work performed since Conditional Acceptance. Any defects found shall be corrected by the Contractor in accordance with the manufacturer's recommendation at no additional cost to the County.

5. Re-inspection shall include at least 20% of the manholes rehabilitated. The Engineer will select the manholes to be re-inspected, the Contractor shall provide all labor and materials required for re-inspection, including traffic control.

    d. If more than 10% of the manholes re-inspected fail a visual inspection, an additional 20% of the manholes rehabilitated shall be re-inspected. If more than 10% of the second group of manholes re-inspected fail, all manholes rehabilitated shall be re-inspected.

    e. The Contractor shall pay the Engineer's expense in addition to all other expenses, for re-inspection of manholes rehabilitated beyond the first 20%. The Engineer's expense shall be the same dollar amount as the liquidated damages identified on page P-1 of the Contract Documents.

**END OF SECTION**

# SECTION 7 – CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete work for:

1. Pipe thrust restraint.
2. Restoration of disturbed/damaged concrete curbs and sidewalks
3. Miscellaneous concrete specified in other Sections.

1.02 REFERENCES

A. American Concrete Institute (ACI)

1. 301 – Specifications for Structural Concrete for Buildings
2. 305- Guide to Hot Weather Concreting
3. 306 – Guide to Cold Weather Concreting
4. 318 – Building Code Requirements for Structural Concrete
5. 347 – Guide for Formwork Concrete

B. American Society for Testing and Materials (ASTM)

1. A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
2. C31 – Making and Curing Concrete Test Specimens in the Field
3. C39 – Compressive Strength of Cylindrical Concrete Specimens
4. C94 – Ready-Mixed Concrete
5. C143 – Slump of Portland Cement Concrete
6. C173 – Air Content of Freshly Mixed Concrete by the Volume Method

C. Pennsylvania Department of Transportation (PennDOT) Publication 408, latest edition

1. Section 704 – Cement Concrete
2. Section 711 – Concrete Curing Material and Admixtures

3. Section 1001 – Cement Concrete Structures

104. PROJECT REQUIREMENTS

A. DEVELOPER shall be responsible for replacing or restoring all concrete damaged or disturbed in performing work of the Project to match original conditions in addition to those requirements specified herein this Section.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Concrete: Class A cement concrete as specified in PennDOT Publication 408, Section 704.1 (b), 3300 psi minimum compressive strength at 28 days.

B. Concrete Admixtures: Curing Materials and Admixtures: As specified in PennDOT Publication 408, Section 711.

C. Liquid Membrane-Forming Curing Compound: As specified in PennDOT Publication 408, Section 711.

D. Reinforcing Bars: 60 ksi yield grade, ASTM A615, deformed billet steel bars.

E. Curb and Sidewalk Restoration Materials: Materials shall comply with Strasburg Borough Specifications.

F. Epoxy Bonding Compound: Use product equivalent to Sika Chemical Sikadur 32 Hi-Mod.

G. Form coatings: Provide commercial formulation form-coating compounds that will not bond with, 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.

**PART 3 - EXECUTION**

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify that excavation is completed to required depth, and that subgrade has been properly compacted.

3.02 PREPARATION

A. Accurately place and adequately support embedded items and joint materials in pour.

B. Prepare existing hardened concrete to bond to new concrete.

1. Roughen and clean existing concrete surface of foreign matter.

2. Apply Epoxy Bonding Compound over existing prepared concrete according to manufacturer's instructions.

C. Sprinkle sufficient water over subgrade to prevent water loss from concrete.

3.03 FORMING

A. Construct forms according to ACI 347 to required dimensions, plumb and straight.

1. Securely brace and shore forms to prevent displacement, bowing and pillowing, and to safely support imposed concrete load.

2. Fabricate forms for easy removal without harming or prying against concrete surfaces.

B. Provide openings in concrete formwork of the correct size and in the proper location to accommodate piping and other construction work items. Accurately place and securely support items to be built into forms.

C. Where soil conditions will permit excavation to accurate sizes without bracing, and where cave-ins can be prevented during the concrete pour, earth forms may be used. Earth forms shall be wetted, but not muddy before concrete is placed.

3.04 REINFORCING

A. Place reinforcing steel accurately and securely brace against displacement using reinforcing accessories according to ACI 318.

B. Splice bars according to ACI 318.

3.05 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify AUTHORITY minimum 24 hours prior to commending concrete pour.

C. Ensure that reinforcement, formed expansion and construction joints and embedded items are not disturbed during concrete placement.

D. Place concrete continuously between predetermined expansion, control, and construction joints.

E. Do not interrupt successive placement; do not permit cold joints to occur.

F. Consolidate concrete by vibration, spading, rodding or other manual methods.

G. Perform concrete work in cold and hot weather according to ACI 306 and ACI 305, respectively.

3.06 FINISHING

A. Finish concrete to match original conditions or as directed by AUTHORITY.

3.07 CURING

A. Cure concrete with Liquid Membrane-Forming Curing Compound. Apply curing compound in accordance with PennDOT Publication 408, Section 1001.3.

3.08 CURB AND SIDEWALK RESTORATION

A. Restore curbs and sidewalks damaged by construction to conform to Strasburg Borough Specifications.

B. Saw cut and reconstruct sidewalks to the first expansion joint on either side of the damaged section.

C. Saw cut and reconstruct curbs to a minimum of one (1) foot beyond each side of damaged section. Match original lines and grades.

**END OF SECTION**

# SECTION 8 – GROUT

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Cement grout for:

1. Manholes

2. Miscellaneous grout requirements

1.02 RELATED WORK

A. Section 5 – Manholes

B. Section 7 – Cast-In-Place Concrete

C. Individual grouting requirements

1.03 REFERENCES

A. American Society for Testing and Materials:

1. ASTM C 191, Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.

2. ASTM C 596, Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement

3. ASTM C 827, Test Method for Early Volume Change of Cementitious Mixtures.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Prevent moisture damage and contamination of materials.

B. Store materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.05 SITE CONDITIONS

A. 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.

1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent cement and water mix as tested per ASTM C 596.

2. Grout shall be nonshrink before initial set and show no expansion after set as tested per ASTM C 827.

3. Initial set of grout not less than 60 minutes per ASTM C 191 Test.

4. Use Type I (Normal) cement for grout applications not in contact with sewage.

5. Use Type II (Sulfate Resistant) cement for grout applications in contact with sewage.

6. Acceptable Manufacturer: U.S. Grout Corporation; FIVE STAR.

2.02 CHEMICAL GROUP

A. General: An intimate mixture of dry acrylamide and dry, N, N-methylenebisacrylamide, in such proportions that dilute aqueous solutions, when properly catalyzed, will form stiff gels.

1. The grout must make a true solution at concentrations as high as three pounds per gallon of water.

2. The viscosity of the chemical solution shall have a viscosity of less than 2 cps, which remains constant until gelation occurs.

3. The reaction time shall be controllable from 10 seconds to 1 hour.

4. The reaction shall produce a continuous and irreversible gel at chemical concentrations as low as 0.4 pounds per gallon of water.

B. Catalyst: The catalyst for the chemical grout shall be ammonium persulfate. The material shall normally be used in combination with an activator, but it may be used in combination with a buffer for high-temperature work. Use of a catalyst containing Dimethyl Amino Propionitrile (DMAPN) is prohibited.

C. Activator: Triethanolamine or other compounds of equivalent properties.

D. Inhibitor: Under some conditions, it may be necessary or desirable to control the chemical reaction by inhibition. The inhibitor used shall be Potassium Ferricyanide.

E. Portland Cement: ASTM C150, Type II.

F. Fine Aggregate: ASTM C 33 gradation.

G. Waterproof Cement Grout: A mixture of Portland cement, finely graded mineral fillers, and a chemical additive equal to Drycon, a product of IPA Systems, Inc., or Thoroseal by Standard Dry Wall Products, Inc.

2.03 GROUT QUALITY

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

**PART 3 – EXECUTION**

3.01 PREPARATION

A. Forming:

1. Use forming procedures that allow proper and complete placement of grout.

2. Anchor support elements so no movement is possible.

3. Remove supports only after grout has hardened.

4. Pre-treat with forming oils wood forms that may absorb moisture.

B. Preparation of Surface:

1. Non-Shrink Grout: Prepare in accordance with manufacturer's printed instructions.

3.02 MIXING

A. Time:

1. Non-Shrink Grout: In accordance with manufacturer's printed instructions.

3.03 PLACING

A. Non-Shrink Non-Metallic Grout: Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing. Place Non-Shrink Non-Metallic grout only where indicated.

3.04 MANHOLE SEALING

A. Manhole Grouting Repair

1. Drill a hole at each identifiable leakage point from the inside of the manhole, extending through the side wall of the manhole. Insert a metal rod through the hole to determine if there is an exterior void space.

2. Fill any void space found with hydraulic grout mix consisting of one part Portland cement, maximum of three parts sand, and water just sufficient to allow the mix to be pumped into the void space until refusal is recorded by a rise in pressure on a pump pressure gauge. Ensure the hole through the manhole wall is kept open and free of hydraulic grout. Plug hole and allow one hour for the hydraulic grout to set.

3. Upon completion of hydraulic void grouting, pump chemical grout until refusal at a minimum pressure of 3.0 psig through probe type injection equipment. Deposit sealant from the interior surface of the set hydraulic grout through the drilled hole to the inside periphery of the manhole. Mix, apply, and cure chemical grout according to manufacturer's instructions.

4. Upon setting of the chemical grout, remove excess material protruding into the inside of the manhole.

5. When authorized by AUTHORITY in writing, parging the interior of manholes when two coats of waterproof cement grout can be done in lieu of hole drilling and hydraulic grouting specified. Prior to parging manhole, surfaces shall be cleaned by high velocity water jet or other means to remove all grease, sludge, sewage and dirt.

B. Sealing Manhole Cover Frames

1. On manholes being grouted and sealed, remove the frame and cover and clean the bottom of the frame of any mortar or other materials stuck to the casting. Remove any loose materials from the manhole structure.

2. Apply joint sealant compound to the top of the manhole and replace the frame and covers squeezing the compound into crevices. Trowel any compound that squeezes into the manhole flush with the interior surface.

**END OF SECTION**

# SECTION 9 – GREASE TRAPS

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Grease Traps

1.02 RELATED SECTIONS

A. Section 2 – Trenching, Backfilling and Compaction

B. Section 5 – Manholes

1.03 REFERENCES

A. ASTM A48, Gray Iron Castings

B. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

C. ASTM C478, Precast Reinforced Concrete Manhole Sections

1.04 SUBMITTALS

A. Make submissions required by Section 1 Construction Submittals

## PART 2 – PRODUCTS

2.01 REQUIREMENTS

A. All connections to the sewer system which discharge wastewater containing oils and/or greases shall be provided with a grease trap. Requirement shall include food processing and/or production establishments serving food, as well as those involving equipment or materials from which oils or greases could enter the wastewater generated from the property.

B. Volume of grease trap shall be determined by DEVELOPER with minimum volume being 500 gallons. AUTHORITY reserves right to require a greater volume or multiple units.

C. Grease trap shall be baffled and provided with direct access for cleanout of each compartment. Unit shall be installed outside in an area with easy and continuous access for a tanker unit to remove waste from the unit.

2.02 GREASE TRAP

A. Unit shall be precast concrete meeting all requirements of Section 5. – Manholes and the Standard Detail Drawing and shall be suitable to withstand traffic loads.

B. Access covers shall be gasketed to prevent the inflow of groundwater, surface water or rain from entering the unit. Where required, covers shall be suitable to withstand traffic loads. Should usage in the area of installation be modified to a traffic area from a non-traffic area, the covers shall be changed to withstand traffic loads.

2.03 PIPE MATERIALS

A. Connection of the grease trap to the AUTHORITY's system shall comply with Section 4 Piping and Appurtenances.

**PART 3 – EXECUTION**

3.01 INSTALLATION

A. Grease trap and all connecting piping and appurtenances shall conform to the requirements of Section 3 – Excavating, Backfilling and Compaction and Section 5 – Pipe and Fittings.

B. Installation shall be in accordance with Standard Detail Drawing.

**END OF SECTION**

# SECTION 10 – PACKAGE GRINDER PUMP STATIONS

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Package Grinder Pump Stations

1.02 RELATED SECTIONS

A. Section 3 – Trenching, Backfilling and Compaction

B. Section 6 – Manholes

1.03 SUBMITTALS

A. Make submissions required by Section 1 Construction Submittals.

1.04 PROJECT REQUIREMENTS

A. Grinder pump stations may only be used if the property cannot be served by a gravity sanitary sewer service. The proposed use of package grinder pump stations will be reviewed on a case-by-case basis, and all information requested by the AUTHORITY Engineer shall be provided for review and approval.

B. Simplex (single) sewage pump units shall be used at residential property locations, and duplex (double) sewage pump systems shall be used at non-residential properties. Additionally, provision of a spare pump and a standby power supply are recommended for non-residential uses. In certain cases, a simplex installation may be permitted for a non-residential use. Such exceptions will be reviewed on a case-by-case basis and must have the approval of the Authority.

C. Pump units shall be installed in either concrete or fiberglass-reinforced polyester basins for outdoor installations only. Indoor installations will not be permitted.

D. The pump package shall consist of the basin, sewage pump(s) and motor(s), quick disconnect rail system, start-stop level controls, high water alarm, shutoff valve and check valve, discharge piping and fittings, all internal wiring terminating in a junction box, and a control/alarm panel.

E. If average daily flows from the site exceed 3,500 gpd, DEVELOPER shall provide a design utilizing an alternative grinder pumping station system for review by the AUTHORITY engineer.

## PART 2 – PRODUCTS

2.01 GRINDER PUMP UNIT

A. The pump unit shall consist of a grinder pump capable of a minimum flow of 10 gpm at a Total Dynamic Head (TDH) as determined by site conditions.

B. Pump:

1. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal.

2. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier.

3. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied.

4. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel.

5. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance.

C. Grinder:

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

2. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. The grinder impeller shall be a one-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth.

3. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance. The teeth shall be ground into the material to achieve effective grinding.

4. The shredder ring shall be of the stationary type and the material shall be white cast iron. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque.

5. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

   a. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

   b. The maximum flow rate through the cutting mechanism shall not exceed 4 feet per second.

   c. The inlet shall have a diameter of no less than 5 inches.

   d. Impeller mechanism shall rotate at a nominal speed no greater than 1,800 rpm.

6. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

D. Motor:

1. The motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F insulation, low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds.

2. The motor shall be press-fit into the casting for better heat transfer and longer winding life.

3. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. The motor protector shall be specifically investigated and listed by Underwriters Laboratories Inc. for the application.

4. The wet portion of the motor armature must be 300 Series stainless steel.

5. Pump operation during instances of potentially damaging high current or low voltage conditions shall be inhibited by an in-pump electrical monitoring system that has been investigated and listed by Underwriters Laboratories Inc. for the application.

6. Motor start shall be controlled by a DC driven electromechanical relay integrated within the control compartment of the pump. Electrical monitoring shall ensure the relay operates reliably.

E. Mechanical Seal:

1. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

F. Manufacturers:

1. Environment One Corporation, Extreme Series.

2.02 PACKAGE GRINDER PUMP STATION BASIN

A. The basin shall consist of fiberglass or high density polyethylene (HDPE) construction.

B. Any incidental sections of a single wall construction are to be a minimum .250 inch thick. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to maximum external soil and hydrostatic pressure.

C. The tank shall be furnished with a factory installed PVC inlet flange to accept a 4.50" OD (4" DWV or SCH 40) inlet pipe.

D. The tank shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be high density polyethylene, green in color, with a load rating of 150 lbs per square foot. The cover assembly shall also include a vent to prevent sewage gases from accumulating in the tank. The accessway design and construction shall facilitate field adjustment of station height in increments of 3" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.

E. The power and control cable shall connect to the pump by means of the provided NEMA 6P Electrical Quick Disconnect (EQD) and shall enter the tank through a factory installed watertight strain relief connector. An electrical junction box shall not be permitted in the tank.

F. Tank heights shall be as shown on the DEVELOPER’s drawings.

G. The station shall have all necessary penetrations factory sealed and tested. No field penetrations shall be acceptable.

2.03 DISCHARGE HOSE AND DISCONNECT/VALVE

A. All discharge fittings and piping shall be constructed of polypropylene, EPDM or PVC.

B. The discharge hose assembly shall include a shut-off valve rated for 200 psi WOG and a quick disconnect feature to simplify installation and pump removal.

C. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

2.04 ELECTRICAL QUICK DISCONNECT

A. The grinder pump core shall include a factory-installed NEMA 6P electrical quick disconnect (EQD) for all power and control functions. The EQD will be supplied with 32', 25' of usable, electrical supply cable (ESC) to connect to the alarm panel. The EQD shall require no tools for assembly, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. The EQD shall be designed to be conducive to field wiring as required.

2.05 CHECK VALVE

A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping.

B. The check valve will provide a full-ported passageway when open and shall introduce a friction loss of less than 6 inches of water at maximum rated flow.

C. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.

D. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back pressure.

E. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi.

2.06 ANTI-SIPHON VALVE

A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge piping.

B. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.

C. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure.

D. The valve body shall be injection-molded from an engineered thermoplastic resin.

E. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

2.06 CONTROLS

A. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners.

B. Wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls.

C. Level sensor housing must be sealed via a radial type seal. Level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. Level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.

D. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch.

E. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be radial sealed with redundant O-rings.

F. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.

G. All fasteners throughout the assembly shall be 300 Series stainless steel.

H. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch.

I. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes.

J. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a factory installed NEMA 6P EQD half attached to it.

2.06 CONTROL/ALARM PANEL

A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel.

B. The alarm panel shall contain one 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.

C. The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; push-to-silence switch; redundant pump start; and high level alarm capability. The alarm sequence is to be as follows when the pump and alarm breakers are on:

1. When liquid level in the sewage wet-well rises above the alarm level, the contacts on the alarm pressure switch activate, audible and visual alarms are activated, and the redundant pump starting system is energized.

2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.

3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

D. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 90 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).

E. The entire alarm panel shall be listed by Underwriters Laboratories, Inc.

F. Alarm panel shall include, at a minimum, normally open relay contacts that close upon alarm activation.

## PART 3 – EXECUTION

3.01 INSTALLATION

A. DEVELOPER shall be responsible for the installation to be completed in accordance with the manufacturer's recommendations/requirements.

**END OF SECTION**

# SECTION 11 – WASTEWATER PUMPING STATIONS

## PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Wastewater pumping stations intended for dedication to the AUTHORITY

1.02 RELATED SECTIONS

A. Section 3 – Trenching, Backfilling and Compaction

B. Section 5 – Pipe and Fittings

C. Section 6 – Manholes

D. Section 7 – Cast-in-Place Concrete

E. Section 8 - Grout

1.03 SUBMITTALS

A. Make submissions required by Section 1 Construction Submittals.

B. Product Data: Prior to fabrication, submit the following to the AUTHORITY Engineer for approval:

1. Shop drawings providing layout of the mechanical equipment and anchor bolt locations, and indicating the use of Unified National Standard bolts and fasteners.

2. Electrical ladder logic drawings illustrating motor branch and liquid level control circuits to the extent necessary to validate function and integration of circuits to form a complete working system.

3. Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head (NPSHR), and hydraulic brake horsepower.

4. Pump Manufacturer's v-belt drive selection calculation summary sheet showing corrected H.P. Per Belt, total H.P. developed, pitch diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical horsepower transmission per v-belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.

5. Certified dimensional drawings indicating size, locations and the spherical solids passing capability of the primary recirculation port.

6. Pre-startup checklist to be completed by the contractor prior to pre-startup inspection.

7. Sample of service agreement and service agreement checklist for the specified equipment.

8. Letter from pump manufacturer certifying that the pump(s), exclusive of the motor, base, drive, controls, or other associated components, are constructed with cast iron, ductile iron, and steel that has been mined, melted, cast, machined, and assembled in the United States.

9. Copy of certificate with course I.D. number for pump manufacturer's PADEP-approved Wastewater Operator training Program in Pump Maintenance and Troubleshooting course that counts toward Pennsylvania pre-certification experience and continuing education unit requirements.

C. Certified Tests: Prior to shipment of the equipment from the pump manufacturer's facility, submit the following certified tests to the AUTHORITY Engineer for approval:

1. Certified copies of factory run pump performance tests. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the performance of the equipment at the design head, capacity and speed.

2. Certified reprime performance test data in accordance with procedures herein specified.

3. Tests shall be certified by a registered professional engineer.

D. Operation and Maintenance Manuals:

1. Operation shall be in accordance with written instructions provided by the pump system manufacturer. Comprehensive instructions supplied at the time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pumping equipment supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall system design, shall be provided by those

supplying the equipment. Instructions shall include the following as a minimum.

a. Functional description of each major component, complete with operating instructions

b. Instructions for operating pumps and pump controls in all modes of operation.

c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

d. Support data for commercially available components not produced by the system manufacturer but supplied in accordance with the specifications shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump control circuits shall be in accordance with branch, control, and alarm system circuits, including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the system operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pumping equipment and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves, and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of a manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

E. Manufacturer’s Field Performance Test Report: The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the equipment startup shall be submitted jointly to the DEVELOPER, AUTHORITY Engineer, and the Contractor. The report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for operation and that nothing in the installation will render the manufacturer's warranty null and void. At a minimum, the report shall include:

1. Nameplate information.

2. Recordings of gauge readings, static discharge head, shutoff head, and total dynamic head for each pump. Gauge readings shall be verified using a multimeter transducer.

3. Recordings of operating speed for each pump, measured with a tachometer.

4. Recordings of level control settings

5. Certification that equipment has been properly installed, lubricated, and is in accurate alignment.

6. Certification that the v-belt drive system has been properly aligned during startup, using a laser alignment instrument, and that v-belts have been tensioned using a belt tensioning instrument.

7. Results of electrical tests, including voltage readings and amperage readings of all motors.

8. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.

9. Outline in detail any deficiencies noted and proposed remedial corrections.

10. Confirm proper installation and operation of the wet well aeration system, including inspection of the aerating piping in the wet well, voltage and amperage readings of motor, and control panel timer adjustment.

11. Confirm that all spare parts are on site. Include photographs of spare parts in the startup report.

12. Include the following photographs in the startup report:

    a. Overall pump station job site

    b. Pumps and motors, including nameplates

    c. Discharge header piping

    d. Pump control panel – closed door

    e. Pump control panel – open door

    f. Wet well

1.04 PROJECT REQUIREMENTS

A. The proposed use of wastewater pumping stations will be reviewed on a case-by-case basis, and all information requested by the AUTHORITY Engineer shall be provided for review and approval.

B. DEVELOPER shall secure, in the name of the AUTHORITY, all permits required from the Department of Environmental Protection, PennDOT, and any other applicable agency. DEVELOPER shall secure, in their own name, all required construction permits such as building permits or local road opening permits. All costs, including bonds and insurance requirements, shall be at the sole expense of the DEVELOPER.

C. The size and location of pumping stations, force mains, valves, and other appurtenances shall be approved by the AUTHORITY Engineer so as to comply with the AUTHORITY's long-range facilities planning.

D. DEVELOPER shall be responsible to furnish the land necessary to include the entirety of the pumping station site to the AUTHORITY via a Bill of Sale in the amount of $1 upon the completion of all project work and acceptance of dedication of the station.

E. Suction lift stations shall be the only stations considered for acceptance by the AUTHORITY. The AUTHORITY's standard suction lift pumping station manufacturer is The Gorman-Rupp Company.

F. All pumping stations shall be equipped with improvements to account for emergency power. The AUTHORITY Engineer will evaluate on a case-by-case basis the need for either a permanent generator (fuel source to be specified by the AUTHORITY) or a portable emergency generator and portable generator connection point. On a case-by-case basis, the AUTHORITY may allow a fee-in-lieu of furnishing a portable emergency generator, provided that necessary connection points and electrical improvements are included within the design.

G. All pumping stations shall include an OmniSite autodialer for remote system alarm monitoring. AUTHORITY Engineer will specify exact model on a case-by-case basis.

H. DEVELOPER shall furnish the AUTHORITY with detailed construction plans, specifications, and design calculations for the pumping station and related facilities, including, but not limited to, hydraulic design calculations. Electrical and structural plans shall be furnished for review where applicable. Plans and specifications are to be sealed by a professional engineer registered in PA. Plans will be examined for general design, general dimensions, and apparent suitability and will be approved or returned for necessary changes. Such approval will not relieve the DEVELOPER of the responsibility for furnishing equipment which will satisfactorily perform under the conditions specified.

1.05 DESIGN CRITERIA

A. Pumping stations shall be designed and constructed to conform to all applicable regulations of the Pennsylvania Department of Environmental Protection, OSHA, the Pennsylvania Department of Labor and Industry, and all other applicable codes.

B. Special considerations shall be given to the fact that wet wells are considered hazardous Class 1, Group D environment.

C. The pumping station site shall be designed to prevent stormwater and/or ponding problems. Provisions shall be made on a case-by-case basis to include shrubbery or trees to act as a visual buffer from surrounding properties.

D. The site shall be of sufficient size to accommodate the pumping facilities and to permit the turn-around of service vehicles. The type of service vehicles necessary to accommodate and the size of the station required shall be determined on a case-by-case basis.

E. Any access road and turn-around at the pumping station shall have a paved surface. The minimum width of the paved surface of the access road shall be 12 feet. This width may increase based on the results of truck-turning movements to accommodate the type of service vehicles necessary to access the station. Access drive paving layers shall be suited to the type of service vehicles necessary to access the station.

F. The AUTHORITY reserves the right to require the site to be protected with a 6'-0" high, barbed wire topped, polyvinyl chloride (PVC) coated chain link fence with a vehicular access gate and man access gate. The AUTHORITY may allow the style of fencing the be adjusted to suit the character of surrounding properties.

G. As determined on a case-by-case basis, DEVELOPER may be required to furnish an influent grinder unit, wet well aeration system, variable frequency drives, a public water supply, a surge relief valve, a bypass standpipe connection, and/or exterior lighting.

1.06 MANUFACTURER'S WARRANTY

A. All pumping equipment components shall be manufactured, assembled, and tested as a unit by the pump manufacturer. The pumping equipment must be a standard catalog item with the manufacturer. The pump manufacturer must assume system responsibility, i.e. the pumping equipment must be warranted by the manufacturer as described herein. Individual component warranties are desirable. However, individual warranties honored solely by the manufacturers of each component will not be acceptable.

B. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. In addition to defects in material and workmanship, fiberglass-reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.

2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, except only those normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for the warranty of the station and all components.

C. Components failing to perform as represented by the manufacturer or as proven defective in material or workmanship during the warranty period shall be repaired, replaced, or modified by the manufacturer.

D. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from the failure of any vendor-supplied product or part that fails to operate properly, however caused. Consequential damages resulting from defects in design or delivery delays are also beyond the manufacturer's scope of liability.

E. This limited warranty shall be valid only when installation is made and use, and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized manufacturer’s representative must be received by the manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

## PART 2 – PRODUCTS

### 2.01 DESCRIPTION

A. DEVELOPER is responsible for furnishing a complete description of all equipment to be supplied, including manufacturer’s information and relevant pump characteristic curves based on laboratory tests of existing similar pumps. Curves shall show the capacity, head, efficiency, and brake horsepower throughout the head and capacity range.

2.02 FENCING

A. The site shall be fenced with a 6'-0" high, barbed wire topped, black, PVC coated chain link fence with a vehicular gate and man access gate.

B. The chain link fabric shall conform to Federal Specification RR-F-191/1D. The chain link fabric shall be Type 1. The fabric shall be 9-gauge core wire and galvanized all conforming to ASTM A641, woven after PVC coating in a 2-inch mesh. Top and bottom selvages shall have a twisted barbed finish, barbs to be formed by cutting wire on a bias. Fabric to be attached to intermediate posts with No. 6 aluminum fabric wire spaced approximately 15-inches apart and to the top rail with 9-gauge wires spaced approximately 18-inches apart. The fabric shall be fastened to all terminal and gate posts with ¼-inch by ¾ inch stretcher bars with No. 11 gauge pressed steel bands spaced approximately 12-inches apart. All bands, wires and tension bars shall conform to Federal Specification RR-F-191/4D.

C. Posts, rails, and braces shall conform to Federal Specification RR-F-191/3D and be fabricated of Class I (round steel sections), Grade A (hot dipped galvanized), seamless steel pipe, in accordance with ASTM A53 (Schedule 40), and be of the following sizes:

1. Corner and terminal posts: SP3 (2.375-inch OD).

2. Line posts: SP2 (1.900-inch o.d.)

3. Gate posts: SP5 (4.000-inch o.d.)

4. Rails and braces: SP1 (1.66-inch o.d.)

5. Spacing of posts shall not exceed 10-feet.

D. Both gates shall be provided with hot-dipped galvanized hinges, latches, stops and keepers in accordance with ASTM A153. Hinges shall be pressed steel or malleable iron, non-lift-off type, and offset to permit 180-degree gate opening. Latch shall be forked type to permit operation from either side of the gate. Provide padlock eye as integral part of latch.

E. The PVC coating for the chain link fabric shall be Class 2a or 2b as defined by ASTM F668.

F. Fence and gate(s) shall be topped with three strands of barbed wire consisting of two 12-1/2 gauge twisted line wires with 14 gauge round aluminum wire barbs having 4 points and spaced at 5-inches on center. Barbed wire support arms shall be single arm, for three strands of barbed wire and be at an angle of 45-degrees, with the top strand being 12-inches above and 12-inches out from the fence line.

G. Set all posts to a depth of 3-feet unless otherwise shown. After setting and plumbing the posts fill the holes with 2,500 psi concrete. Crown top of concrete to shed water.

2.03 WET WELLS

A. Wet wells shall be designed in accordance with PA DEP Standards. It shall be sized to avoid heat buildup in the pump motor due to frequent starts and to avoid septic conditions due to excessive detention time. The effective capacity (e.g., capacity between working levels) of the wet well shall generally provide a holding period of approximately 10-minutes for the design peak instantaneous flow.

B. Wet wells shall include concrete fillets (typically field-installed by the contractor) that should be at a 1:1 slope and should not extend about the "Lead Pump On" elevation. The horizontal area of the hopper bottom shall not be greater than necessary for proper installation and function of the pumping station.

C. There shall be sufficient submergence at the low water level to allow entrained air to escape, to prevent vortex formation, and provide adequate net positive suction head available (NPSHA) at the pump inlet.

D. The wet well access hatches shall be Type 316 stainless steel as manufactured by Bilco, Halliday Products or approved equal. Access hatches shall include a positive locking hold-open arm and aluminum "I" bar safety grating.

E. The elevation of the top floor and/or access to the pumping station shall be minimum 2 feet above the 100-year flood elevation and 6-inches above surrounding grade.

2.04 WET WELL LINER

A. All interior concrete surfaces (floor, walls, ceiling, pipe entries, and structure chimney (where applicable) shall have an epoxy liner applied to mitigate hydrogen sulfide corrosion. Epoxy liner shall be DuraPlate 6000, as manufactured by the Sherwin-Williams Company. This Epoxy liner shall have a minimum dry film thickness of 125 mils. Liner shall result in a monolithic structure conforming to the shape and contour of the wet well. Liner shall be completely watertight, free of any joints or openings other than pipe openings and hatch opening. Surface preparation shall be in accordance with the manufacturer's recommendations. No application shall be made unless the ambient temperature inside the structure is 50˚F or higher.

2.05 INFLUENT GRINDER

A. The influent grinder unit, if required, shall normally be on a wallmount frame allowing for removal to surface with no requirement to enter the wet well. It shall be incorporated into the OmniSite system for remote monitoring. The unit shall be

a X-Ripper by Volgelsang. Any other grinder makes and models are subject to the approval of the AUTHORITY. The unit shall be capable of passing the peak hour design flow without bypassing flow and have satisfactory operation under zero flow conditions. The unit shall be powered by a totally enclosed, non-vented, flood proof motor, suited for occasional total submergence. The grinder shall be of two-shaft design and be capable of continuous operation, processing wet or dry. Two-shaft design shall consist of two parallel shafts with monolithic rotors positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft.

B. The custom wallmount frame shall be of suitable dimension and strength to support grinder in place and direct flows toward cutters. The wallmount frame shall be of stainless-steel Type 304 construction and firmly anchored to the wet well wall. An overflow bar rack shall be provided to assure screening upon possible failure of grinder. A guide rail system shall be provided to permit easy removal of grinder for maintenance. There shall be no need for personnel to enter the wet well. An aluminum basket strainer shall be provided for installation in the channel frame to ensure continued screening when the grinder is removed for maintenance or inspection.

C. When a grinder jam condition occurs in the grinder ON or AUTO mode the controller shall stop the grinder, then reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. Up to four (4) additional reversing cycles (5 times total) may occur within 30 seconds before the controller de-energizes the grinder motor and activates the grinder fail indicator and relay.

2.06 PUBLIC WATER SUPPLY

A. If required, and where public water supply is available, furnish and install a minimum 1” diameter metered water service meeting all requirements of the public water provider. The water supply shall terminate at a frost-proof yard hydrant.

2.07 WET WELL AERATION

A. If required, furnish and install a Pro-Air Wet Well Aeration System pad mounted and within their standard weatherproof enclosure. This system shall consist of a blower assembly with a 1.5 HP motor, muffler, pressure gauge, vacuum gauge, relief valve, inlet filter, and all other vendor-recommended appurtenances to fit the application. The concrete pad to mount the system shall be set at least 2 feet above the 100-year flood elevation.

B. Aeration system shall come equipped with a control panel and control wiring necessary to accommodate Hand-Off-Auto controls, with the “Auto” position controlling the blower to run when the repeat cycle timer “ON” is activated and

controlling the blower to stop when the repeat cycle timer "OFF" is activated or a suction-lift pump is running. A manual motor protector shall be included to account for overload. Dry contacts shall be provided in the pump control panel to interface with the aeration system to ensure coordination between systems.

C. It shall be evaluated on a case-by-case basis whether to allow PVC Schedule 80 air header piping or a retrievable diffuser. Hopper bottom size, wet well diameter, and other design criteria shall factor into the air dispersion delivery method.

D. The following accessories should be installed with the wet well aeration system:

1. (1) Gauge kit - including independent, full-range indication of aeration blower inlet and outlet conditions. Total pressure across the aeration blower shall be the difference of the gauge indications.

2. (1) Inlet filter kit with replaceable filter element and shall be designed to protect the blower from pre-mature wear. Inlet filter must be installed outdoors.

3. (1) Spare inlet filter element

4. (1) Discharge ball valve, full port (port diameter equal to the nominal inside pipe diameter of the blower discharge port).

5. (1) Relief valve of adequate capacity to provide system protection. Relief valve shall have an adjusting screw capable of adjusting the blow-off pressure over the entire range of the blower. Relief valves utilizing weights are not acceptable.

6. (1) Flexible mounting system – shall include seven (7) flexible vibration isolating mounts for blower and piping.

7. (1) Inlet muffler/silencer

## 2.08 WET WELL PIPING AND FITTINGS

A. Suction and discharge flanged piping shall be Class 53 (min), epoxy lined ductile iron in accordance with ANSI A21.50 and ANSI A21.51 or AWWA C115 and C150. Fittings shall be ductile iron in accordance with ANSI A21.10 or AWWA C110, up to 12" inclusive, 250 psi rated. Flanged joints shall be used inside structures or above grade. Piping 2" or less shall be Schedule 40 Type 316 Stainless Steel.

B. Unless otherwise specified, all exposed exterior ferrous surfaces shall be painted with an applicable paint system.

C. Pipe hangers and supports shall be provided at suitable distances along the pipeline. Pipe hangers and supports shall conform to MSS SP-58, Pipe Hangers and

Supports - Materials, Design and Manufacture and MSS SP-69, Pipe Hangers and Supports - Selection and Application. All hangers and supports shall be of an approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-feet of water filled pipe being supported. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.

D. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required, where cold-applied galvanizing may be used. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper plated or shall have a 1/16-inch plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe, pipe within outdoor structures, and pipe in wet wells or other corrosive areas shall be of Type 304 or 316 stainless steel.

E. Ductile iron piping shall be supported at a maximum support spacing of 10-feet with a minimum of one pipe support per pipe section or joint. Floor supports shall be given preference. Support spacing for steel and stainless-steel piping, 2-inch and smaller in diameter shall not exceed 5-feet. For all stainless-steel piping, provide neoprene isolators between the pipe and support components. All vertical pipes shall be supported at each floor or at interval of not more than 12-feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction. All vertical pipes passing through pipe sleeves shall be secure using a pipe collar. No piping shall be supported from other piping unless specifically directed or authorized by the AUTHORITY.

## 2.09 VALVES

A. Plug Valves:

1. Plug valves shall be of the offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at the rated pressure. The disc shall be completely out of the flow path when open. Plug valves shall be as manufactured by DeZurik.

2. Plug valves shall have a minimum port area of 80-percent. Valves shall be rated for 175 psi WOG (Water, Oil and Gas) working pressure for sizes 4-in to 12-in inclusive and conform to the requirements of AWWA C504. All exposed bolts, nuts, and hardware shall be Type 316 stainless steel.

3. The valve disc shall be cast iron, ASTM A126, Grade B, or ductile iron, ASTM A536, Grade 65-45-12, and be of one piece. It shall be removable without removing the valve from the line.

4. Valve seats shall be resilient and of the continuous interface type having consistent opening and closing torques and shall be no-jamming in the closed position. Screw-in seats are not acceptable.

5. Plug valves shall be installed so that the direction of flow through the valve and the shaft orientation is in accordance with the manufacturer's recommendations. Unless otherwise noted, the shaft shall be horizontal with the plug opening up.

B. Check Valves:

1. Check valves 2-inch diameter and larger shall be iron body, bronze mounted, single cast iron or cast steel disc with bronze seat ring, extended stainless steel hinge arm with outside lever(s) and weight(s), with oil damped controlled closing, full opening with bolted cover, and shall conform to AWWA C508. They shall be designed for a minimum working water pressure of 150 psi water working pressure non-shock and hydrostatically tested at 300 psi.

2. Check valves shall be manufactured by APCO or approved equal.

C. Ball Valves:

1. Ball valves shall be manual actuated, bronze, resilient seated, regular port, threaded two piece bolted body type valves. The body and cap shall be of brass, ASTM B30, the ball and stem of Type 316 stainless steel and the seats and seals of TFE. The valves shall have full floating ball and shall be non lubricated. Valve seats shall be easily accessible and replaceable. Valves shall be rated to 250 psi and shall be as manufactured by Neles-Jamesbury, WKM or equal.

D. Air Release and Vacuum Valves:

1. Air release and vacuum valves shall include a valve body of 316 stainless steel and flushing connections. Valves shall be rated to 250 psi with a non-leaking sela closing at 0 psi. Air release and vacuum valves shall be furnished with piping to accommodate flushing (return) piping into wet well. Air release and vacuum valves shall be as manufactured by H-Tec or equal.

E. Surge Relief Valves:

1. Sewage surge relief valves may be required in combination with the controlled closing swing check valves to limit water hammer associated

with pump shut down and check valve closure on pumping stations with high total dynamic head and/or long force mains. If required, they shall be manufactured by APCO or approved equal.

2. If surge valves are utilized, they shall be manufactured by the same manufacturer as that of the controlled closing check valves. A manufacturer's representative shall be on-site to coordinate the operation of these valves during start-up.

## 2.10 PACKAGE STATION ENCLOSURE

A. The station enclosure shall be sized to contain and protect all pumps, interior piping, and valves. Enclosure shall incorporate the following design and service features:

1. Access doors shall be supplied on all sides. Doors shall be sized and placed to permit routine maintenance operations through the door openings of the enclosure. For these purposes, routine maintenance shall include pump and motor inspection, drive belt adjustment, and pump cleanout. Doors shall be supplied with tamper-proof hardware.

2. Doors shall provide access to frequently performed adjustments and inspections. Hinges shall be the continuous type. Latches shall engage the enclosure at not less than two places, and shall be protected by a keyed lock.

3. One door shall contain a screened vent to maximize airflow for enclosure ventilation.

4. Station enclosure, less base must be completely removable or able to disassemble following the removal of reusable hardware. After removal or disassembly, no portion of the enclosure (except conduit entrance) shall project above the surface of the base to interfere with maintenance operations or endanger personnel.

B. Materials:

1. The station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used. Glass fibers shall have a minimum average length of 1 1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to microorganisms, mildew, mold, fungus, corrosive liquids, and gases, which can reasonably be expected to be present in the environment surrounding the wet well.

2. All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide: maintenance-free service; abrasion resistance; and protection from greases, oils, gasoline, and other common chemicals.

C. The outside of the enclosure shall be coated with a suitable pigmented resin compounded to insure long, maintenance-free life.

D. Enclosure Base:

1. The station base shall be constructed of pre-cast, reinforced concrete, bonded inside a fiberglass form covering top and sides, and shall be designed to insure adequate strength to resist deformation of structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and shall be provided with an opening of sufficient size to permit piping and service connections to the wet well.

2. Station base shall incorporate anchor recesses for securing the pump station to the concrete pad supplied by the contractor in accordance with the station plans.

3. Color used shall de-emphasize the presence of dirt, grease, etc.

E. Exhaust Blower:

1. An exhaust blower shall be mounted in the roof of the enclosure. Blower capacity shall be sufficient to change station air once every two minutes. Blower motor shall be operated automatically and shall be turned on at approximately 70-degrees F and shall turn off at 55-degrees F. Blower motor and control circuit shall be protected by a thermal-magnetic air circuit breaker to provide overcurrent and overload protection. Blower exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

F. Station Heater:

1. Pump station shall be provided with a 1300/1500-watt, 115-volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable.

G. Enclosure Insulation:

1. The enclosure shall be provided with a 1-inch thick spray foam insulation, which shall be applied to the roof, doors, and corner panels.

H. Low Station Enclosure Temperature:

1. The enclosure shall be provided with a thermostat to serve as a low temperature alarm.

## 2.11 PACKAGE STATION PUMPS

A. Pump Description:

1. Pumps shall be Gorman-Rupp horizontal, self-priming, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

2. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capacity, and any trash or stringy material which may pass through the average house collection system.

B. Pump Performance:

1. Each pump shall have the necessary characteristics and be properly selected to perform under project-specific operating conditions, including:

a. Capacity, gpm

b. Total dynamic head, ft

c. Total dynamic suction lift, ft

d. Maximum static suction lift, ft

e. Discharge static head, ft

2. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

3. In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

C. Reprime Performance:

1. Each pump must be capable of the specified reprime lift while operating at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump

casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices shall not be acceptable. Additional standards under which reprime tests shall be run are:

a. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.

b. A ten-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump system fitted with an air release valve.

c. No restrictions shall be present in pump or suction piping that could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.

d. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.

e. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.

f. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.

g. Liquid to be used for reprime test shall be water.

D. Construction:

1. The pump, excluding the base frame and motor, shall be manufactured of iron that is melted and cast in the United States.

2. Pump design: Pumps shall be the original design of the pump manufacturer. Products violating intellectual property regulations shall not be allowed, as they may violate domestic or international law and expose the user or engineer to unintended liabilities. Reverse-engineered products fabricated to imitate the design of original products shall not be allowed as they may contain substantial differences in tolerances and material applications that may contribute to product failure.

3. Hardware: All hardware, nuts and bolts, shall be Unified Thread Standard (UNC) per ASME/ANSI standards.

4. Pump casing: Made of Gray Iron 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge. Suction

connection and discharge connection shall be vertically in-line with one another.

a. The casing shall have a top mounted 3-1/2 inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

b. Casing shall have no openings of smaller diameter than the specified sphere size.

c. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.

d. A minimum 1-1/4 inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.

e. Bolts and other threaded fasteners shall have Unified National Standard threads.

f. Suction flap valve: Molded neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of the pump without disturbing the suction piping or draining the casing. Sole function of the suction flap valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

g. Pump shall be provided with a separate capped threaded port for use of an optional casing heater.

5. Cover plate: Cover plate shall be Gray Iron 30.

a. A lightweight inspection coverplate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete coverplate assembly for access to the impeller will not be accepted.

b. Retained by four (4) hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and the allow removal or service to the impeller, seal, wear plate or suction flap valve.

c. Replaceable wear plate: Secured to the cover plate by four (4) welded studs and nuts. The wear plate shall be cast in Carbon Steel ASTM A36. The wear plate shall be the Gorman-Rupp Eradicator design for handling of solids and rags. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. Wear plate attachment hardware shall have Unified National Standard threads and shall be located out of the direct flow path of the liquid into the impeller.

d. O-ring Seals: Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The inner cover plate o-rings shall provide a seal between the suction chamber and the discharge chamber of the pump casing to eliminate the possibility of recirculation at the wear plate.

e. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75 PSI.

f. Pusher bolt capability to assist in removal of coverplate. Threaded pusher boltholes shall be sized to accept same retaining capscrews as used in rotating assembly.

g. Easy-grip handle shall be mounted to face of coverplate.

6. Rotating assembly:

a. Impeller: Two-vaned, semi-open, non-clog, cast in Ductile Iron 65-45-12 with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew.

b. Shaft: Shaft shall be constructed of Alloy Steel 4150 with an Alloy Steel 4130 shaft sleeve..

c. Mechanical seal: A mechanical cartridge seal shall seal the pump shaft against leakage. The stationary sealing member and the mated rotating face shall be silicon carbide. Each of the mated surfaces shall be lapped to a flatness of three light bands (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflection, vibration, and axial movement of the pump shaft. The seal shall be warranted for five (5) years from date of shipment.

d. Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Oil cavities must be

cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

i. The bearing cavity shall have an oil level sight gauge and fill plug with check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

ii. The seal cavity shall have an oil level sight gauge and fill plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.

iii. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

e. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

f. Seal plate: Replaceable seal plate shall be constructed of Gray Iron 30 and shall be bolted to the bearing housing.

g. Shaft bearings: Shall be anti-friction ball bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation.

h. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

7. Suction and discharge spools: Each pump shall be equipped with one-piece, cast iron spools, flanged on each end. Each spool shall have one 1 1/4-inch NPT and one 1/4-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

## 2.12 PACKAGE STATION PUMP ACCESSORIES

A. Spare Parts: Furnish the following spare parts:

1. Two (2) Spare Parts Kits, each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate O-ring, one (1) rotating assembly O-ring

2. One (1) complete rotating assembly

3. One (1) impeller
4. One (1) impeller washer
5. One (1) impeller socket head capscrew
6. One (1) wear plate with attachment hardware
7. One (1) impeller shaft
8. Four (4) suction flap valve assemblies
9. One (1) belt tensioning gauge – spring loaded
10. Two (2) quarts of seal lubricant
11. One (1) spare submersible transducer
12. One (1) spare float switch
13. Two (2) air-release valve diaphragms
14. Two (2) air-release valve springs
15. One (1) ARV spring compression tool
16. One (1) gallon touch-up paint, white
17. One (1) quart touch-up paint, safety orange

B. Gauge Kit With Vibration Isolation Frame:

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.

2. Gauges shall be mounted on a vibration isolation frame assembly with resilient panel, frame, and adjustable brackets which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

3. Gauge kit shall be supplied with stainless steel fittings.

C. Pump Drain Kit:

1. A pump drain kit shall be provided, including the following:

a. One set of drain fittings for each pump. Each set of drain fittings includes a pipe nipple, bushing, bronze ball valve and aluminum quick connect male Kamlock fitting.

b. One drain hose for common use among all pumps. Drain hose shall consist of a 10' length of plastic hose with an aluminum quick connect female Kamlock fitting on one end.

2. All fittings shall be supplied as stainless steel, unless specified otherwise above.

## 2.13 PACKAGE STATION VALVES AND PIPING

A. Check Valves:

1. Each pump shall be equipped with a full flow type check valve with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure.

2. Each check valve shall be provided with a ¼-inch treaded tap with plug on the downstream side of the valve for installation of a pressure gauge.

B. Plug Valves:

1. Each pump shall be equipped with a full flow type plug valve with flanged ends and be fitted with a lever operator to permit the pump to be isolated from the common discharge header. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

C. Air Release Valves (Diaphragm Type):

1. Each pump shall be equipped with one pressure actuated automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure, and shall operate solely on discharge pressure. Level/float actuated air release valves shall not be acceptable.

2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms shall be fabric-reinforced neoprene or similar inert material.

3. A cleanout port shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Air release valves shall be connected to pump station piping using stainless steel pipe fittings.

6. Each air release valve shall be provided with an isolation ball valve.

7. Air release valve piping must discharge directly into wet well. ARV piping shall not discharge to a sump.

8. Each air release valve shall have a separate air release discharge pipe back to the wet well for each air release valve. Discharge pipe shall be minimum 1-½-inch diameter.

D. Header Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be cast iron Class 125 and comply with ANSI B16.1. All piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

2. Boltholes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of ¼ inch apart.

E. Supports and Thrust Blocks:

1. Contractor must ensure all pipes connected to the pumping system are supported to prevent piping loads from being transmitted to pumps or system piping.

2. Pump station discharge force main piping shall be anchored with thrust blocks by the contractor where shown on the contract drawings.

F. Gauge Connection Assembly:

1. The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.

2. The gauge assembly shall consist of a 1/4" brass pipe nipple, 1/4" brass full port ball valve and a quick connect fitting.

3. The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

G. Portable Pump Discharge Bypass Connection:

1. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps.

2. The bypass connection shall terminate with a male OPW type quick connect fitting. Quick connect fitting shall be provided with a dust cap.

2.14 PACKAGE STATION DRIVE UNIT

A. Motors:

1. Provide motors as specified herein. Any additional motor requirements specified in another Specification Section, but not specified herein, shall not apply to the motors for this equipment.

2. The pump motors shall be horizontal, totally enclosed fan cooled, induction type, with normal starting torque and low starting current characteristics.

3. The motors shall not be overloaded at the design condition or at any head in the operating range as specified.

4. Motors shall be suitable for use with variable frequency drives.

5. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.

6. Each motor shall be in current NEMA design B cast iron frame with copper windings.

7. Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

B. Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.

2. Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a safety factor of less than 1.5 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.

3. V-belts shall be the banded type.

C. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.

2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.

3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.

4. The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

## 2.15 PACKAGE STATION PUMP CONTROL SYSTEM

A. General:

1. This specification covers a pump control system for the duplex pumping system, including motor circuit breakers, motor starters, door-mounted operator controls, and liquid level controls.

2. The primary liquid level control will include a submersible transducer level control system, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

3. The backup liquid level control will include two (2) intrinsically safe floats and an independent smart relay.

4. Each pump shall be equipped with reduced voltage solid state motor starters or variable frequency drives.

B. UL Listing:

1. The pump controls shall be manufactured by the pump manufacturer, a UL panel builder, and each assembly shall bear a serialized UL label listed as "Enclosed Industrial Control Panels."

2. The pump station/control panel manufacturer must maintain a local parts and service organization within 100 miles of the pumping station site.

3. The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open-style industrial control panels or an assembly of listed or recognized components is unacceptable.

C. Equipment Marking

1. A permanent corrosion-resistant nameplate(s) shall be attached to the control and include the following information:

a. Equipment serial number

b. Control panel short circuit rating

c. Supply voltage, phase, and frequency

d. Current rating of the minimum main conductor

e. Electrical wiring diagram number

f. Motor horsepower and full-load current

g. The motor overload heater element

h. Motor circuit breaker trip current rating

i. Name and location of equipment manufacturer

2. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to the device being identified.

3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to or above the device.

D. Panel Enclosure:

1. The enclosure shall conform to the applicable section of the National Electrical Manufacturers' Association (NEMA) standards for Type 1 electrical enclosures. The enclosure shall be fabricated of stainless steel with a minimum thickness of not less than 0.075 inch (14 gauge).

2. The door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. The door shall accommodate the mounting of switches and indicators.

3. The enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. The panel shall be of adequate size to accommodate all basic components.

4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators, and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.

5. Each control assembly shall be furnished with main terminals and ground lug for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115-volt, single-phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.

E. Motor Branch Components:

1. All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts and

suitable for use in a voltage range of 108 to 132 volts, 60 hertz. The short circuit rating of all power circuit devices shall be a tested combination or evaluated per the National Electric Code Article 409. The lowest-rated power circuit component shall be the overall control panel short circuit rating, not less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers that limit that fault current and may be rated less than the minimum required short circuit rating.

2. Circuit Breakers and Operating Mechanisms:

j. A properly sized heavy-duty air circuit breaker shall be furnished for each pump motor. The manufacturer shall seal All circuit breakers after calibration to prevent tampering.

k. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks that permit the door to be opened only when circuit breakers are in the "off" position.

F. Indicators:

1. Physical indicating light operators shall be made of an industrial-grade thermoplastic and chemical-resistant for harsh environments. Lights shall have a protection rating of IP 65/66 (type 3/3R/4/4X/12/13). Lights shall include an easily replaceable, integrated LED power module for long lamp life. Indicating lights shall be push-to-test.

2. Indicating lights will be furnished for the following functions:

a. General alarm (Integrinex) - Red

b. Pump No. 1 run - Green

c. Pump No. 2 run - Green

d. Pump No. 1 fault - Red

e. Pump No. 2 fault – Red

f. RVSS or VFD No. 1 fault – Red

g. RVSS or VFD No. 2 fault – Red

h. High water alarm – Red

i. Backup level control enabled - Red

G. Switch Controls:

1. A normal-duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

2. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump individually or permit automatic operation under the control of the liquid level control system. Manual operation shall override shutdown systems except for motor overload and phase failure relays. Selector switches shall be oil-tight design with contacts rated NEMA A-300.

3. Override switches shall be connected to bypass the level control system and all shutdown systems supplied with it, to provide manual start and manual stop of each pump individually in the event of level control system malfunction.

4. A pushbutton switch shall be provided to silence the 115-volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence push button shall also cause the high water alarm circuit to reset when the liquid level has been lowered.

H. High Pump Temperature Shutdown:

1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.

2. A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level that could cause pump damage, the thermostat shall cause the pump motor to shut down. A visual, mechanical indicator shall indicate that the pump motor has been stopped because of a high-temperature condition.

3. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

I. Elapsed Time Meters:

1. Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in “hours” and “tenths of hours”.

J. Elapsed Time Meter for Two Pump Operation:

1. A Six-digit elapsed time meter (non-reset type) shall be connected to both motor starters to indicate the total running time of both pumps operating simultaneously. Activation of ETM for two pump operation shall not disable individual ETMs.

K. Pump Start Delay:

1. The lag pump will be equipped with a time delay to prevent simultaneous motor starts.

L. Alarm Contacts:

1. Provide separate alarm contacts for the following alarm conditions:

a. High water (transducer)

b. High water (float)

c. Low water (transducer)

d. Phase failure

e. Pump No. 1 fault

f. Pump No. 2 fault

g. RVSS or VFD No. 1 fault

h. RVSS or VFD No. 2 fault

i. Station low temperature

j. Backup level control system enabled

k. Pump No. 1 run – normally open

l. Pump No. 2 run – normally open

m. Pump No. 1 run – normally closed

n. Pump No. 2 run – normally closed

o. Simultaneous pump run – normally open (Activation of simultaneous run contact shall deactivate individual pump run contacts.)

M. Three-Phase Voltage Monitor:

1. The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by phase reversal, phase loss, and voltage. The motor(s) shall automatically restart when power conditions return to normal.

N. Secondary Surge Arrestor:

1. All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/DC and shall be as follows:

2. Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.

3. Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).

4. Have a Surge Current Capacity (Imax) of at least 4X the available fault current at the station.

5. Have a Nominal Surge Current Rating (In) of 2X the available fault current at the station.

6. Use MOV technology with thermal disconnect.

7. Be RoHS compliant.

8. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.

9. Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:

a. All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in designing, developing and manufacturing such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The manufacturer shall offer a minimum five (5) year warranty for its Type 1 and Type 2 surge protective devices.

b. The hardwired surge protective device shall have specifications as shown below:

i. The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used

ii. Prewired NEMA 1 or NEMA 4X factory-sealed enclosure suitable for the intended installation location

iii. Shall have a two-color LED status indicator per phase

iv. Have an operating temperature range of at least -40˚C to +50˚C

v. Only use thermally protected MOV technology, such as Bussmann SurgePOD™.

vi. Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.

vii. Manufacturers must verify performance data for UL and CSA standards.

viii. All SPDs must be RoHS compliant.

ix. Surge protective devices shall be installed and located in accordance with all applicable agency, NEC®, and local code requirements. In addition, the SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of the service entrance Overcurrent Protective Device (OCPD).

x. All SPDs shall match voltage and system-specific requirements as provided by the manufacturer.

xi. All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).

xii. Surge protective device shall be marked with specifications as required by UL 1449 3rd Edition, along with UL holographic label on the SPD.

xiii. Each surge protective device should be serial numbered and have a barcode for easy identification and traceability.

O. Receptacle:

1. A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, and single-phase current shall be provided. The receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

P. Auxiliary Power Transformer:

1. A 3 KVA step-down transformer shall supply 115-volt AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit breaker, specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall be installed on the circuit breaker to provide a means of disconnecting power to the transformer.

2. A pad-lockable operator handle for the operating mechanism shall be located on the control panel's exterior with interlocks that prevent door opening until the primary circuit breaker is in the "OFF" position.

## 2.16 PACKAGE STATION WIRING

A. General:

1. The pump control furnished by the manufacturer shall be wired entirely except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.

2. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications set forth by the National Electric Code (NEC).

3. All user-serviceable wiring shall be Type MTW or THW, 600 volts, and shall be color-coded as follows:

a. Line and load circuits, AC or DC power Black

b. AC control circuit less than line voltage Red

c. DC control circuit Blue

d. Interlock control circuit, from external source Yellow

e. Equipment grounding conductor Green

f. Current carrying ground White

g. Hot with circuit breaker open Orange

B. Wire Identification and Sizing:

1. Control circuit wiring inside the panel, except internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.

2. Motor branch and other power conductors shall not be loaded above 60-degree C temperature rating on circuits of 100 amperes or less, nor above 75-degree C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied or installed in a duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

C. Wire Bundles:

1. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so the door can swing to its fully open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

D. Conduit:

1. All conduit and fittings shall be UL-listed.

2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid-tight, polyvinyl chloride cover.

3. Conduit shall be supported in accordance with Articles 346, 347, and 350 of the National Electric Code.

4. Conduit shall be sized according to the National Electric Code.

E. Grounding:

1. The pump control manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

2. The Contractor shall provide an earth-driven ground connection to the control panel at the main ground lug following the National Electric Code (NEC).

## 2.17 PACKAGE STATION LEVEL CONTROL SYSTEM

A. Liquid Level Control:

1. The level control system shall be a Gorman-Rupp Integrinex Standard Electronic Pressure Switch controller.

2. The manufacturer of the liquid level control system must be ISO 9001:2008 revision certified, with a scope of registration including design control and service after-sales activities.

3. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

4. The level control system shall be furnished as a submersible transducer type level control system; however, it must be capable of being operated as an air bubbler type system or radar transmitter type system.

5. The level control system shall incorporate automatic alternation to select the first pump, then the second pump, then subsequent pumps (if required) to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

6. The level control system shall utilize an electronic pressure switch, which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level." When the liquid is lowered to the "lead pump stop level," the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or subsequent pumps when the liquid reaches the "lag pump start level" or subsequent pump start levels so that all pumps are operating. These levels shall be adjustable as described below.

a. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120-volt outputs. Comparators shall be solid state and integrated with other components to perform as described below.

b. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24VDC in an ambient temperature range of -10

degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back-up.

c. Eleven optically isolated, user-defined digital inputs for pump and alarm status. Rated at 10mA at 24VDC. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12A at 28VDC and 120 VAC, five relays rated at 3A at 30VDC and 120VAC. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs, and digital output relays.

i. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be three times full scale.

ii. The electronic pressure switch shall incorporate a digital backlighted LCD panel display, which, upon operator selection, shall indicate liquid level in the wet well and pump status indication for up to 3 pumps. The display shall include a 128 x 64-bit resolution LCD to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full-scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

iii. Level adjustments shall be electronic comparator set points to control the levels at which the lead, lag, and standby pumps start and stop. Each level setting shall be easily adjustable using membrane-type switches and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, electronic test equipment, artificial level simulation,

or the introduction of pressure to the electronic pressure switch.

iv. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.

v. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.

d. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notifications. Alarm history will retain 16 of the most recent alarm events.

e. The electronic pressure switch shall be capable of jumping to the next available pump if the current pump is out of service due to pump failure or manual selection. Circuit design in which the application of power to the lag pump motor starter is contingent upon the completion of the lead pump circuit shall not be acceptable.

f. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

g. The electronic pressure switch shall be capable of controlling liquid levels in either a pump-up or pump-down application.

h. The electronic pressure switch shall have pump start/stop and alarm input delay(s) with adjustable delay set points.

i. The electronic pressure switch shall be capable of calculating and displaying the pump's elapsed run time. The elapsed run time is resettable and adjustable.

j. An Antiseptic function with a built-in timer shall be incorporated into the electronic pressure switch to prevent the well from becoming septic.

k. The electronic pressure switch shall have the internal capability of providing automatic simplex, duplex, and triplex automation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.

l. The electronic pressure switch shall be equipped with a security access code to prevent accidental setup changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.

m. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5VDC or 4-20mA, and one (1) scalable analog output of either 0-5VDC, 0-10VDC, or 4-20mA. Output is powered by 10-24VDC supply. Load resistance for 4-20mA output shall be 100-1000 ohms.

n. The electronic pressure switch shall include a DC power supply to convert 120 VAC control power to 12 or 24VDC power. The power supply shall be 500-mA (6W) minimum and be UL-listed Class II power limited power supply.

o. The electronic pressure switch shall have an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. In addition, a high water alarm shall be furnished with a dry contact wired to terminal blocks.

7. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are underway. After silencing the alarm device, a manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane-style button integral to the Integrinex Standard level controller.

B. Submersible Transducer System:

8. The level control system shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be 0-12 ft. W.C. minimum with an over-pressure rating 3 times full scale. The transducer shall have output capability of 0-5Vdc or 4-20mA. The transducer's polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

9. An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all

connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.

## 2.18 PACKAGE STATION BACKUP LEVEL FLOAT CONTROL

A. The pump control panel shall include an independent redundant float backup level control. The system shall work independently of the primary level control and utilize a small dedicated PLC.

B. The control shall operate as follows:

1. The low-level float (pumps off) shall be placed below all primary pump-off set-points. The high-level float (pumps start) shall be placed above all primary on set-points. A "Float Control Timer" shall begin to count if either float condition is achieved. When the timer expires, the Backup Level Float Control shall be latched in, the primary level control shall be disabled, and the floats shall become active, causing an indicating light to become illuminated on the front of the control panel and causing the dry contacts for the Backup Level Float Control Activation alarm circuit to close. Each time the high-level float is achieved, both pumps shall start. All pumps shall shut off when the wet well reaches the low-level float. The float control system shall remain active until manually reset.

2. The Backup Level Float Control system shall have the following functions:

a. Pumps On, High Water Alarm, Backup Level Float Control Activation – high-level float

b. Pumps Off – low-level float

c. Float Control Timer for high-level float (operator adjustable)

d. Float Control Timer for low-level float (operator adjustable)

e. Manual reset of Backup Level Float Control

C. The control system shall include the following:

1. Intrinsically safe relays

2. Independent PLC

3. Two (2) non-mercury float switches.

4. Dry contacts wired to terminal blocks for the Backup Level Float Control active alarm circuit.

5. Indicating light(s)

6. Float system includes a stainless steel chain and weight.

## 2.19 PACKAGE STATION REDUNDANT HIGH WATER ALARM FLOAT

A. A float switch shall be mounted in the wet well and wired in parallel to the standard high water alarm relay to serve as a redundant high water alarm.

1. Float switch shall be mercury-free.

2. Intrinsically safe barrier.

3. Float shall utilize the same NEMA 4X stainless steel junction box, anchor and stainless steel chain as the backup float level control system.

## 2.20 ELECTRICAL COMPONENTS

A. General:

1. The work shall include furnishing and installing the electrical service from the power company, lightning and surge protection equipment and wiring at the electrical service entrance and instrumentation transmitter, alarm system, grounding system, underground and exposed conduit, wire, cabling, and terminations for motors, motor controllers, control devices, control panels, electrical equipment, lighting, primary elements, transmitters, and local indicators.

2. All electrical panels, including, but not limited to, disconnect switches, meter base, automatic transfer switch, and distribution panels, shall be located under a suitable canopy to mitigate the introduction of hazardous weather conditions from impacting an operator's ability to access these panels and their internal components. Canopy shall extend a minimum of 4'-0" beyond the strut rack on which these electrical components are mounted. Canopy shall provide a working height of 7'-0". Construction typically includes a cover welded to the strut rack with corner posts installed to support the weight of the canopy. Canopy shall be sloped so as to prevent the buildup of snow and shall comply with load requirements as dictated by code requirements.

3. Electric equipment, materials and installation shall comply with the latest edition of the National Electrical Code (NEC) and with the latest edition of the following codes and standards:

a. National Electrical Code (NEC)

b. National Electrical Safety Code (NESC)

c. Occupational Safety and Health Administration (OSHA)

d. National Fire Protection Association (NFPA)

e. National Electrical Manufacturers Association (NEMA)

f. American National Standards Institute (ANSI)

g. Insulated Cable Engineers Association (ICEA)

h. Instrument Society of America (ISA)

i. Underwriters Laboratories (UL)

j. Factory Mutual (FM)

k. National Electrical Testing Association (NETA)

4. Area Classifications and Enclosure Types:

a. NEMA 12 for dry, indoor above grade locations including generator or pump station building interiors.

b. NEMA 3R for outdoor non-corrosive and non-hazardous areas at least 10’ away from open wet well or basin.

c. NEMA 4 for outdoor locations, rooms below grade, including basements and buried vaults at least 10’ away from open wet well or basin.

d. NEMA 4X, 316 Stainless Steel for corrosive areas or within 10’ from open wet well or basin.

e. NEMA 7 areas shall be rated "Class I Div. 1 Group D", including open wet wells and basins.

f. All electrical equipment shall be rated for the location of installation.

5. Hazardous Areas:

a. Equipment, materials and installation in areas designated as hazardous shall comply with National Electrical Code Articles 500, 501, 502 and 503.

b. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

6. Materials and Equipment:

a. Materials and equipment shall be new.

b. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

7. Equipment Identification:

a. Identify all electrical equipment including disconnect switches, separately mounted motor starters, control stations, motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches.

b. Nameplates shall be engraved, laminated plastic, not less than 1/16 in thick by 3/4 in by 2 1/2 in with 3/16 in high white letters on a black background.

c. Nameplates shall be screw mounted to NEMA 12 enclosures and bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two-sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

B. Service and Metering:

1. Service will be obtained at 240 or 480 Volts, 3 Phase, 4 Wire, 60 Hz.

2. Coordinate with the power company to obtain electrical service, pay all power company charges and furnish all labor and material required to install all electrical equipment required by the power company, including all service entrance conduits and cabling, a power company approved metering current transformer enclosure and a pedestal or meter base. The power company shall approve conduit size and type.

3. Provide a main service entrance approved disconnect switch with current limiting fuses as required.

C. Permanently-Installed Emergency Power:

1. If required, permanent emergency power shall be provided by a liquid propane powered emergency generator set and automatic transfer switch to run the pumps and all equipment within the station upon loss of normal power.

a. The system components shall be new equipment of current design, not one-of-a-kind, and consist of a Pennsylvania approved engine-driven, electric plant with mounted start- stop controls, an automatic load transfer control, fuel, oil, and anti-freeze, and necessary accessories. All components shall be completely built, tested, and shipped by a manufacturer who has been regularly engaged in the

production of such equipment for the past ten years and who has a local parts and service facility, so there is one responsibility for the proper functioning of the entire system. The plant shall be as manufactured by Cummins, MTU, or approved equal.

b. Provide a line circuit breaker with the generator. Breaker shall be rated to handle the generated fault currents and shall be one of those listed by the transfer switch manufacturer. Breaker shall have the required number of poles and current rating capable of handling required load.

c. Provide generator control panel with the following: voltmeter, ammeter, selector switch, start controls, voltage level adjustment rheostat, oil pressure gauge, fault indicators for safety shutdown, "Auto/Manual" switch, water temperature gauge, battery charge rate ammeter, field circuit breaker, running time meter, panel face illumination from the battery, generator failure output contacts.

d. A current limiting battery charger shall be furnished to automatically recharge the starting batteries. Charger shall float at 2.17 Volts per cell and equalize at 2.33 Volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, and fused AC input. AC input voltages shall be 120 Volts. Amperage output shall be no less than 5 amperes. Charger shall be LaMarche Manufacturing Company, Model A-5, ESB Inc., or approved equal.

e. Provide pad-mounted liquid propane tank of sufficient capacity to sustain a minimum of 24 hours running at full load, fuel gauge, fuel lines, and a full tank of propane.

f. The Automatic Transfer Switch shall be designed for an emergency and normal source of 240 or 480 Volt, 3 Phase, 3 Wire, 60 Hz. Current ratings shall be as required. Switches shall be listed under UL 1008. The switches shall initiate transfer of the load to the emergency source when any phase of the normal source drops below 90 percent of normal voltage. The transfer switches shall be adequately constructed to carry full rated current on a continuous 24-hour basis in all approved enclosures and shall not show excessive heating or be subject to de rating. The transfer switches shall be capable of withstanding all available system fault currents without parting of or damage to contacts during the fault clearing time of the system over current device. The transfer switches shall be of inherently 3 Pole double throw construction and shall have three position operations: closed to normal source, open, closed to emergency source. Time delay between opening of the closed contacts and closing of the open contacts shall be a minimum of

400 milliseconds to allow for voltage decay before transfer is complete. The transfer switch shall be furnished with a close differential adjustable phase sensing relay set to drop out at 80 percent of rated voltage and pick up at 90 percent of rated voltage. The relay shall be adjustable 0.5 to 6.0 second tune delay to override normal source power outages (set at 2 seconds) with two auxiliary contacts to open on normal source failure (for combustion air damper control) and two auxiliary contacts to close on normal source failure (for remote alarm and engine start). The transfer switch shall be furnished with a neutral (off) position relay with adjustable time delay 0.1 to 10 seconds, auxiliary contacts to open 0 to 30 seconds (adjustable) before transfer to either normal or emergency source and to close after transfer has occurred. These contacts are to cause variable frequency drive controllers to come to a controlled stop before transfer to either source and allow re start after transfer has occurred. Each transfer switch shall have one set of these contacts for each current source variable frequency drive controller connected downstream. Adjustable time delay on retransfer to normal (1 to 300 seconds) with a 0-to-25-minute adjustable unloaded engine running time after retransfer. A maintained contact test auto switch and normal/emergency pilot lights shall be mounted on the door. Enclosure paint color shall be ANSI Z55.1, No. 61, light gray. Automatic transfer switch shall have the following withstand ratings (10 cycle):

| Switch Rating | Withstand Rating |
|---|---|
| 100 to 200 Amps | 22,000 Amps at 480 Volts RMS SYM |
| 225 to 800 Amps | 40,000 Amps at 480 Volts RMS SYM |
| 1000 to 1600 Amps | 50,000 Amps at 480 Volts RMS SYM |

The automatic transfer switch shall also be furnished with a plant exerciser for automatic test operation of plant with transfer of load for pre-selected intervals (adjustable 0-168 hours in multiples of 15 minutes) at least once a week. All accessories and equipment shall be front accessible for ease of maintenance or removal. Automatic transfer switches shall be Russelectric, Type RMTD; Automatic Switch Company; ASCO, Cummins or equal.

D. Portable Emergency Power:

1. If allowed by special exception, emergency power may be provided by including a NEMA 3R transfer switch, portable generator compatible receptacle, circuit breaker and enclosure, and all related conduit and

wiring to run the pumps and all equipment within the station upon loss of normal power.

E. Main Circuit Breaker shall be a thermal magnetic molded case circuit breaker 240/480 Volt, 3 Pole. Main circuit breaker type shall be coordinated with the automatic transfer switch to obtain AIC rating withstand/closing.

F. Panelboards:

1. Distribution panelboards shall be of size, voltage, and number of phases as required, 240/480 Volt, 3 Phase, 4 Wire. Panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable. Panelboards shall be equipped with circuit breakers. Circuit breakers shall be molded case, bolt in type. Each circuit breaker used in 240/480 Volt panelboards shall have an interrupting capacity of not less than 22 K AIC. GFCI (ground fault circuit interrupter) shall be provided for circuits where required. GFCI units shall be 1 Pole, 120 Volt molded case, bolt on breakers, incorporating a solid-state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 22 K AIC. Circuit breakers shall be as manufactured by the panelboard manufacturer. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

2. Mount boxes for surface mounted panelboards so there is at least 1/2 in air space between the box and the wall.

3. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.

4. Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.

5. Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self-sticking B 500 vinyl cloth printed with black characters on an Alert Orange background, 2 1/4 in high by 9 in wide, Style A as manufactured by W.H. Brady Co. or equal.

6. Install a 1 in by 3 in laminated plastic nameplate with 1/4 in white letters on a black background on each panelboard. Nameplates shall be stainless steel screw mounted.

G. Disconnect Switches shall be heavy duty, quick make, quick break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle, as manufactured by the Square D Co. or equal.

H. Fused Disconnect Switches shall be heavy duty, quick make, quick break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle. Fuses shall be rejection type, 600 Volt, 200K A.I.C., dual element, time delay, as manufactured by Bussman, Gould Shawmut, Littelfuse Power Fuse Division or equal. Switches shall be as manufactured by the Square D Co. or equal.

I. General Purpose Dry Type Transformers shall be dry type, two winding with kVA and voltage ratings as required, four full capacity taps shall be furnished, two 2 1/2 percent above and two 2 1/2 percent below rated primary voltage. Maximum temperature rise shall be 115 degrees C. Windings shall be copper. Transformers shall be built in accordance with ANSI C89.2 and NEMA ST 20. Transformers shall be furnished with mounting hardware. Transformers shall be manufactured by the Square D Co. or equal.

J. Transient Voltage Surge Suppressors (TVSS) shall be a hybrid device utilizing SAD (Silicon Avalanche Diodes), MOV (Metal Oxide Varistors) and CAP (Capacitors) technology. The TVSS unit shall be listed under UL 1449 Second Edition and UL 1283 for noise attenuation devices. Units shall have parallel line-neutral, line-ground and neutral ground connection configuration, one Nanosecond or less response time, extend noise filtration with a 10 kHZ to 100 MHZ range, fused internal disconnect switch with 60 Amps, 300,000 AIC rating, LED indications, six-digit surge counter, form C output contacts, 240/480 Volt, 3-phase, 4 wire, grounded voltage configuration. TVSS shall be as manufactured by United Power Corporation; Transtector Systems; Current Technology or equal.

K. Lighting:

1. If required, DEVELOPER shall furnish and install lamps and accessories as required. Overhead exterior lighting shall provide adequate lighting in wet well area and shall be in compliance with municipal Subdivision and Land Development Ordinance and/or municipal Subdivision and Land Development Code. Prior to acceptance of building by AUTHORITY, all fixtures shall be cleaned, free of dust, insects and all foreign matter. The light fixture schedule is listed below:

    a. Industrial, ceiling mounted LED, 2-lamp, 4-foot, 10-15 aperture up-light porcelain enamel reflectors, 120 Volts.

    b. Outdoor wall-mounted LED, 120 Volts with integral photocell control.

L. Conduits, Boxes and Fittings:

1. Materials:

   a. PVC conduit shall be used for concrete encased underground duct banks. PVC conduit shall be rigid polyvinyl chloride (PVC) schedule 40 and 80 as manufactured by Highland Plastics Inc. or equal.

   b. Handholes shall be precast concrete, heavy duty type, designed for a Class H 20-wheel load and conform to ASTM C478. Precast units shall be as manufactured by Chase Precast Corp.; American Precast Co. or equal and constructed to dimensions as shown on the Drawings. Handhole frames and covers shall be cast-iron, heavy-duty type for Class H 20 wheel loading.

   c. Liquid-tight flexible metal conduit, couplings and fittings shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal. Fittings used with liquid-tight flexible metal conduit shall be of the screw in type as manufactured by the Thomas & Betts Co.; Crouse Hinds Co. or equal.

   d. Flexible couplings shall be type ECGJH as manufactured by the Crouse Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

   e. Pressed steel switch and outlet boxes shall be hot dipped galvanized as manufactured by the Raco Manufacturing Co.; Adalet Co.; O.Z. Manufacturing Co. or equal.

   f. Terminal boxes, junction boxes, and pull boxes for NEMA-4 and 12 areas, shall be galvanized sheet steel with continuously welded seams. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14-gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt. Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; Keystone/Rees, Inc. or equal.

   g. Terminal boxes, junction boxes, and pull boxes for NEMA-4X areas, shall be Type 316 stainless steel with stainless steel hardware and covers having a continuous gasket on all four sides. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt. Boxes shall be as

manufactured by Hoffman Engineering Co.; Lee Products Co.; Keystone/Rees, Inc. or equal.

h. Explosion proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations. They shall be cast iron with cadmium zinc or hot dipped galvanized finish, stainless steel or hot dipped galvanized bolts; Type EJB as manufactured by the Crouse Hinds Company; Appleton Electric Co.; The Pyle National Co. or equal.

i. Conduit hubs shall be as manufactured by Myers Electric Products, Inc. or equal.

j. Explosion proof fittings shall be as manufactured by the Crouse Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

k. Conduit sealing bushings shall be O.Z./Gedney Type CSB or equal.

l. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by Crouse-Hinds Co.; Type AXDX as manufactured by O.Z./Gedney Co.; Type DF as manufactured by Appleton Electric Co. or equal.

m. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type AXDX as manufactured by O.Z./Gedney Co.; Type DF as manufactured by Appleton Electric Co. or equal.

M. Wire, Cable, and Accessories:

1. Materials:

a. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

b. All conductors shall be stranded, except that lighting and receptacle wiring may be solid.

c. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

d. Wire for lighting, receptacles and other circuits not exceeding 150 Volts to ground shall be NEC Type THHN/THWN as manufactured by Okonite Co.; Southwire Co.; Pirelli Corp., or equal.

e. Wire for circuits over 150 Volts to ground shall be NEC type

THHN/THWN for dry locations and XHHW for wet locations as manufactured by Okonite Co.; Southwire Co., or equal.

f. Wire for control, status and alarm circuits shall be No.14 AWG NEC type THHN/THWN for dry locations and XHHW for wet locations as manufactured by the Okonite Co.; Carol Cable Co. Inc. West; Pirelli Cable Corp. or equal.

g. Wire for process instrumentation signals (i.e. 1-5 VDC, 4-20 mA), R.T.D., potentiometer and similar signals shall be single pair cable, 2 or 3 wire or multiple pair, No.16 AWG stranded and twisted on 2 in lay, PVC with 300 Volt, 105 degrees C rated insulation, 100% mylar tape with drain wire, PVC jacket with UL Subject 13, UL 1581, and manufacturer's identification, and UL listed for underground wet locations as manufactured by Belden (No. 1030) or equal.

h. Splices for power wiring shall be compression type connectors insulated with a heat shrink boot or outer covering and epoxy filling. Splice kits shall be as manufactured by Raychem; Ideal Industries; 3M Co. or equal.

i. Motor connections shall be ring type mechanical compression terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and spring washer. Connections shall be insulated with a Raychem Type RVC, roll on stub insulator or equal.

j. Termination connectors for control wiring shall be of the locking fork end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

k. Splices for control wiring shall be insulated compression type connectors of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

l. Termination connectors for shielded instrumentation wiring shall be of the locking fork end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

m. Wire markers shall be "Omni Grip" as manufactured by the W.H. Brady Co.; Thomas & Betts Co.; 3M Co. or equal.

n. Wire and cables with diameters exceeding the capacity of the "Omni Grip" shall be marked with preprinted, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp. or equal.

o. Direct buried cable warning tape shall be 6 in wide, red polyethylene not less than 0.0035 in thick. Tape shall be W.H. Brady Co., Catalog No. 91296 or equal.

N. Wiring Devices:

1. Materials:

a. Weatherproof/corrosion resistant single or duplex, 20 Amp, 125 Volt, 2P, 3W, with cover; Crouse Hinds Co., Catalog No. WLRS 5 20, or equal by Appleton Electric.

O. Grounding/Lightning Protection:

1. Ground rods shall be 3/4 in by 10 ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm. Ground rods shall be Copperweld or equal.

2. Grounding conduit hubs shall be malleable iron type similar to Thomas & Betts Co.; Cat No. 3940 (3/4 in conduit size) by Burndy; O.Z./Gedney Co. or equal, and of the correct size for the conduit.

3. Waterpipe ground clamps shall be cast bronze saddle type, similar to Thomas & Betts Co. Cat. No. 2 (1/2 in, 3/4 in, or 1 in size) or equal by Burndy; O.Z./Gedney Co. or equal, and of the correct size for the pipe.

4. Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

5. A grounding grid shall be provided at the service pole. Metal raceways, metal enclosures of electrical devices, transformer frames, neutral conductor and other equipment shall be completely grounded in accordance with the National Electrical Code. All necessary conduit, conductors, clamps, connectors, etc. for the grounding system shall be furnished and installed by the Applicant.

6. Run grounding electrode conductors in rigid steel conduits. Bond the protecting conduits to the grounding electrode conductors at both ends. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.

7. Install equipment grounding conductors with all feeders and branch circuits.

8. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus.

9. Ground wire connections to structural steel columns shall be made with long barrel type one-hole heavy duty copper compression lugs, bolted

through 1/2 in maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts.

10. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250 95, except that a minimum No. 12 AWG shall be used.

11. Liquid tight flexible metal conduit in sizes 1 1/2 in and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.

12. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250 94.

13. Seal exposed connections between different metals with No Oxide Paint Grade A or equal.

14. Lay all underground grounding conductors' slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

15. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

16. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

17. Lightning protection shall be provided on the feeders immediately on the load side of the main disconnect switch, grounding lead as short as possible to grounding system, Innovative Technology, Inc. "P-Plus" series, no equal; A plug-in protector shall be used which has receptacles and RJ-11 jack for the telephone/dialer connections, Innovative Technology, Inc. Model PIU, no equal.

P. Sleeves and Forms for Openings.

1. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

2. Exact locations are required for stubbing up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or

other subcontractors and locate the concealed conduit before the floor slab is poured.

3. Seal all openings, sleeves, penetration and slots.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

A. Install pumping station equipment where indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, to ensure that stations comply with requirements and serve intended purposes. Comply with requirements of governing regulations. Any work not installed according to the specifications shall be subject to change as directed by the AUTHORITY.

B. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the AUTHORITY's discretion.

C. Install, level, and align the pump station as indicated on project drawings. Installation must follow written instructions supplied by the manufacturer at the time of delivery.

D. Set all fence posts to a depth of 3 feet unless otherwise shown. After setting and plumbing the posts, fill the holes with 2,500-psi concrete. Crown top of concrete to shed water.

E. After final grading, site shall be seeded and landscaped. DEVELOPER is responsible for obtaining site stability and germination prior to the time of first cutting.

F. Suction pipe connections must be vacuum-tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve, or pump drain lines) in the wet well as required.

G. Provide adequate clearance for removal of pump rotating assembly and cover plate.

H. Each air release valve shall have a separate air release discharge pipe back to the wet well for each air release valve. The discharge pipe shall be a minimum 1-½-inch diameter and constantly downward slope towards the wet well.

I. Motors are to be wired with appropriate Split-Bolt or Pre-Insulated Connectors. Connection shall be adequately insulated, using best industry practices.

J. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

K. Prior to applying electrical power to motors or control equipment, check all wiring for tight connection. Verify that fuses and circuit breakers conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

L. After all anchor bolts and piping connections are installed, seal all openings between wet well and the pump enclosure.

M. If AUTHORITY Engineer and/or manufacturer at startup determines that grouting the pump/motor base is needed, the CONTRACTOR shall be responsible for installing grout to the pump/motor base. If grout is installed, the CONTRACTOR shall ensure that the grout does not interfere with the pump/motor/belt guard adjustment or mounting hardware.

N. The VFD shall be covered and protected from dust, moisture, and contamination.

O. All valves shall be installed so that the direction of flow through the valve and the shaft orientation is in accordance with the manufacturer's recommendations.

P. Conduit Installation:

1. PVC conduit shall be used for concrete encased underground duct banks.

2. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast or malleable iron, except that cast aluminium shall be used with aluminium conduit.

3. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed.

4. Conduit wall seals shall be used where underground conduits penetrate walls.

5. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather.

6. No conduit shall any have more than the equivalent of three 90-degree bends in any one run. Pull boxes shall be provided as required or directed.

7. No wire shall be pulled until the conduit system is complete in all details.

8. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.

9. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.

10. All conduits shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true.

11. Conduit terminating in NEMA 3R, 4, 4X and 12 enclosures shall be terminated with Myers type conduit hubs.

12. Liquid-tight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present.

13. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

14. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.

15. PVC conduit to non-metallic box connections shall be made with PVC socket to male thread terminal adapters with neoprene O ring and PVC round edge bushings.

16. Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

17. PVC conduit shall be supported with non-metallic clamps, PVC coated steel or non- metallic racks and stainless steel hardware.

18. PVC boxes, conduit fittings, etc. with integral hubs shall be solvent welded directly to the PVC conduit system.

19. Non-metallic boxes with field drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.

20. All conduit entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated.

21. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 7.

22. All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc., shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits.

23. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of N.E.C. Article 370.

24. Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed.

25. Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc. for a rigid installation.

26. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

27. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.

28. Conduit expansion and deflection fittings shall be installed on all conduits crossing building expansion joint. Where conduits are installed outdoors provide expansion and deflection fittings on all conduits crossing expansion joints or at 200-foot intervals whichever is the least dimension.

Q. Wire, Cable, and Accessories Installation:

1. Uniquely identify all wires, cables, and each conductor of multi conductor cables (except lighting and receptacle wiring) at each end with wire and cable markers.

2. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.

3. All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, and other accessible intermediate locations as well as at each termination.

4. The following coding shall be used:

| System | Wire | Color |
|---|---|---|
| 240/120 Volts | Neutral | White |
| 1 Phase, 3 Wire | Line 1 | Black |
| | Line 2 | Red |
| 208Y/120, Volts | Neutral | White |
| 3 Phase, 4 Wire | Phase A | Black |
| | Phase B | Red |
| | Phase C | Blue |
| 240/120 Volts | Neutral | White |
| 3 Phase, 4 Wire | Phase A | Black |
| delta, center tap | Phase B (High) | Orange |
| ground on phase coil A C | Phase C | Blue |

| System | Wire | Color |
|---|---|---|
| 480Y/277 Volts | Neutral | White |
| 3 Phase, 4 Wire | Phase A | Brown |
| | Phase B | Orange |
| | Phase C | Yellow |

5. Power conductors: Terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling. Aluminium conductors (where specified) shall employ terminations and splices specifically designed for aluminium conductors.

6. Control Conductors: Termination on saddle type terminals shall be wired directly with a maximum of two conductors. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors.

7. Instrumentation Signal Conductors (including graphic panel, alarm, low- and high- level signals): terminations same as for control conductors. Splices allowed at instrumentation terminal boxes only.

8. Except where permitted by the Authority no splices will be allowed in manholes, handholes or other below grade located boxes.

9. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc), conduit bodies, etc.

10. Instrumentation cables shall be installed in rigid steel raceways as specified. All circuits shall be installed as twisted pairs or triads. In no case shall a

circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

11. Terminal blocks shall be provided at all instrument cable junction and all circuits shall be identified at such junctions.

12. Shielded instrumentation wire shall be run without splices between instruments, terminal boxes, or panels.

13. Shields shall be grounded as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for interconnecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

R. Wiring Device Installation:

1. Switch and receptacles outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypboard construction, or when raceways are concealed. In dry areas with cement block construction surface mounted devices may be installed.

S. Grounding Installation (Where Required by NEC):

1. Run grounding electrode conductors in rigid steel conduits. Bond the protecting conduits to the grounding electrode conductors at both ends. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.

2. Install equipment grounding conductors with all feeders and branch circuits.

3. Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus.

4. Ground wire connections to structural steel columns shall be made with long barrel type one-hole heavy duty copper compression lugs, bolted through 1/2 in maximum diameter holes drilled in the column web, with stainless steel hex head cap screws and nuts.

5. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connect to the motor control center ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250 95, except that a minimum No. 12 AWG shall be used.

6. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250 94.

7. Seal exposed connections between different metals with No Oxide Paint Grade A or equal.

8. Lay all underground grounding conductors' slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

9. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

10. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

11. Test the grounding system. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.

12. Testing shall be performed before energizing the distribution system.

13. Notify the AUTHORITY immediately if the resistance to ground for any building or system is greater than five ohms.

T. Cutting and Patching:

1. Cutting and patching shall be done in a thoroughly workmanlike manner. Saw cut concrete and masonry prior to breaking out sections.

2. Core drill holes in concrete floors and walls as required.

3. Install work at such time as to require the minimum amount of cutting and patching.

4. Do not cut joists, beams, girders, columns or any other structural members.

5. Cut opening only large enough to allow easy installation of the conduit.

6. Patching to be of the same kind and quality of material as was removed.

7. The completed patching work shall restore the surface to its original appearance or better.

8. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

9. Remove rubble and excess patching materials from the premises.

10. When existing conduits are cut at the floor line of wall line, they shall be filled with grout of suitable patching material.

U. All motors, pumps, bases, brackets, ladders, piping and steel supports shall be properly primed and painted with two coats of rust inhibitor paint in strict accordance with the manufacturer's recommendations.

3.02 PROTECTION AND STORAGE OF EQUIPMENT AND MATERIALS

A. The CONTRACTOR shall store equipment and materials strictly per the manufacturer's recommendations and as directed by the AUTHORITY Engineer. Material or equipment stored on the job site is stored at the CONTRACTOR's risk.

B. The pumping equipment should be placed into service soon after delivery of the equipment. If the installation is delayed, the pumping equipment and pump control panel shall be stored indoors, free of excessive dust, in a low-humidity, heated environment.

C. Spare parts shall be stored separately in a locked area maintained by the CONTRACTOR. The spare parts shall be made available for inspection by the manufacturer’s service technician at Startup. Parts shall be turned over to the AUTHORITY prior to substantial completion. Spare parts shall be properly packed, labeled, and stored where directed by the AUTHORITY. The CONTRACTOR assumes responsibility for missing/lost spare parts.

D. During installation and after the pumping equipment is placed into operation, the pump control panel shall operate in an environment free of excessive dust, in a low humidity, heated environment.

3.03 FIELD QUALITY CONTROL

A. Before the AUTHORITY accepts, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable, safe, and in optimum working condition and conforms to the specified operating characteristics.

B. A factory trained technical representative shall provide a minimum of one day installation supervisor, one day of start-up services, and one day for operator training. Additional time shall be provided as necessary to have a properly functioning system in accordance with the specifications.

C. A factory trained technical representative shall provide a written statement that the pumping system and controls have been installed in accordance with manufacturer’s recommendations.

D. Prior to start-up, clean wet well by removing construction debris and foreign material.

3.04 PRE-STARTUP INSPECTION

A. Coordinate system pre-startup with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the CONTRACTOR, Engineer, or AUTHORITY.

B. The CONTRACTOR shall arrange for a qualified service technician regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the service technician shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the AUTHORITY.

C. The manufacturer's representative shall provide a pre-startup checklist to be completed by the CONTRACTOR before pre-startup inspection.

D. Verify that the operations and maintenance manual is on-site and that installation instructions contained in the manual have been followed.

E. Verify that all pumping equipment, piping, level control system, alarms, and ancillary equipment have been properly installed and all wiring is complete.

F. Verify that all spare parts for the pumping equipment are on site.

G. Pre-startup inspection shall be a separate trip and shall not be less than two (2) weeks prior to the startup of the equipment.

3.05 STARTUP AND FIELD PERFORMANCE TESTING

A. Coordinate system start-up with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise the correction of defects or malfunctions. The tests shall prove that the equipment and appurtenances are properly installed and are free from defects such as overheating, overloading, and undue vibration and noise. Startup shall be performed with the assistance of the CONTRACTOR and in the presence of the Engineer and AUTHORITY.

B. Equipment startup shall be tested under both utility power and emergency power.

C. CONTRACTOR shall supply clear water of adequate volume to operate the system, including the force main, through several pumping cycles. Water must be available in a quantity adequate to verify the following test parameters:

1. Pumping rate of each pump individually (via conducting pump drawdown test) using primary electrical service.

2. Pumping rate of both pumps at the same time using primary electrical service.

3. Current and voltage readings of each pump individually and both pumps at the same time.

4. Verification that both primary and backup level controls are operating as intended.

5. Verification that any flow metering is calibrated and corresponds to the results of the pump drawdown tests.

6. Verification that pumping station can run as designed using emergency power.

D. Contractor shall have an electrician present at startup to resolve any wiring issues.

E. If any of the parameters listed above do not conform within reason to the design conditions, or if any of the appurtenances installed do not perform as intended on the Contract Drawings, CONTRACTOR shall be responsible to rectify them and if necessary, organize an additional pumping station startup at no additional cost to the AUTHORITY (including any costs to have the Engineer, Manufacturer, and any additional necessary parties return for an additional day).

F. Observe and record the operation of pumps, suction and discharge gauge readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check the calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report any undue noise, vibration or other operational problems.

G. Startup shall be a separate trip with at least two (2) man-days on site for the manufacturer.

H. The CONTRACTOR shall bear all costs concerning field testing of equipment such as lubricants, temporary instruments, labor, materials, electrician, equipment, etc..

3.06 OPERATION AND MAINTENANCE TESTING

A. The manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train Owner’s personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

1. Theory of operation

2. Actual operation

3. Mechanical maintenance

4. Hydraulic troubleshooting

5. Electrical maintenance

6. Instrumentation and level controls

7. Optimization of the system

8. Alarm circuits

9. Safe operating and working practices and operation of safety devices.

B. One (1) training session is required. Training shall be completed after startup services have been performed. Hands-on training and demonstrations shall use the installed equipment.

C. Hands-on training and demonstrations shall use the installed equipment.

D. Supplier shall provide all training materials and training manuals to all personnel being trained.

3.07 EQUIPMENT RE-CERTIFICATION

A. The CONTRACTOR shall require, and cover the cost in his bid, for the manufacturer's factory-trained service technician to return to the site six (6) months after initial startup of the equipment to perform a final re-certification of the equipment.

B. The re-certification shall demonstrate and certify that the equipment meets the performance requirements of the specifications. The equipment service technician shall perform field testing of the equipment in the AUTHORITY's presence. Results of all field testing shall be submitted to the Engineer and the AUTHORITY.

3.08 MANUFACTURER CALL-BACKS

A. In addition to the services specified above, the CONTRACTOR shall cover the cost for two (2) on-site call-backs provided to the AUTHORITY by the manufacturer's factory-trained service technician.

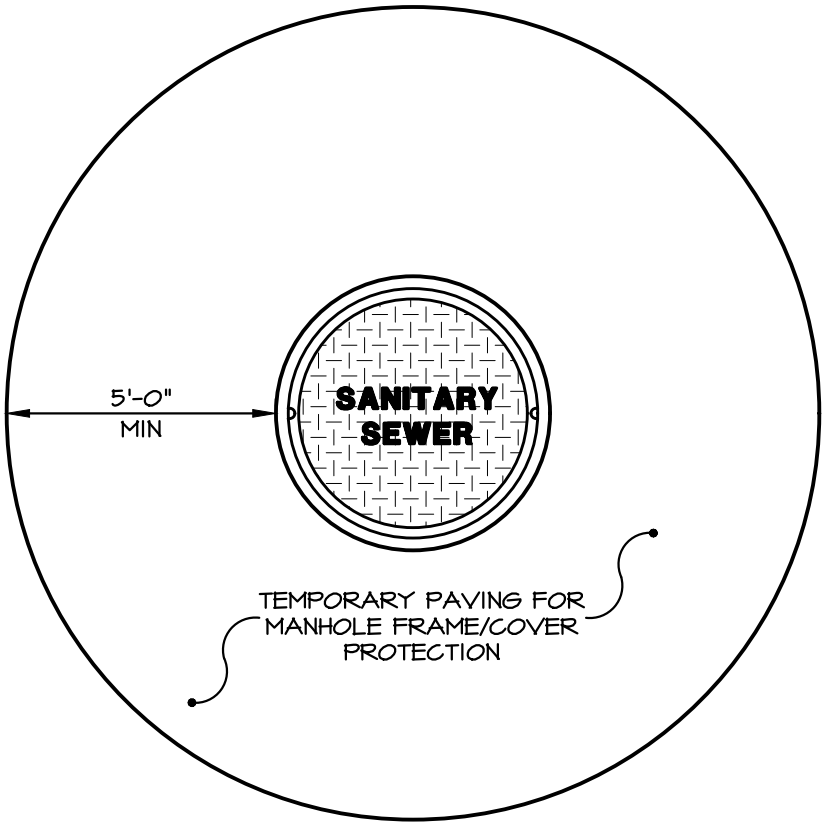
B. Call-backs may be used anytime, up to one (1) year from the startup date. Each call-back shall be a separate trip with up to eight (8) hours on-site.

C. Use of manufacturer’s call-backs shall be at the AUTHORITY's sole discretion. Call-backs may be used for equipment repair, warranty evaluation, routine maintenance, operator training, etc.

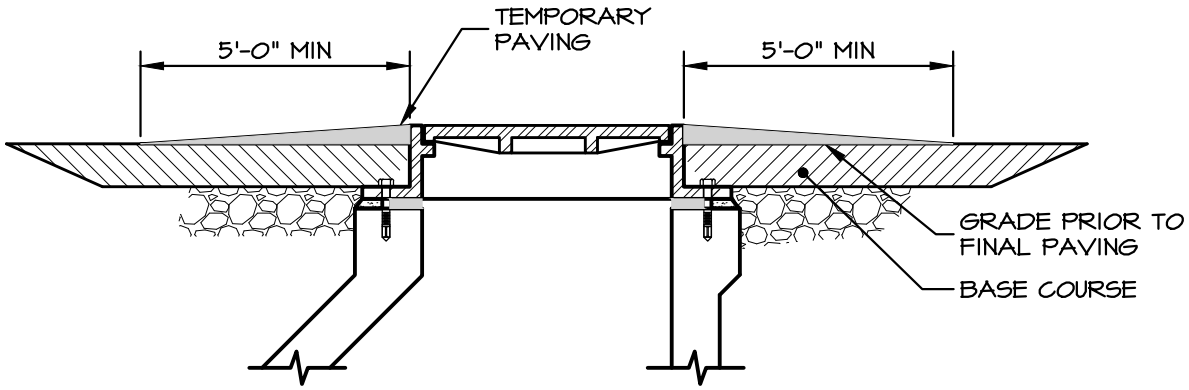
3.09 CLEANING AND HOUSEKEEPING

A. Before acceptance, inspect the pump station's interior and exterior for dirt, splashed material or damaged paint. Clean or repair accordingly. Use touch-up paint provided under spare parts to repair any painted surfaces damaged during installation or startup. Remove all tools, surplus materials, scrap, and debris from the job site.

**END OF SECTION**




PLAN




SECTION

# MANHOLE FRAME/COVER PROTECTION DETAIL PRIOR TO FINAL PAVING

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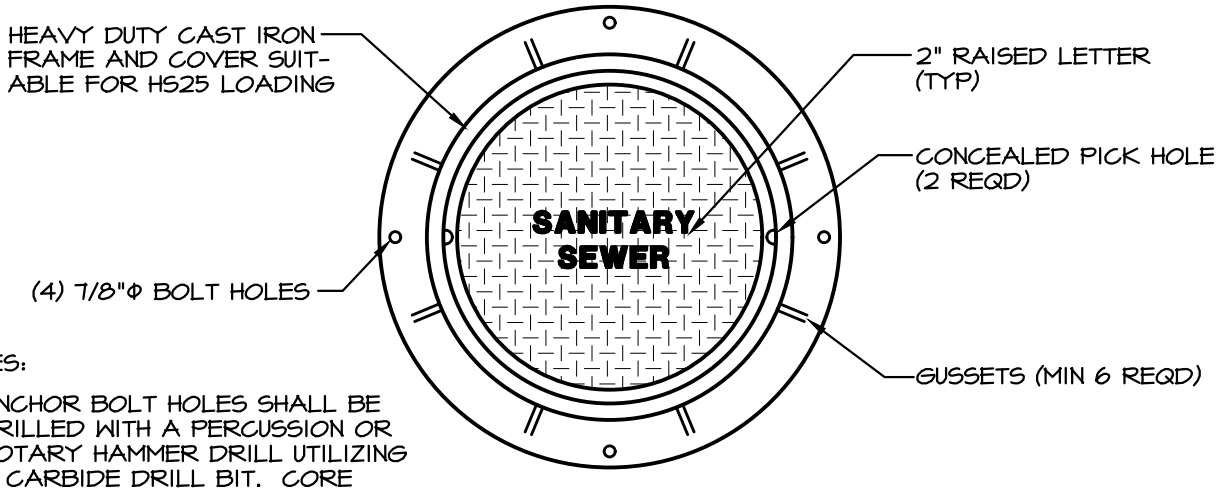
ELA group, inc.
ENGINEERS • LANDSCAPE ARCHITECTS
743 S. BROAD ST.
LITITZ, PA 17543
(717) 626-7271
elagroup.com

MANHOLE FRAME/COVER PROTECTION DETAIL PRIOR TO FINAL PAVING
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-1

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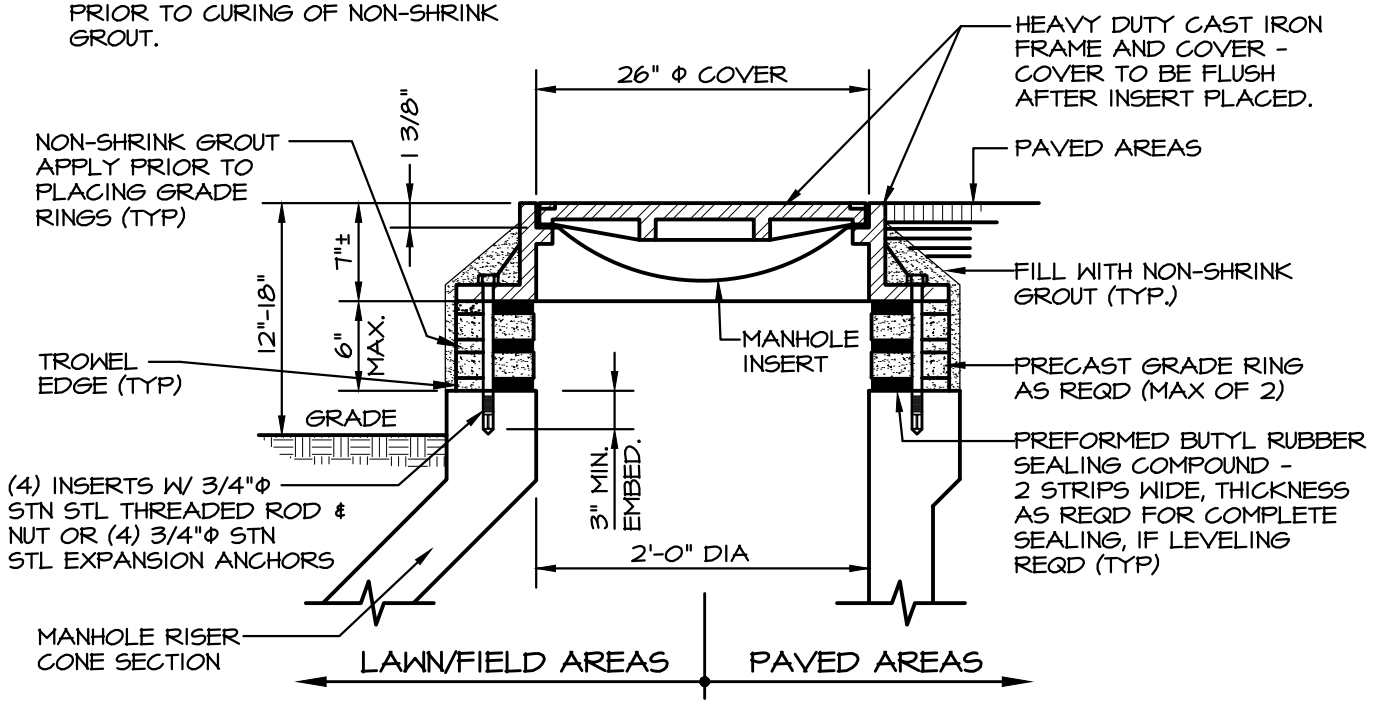



NOTES:

1.) ANCHOR BOLT HOLES SHALL BE DRILLED WITH A PERCUSSION OR ROTARY HAMMER DRILL UTILIZING A CARBIDE DRILL BIT. CORE DRILLING, OR ROTATIONAL ONLY DRILLING, OF ANY KIND, IS NOT ALLOWED.

2.) FRAME ANCHORS SHALL BE TIGHTENED PRIOR TO CURING OF NON-SHRINK GROUT.

COVER PATTERN




# STANDARD MANHOLE FRAME & COVER WITH GRADE RINGS

NO SCALE

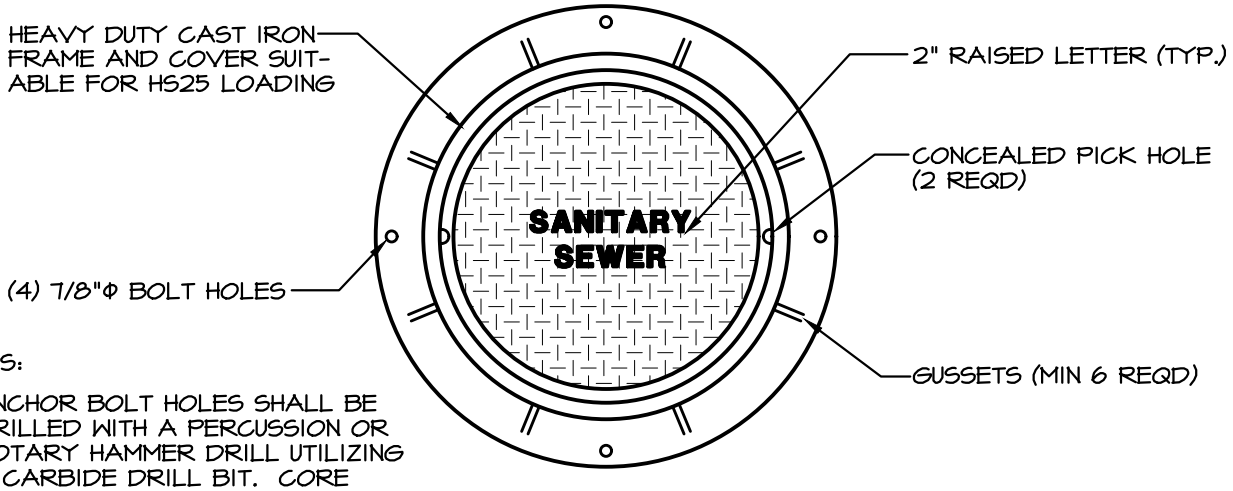
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LITITZ, PA 17543
(717) 626-7271
elagroup.com

STANDARD MANHOLE FRAME & COVER WITH GRADE RINGS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

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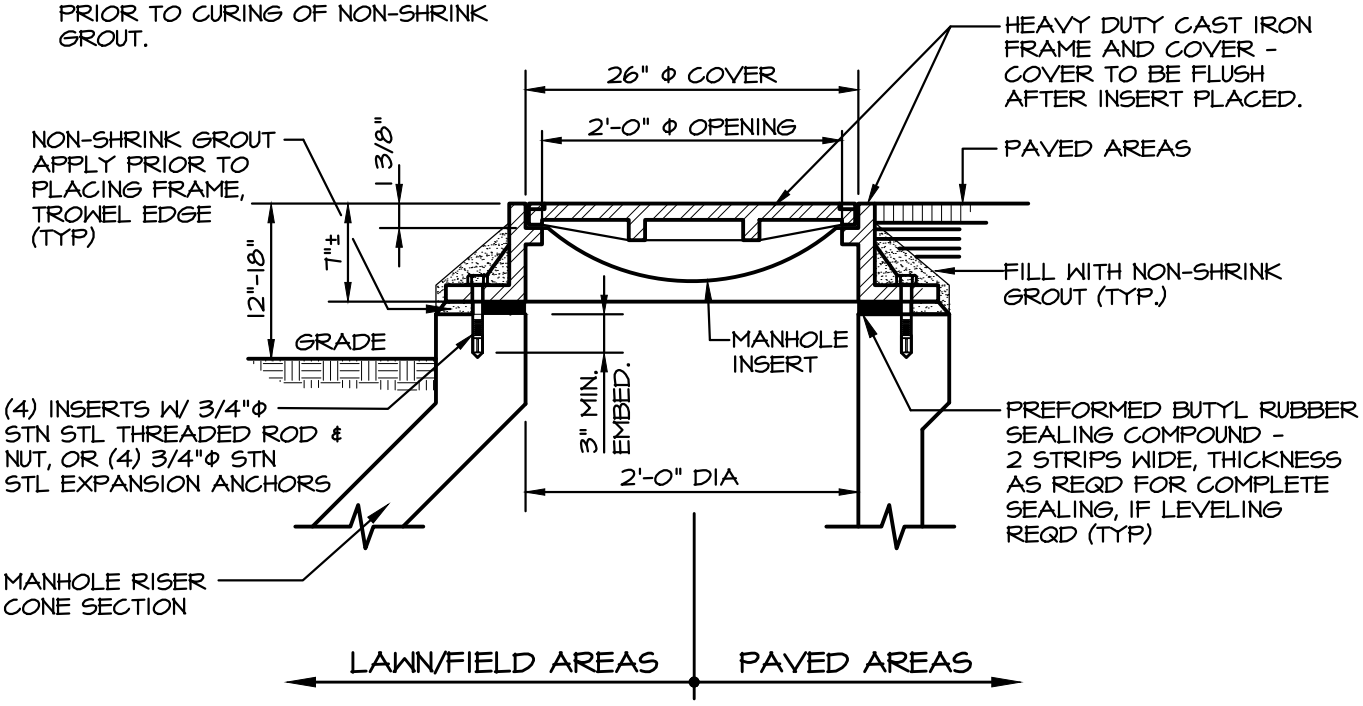



NOTES:

1.) ANCHOR BOLT HOLES SHALL BE DRILLED WITH A PERCUSSION OR ROTARY HAMMER DRILL UTILIZING A CARBIDE DRILL BIT. CORE DRILLING, OR ROTATIONAL ONLY DRILLING, OF ANY KIND, IS NOT ALLOWED.

COVER PATTERN

2.) FRAME ANCHORS SHALL BE TIGHTENED PRIOR TO CURING OF NON-SHRINK GROUT.




# STANDARD MANHOLE FRAME & COVER WITHOUT GRADE RINGS

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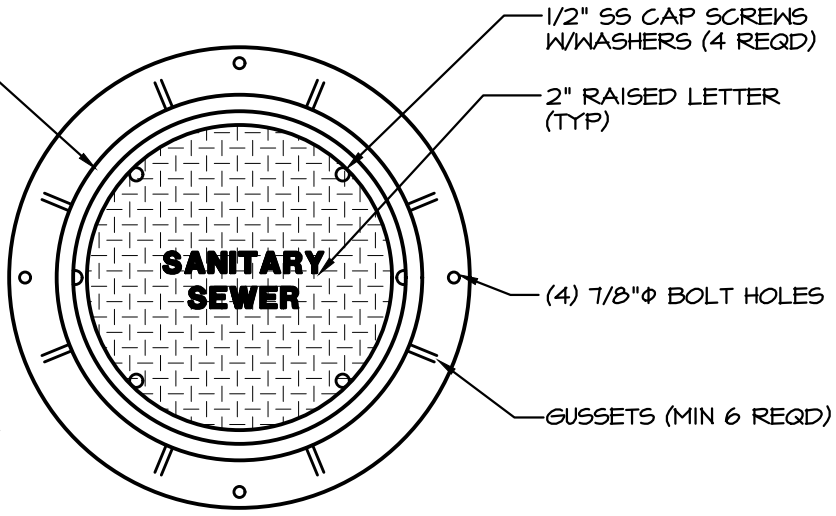
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elagroup.com

STANDARD MANHOLE FRAME & COVER WITHOUT GRADE RINGS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-3

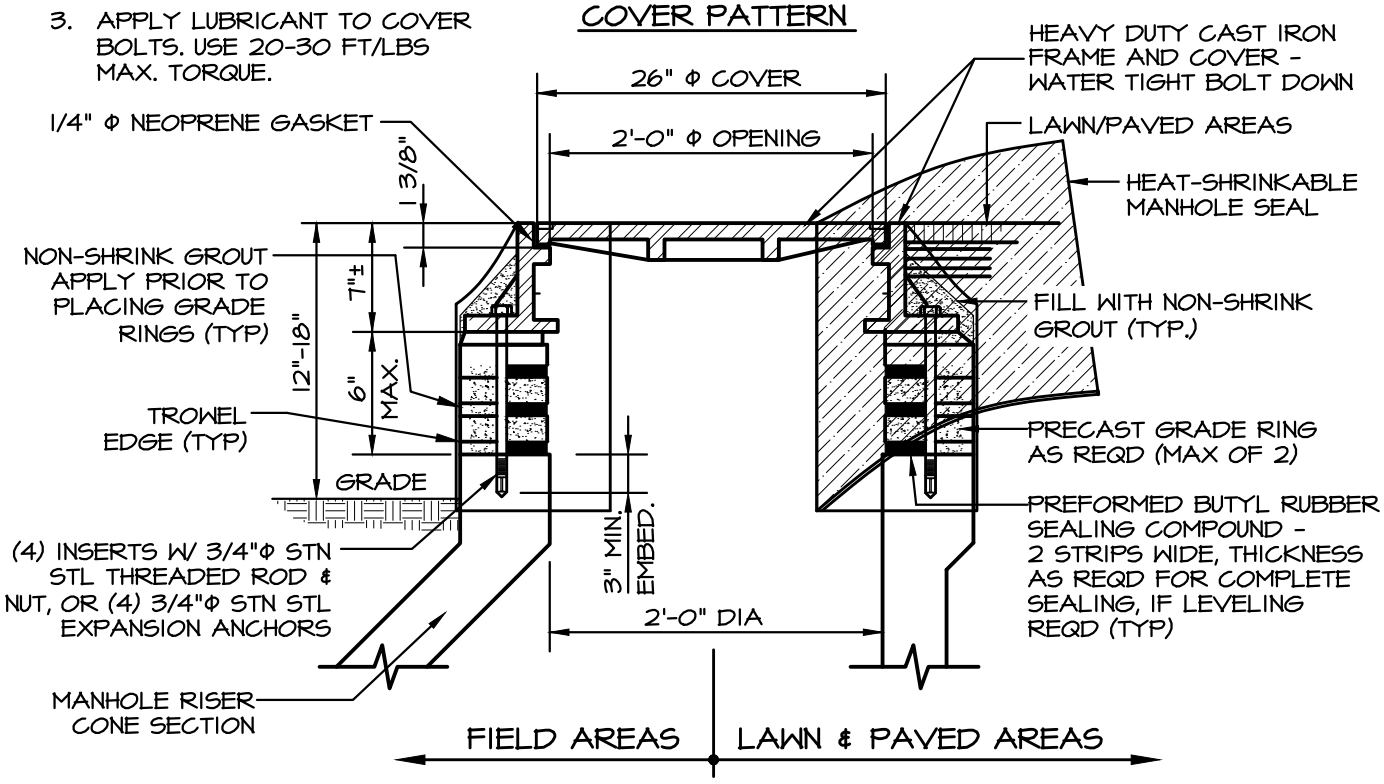
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NOTES:

1. ANCHOR BOLT HOLES SHALL BE DRILLED WITH A PERCUSSION OR ROTARY HAMMER DRILL UTILIZING A CARBIDE DRILL BIT. CORE DRILLING, OR ROTATIONAL ONLY DRILLING, OF ANY KIND, IS NOT ALLOWED.
2. FRAME ANCHORS SHALL BE TIGHTENED PRIOR TO CURING OF NON-SHRINK GROUT.
3. APPLY LUBRICANT TO COVER BOLTS. USE 20-30 FT/LBS MAX. TORQUE.

COVER PATTERN




NOTE:
PROVIDE WATERTIGHT MANHOLE FRAME & COVER IN SWALES, GUTTERS, FLOOD PRONE AREAS & ALL AREAS OUTSIDE OF ROADWAYS.

# WATERTIGHT MANHOLE FRAME & COVER WITH GRADE RINGS

NO SCALE

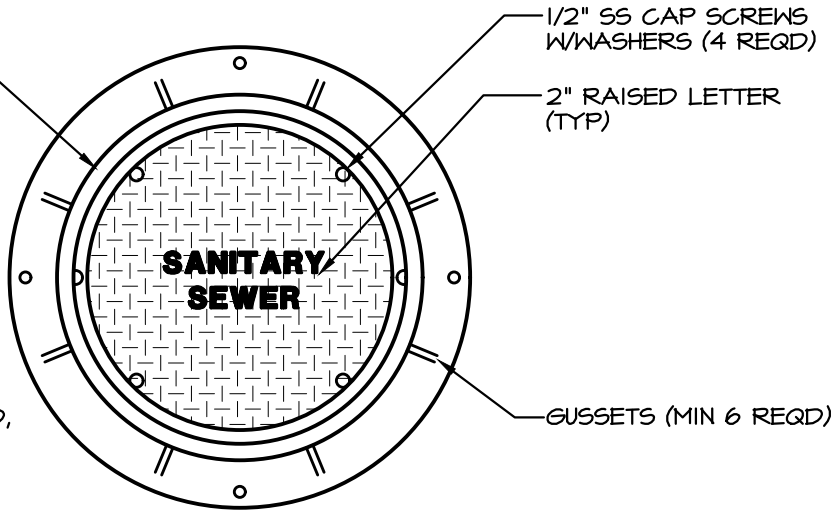
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WATERTIGHT MANHOLE FRAME & COVER WITH GRADE RINGS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-4

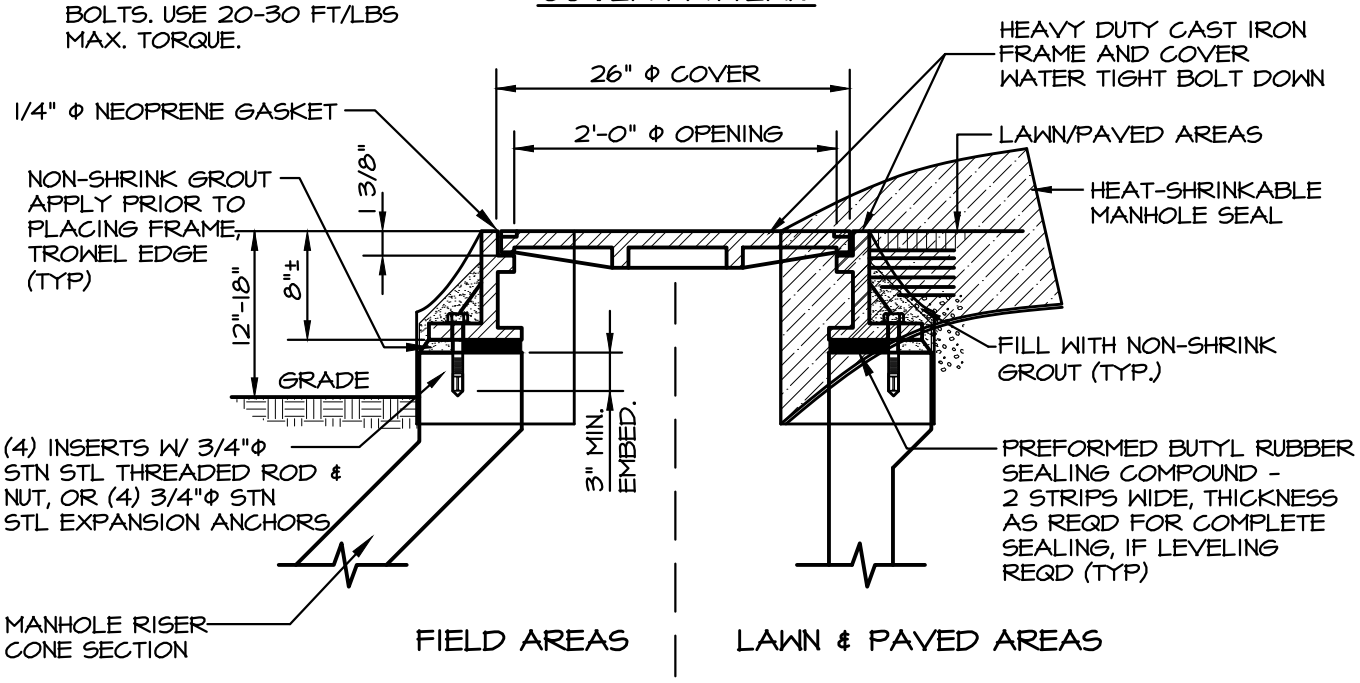
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NOTES:

1. ANCHOR BOLT HOLES SHALL BE DRILLED WITH A PERCUSSION OR ROTARY HAMMER DRILL UTILIZING A CARBIDE DRILL BIT. CORE DRILLING, OR ROTATIONAL ONLY DRILLING, OF ANY KIND, IS NOT ALLOWED.
2. FRAME ANCHORS SHALL BE TIGHTENED PRIOR TO CURING OF NON-SHRINK GROUT.
3. APPLY LUBRICANT TO COVER BOLTS. USE 20-30 FT/LBS MAX. TORQUE.

COVER PATTERN




NOTE: PROVIDE WATERTIGHT MANHOLE FRAME & COVER IN SWALES, GUTTERS, FLOOD PRONE AREAS & ALL AREAS OUTSIDE OF ROADWAYS.

# WATERTIGHT MANHOLE FRAME & COVER WITHOUT GRADE RINGS

NO SCALE

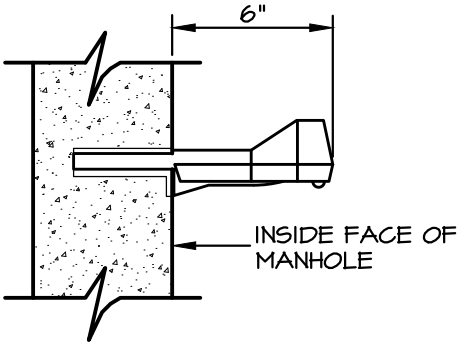
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WATERTIGHT MANHOLE FRAME & COVER WITHOUT GRADE RINGS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

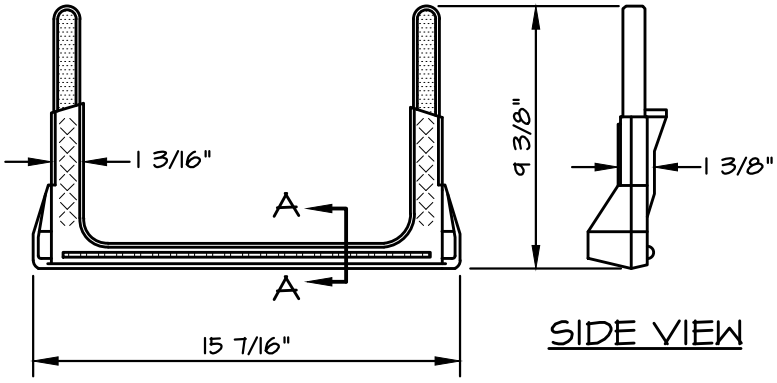
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-5

DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\452-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am

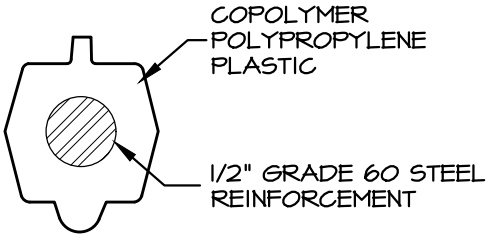



SECTION

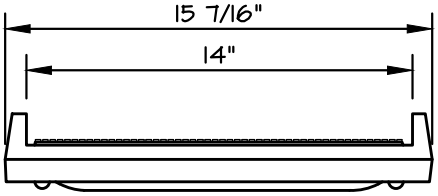



SIDE VIEW

PLAN




SECTION A-A




FRONT VIEW

NOTES:

1. ATTACH INSERTS USING MANUFACTURER'S INSTRUCTIONS AND SPECIFICATIONS.
2. DRIVE STEP INTO INSERTS UNTIL BOTH LEGS ARE COMPLETELY SEATED.
3. STEP SHALL MEET OR EXCEED ASTM C-478 AND OSHA STANDARDS WHEN PROPERLY INSTALLED.

# MANHOLE STEP DETAIL

NO SCALE

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MANHOLE STEP DETAIL
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

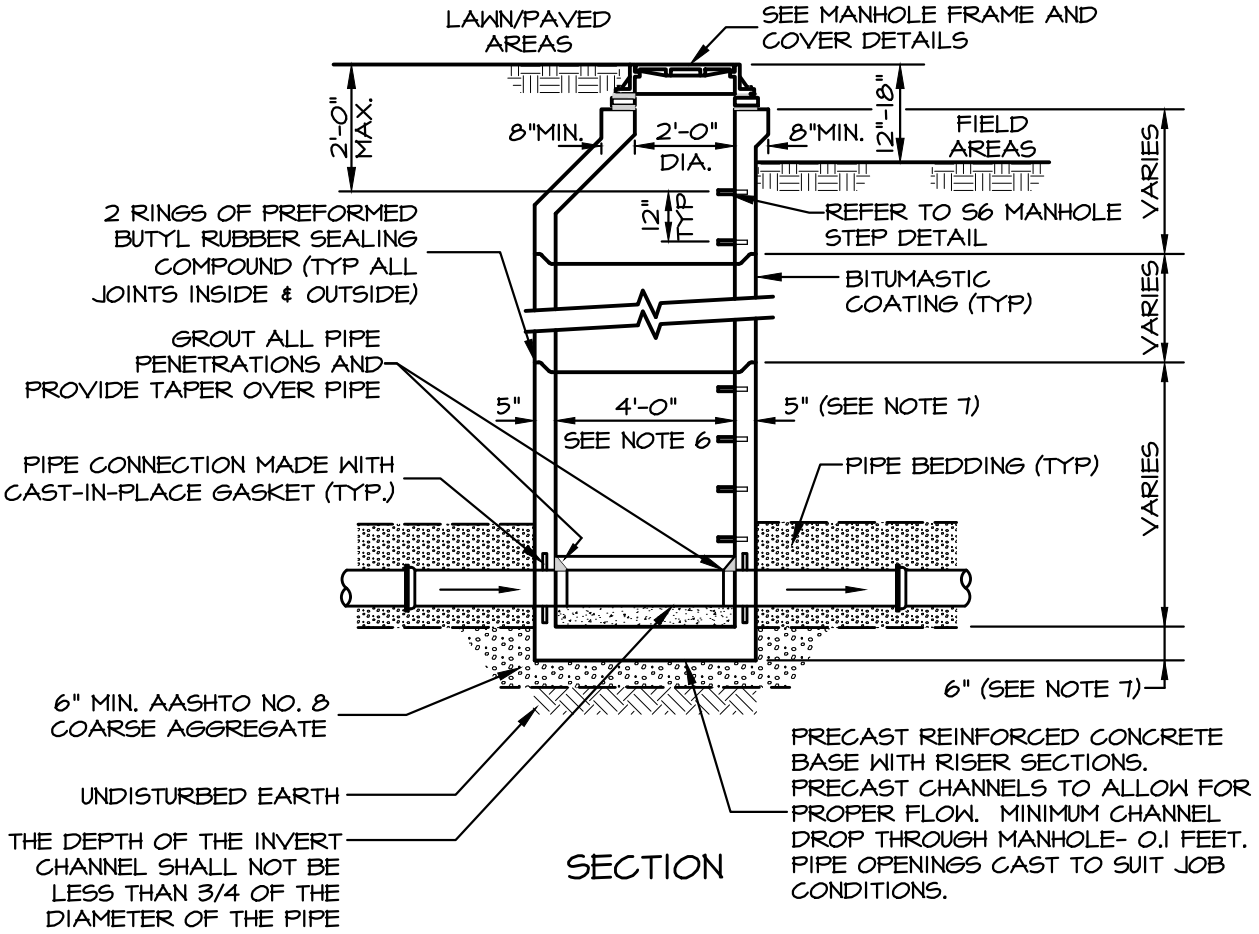
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| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-6

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NOTES:

1. ADJUST TO GRADE WITH CONCRETE GRADE RINGS (MAX. VERT. ADJUST. 6") SEE FRAME & COVER DETAILS.
2. MECHANICALLY VIBRATED PRECAST CONC SHALL CONFORM TO A.S.T.M. SPEC. C-478.
3. IF INCOMING INVERT EXCEEDS OUTGOING INVERT BY GREATER THAN OR EQUAL TO 6", SEE INSIDE SPLASH/ INSIDE DROP MANHOLE DETAILS.
4. FOR MANHOLES WHERE TOP OF RIM TO INVERT DISTANCE IS LESS THAN 5'-0", USE FLAT TOP MANHOLE IN LIEU OF CONE TOP.
5. FILL ALL LIFTING HOLES WITH NON-SHRINK GROUT.
6. MANHOLE DIAMETER IS TO BE EVALUATED ON A CASE-BY CASE BASIS. CONTRACTOR SHOULD ASSUME 4' DIAMETER FOR ANY STANDARD MANHOLE (NOT SPECIAL, SPLASH GREATER THAN 1' DROP, OR INSIDE DROP) UNLESS OTHERWISE SPECIFIED.
7. REFER TO SPECIFICATIONS FOR MINIMUM FLOOR SLAB AND WALL THICKNESS.




SECTION

# PRECAST MANHOLE 8" THRU 24" SEWERS

NO SCALE

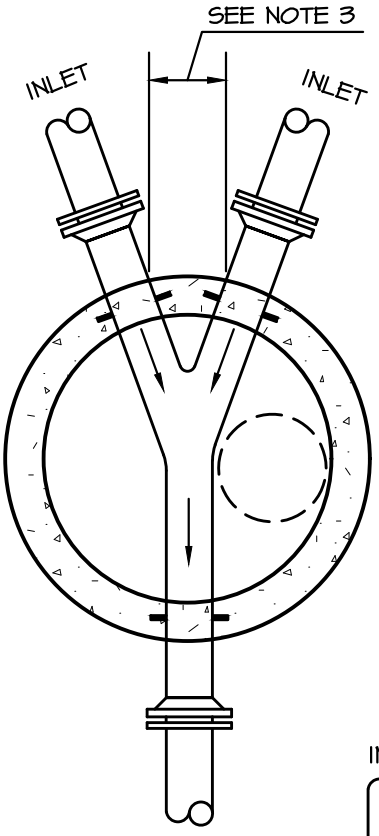
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PRECAST MANHOLE 8" THRU 24" SEWERS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-7

DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\152-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am

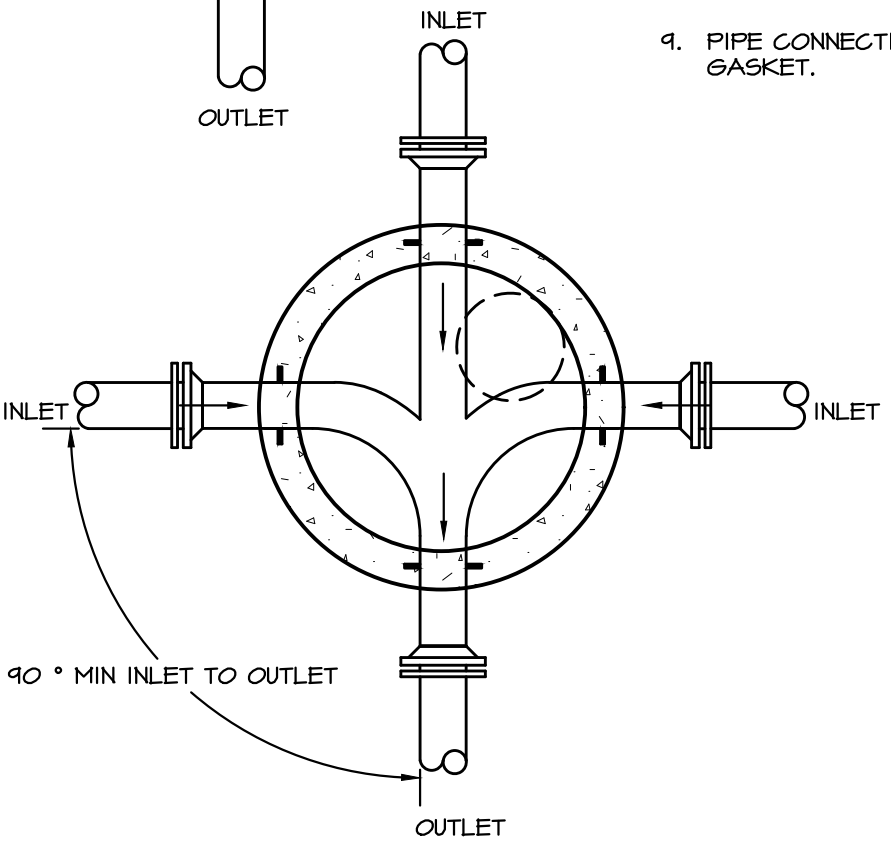


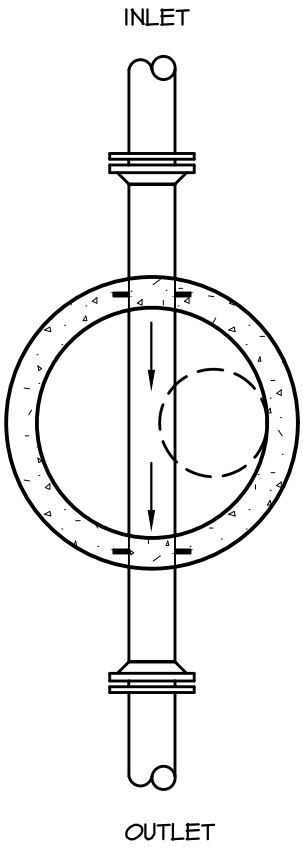

NOTES:

1. THREE INLET PIPES AND ONE OUTLET PIPE MAX INTO MANHOLE.
2. MINIMUM 12" SEPARATION FROM EDGE OF PIPE PENETRATION TO EDGE OF PIPE PENETRATION.
3. MINIMUM CHANNEL DROP THROUGH MANHOLE:

| | |
|---|---|
| STRAIGHT THROUGH | 0.1 FEET |
| BEND | 0.2 FEET |

4. ALL CHANNELS SHALL BE PRECAST, UNLESS OTHERWISE SPECIFICALLY NOTED OR APPROVED.
5. THESE DETAILS APPLY TO PRECAST AND FIELD-FORMED CHANNELS IN NEW AND EXISTING MANHOLES.
6. CHANNEL BENCH AT PIPE SHALL MATCH CROWN ELEVATION OF PIPE AND RISE 1/2" PER FOOT TO THE MANHOLE WALLS.
7. CHANNELS SHALL MATCH THE CROSS-SECTIONAL DIMENSIONS OF THE PIPES ENTERING AND EXITING THE MANHOLE. SMOOTH TRANSITIONS SHALL BE PROVIDED BETWEEN CHANGES IN PIPE SIZE.
8. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THAN 3/4 OF THE DIAMETER OF THE PIPE.
9. PIPE CONNECTION SHALL BE MADE WITH CAST-IN-PLACE GASKET.




# PRECAST CHANNEL

NO SCALE

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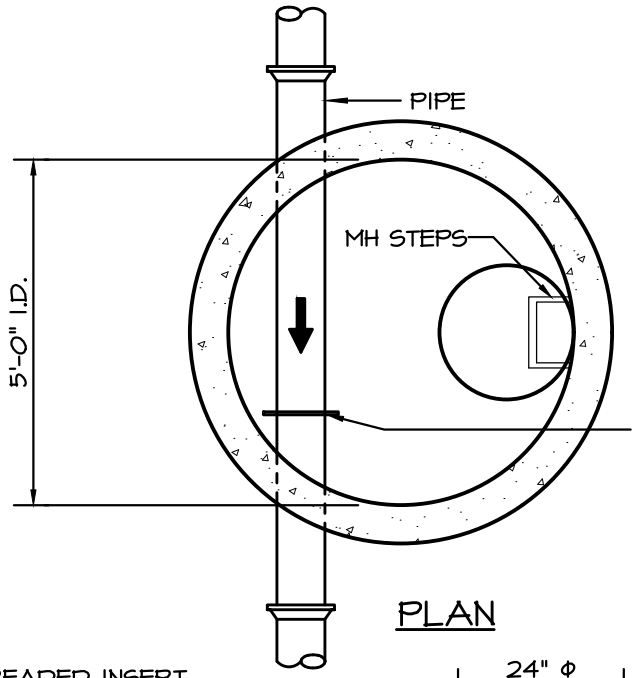
## PRECAST CHANNEL

STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

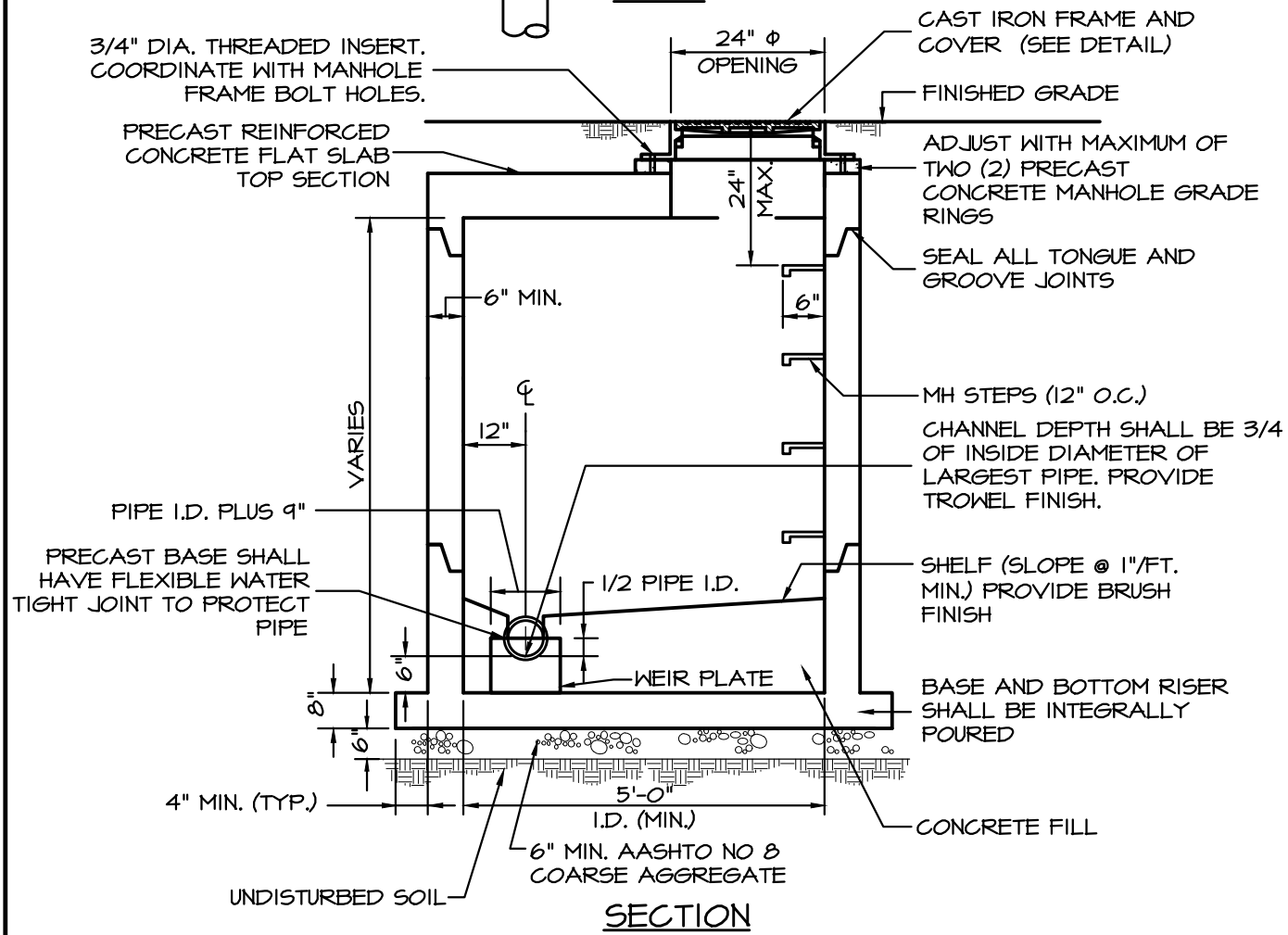
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DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\952-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am




NOTE:
REFER TO ST PRECAST MANHOLE 8" THRU 24" SEWER DETAIL FOR TYPICAL MANHOLE DETAILS.

PLAN




SECTION

# SAMPLING MANHOLE

NO SCALE

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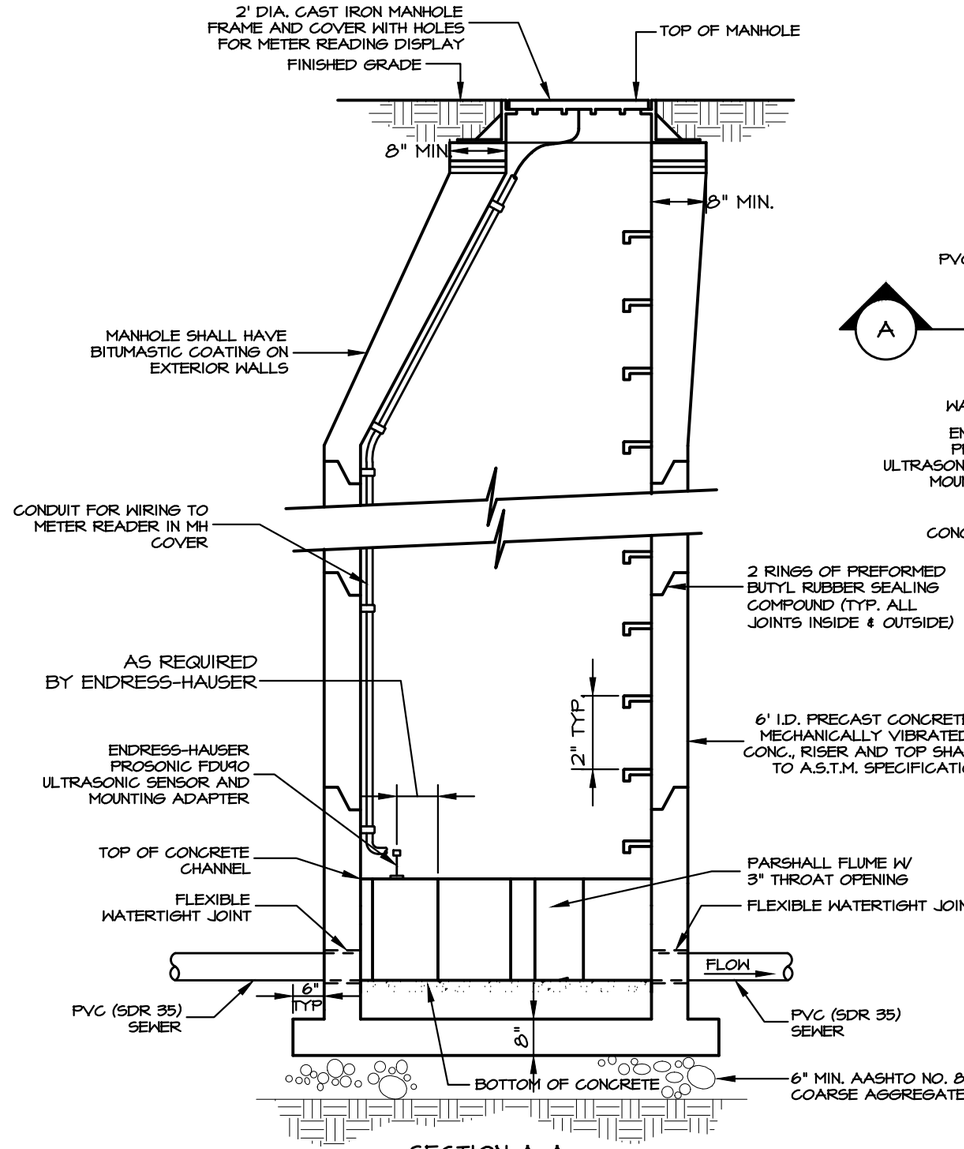
## SAMPLING MANHOLE

STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

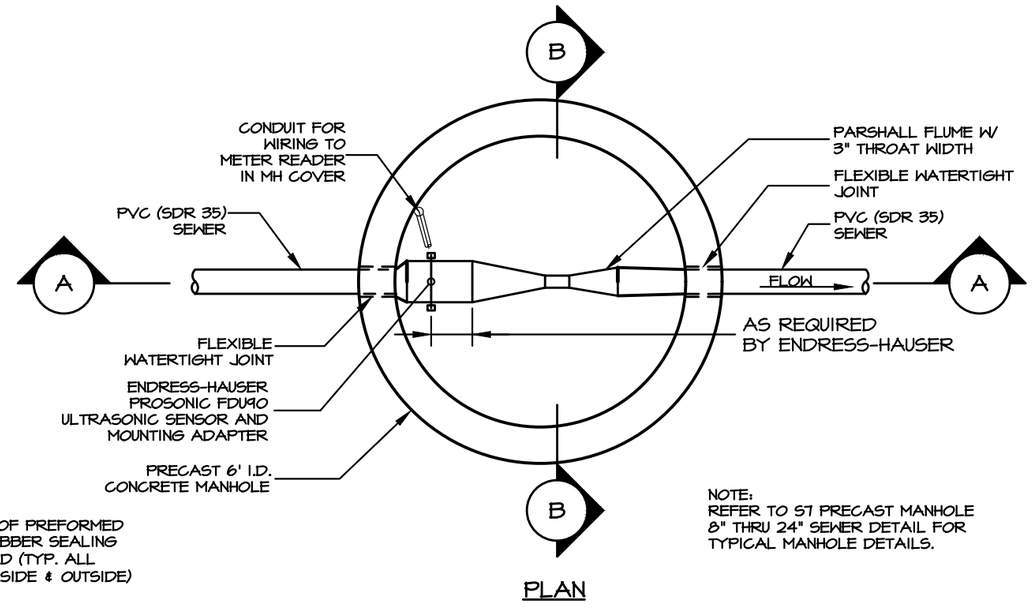
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| DATE: | AUGUST 2023 |

DRAWING: S-9

DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\952-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am

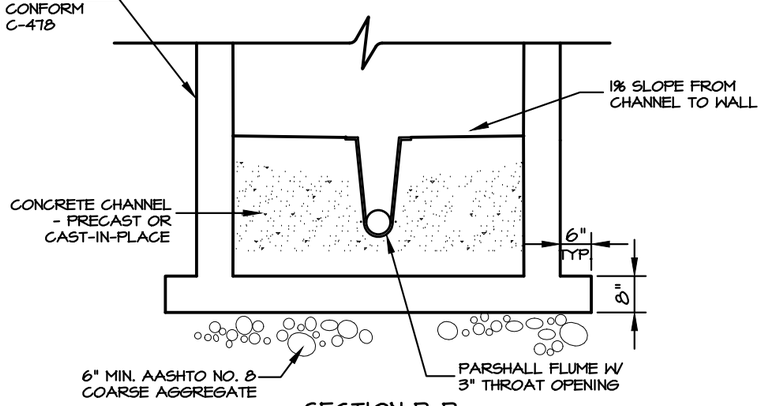



SECTION A-A




PLAN

NOTE:
REFER TO S7 PRECAST MANHOLE 8" THRU 24" SEWER DETAIL FOR TYPICAL MANHOLE DETAILS.




SECTION B-B

# METERING MANHOLE - ROUND

NO SCALE

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METERING MANHOLE - ROUND
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

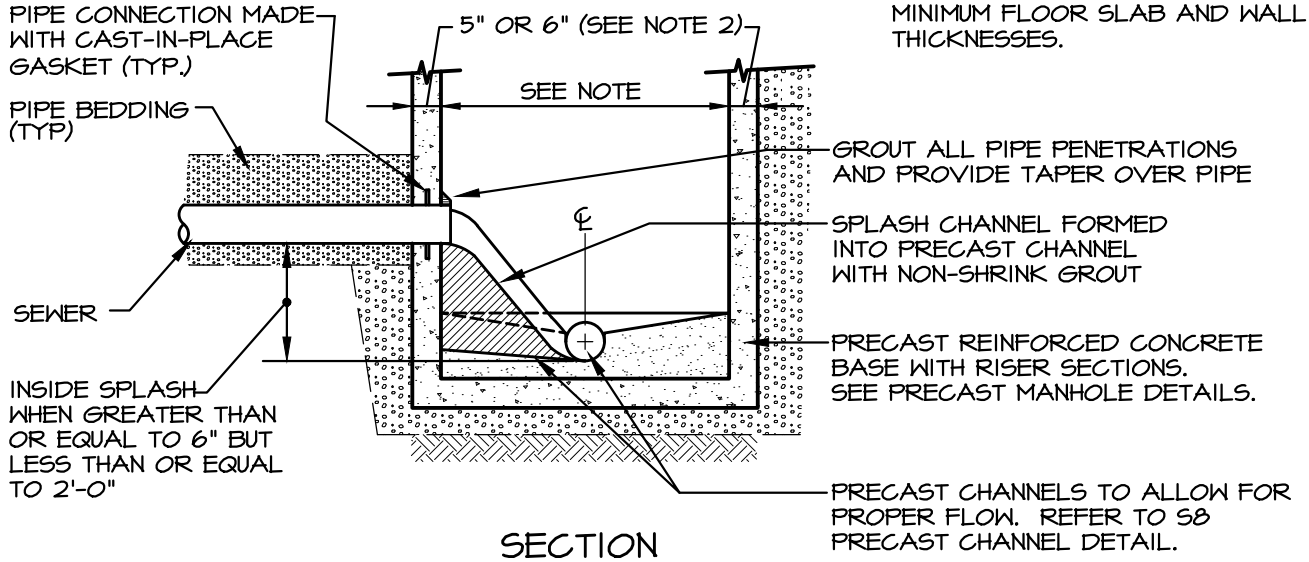
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| DATE: | AUGUST 2023 |

DRAWING: S-10

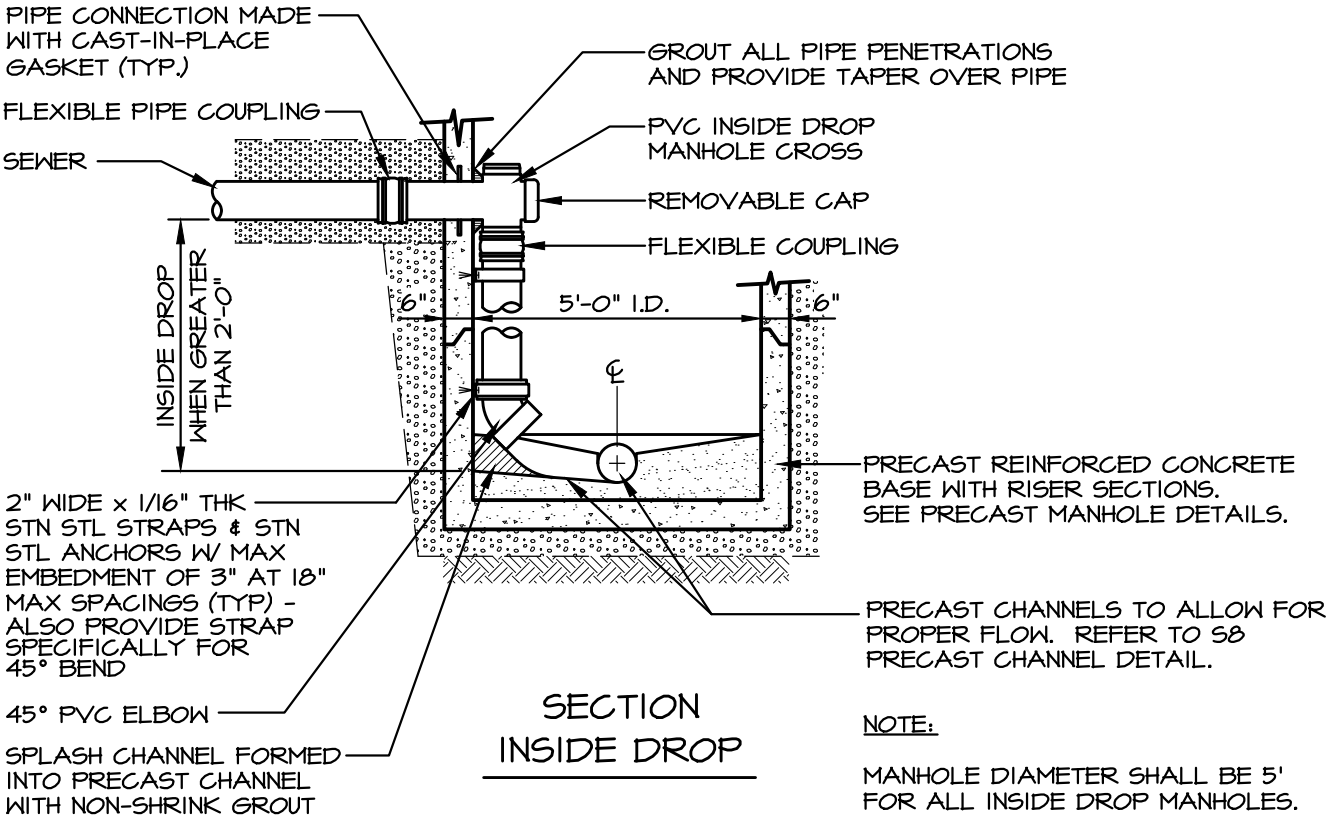
DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\452-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am

NOTES:

1. MANHOLE DIAMETER SHALL BE 4' WHEN SPLASH IS 6" TO 1'-0" AND 5' WHEN SPLASH IS 1'-0" TO 2'-0".
2. REFER TO SPECIFICATIONS FOR MINIMUM FLOOR SLAB AND WALL THICKNESSES.




## SECTION INSIDE SPLASH




## SECTION INSIDE DROP

NOTE:

MANHOLE DIAMETER SHALL BE 5' FOR ALL INSIDE DROP MANHOLES.

# INSIDE SPLASH - INSIDE DROP MANHOLE

NO SCALE

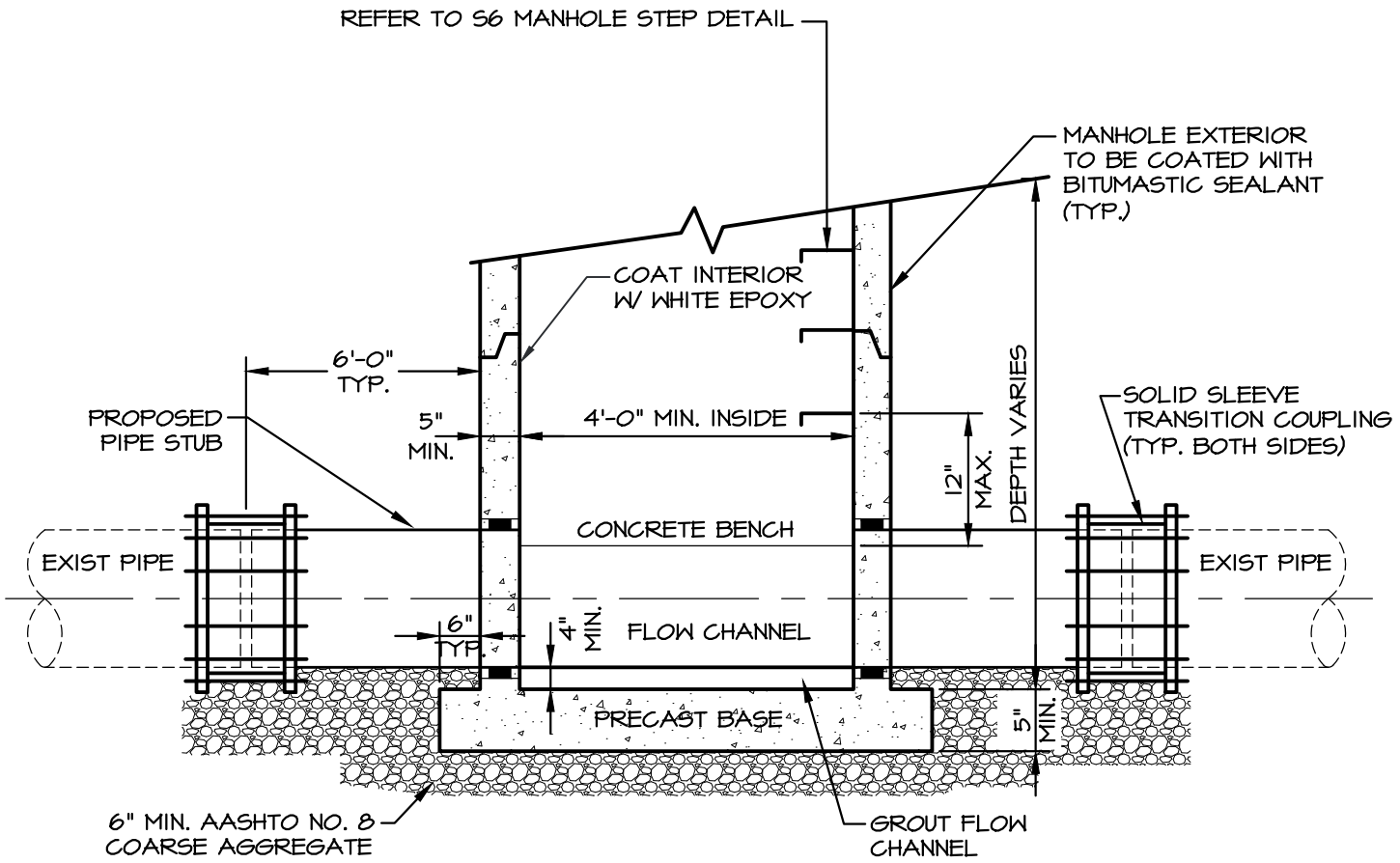
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INSIDE SPLASH - INSIDE DROP MANHOLE
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-11

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## ELEVATION

NOTES:

1. THE BENCH SHALL SLOPE TO INVERT CHANNEL AT THE RATE OF 1" PER FOOT (MIN.)
2. THE DEPTH OF THE INVERT CHANNEL SHALL BE NOT LESS THEN ¾ OF THE DIAMETER OF THE PIPE.
3. THE 48"Φ MANHOLE SHALL BE USED ON PIPE SIZES 8" TO 18"
4. FINISH GRADE SHALL BE FLUSH WITH TOP OF COVER, UNLESS OTHERWISE NOTED. MANHOLES INSTALLED OUTSIDE OF PAVED AREAS SHOULD BE RAISED BETWEEN 12"-18" ABOVE GROUND ELEVATION.
5. ALL PIPE TO MANHOLE CONNECTIONS SHALL BE MADE WITH A CAST-IN-PLACE GASKET. (TYP.)
6. REFER TO APPROPRIATE MANHOLE DETAILS FOR UPPER SECTION REQUIREMENTS.
7. SOLID SLEEVE TRANSITION COUPLINGS SHALL INCLUDE A DUCTILE IRON MECHANICAL JOINT SOLID SLEEVE WITH MEGA-LUG GLANDS AND TRANSITION GASKETS (IF REQUIRED).

# INSERTION MANHOLE DETAIL

NO SCALE

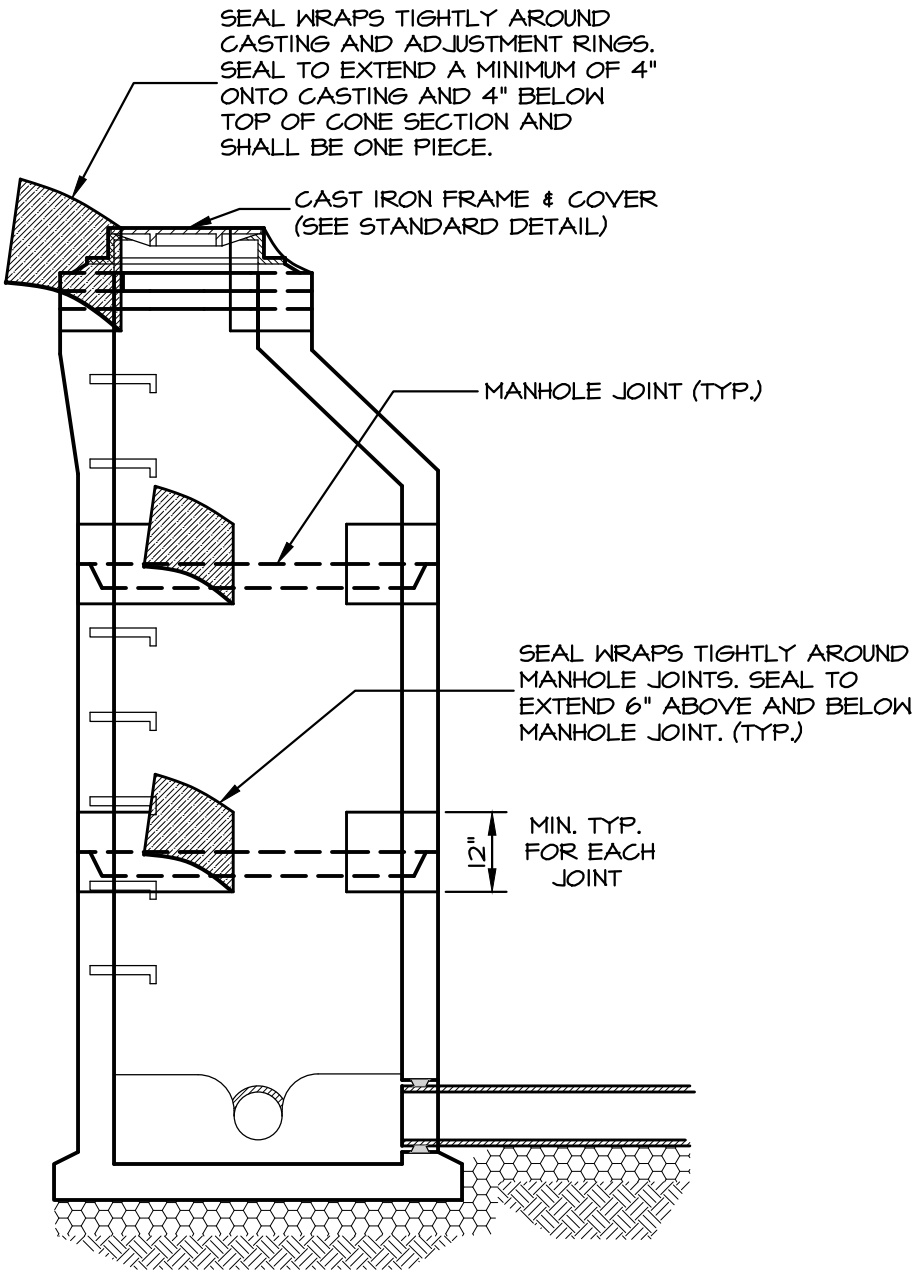
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INSERTION MANHOLE DETAIL
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-12




NOTES:

1. MANHOLE SEAL SHALL BE "WRAPIDSEAL"™ MANUFACTURED BY CANUSA-CPS (SHAWCOR CO.) OR APPROVED EQUAL.
2. MANHOLE JOINT SEAL SHALL BE INSTALLED AS SHOWN ON THIS DETAIL.

# HEAT SHRINKABLE MANHOLE SEAL DETAIL

NO SCALE

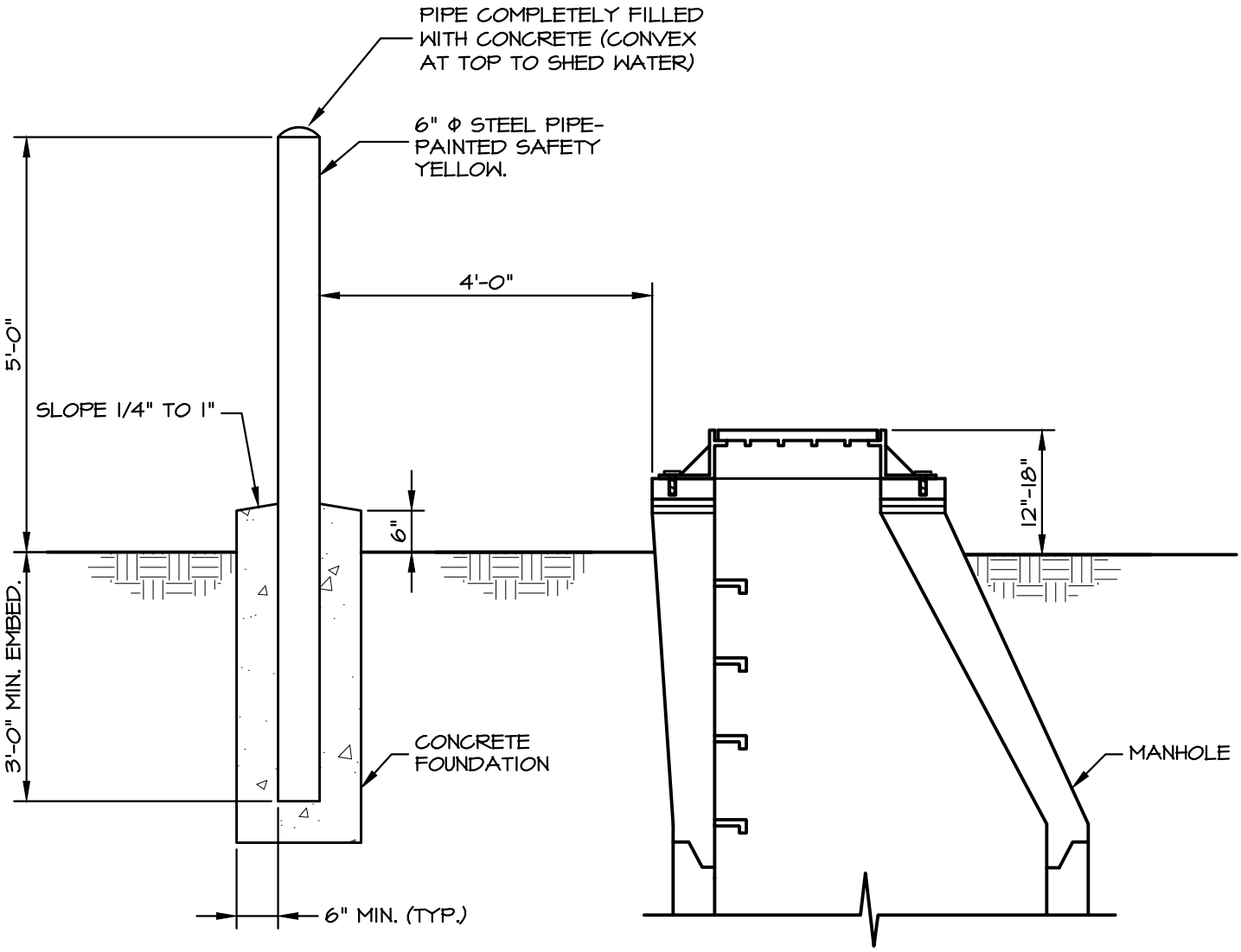
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HEAT SHRINKABLE MANHOLE SEAL DETAIL
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-13

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NOTES:

1. INSTALL IN FIELD AREAS OR ADJACENT TO PARKING AREAS.
2. INSTALL A TOTAL OF 4 POSTS AT EACH MANHOLE SPACED IN AN EQUIDISTANT SQUARE AROUND THE MANHOLE WITH THE SQUARE RING PARALLEL WITH CROP CONTOURS, ROADWAYS, CURBLINES, OR ANY NEARBY PAVEMENT.

# MANHOLE PROTECTION POST-FIELD AREAS

NO SCALE

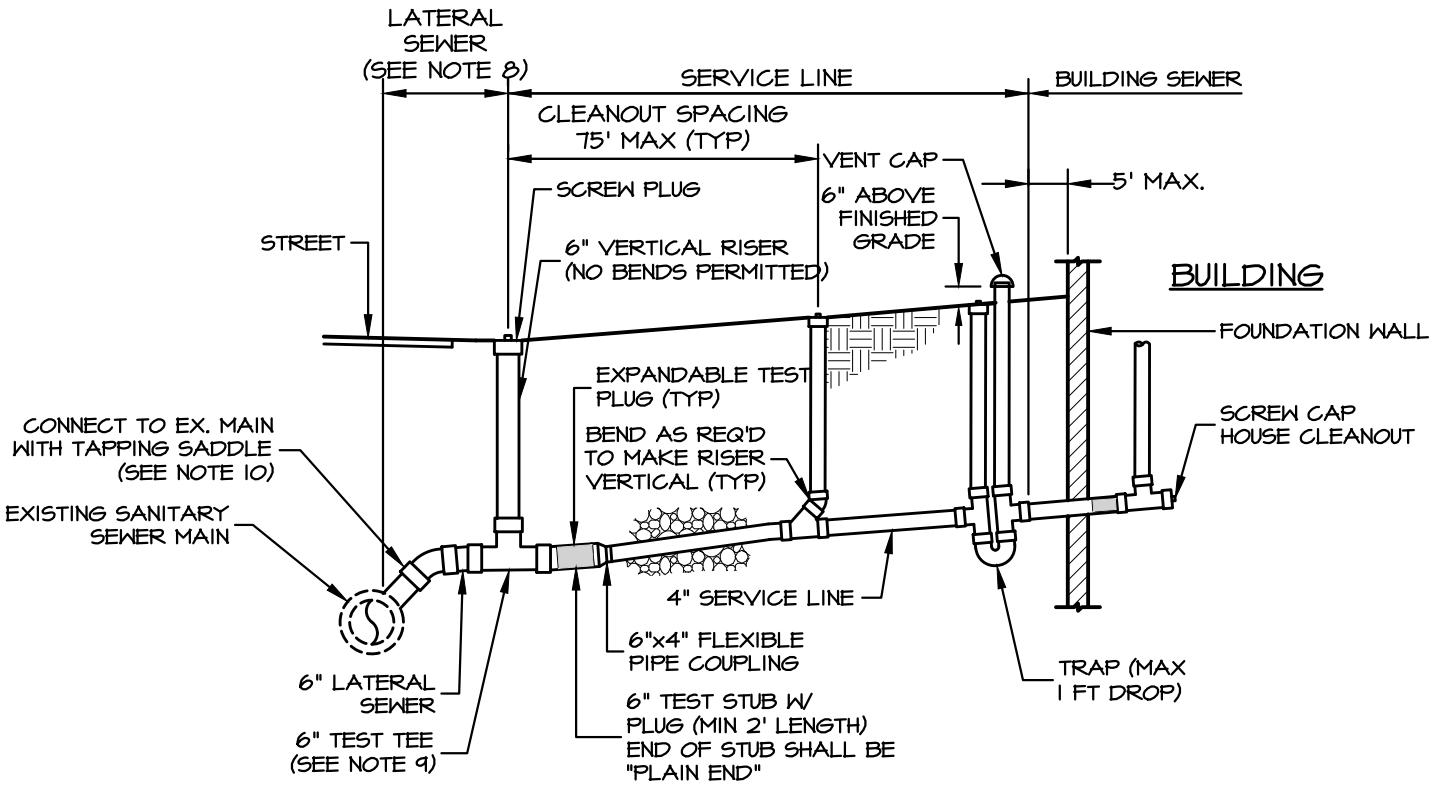
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MANHOLE PROTECTION POST-FIELD AREAS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-14

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NOTES:

1. PROVIDE 6" OF AASHTO NO. 8 (1B) STONE BELOW PIPE AND 12" ABOVE PIPE (TYPICAL ENTIRE LENGTH OF LATERAL).
2. MINIMUM SLOPE: 6" MIN. SLOPE = 1% (1/8" PER FT.), 4" MIN. SLOPE = 2% (1/4" PER FT)
3. MINIMUM DEPTH OF COVER: 4 FT (UNLESS SPECIFICALLY APPROVED BY AUTHORITY)
4. PIPE MATERIALS: LATERAL SEWER AND SERVICE LINES SHALL CONSIST OF PVC SDR-35 PIPING (UNLESS SPECIFICALLY APPROVED BY AUTHORITY).
5. TO CONDUCT AIR TESTING OF SERVICE LINE, INSTALL EXPANDABLE PLUGS AT LOCATIONS SHOWN. AT COMPLETION OF AIR TESTING, REMOVE PLUGS, & INSTALL RISER ON 6" LATERAL SEWER TEST TEE.
6. NO SEWER SERVICE LINE VENT CAPS SHALL BE INSTALLED WITHIN A 100-YR FLOOD PLAIN OR WITHIN FLOOD PRONE AREAS.
7. NO VENT CAPS OR CLEANOUTS SHALL BE INSTALLED IN DRIVEWAYS OR OTHER PAVED AREAS, UNLESS SPECIFICALLY APPROVED BY AUTHORITY.
8. THE LATERAL SEWER SHALL BE INSTALLED TO THE EDGE OF THE SEWER EASEMENT FOR SEWERS LOCATED IN AN EASEMENT OR TO THE STREET RIGHT-OF-WAY AS A MINIMUM, OR TO SUCH POINT, AS REQUIRED, TO CLEAR STREET SIDEWALKS AND UNDERGROUND UTILITIES.
9. SET 6" TEST TEE AT 1% SLOPE TO PERMIT VERTICAL RISER INSTALLATION W/ NO BENDS.
10. REFER TO S16 SADDLE CONNECTION DETAIL OR S17 TAPPING LINED RIGID PIPE DETAIL.

# TYP. LATERAL SEWER & SERVICE LINE INSTALLATION

NO SCALE

TYP. LATERAL SEWER & SERVICE LINE INSTALLATION

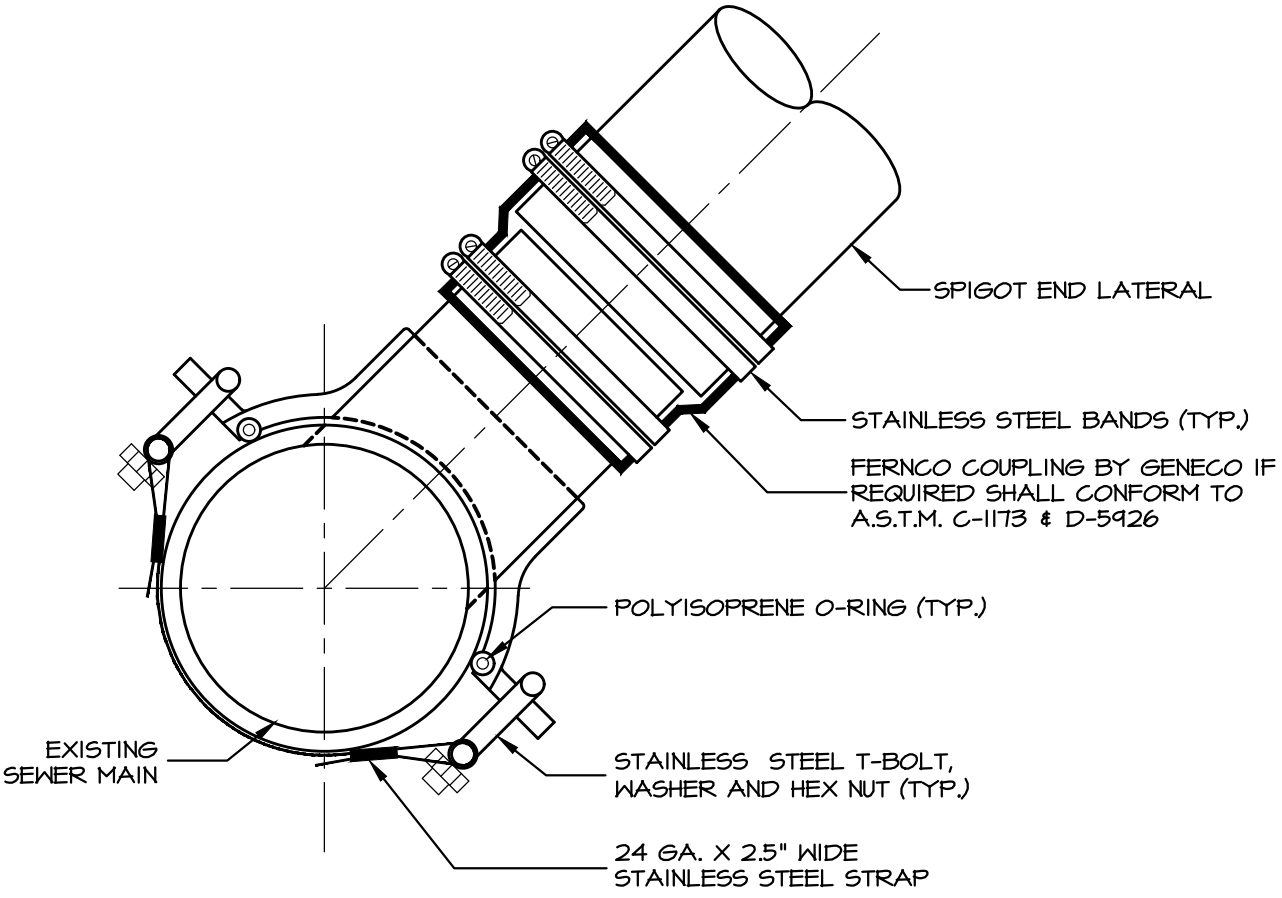
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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DRAWING: S-15

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NOTES:

1. PIPE SADDLES SHALL BE "GENECO" SEALTITE SADDLE AS MANUFACTURED BY THE GENERAL ENGINEERING COMPANY OR APPROVED EQUAL.
2. INSTALLATION SHALL BE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
3. THE CONTRACTOR SHALL MAKE THE TAP INTO THE EXISTING PIPE USING SUITABLE HOLE CUTTING EQUIPMENT AND WITHOUT DAMAGING THE EXISTING PIPE.

# SADDLE CONNECTION DETAIL

NO SCALE

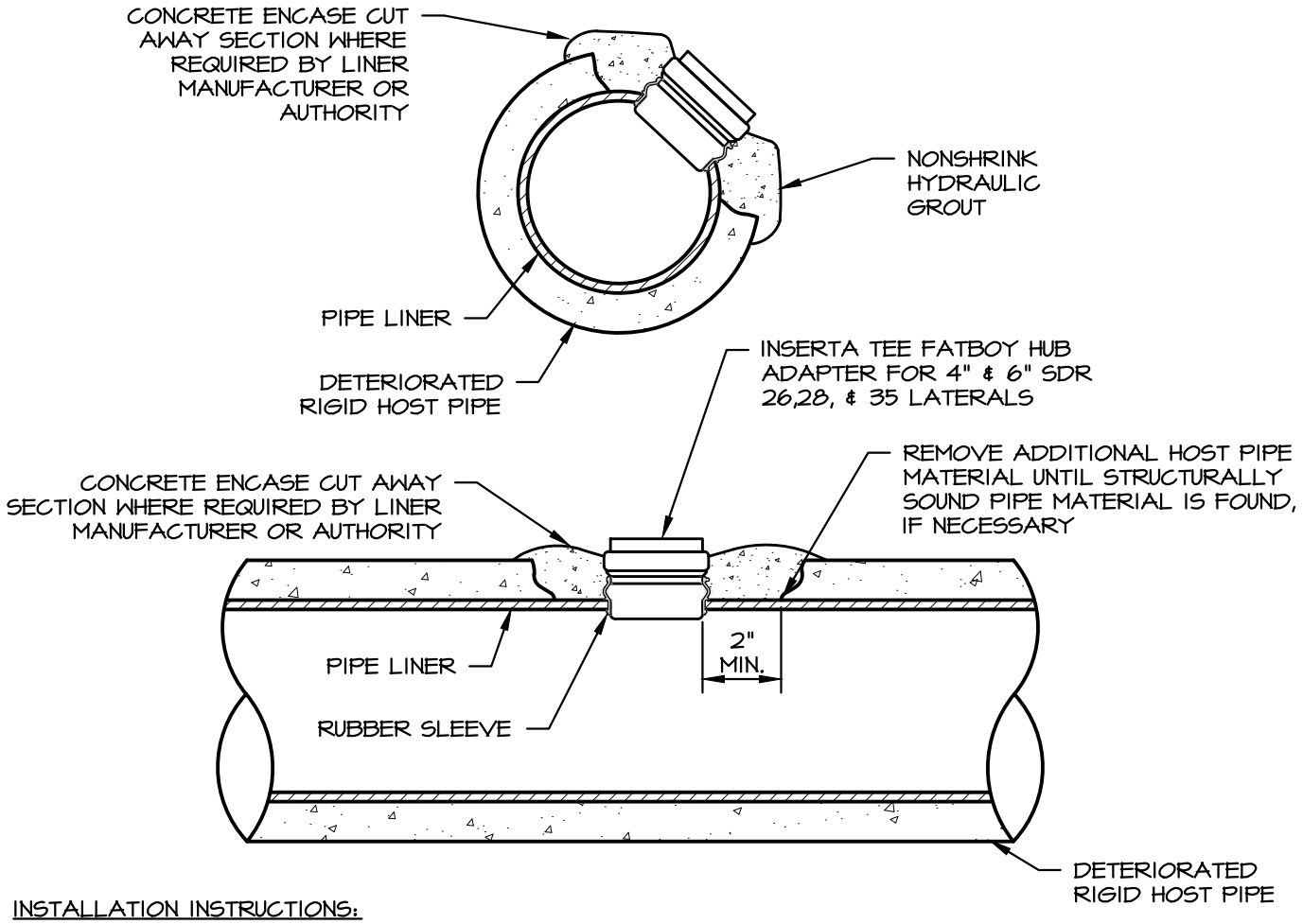
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SADDLE CONNECTION DETAIL
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-16

DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\952-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am




INSTALLATION INSTRUCTIONS:

1. MARK AREA TO BE TAPPED ON SURFACE OF RIGID PIPE. WORKING AREA SHOULD BE 2 INCHES WIDER THAN DIAMETER OF INSERTA TEE.
2. BREAK AWAY RIGID PIPE SECTION TO BE TAPPED AND EXPOSE NEW LINER SECTION.
3. BRUSH AND CLEAN PIPE LINER SURFACE AND REMOVE DAMAGED SECTIONS OF RIGID PIPE.
4. CORE HOLE INTO LINER WITH APPROPRIATE INSERTA TEE HOLE SAW.
5. INSTALL INSERTA TEE FATBOY TAP CONNECTION PER PROVIDED INSTALLATION INSTRUCTIONS.
6. ENCASE CUT OUT SECTION OF RIGID PIPE WITH CONCRETE WHERE REQUIRED BY LINING MANUFACTURER.
7. AUTHORITY STAFF SHALL DETERMINE IF ADDITIONAL HOST PIPE MATERIAL MUST BE REMOVED AND IF FULL CONCRETE ENCASEMENT OF THE SEWER MAIN IS REQUIRED FOR SEVERELY DETERIORATED SECTIONS OF SEWER MAIN.
8. DAMAGE TO THE PIPE LINER THAT COULD IMPACT THE STRUCTURAL INTEGRITY OF THE LINER SHALL BE REMOVED, THE LIMITS DETERMINED BY THE AUTHORITY STAFF, AND BE REPLACED USING AUTHORITY APPROVED FLEXIBLE COUPLINGS CONNECTING DIRECTLY TO THE PIPE LINER AND FULLY CONCRETE ENCASED 6-INCH IN MINIMUM THICKNESS 2-FEET PAST EACH FLEXIBLE COUPLING.

# TAPPING LINED RIGID PIPE DETAIL

NO SCALE

TAPPING LINED RIGID PIPE DETAIL

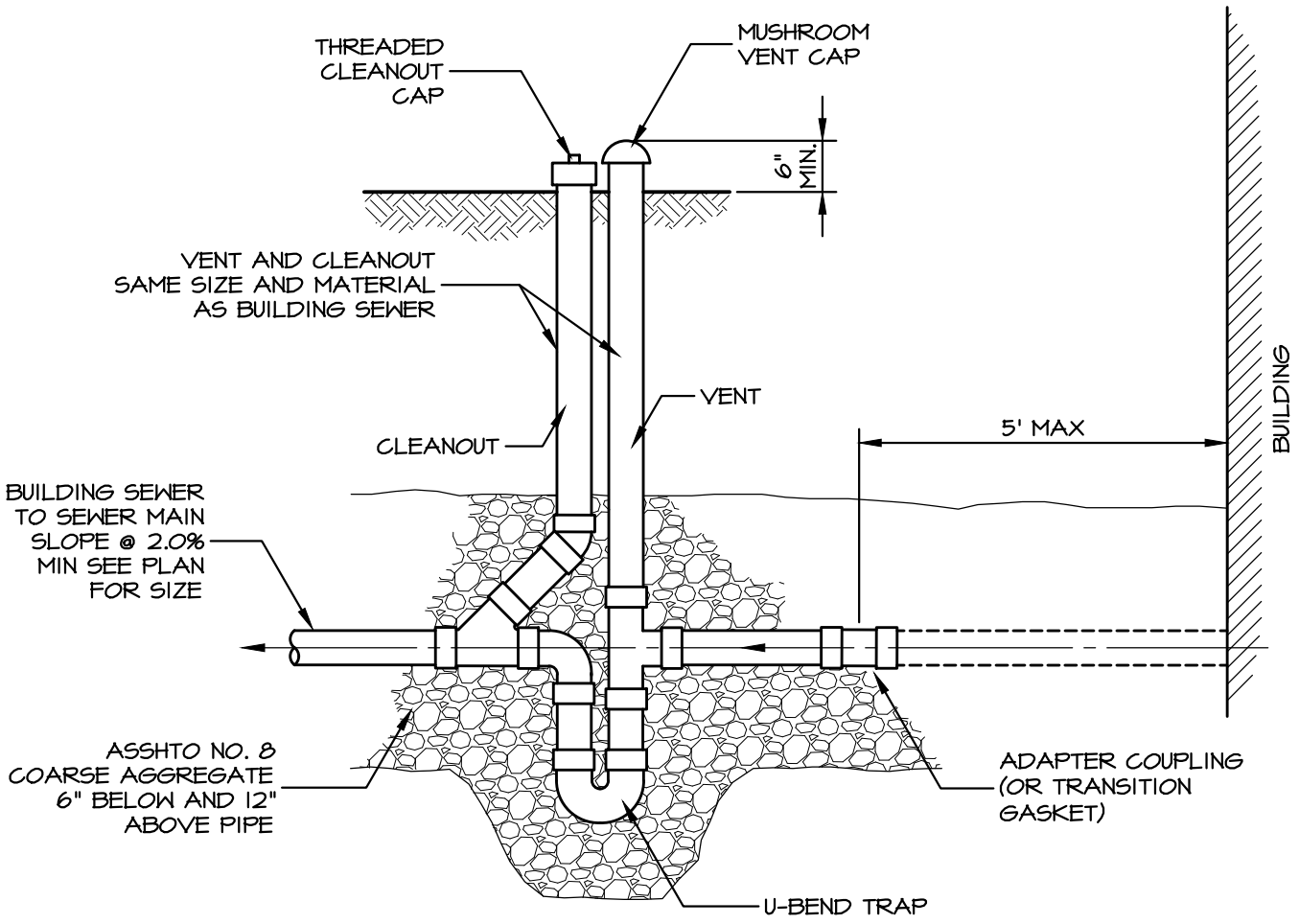
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
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DRAWING: S-17

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NOTE:
ALL FITTINGS ASSOCIATED WITH CLEANOUT, TRAP AND VENT SHALL BE SOLVENT WELD.

# TRAP AND VENT DETAIL

NO SCALE

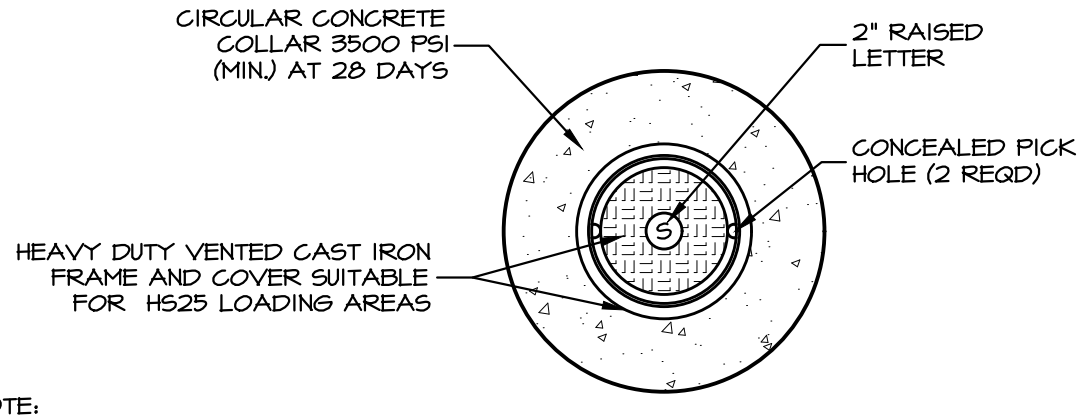
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TRAP AND VENT DETAIL
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

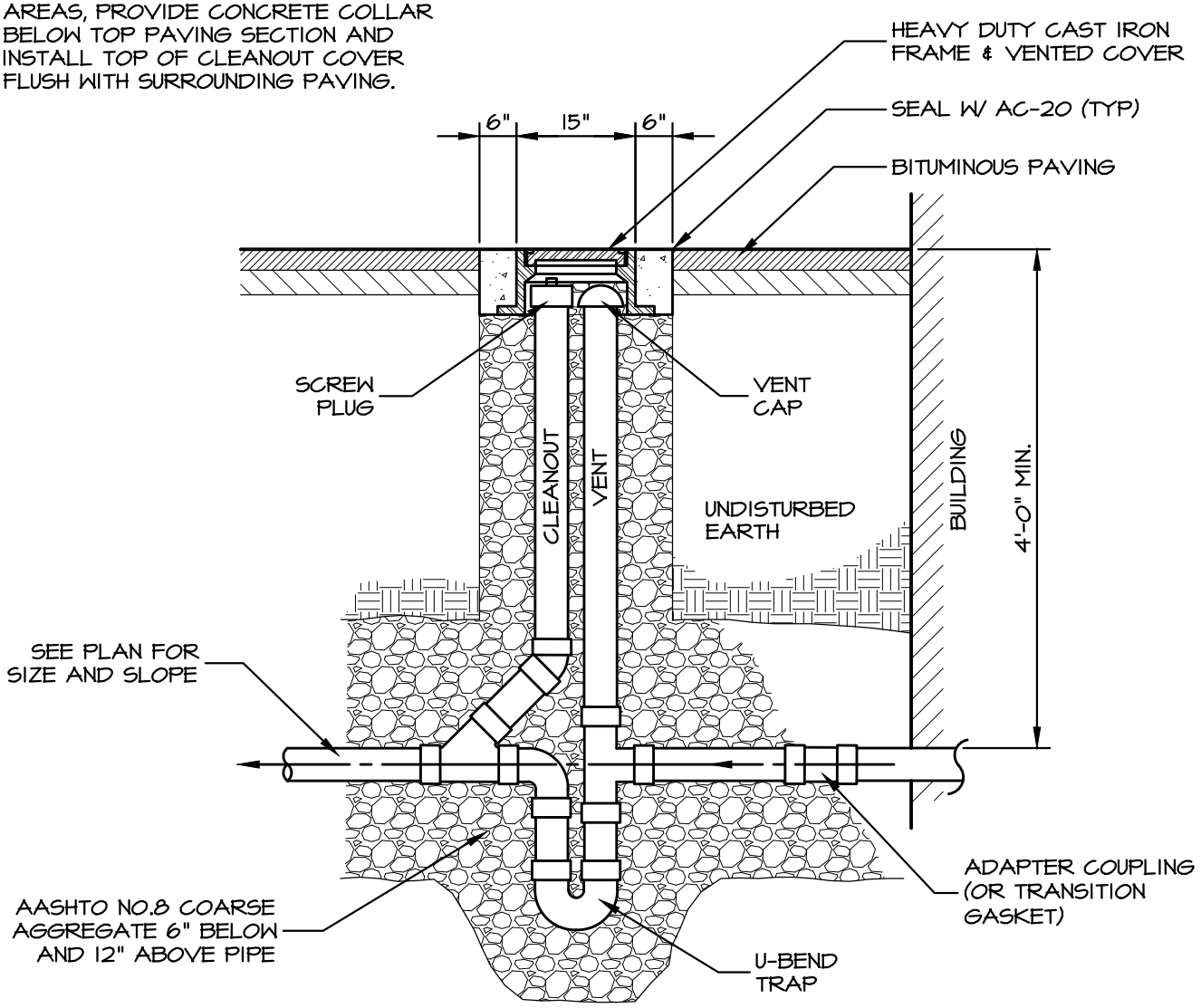
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-18




NOTE:
BITUMINOUS OR CONCRETE PAVING (SEE PLAN) IN BITUMINOUS PAVING AREAS, PROVIDE CONCRETE COLLAR BELOW TOP PAVING SECTION AND INSTALL TOP OF CLEANOUT COVER FLUSH WITH SURROUNDING PAVING.

## COVER PATTERN




# TRAP & VENT IN PAVING DETAIL (BY SPECIAL EXCEPTION ONLY)

NO SCALE

## VENT & TRAP IN PAVING DETAIL (BY SPECIAL EXCEPTION ONLY)

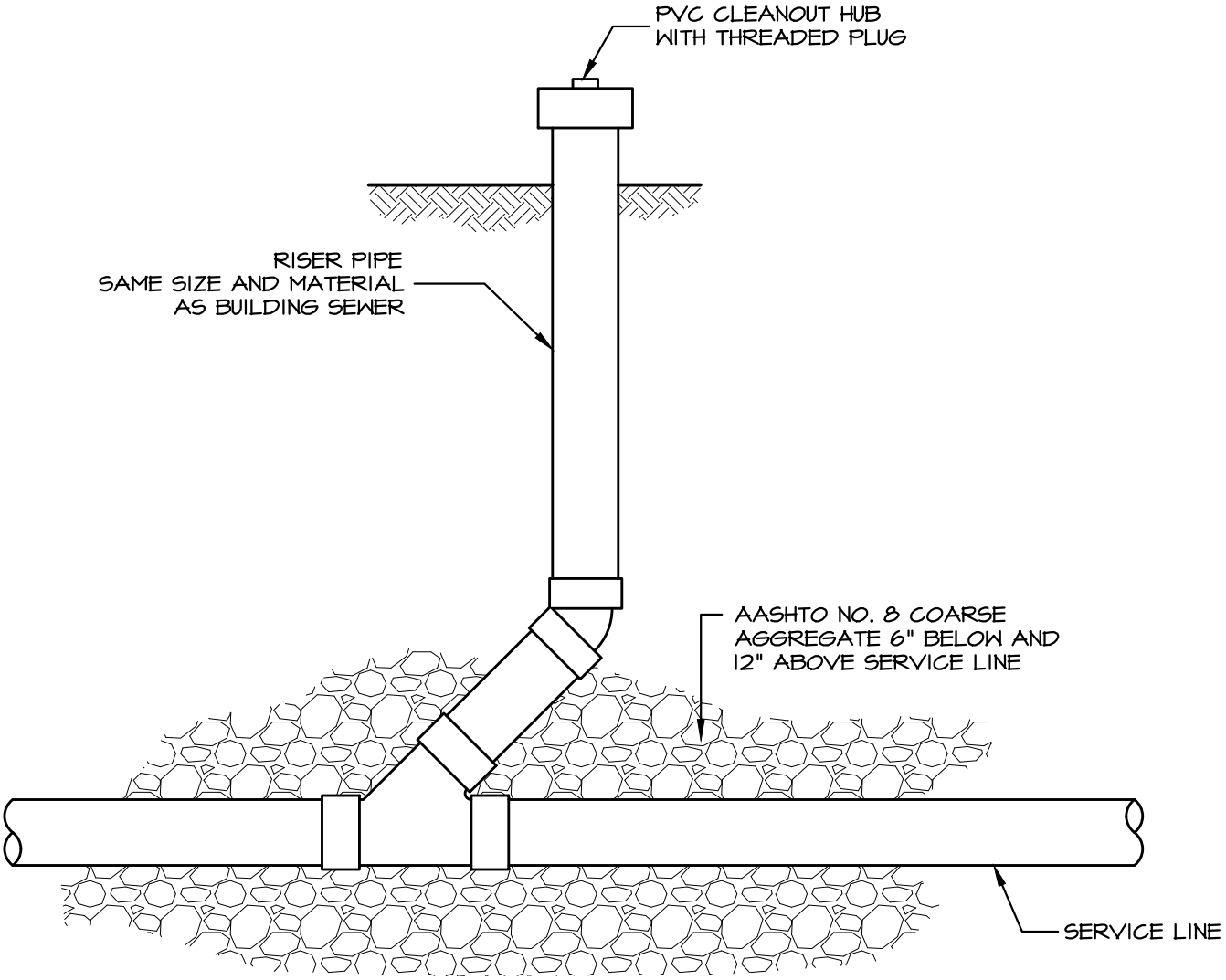
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-19

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NOTES:

1. CLEANOUTS SHALL BE INSTALLED ON ALL GRAVITY SERVICE LINE AND LATERAL BENDS AND SHALL BE A MAXIMUM OF 75' APART ON STRAIGHT RUNS.
2. TOPS OF CLEANOUTS SHALL BE SET 3"-6" ABOVE GRADE UNLESS OTHERWISE DIRECTED BY THE AUTHORITY.

# NEW CLEANOUT IN LAWN AREAS

NO SCALE

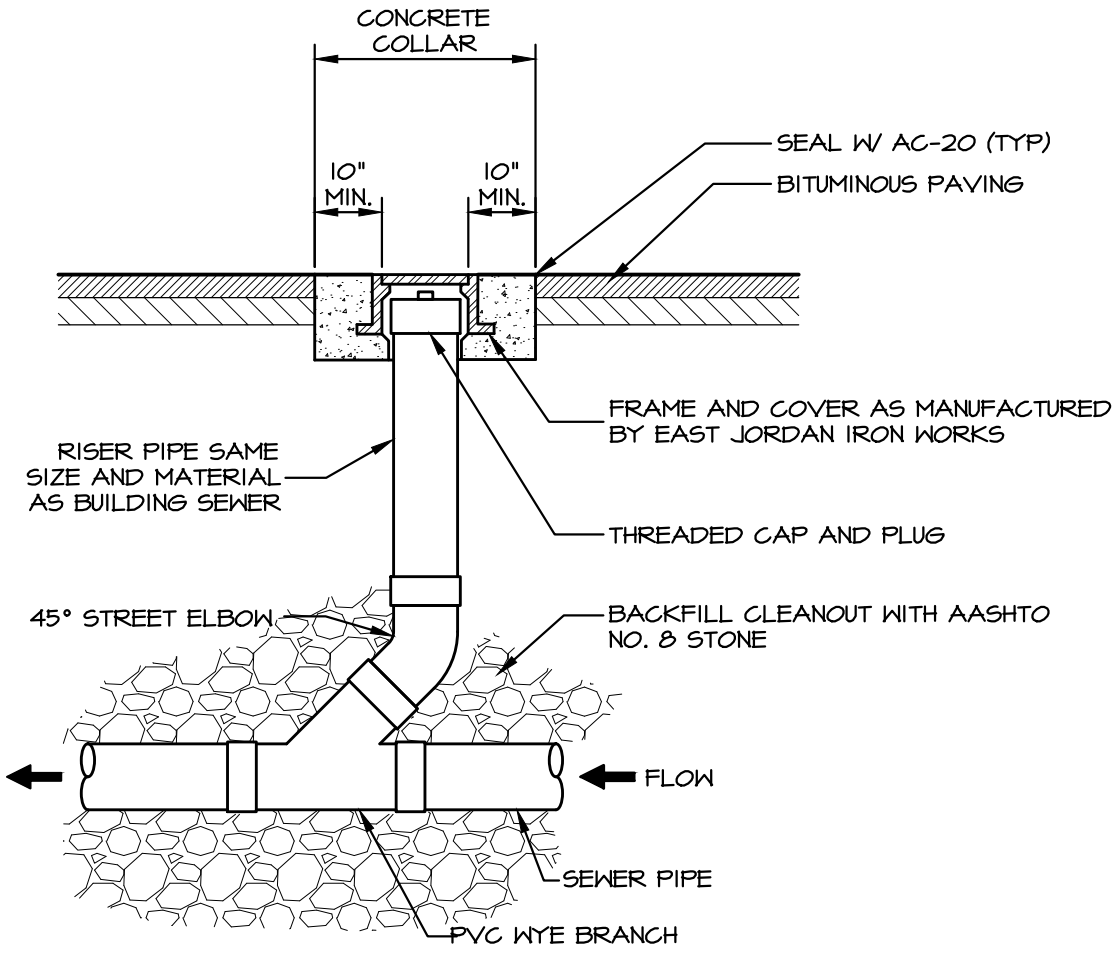
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NEW CLEANOUT IN LAWN AREAS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-20

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# GRAVITY SEWER CLEANOUT IN PAVED AREAS (BY SPECIAL EXCEPTION ONLY)

NO SCALE

GRAVITY SEWER CLEANOUT IN PAVED AREAS (BY SPECIAL EXCEPTION ONLY)

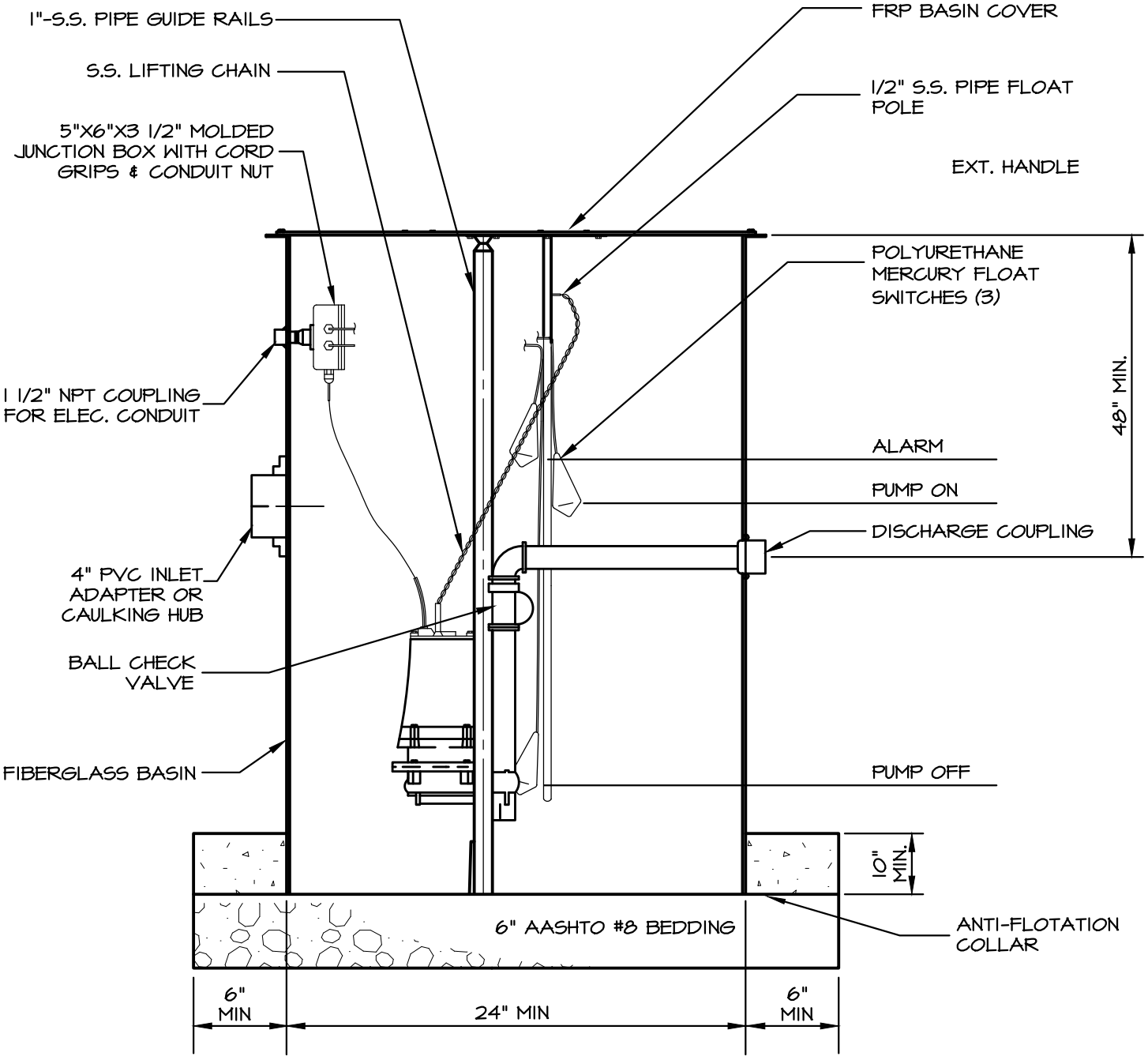
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
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DRAWING: S-21

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# TYPICAL RESIDENTIAL GRINDER PUMP STATION-FIBERGLASS

NO SCALE

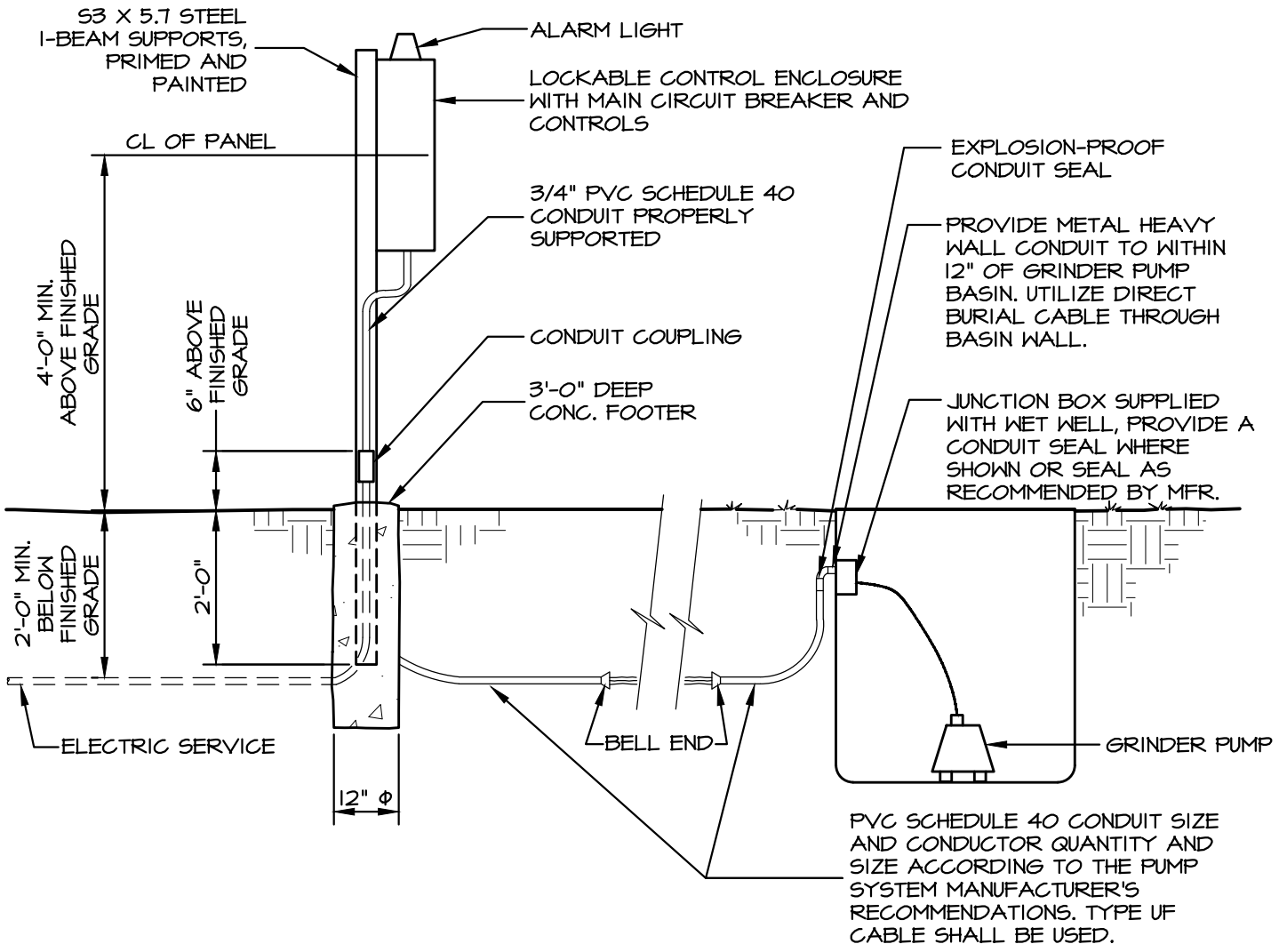
DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\452-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am

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TYPICAL RESIDENTIAL GRINDER PUMP STATION-FIBERGLASS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-22




# GRINDER PUMP ELECTRICAL DETAIL

NO SCALE

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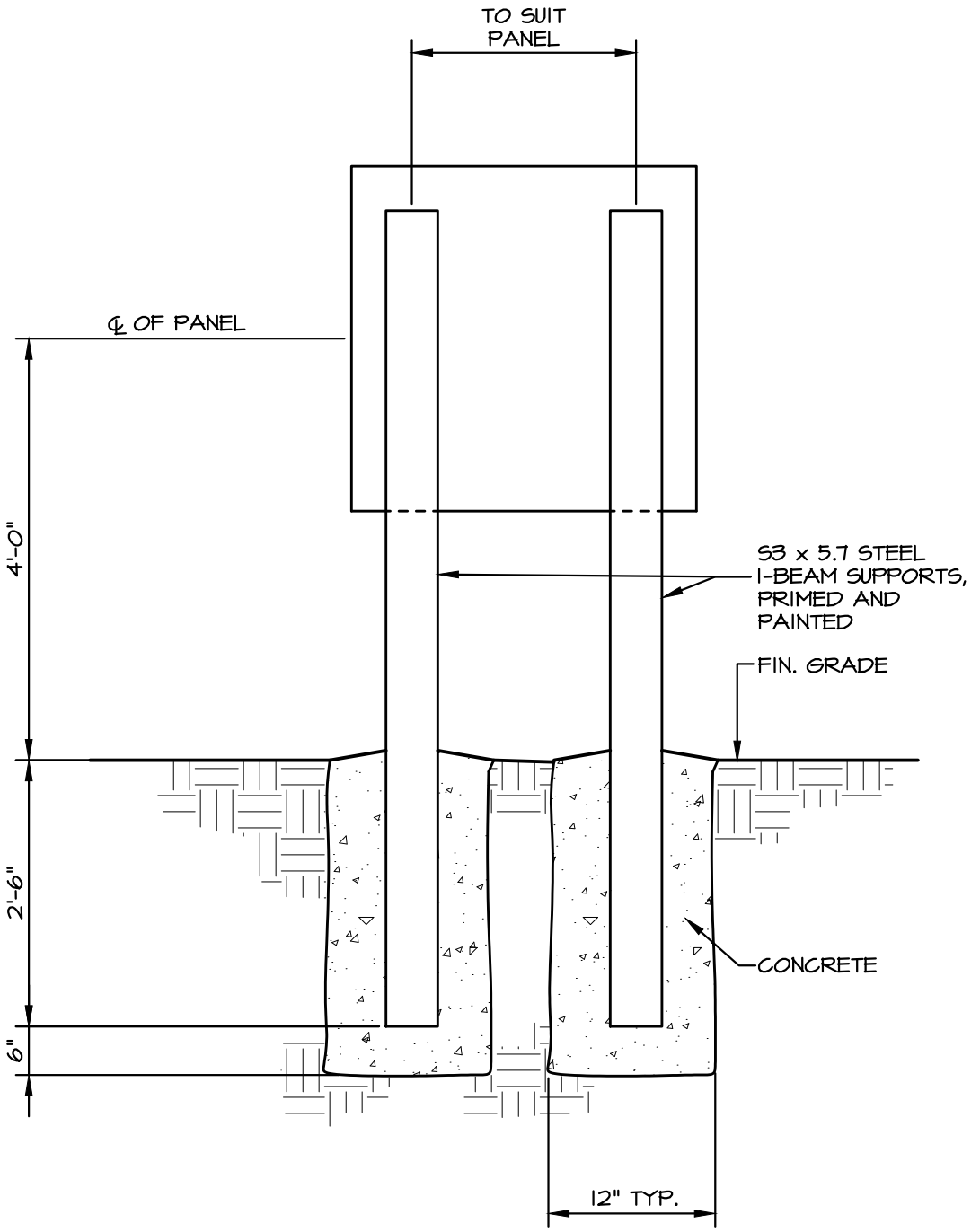
GRINDER PUMP ELECTRICAL DETAIL

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|---|---|
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| DATE: | AUGUST 2023 |

DRAWING: S-23




# PUMP STATION
# CONTROL PANEL SUPPORT POST

NO SCALE

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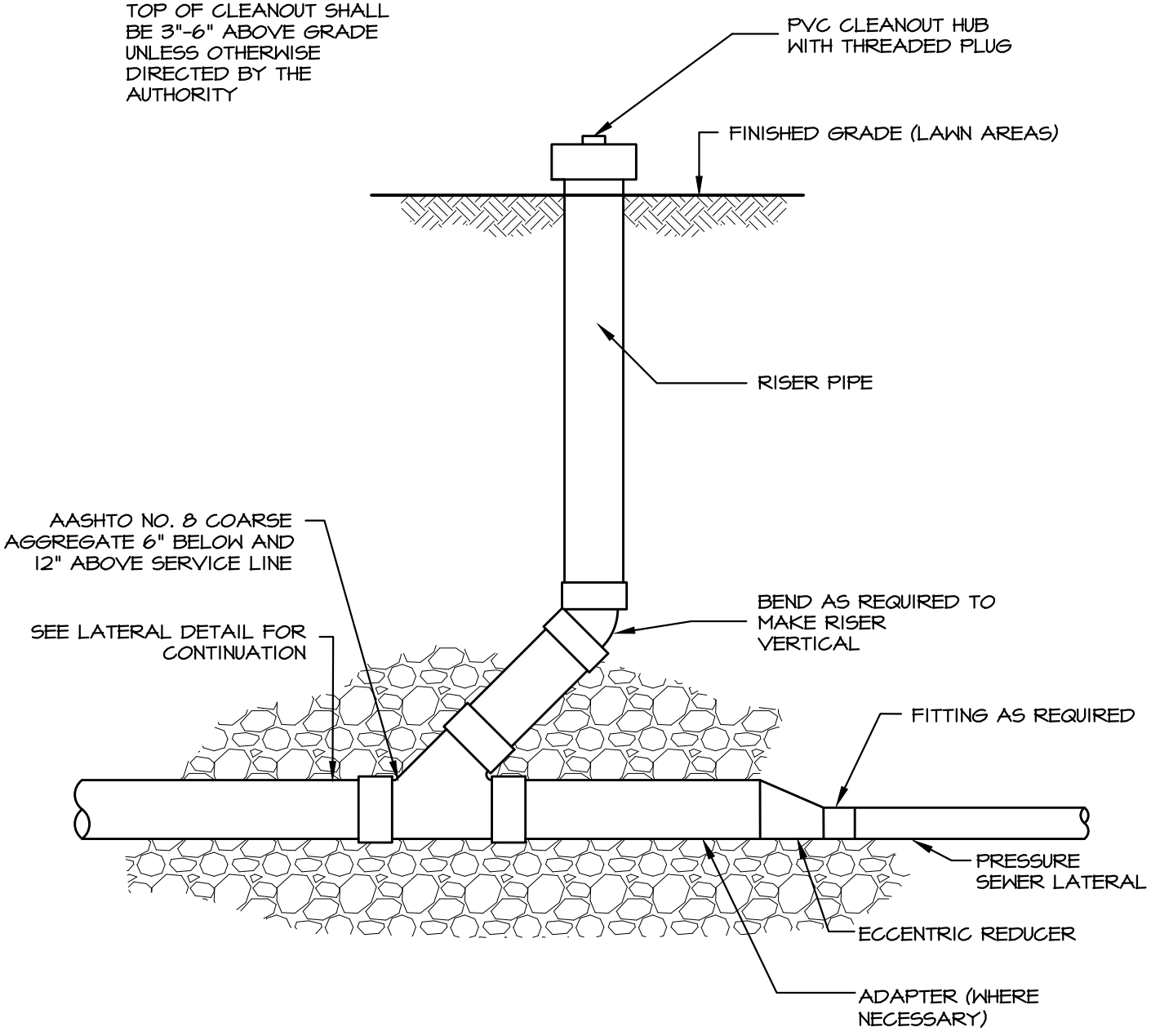
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PUMP STATION CONTROL PANEL SUPPORT POST
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-23A

NOTE:
TOP OF CLEANOUT SHALL BE 3"-6" ABOVE GRADE UNLESS OTHERWISE DIRECTED BY THE AUTHORITY




# PRESSURE LATERAL PIPE TRANSITION TO GRAVITY SEWER

NO SCALE

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PRESSURE LATERAL PIPE TRANSITION TO GRAVITY SEWER
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

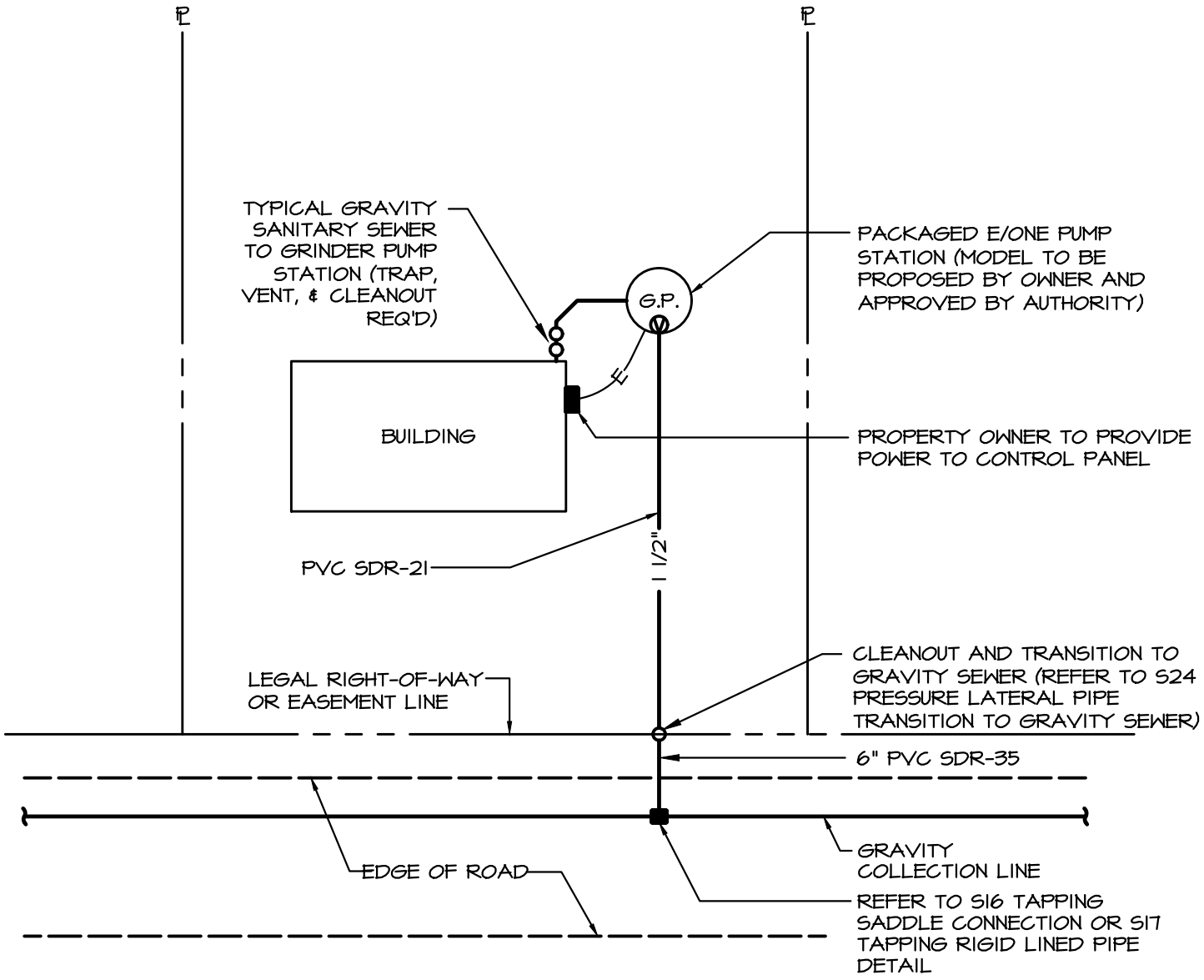
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-24

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NOTES:

1. CONTRACTOR SHALL BE RESPONSIBLE TO LINE NEXT FOUR (4) DOWNSTREAM MANHOLES OR ALL MANHOLES WITHIN 1,000 LINEAR FEET DOWNSTREAM OF CONNECTION POINT, WHICHEVER IS GREATER. MANHOLES SHALL BE LINED WITH SPRAYROQ SPRAYWALL LINING SYSTEM, OR APPROVED EQUAL.




# TYPICAL PRESSURE SEWER WITH GRAVITY SEWER PROPERTY CONNECTION SCHEMATIC

NO SCALE

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TYPICAL PRESSURE SEWER WITH GRAVITY SEWER PROPERTY CONNECTION SCHEMATIC
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

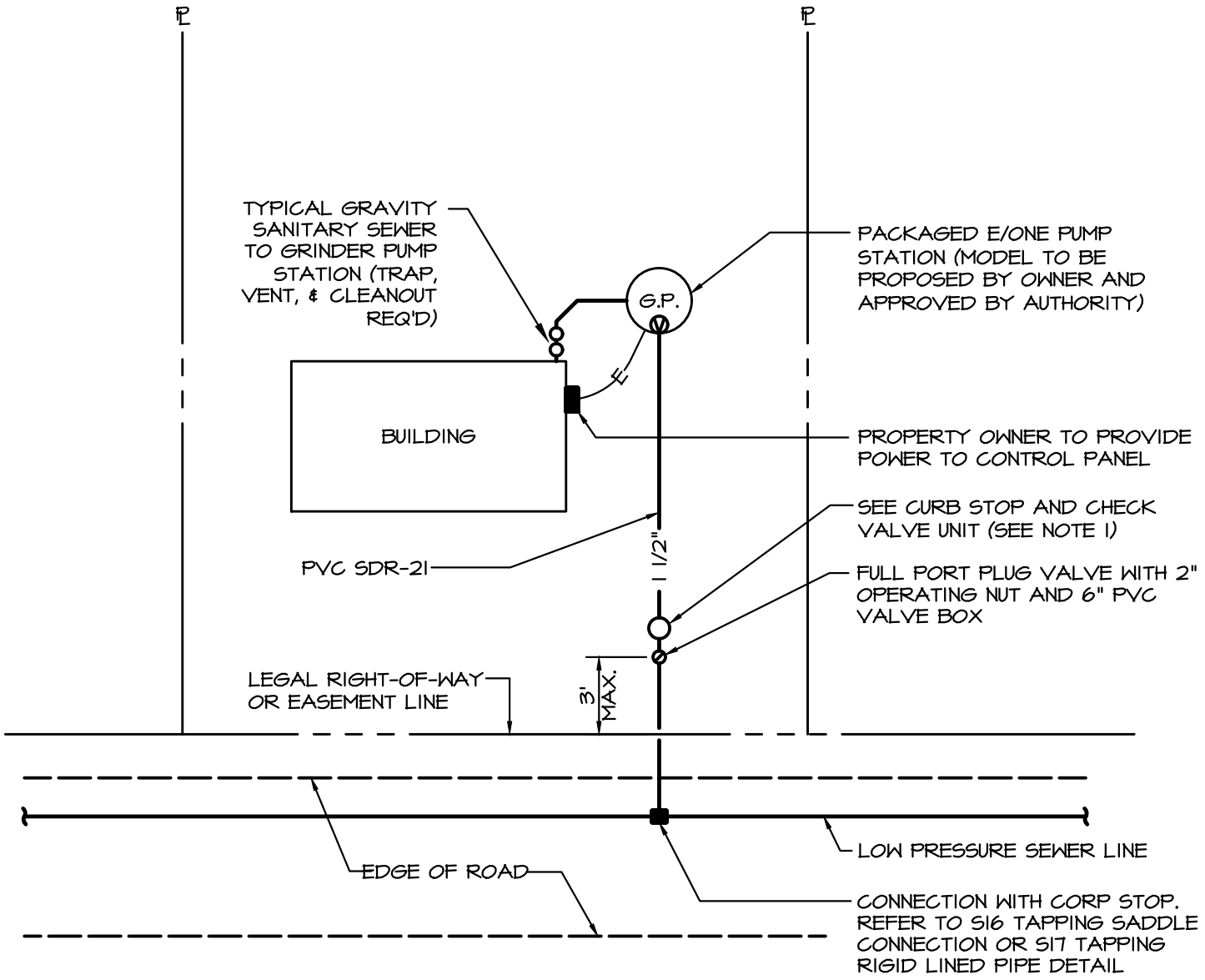
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-25

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NOTES:

1. REFER TO S27 PRESSURE SERVICE LATERAL CURB STOP/CHECK VALVE ASSEMBLY DETAIL.
2. CONTRACTOR SHALL BE RESPONSIBLE TO LINE NEXT FOUR (4) DOWNSTREAM MANHOLES OR ALL MANHOLES WITHIN 1,000 LINEAR FEET DOWNSTREAM OF CONNECTION POINT, WHICHEVER IS GREATER. MANHOLES SHALL BE LINED WITH SPRAYROQ SPRAYWALL LINING SYSTEM, OR APPROVED EQUAL.




# TYPICAL PRESSURE SEWER PROPERTY CONNECTION SCHEMATIC (BY SPECIAL EXCEPTION ONLY)

NO SCALE

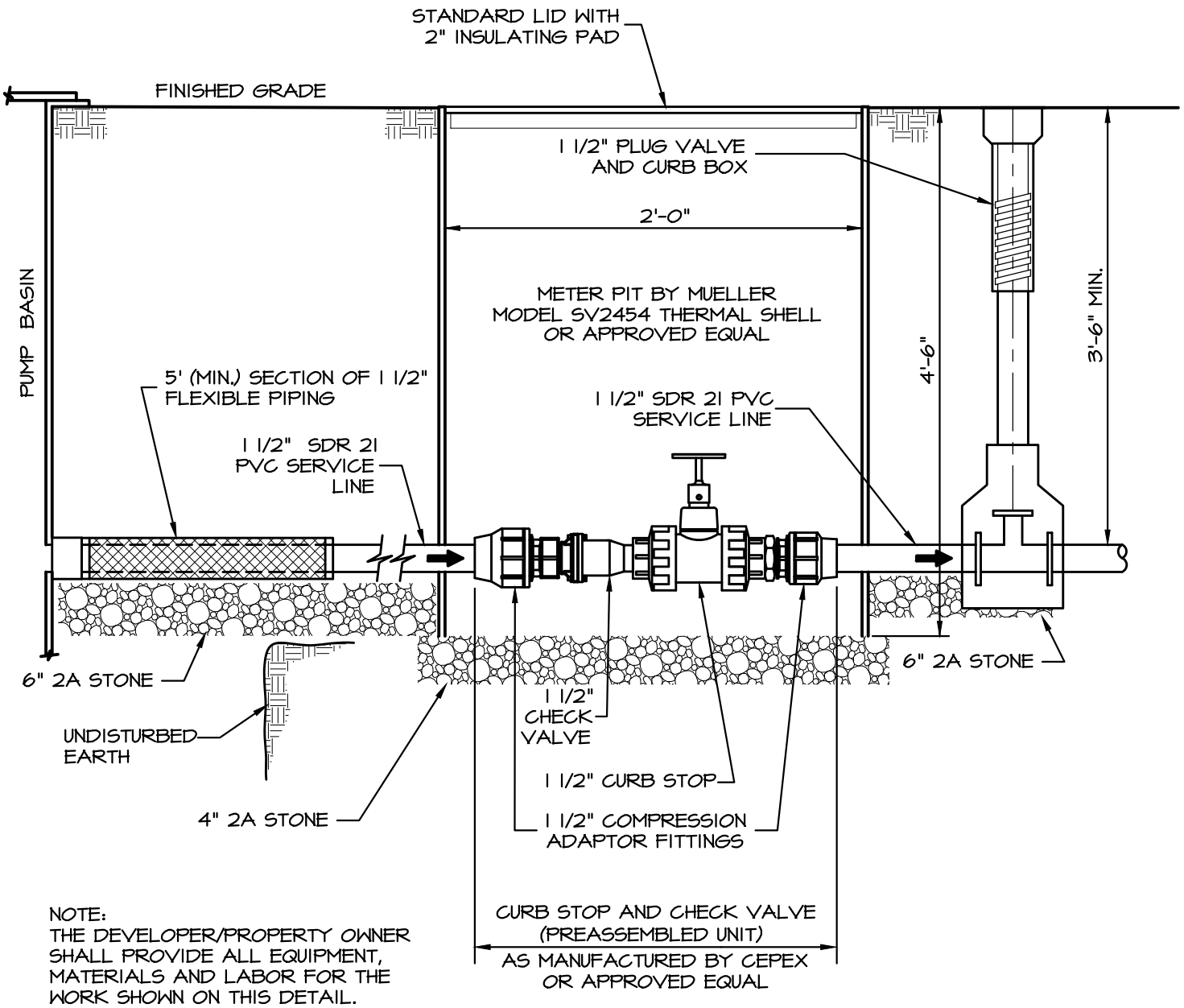
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TYPICAL PRESSURE SEWER PROPERTY CONNECTION SCHEMATIC (BY SPECIAL EXCEPTION ONLY)
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-26

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NOTE:
THE DEVELOPER/PROPERTY OWNER SHALL PROVIDE ALL EQUIPMENT, MATERIALS AND LABOR FOR THE WORK SHOWN ON THIS DETAIL.

# LOW PRESSURE SERVICE LATERAL CURB STOP/CHECK VALVE ASSEMBLY

NO SCALE

LOW PRESSURE SERVICE LATERAL CURB STOP/CHECK VALVE ASSEMBLY

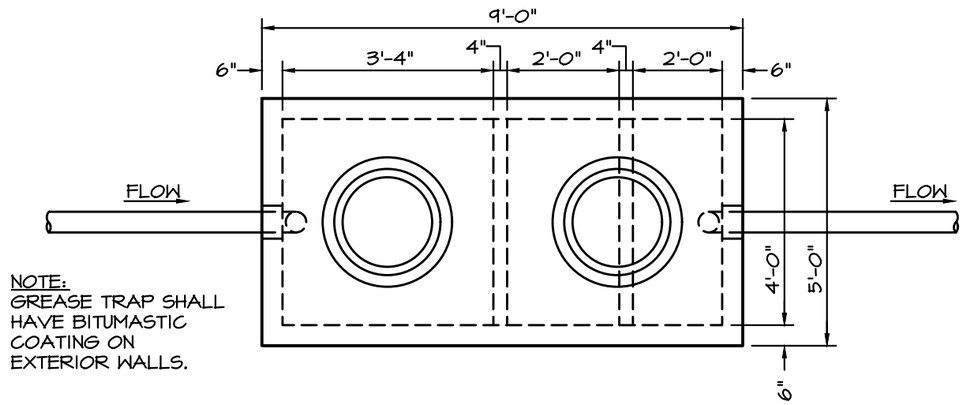
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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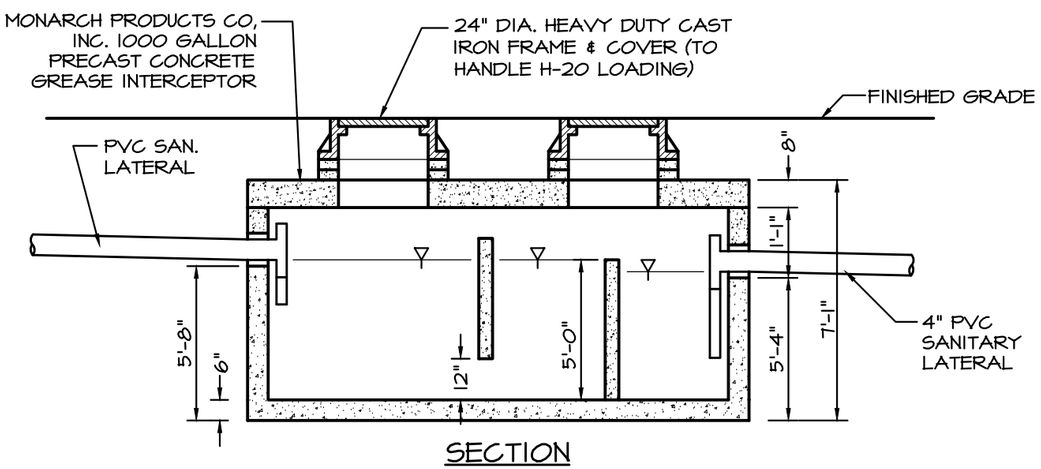
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-27

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PLAN




SECTION

NOTES:

1. TANK TO BE PRECAST AS MANUFACTURED BY: MONARCH, OR APPROVED EQUAL.
2. ALL WASTE MUST ENTER THROUGH INLET FITTING ONLY. NO OTHER CONNECTION PERMITTED.
3. INTERIOR PIPE SHALL BE 6" DIA. MAX. PVC SDR 26 OR SCHEDULE 40 PVC.
4. A WATERSTOP CONSISTING OF A STANDARD MANHOLE ADAPTOR GASKET AS SUPPLIED BY THE PIPE MFR. TO BE GROUTED INTO THE BOX WALL NEAR THE CENTER OF THE WALL.
5. CONCRETE MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS.
6. GREASE INTERCEPTORS SHALL BE LOCATED OUTSIDE OF BUILDINGS IN A LOCATION ACCESSIBLE TO WASTEHAULER PUMPER.
7. INTERCEPTOR TO BE USED IN CONJUNCTION WITH SAMPLING MANHOLE PER STANDARD.
8. ALL WASTE MUST ENTER THROUGH INLET FITTING ONLY.
9. 'INLET' TO BE STENCILED ON UPPER LEFT HAND CORNER ON INLET END IN WHITE.
10. STAINLESS STEEL CLAMP AND BOLTS 3' O.C. MAX. (TYP.) MIN. 2 REQUIRED.
11. TANK CAPACITY TO BE DETERMINED AT THE TIME OF PERMIT APPLICATION.
12. PIPE AND FITTINGS SHALL BE 4" SCH. 40 PVC OR SDR 26 PVC.
13. ALL WORK SHALL COMPLY WITH THE REQUIREMENTS OF THE AUTHORITY.
14. STRUCTURE, RISERS, AND FRAME/COVER SHALL BE DESIGNED FOR H-20 LOADING IN TRAFFIC AREAS.
15. PRECAST SUPPLIER SHALL PROVIDE STRUCTURAL AND FLOATATION CALCULATIONS FOR REVIEW.
16. ALL DIMENSIONS ARE MINIMUM VALUES.
17. ALL STRUCTURE AND RISER JOINTS SHALL BE WATERTIGHT.
18. CALCULATIONS SUPPORTING SIZING OF GREASE TRAP / OIL & WATER SEPARATOR SHALL BE PROVIDED BY THE ENGINEER OF RECORD FOR REVIEW BY THE AUTHORITY. IF A LARGER INTERCEPTOR IS REQUIRED, ENGINEER OF RECORD SHALL PROVIDE A SEPARATE DETAIL.

# 1,000 GAL GREASE TRAP / OIL & WATER SEPARATOR

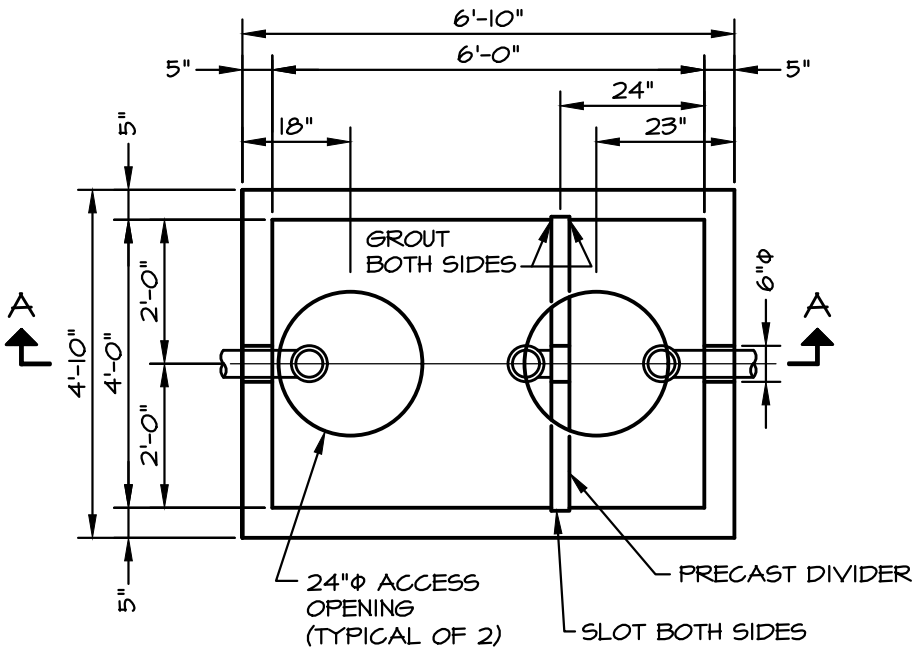
NO SCALE

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1,000 GAL GREASE TRAP / OIL & WATER SEPARATOR
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| SCALE: | NO SCALE | DRAWING: S-28 |
| DRAWN BY: | TMO | |
| DATE: | AUGUST 2023 | |

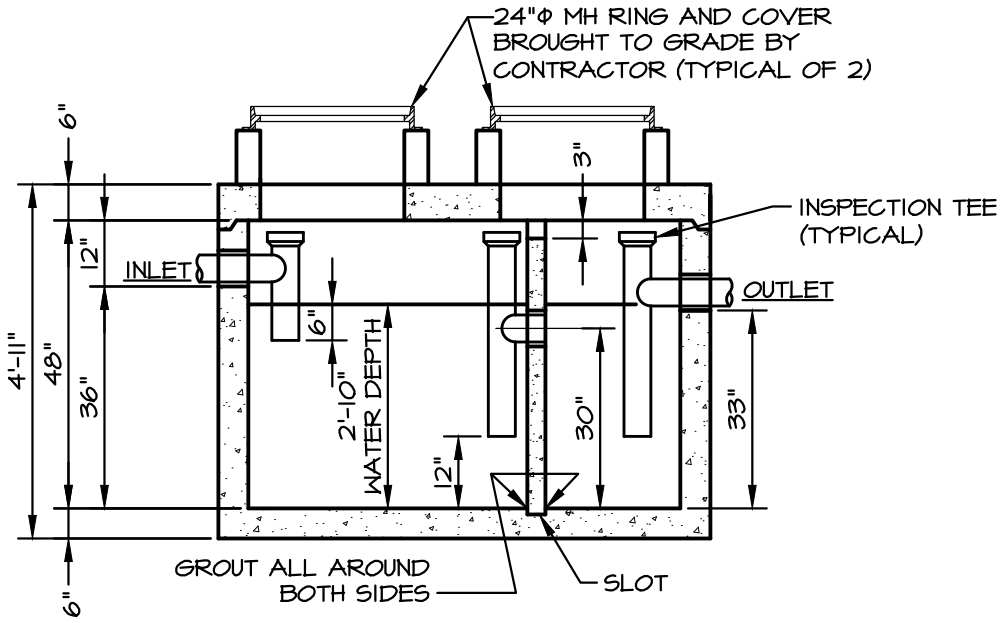
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PLAN VIEW

GENERAL NOTES:

1. CONCRETE: 28 DAY COMPRESSIVE STRENGTH F'E = 4,500 PSI
2. REINFORCEMENT: ASTM A-615, GRADE 60
3. LOADS: H-20 TRUCK WHEEL WITH 30% IMPACT PER AASHTO
4. BUTYL RUBBER JOINT SEALANT SS-S-00210
5. **GRAY WATER ONLY**, BLACK WATER SHALL BE CARRIED BY SEPARATE SIDE SEWER.
6. CONTRACTOR TO:
   - SUPPLY AND INSTALL ALL PIPING AND SAMPLING TEES
   - GROUT IN ALL PIPES AND WEIRS
   - FILL W/ CLEAN WATER PRIOR TO "START-UP" OF SYSTEM
   - VERIFY SIZE AND LOCATION OF ALL OPENINGS




SECTION VIEW A-A

# 500 GALLON GREASE INTERCEPTOR

NO SCALE

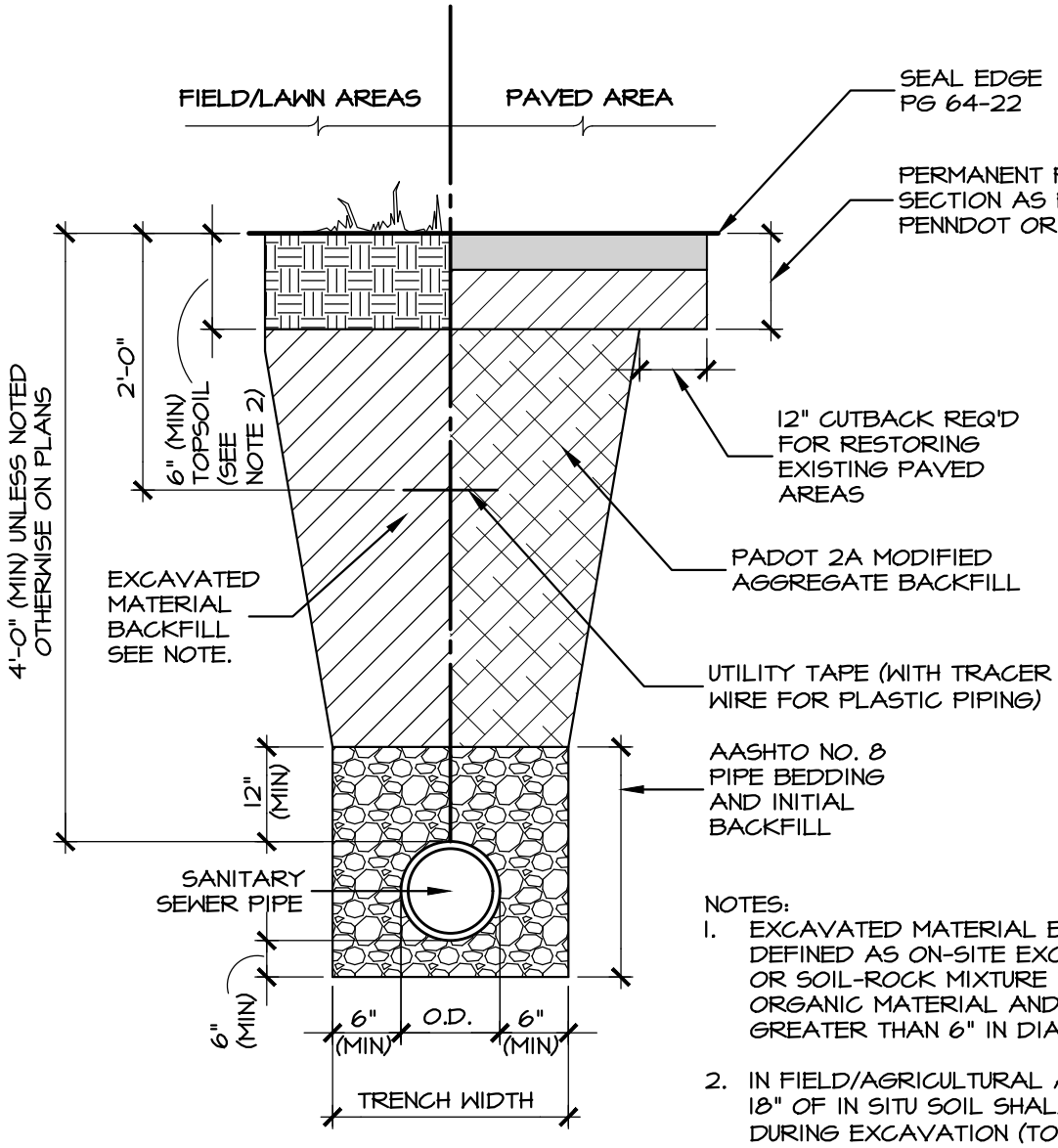
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500 GALLON GREASE INTERCEPTOR
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | JULY 2026 |

DRAWING: S-28A

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NOTES:

1. EXCAVATED MATERIAL BACKFILL IS DEFINED AS ON-SITE EXCAVATED SOIL OR SOIL-ROCK MIXTURE FREE OF STONES, ORGANIC MATERIAL AND OTHER DEBRIS GREATER THAN 6" IN DIAMETER.
2. IN FIELD/AGRICULTURAL AREAS, THE TOP 18" OF IN SITU SOIL SHALL BE REMOVED DURING EXCAVATION (TO BE STOCKPILED AND REPLACED).

# GRAVITY SANITARY SEWER PIPE INSTALLATION

NO SCALE

GRAVITY SANITARY SEWER PIPE INSTALLATION

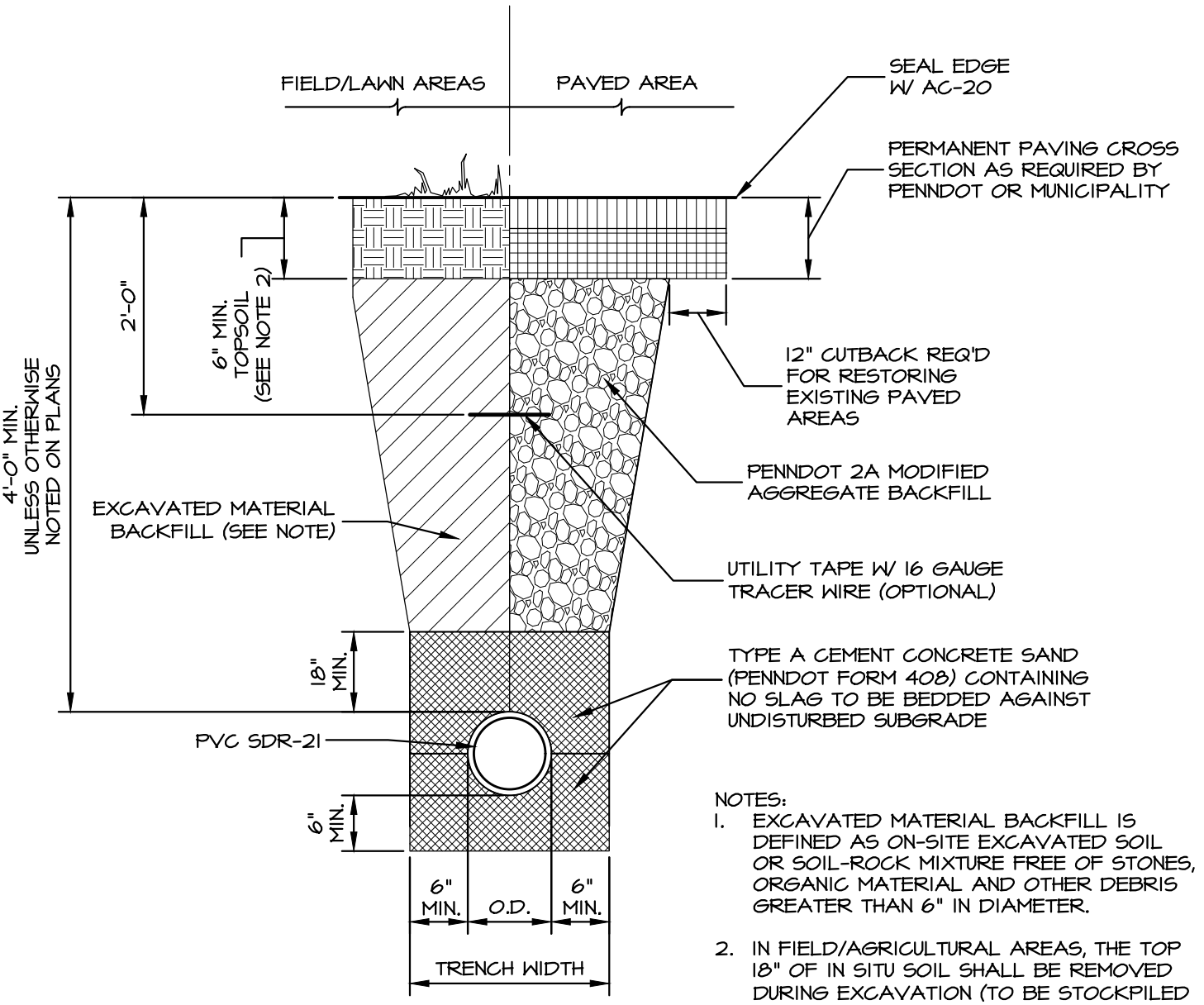
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| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

DRAWING: S-29

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NOTES:

1. EXCAVATED MATERIAL BACKFILL IS DEFINED AS ON-SITE EXCAVATED SOIL OR SOIL-ROCK MIXTURE FREE OF STONES, ORGANIC MATERIAL AND OTHER DEBRIS GREATER THAN 6" IN DIAMETER.
2. IN FIELD/AGRICULTURAL AREAS, THE TOP 18" OF IN SITU SOIL SHALL BE REMOVED DURING EXCAVATION (TO BE STOCKPILED AND REPLACED).

# PRESSURE SEWER SERVICE LINE INSTALLATION

NO SCALE

PRESSURE SEWER SERVICE LINE INSTALLATION

STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

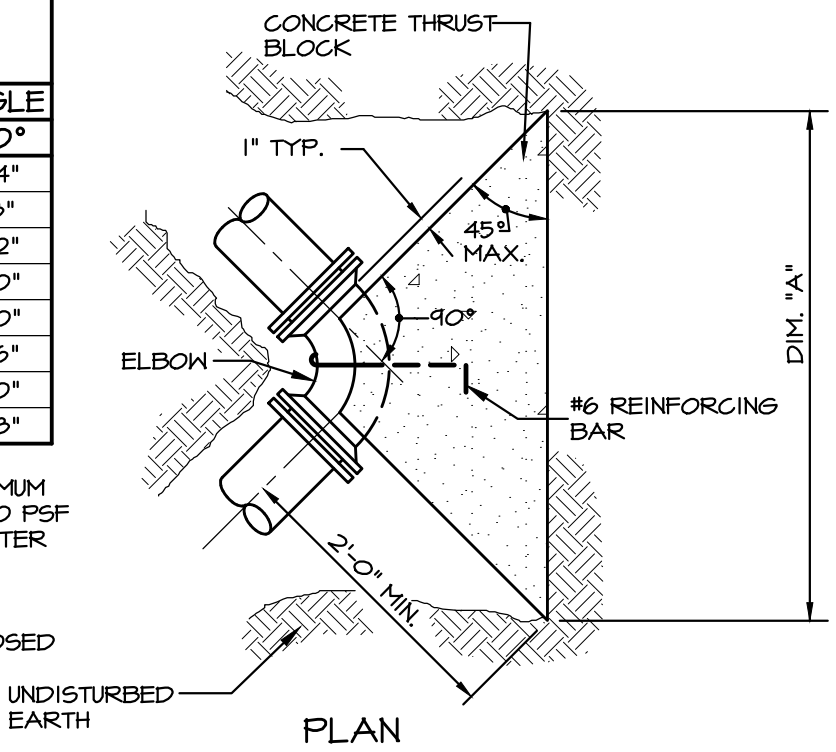
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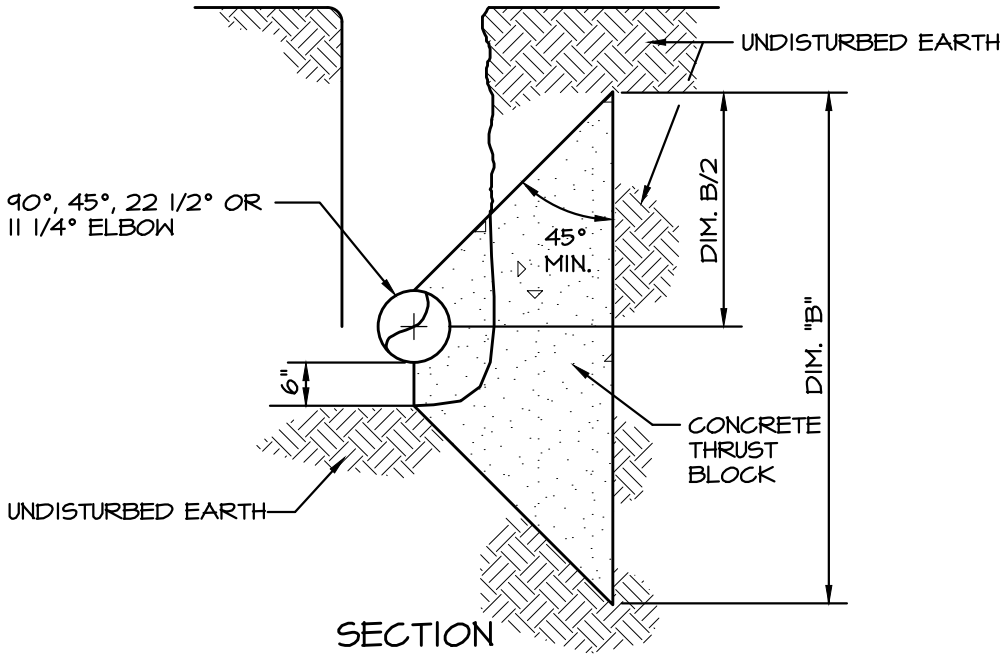
| THRUST BLOCK DIMENSION SCHEDULE - ELBOWS(*) (DUCTILE IRON PIPE) | | | | | |
|---|---|---|---|---|---|
| PIPE DIAM. | DIM. | ELBOW DEFLECTION ANGLE | | | |
| | | 11 1/4° | 22 1/2° | 45° | 90° |
| 4" | A | 12" | 18" | 24" | 24" |
| | B | 12" | 12" | 12" | 18" |
| 6" | A | 18" | 24" | 30" | 42" |
| | B | 12" | 18" | 24" | 30" |
| 8" | A | 24" | 24" | 42" | 60" |
| | B | 12" | 24" | 30" | 36" |
| 12" | A | 30" | 42" | 54" | 90" |
| | B | 24" | 30" | 36" | 48" |

(*) THRUST BLOCK DESIGN BASED ON THE MINIMUM SOIL HORIZONTAL BEARING STRENGTH OF 3000 PSF AND 150 PSI WORKING PRESSURE PLUS 50% WATER HAMMER ALLOWANCE.

FOR PIPE SIZES GREATER THAN 12", SUBMIT ENGINEERING CALCULATIONS TO VERIFY PROPOSED THRUST BLOCK SIZES.




PLAN




SECTION

# HORIZONTAL AND VERTICAL UP RESTRAINT THRUST BLOCKING DETAIL - ELBOWS

NO SCALE


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HORIZONTAL & VERTICAL UP RESTRAINT THRUST BLOCKING DETAIL - ELBOWS
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

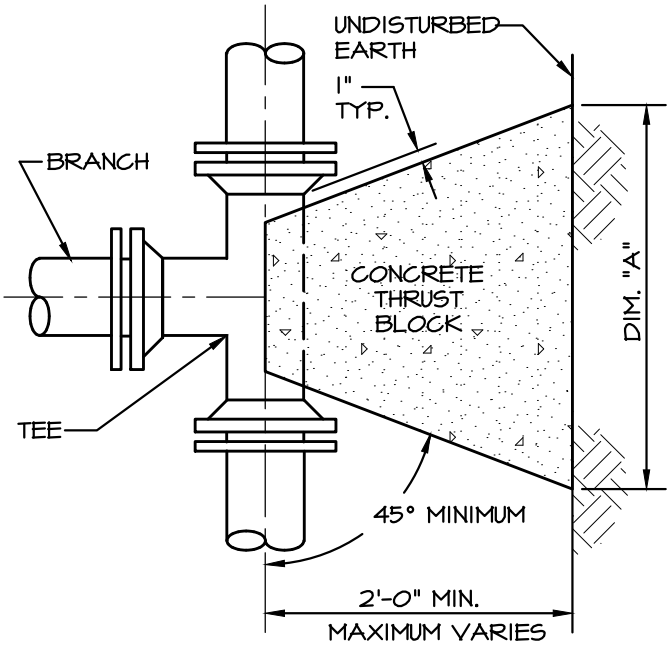
DRAWING: S-31

DRAWING: C:\Users\tmoberholtzer\DC\ACCDocs\ELA Group\952-033 Sanitary Sewer Specs and Detail Updates\Project Files\CAD Data\Utility\DETAILS.dwg - PLOTTED: Jul 20, 2026 11:44 am

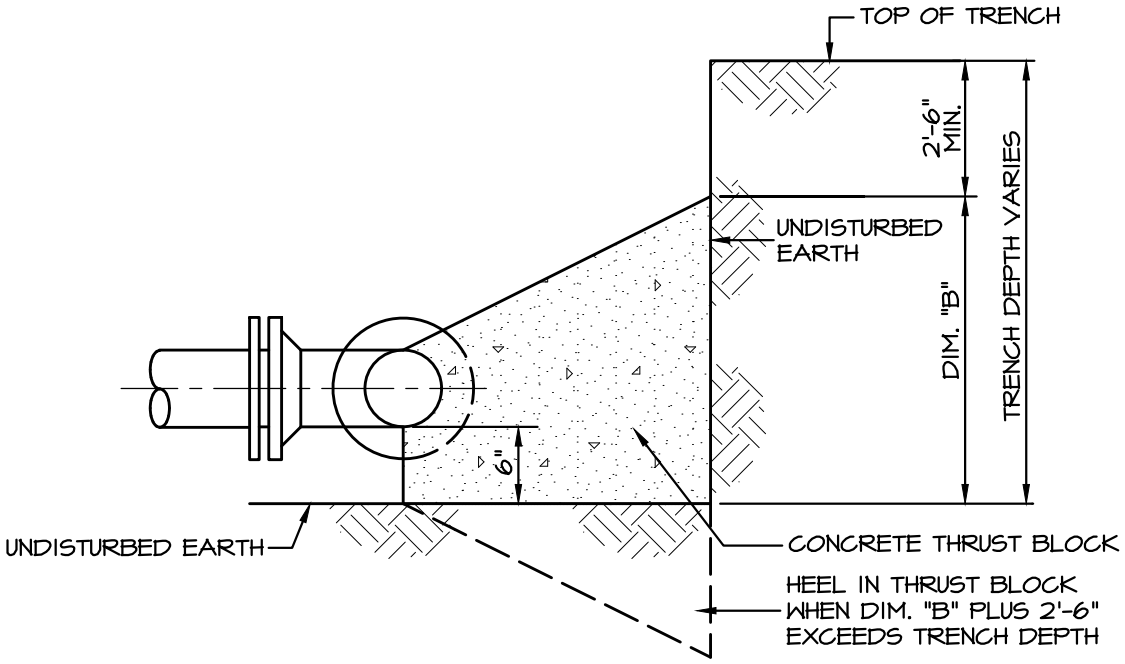
| THRUST BLOCK DIMENSION SCHEDULE - ELBOWS(*) (DUCTILE IRON PIPE) | | | | |
|---|---|---|---|---|
| DIM. | BRANCH SIZE | | | |
| | 4" | 6" | 8" | 12" |
| A | 36" | 42" | 60" | 96" |
| B | 18" | 24" | 30" | 42" |

(*) THRUST BLOCK DESIGN BASED ON THE MINIMUM SOIL HORIZONTAL BEARING STRENGTH OF 3000 PSF AND 150 PSI WORKING PRESSURE PLUS 50% WATER HAMMER ALLOWANCE.

FOR PIPE SIZES GREATER THAN 12", SUBMIT ENGINEERING CALCULATIONS TO VERIFY PROPOSED THRUST BLOCK SIZES.




PLAN




SECTION

# HORIZONTAL RESTRAINT THRUST BLOCKING DETAIL - TEES

NO SCALE

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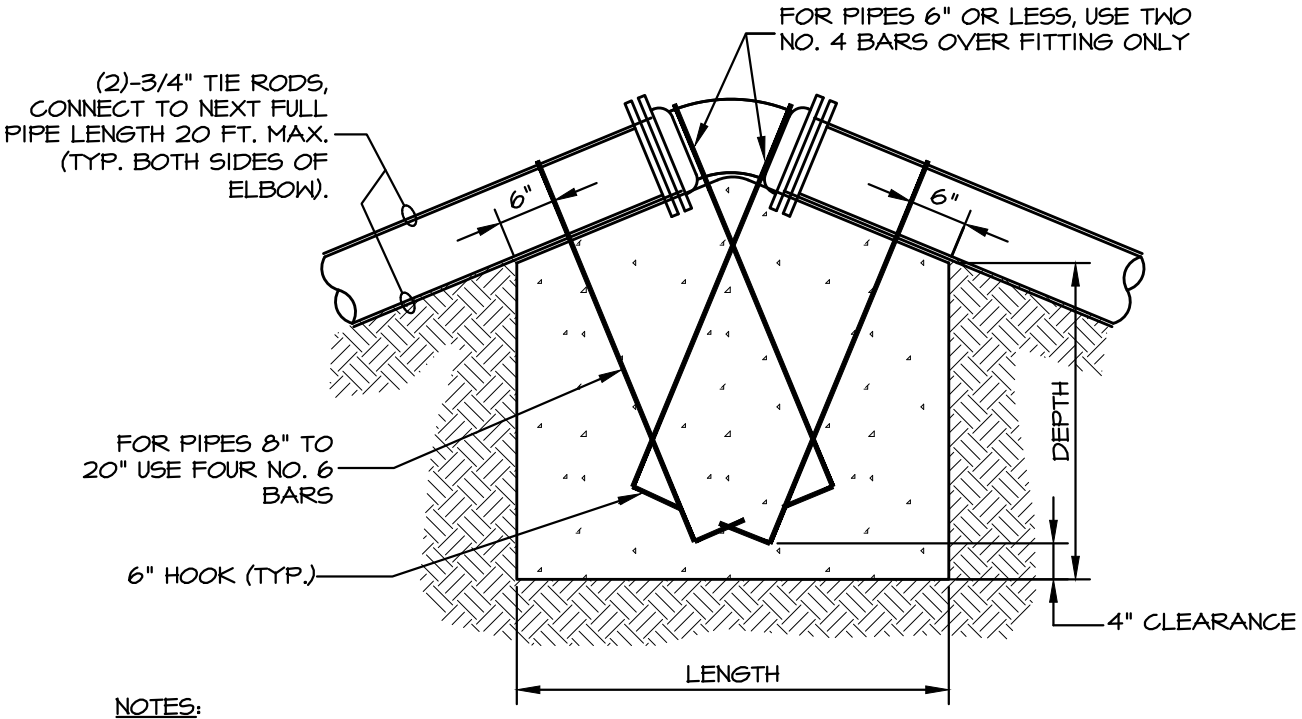
HORIZONTAL RESTRAINT THRUST BLOCKING DETAIL - TEES
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
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DRAWING: S-32

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| PIPE SIZES | DIMENSIONS OF CONCRETE BLOCKING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LENGTH | | | WIDTH | | | DEPTH | | |
| | 11 1/4° | 22 1/2° | 45° | 11 1/4° | 22 1/2° | 45° | 11 1/4° | 22 1/2° | 45° |
| 4" AND SMALLER | 2' | 4' | 4' | 1.5' | 3' | 3' | 1' | 2' | 3' |
| 6" AND 8" | 3' | 4' | 6' | 3' | 3' | 3' | 2' | 3' | 4' |
| 10" AND 12" | 4.5' | 6' | 8' | 3' | 3' | 4' | 3' | 4.5' | 5' |
| 14" AND 16" | 6' | 8' | 11' | 3.5' | 3.5' | 5' | 2.5' | 5' | 5' |
| 18" AND 20" | 7' | 9' | 13' | 4' | 5' | 5.5' | 4' | 5' | 6' |




NOTES:

1. DIMENSIONS OF CONCRETE BLOCKS VERIFIED USING AWWA M41 DUCTILE IRON PIPE AND FITTINGS. ASSUMPTIONS USED FOR CALCULATIONS WERE A WORKING PRESSURE OF 200 PSI AND A SAFETY FACTOR OF 1.5.
2. IF THE OWNER AGREES, TIE RODS MAY BE ELIMINATED PROVIDED ALL JOINTS ARE MECHANICAL JOINT TYPE WITH JOINT RESTRAINT. (MEGALUG BY EBAA IRON SERIES 1100 OR APPROVED EQUAL).
3. NO COUPLING OR JOINTS SHALL BE COVERED WITH CONCRETE
4. REINFORCING BAR STRAPS TO BE SHAPED TO PIPE CURVATURE.
5. ALL EXPOSED STEEL TO BE PAINTED WITH TWO COATS ASPHALTIC PAINT.
6. CONCRETE BEARING SURFACES SHALL BE UNDISTURBED SOIL.

# TYPICAL THRUST BLOCKING FOR VERTICAL UPWARD THRUSTS

NO SCALE

TYPICAL THRUST BLOCKING FOR VERTICAL UPWARD THRUSTS

STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

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## ELBOW DIMENSION SCHEDULE

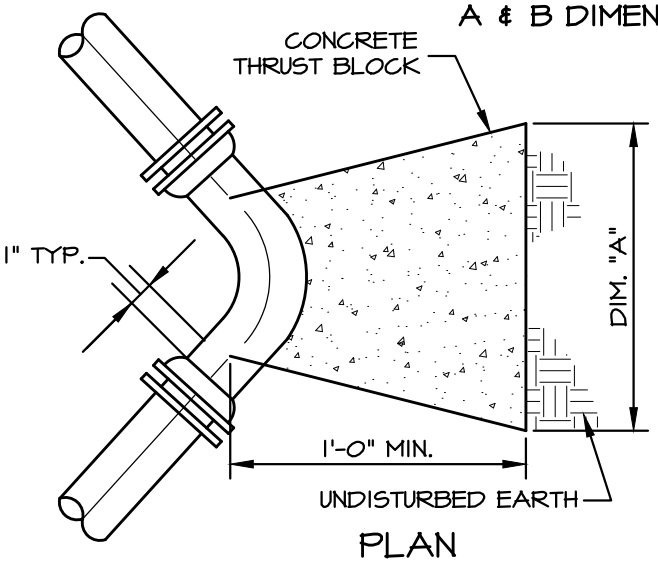
| DIM. | 4"-90° | 6"-90° | 8"-90° | 12"-90° | 4"-45° | 6"-45° | 8"-45° | 12"-45° | 4"-22 1/2° | 6"-26° | 8"-22 1/2° | 12"-22 1/2° | 4"-11 1/4° | 6"-11 1/4° | 8"-11 1/4° | 12"-11 1/4° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 24 | 42 | 60 | 90 | 24 | 30 | 42 | 54 | 18 | 24 | 24 | 42 | 12 | 18 | 24 | 30 |
| B | 18 | 30 | 36 | 48 | 12 | 24 | 30 | 36 | 9 | 18 | 24 | 30 | 9 | 12 | 12 | 24 |

A & B DIMENSIONS ARE IN INCHES

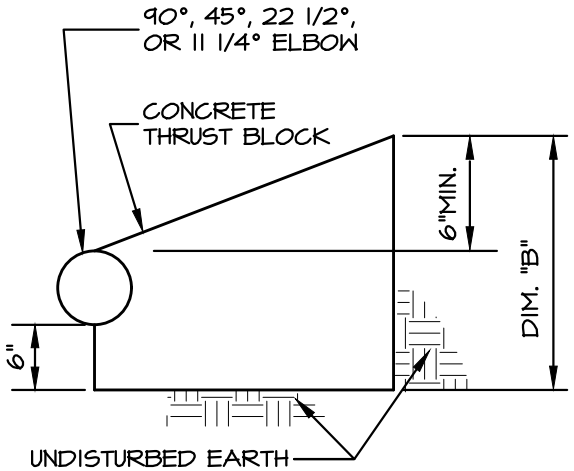
## ELBOW DIMENSION SCHEDULE

| DIM. | 3"-90° | 2 1/2"-90° | 2"-90° | 1 1/2"-90° | 3"-45° | 2 1/2"-45° | 2"-45° | 1 1/2"-45° | 3"-22 1/2° | 2 1/2"-22 1/2° | 3"-11 1/4° |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 20 | 18 | 16 | 14 | 18 | 16 | 14 | 12 | 16 | 14 | 12 |
| B | 15 | 15 | 14 | 14 | 15 | 15 | 14 | 14 | 15 | 15 | 14 |

A & B DIMENSIONS ARE IN INCHES




PLAN




SECTION

# HORIZONTAL THRUST BLOCKING DETAILS (LOW PRESSURE SEWER)

NO SCALE

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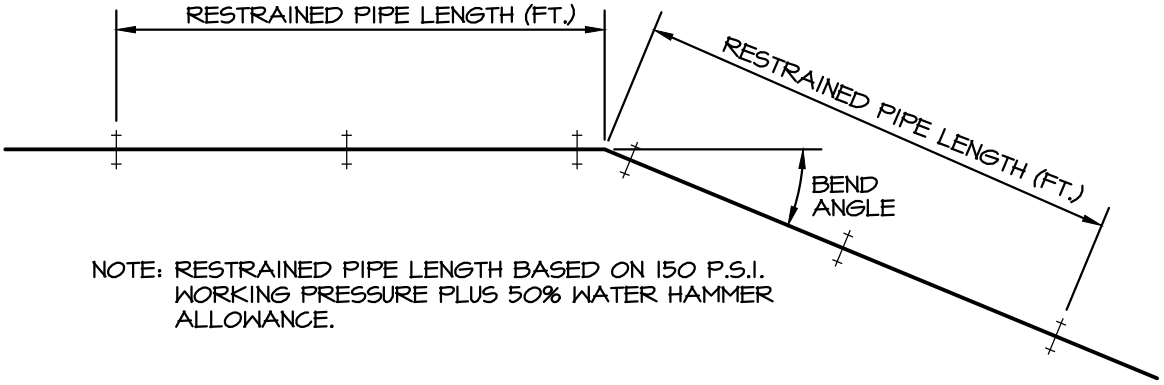
HORIZONTAL THRUST BLOCKING DETAILS (LOW PRESSURE SEWER)

STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

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NOTE: RESTRAINED PIPE LENGTH BASED ON 150 P.S.I. WORKING PRESSURE PLUS 50% WATER HAMMER ALLOWANCE.

| HORIZONTAL RESTRAINED PIPE LENGTH SCHEDULE (DUCTILE IRON PIPE) | | | | |
|---|---|---|---|---|
| PIPE DIAMETER | HORIZONTAL ELBOW DEFLECTION ANGLE | | | |
| | 90° | 45° | 22 1/2° | 11 1/4° |
| 3" THRU 4" | 19' | 8' | 4' | 2' |
| 6" | 27' | 11' | 7' | 3' |
| 8" | 35' | 14' | 8' | 4' |
| 10" | 42' | 17' | 8' | 5' |
| 12" | 49' | 20' | 10' | 5' |

*ADD 12% TO LENGTH IF PIPE IS POLYETHYLENE ENCASED

| VERTICAL RESTRAINED PIPE LENGTH SCHEDULE (DUCTILE IRON PIPE) | | | |
|---|---|---|---|
| PIPE DIAMETER | VERTICAL ELBOW DEFLECTION ANGLE | | |
| | 45° | 22 1/2° | 11 1/4° |
| 3" THRU 4" | 20' | 10' | 5' |
| 6" | 28' | 14' | 7' |
| 8" | 37' | 18' | 9' |
| 10" | 44' | 21' | 11' |
| 12" | 52' | 25' | 12' |

*ADD 12% TO LENGTH IF PIPE IS POLYETHYLENE ENCASED

NOTE: FOR PIPE SIZES GREATER THAN 12", SUBMIT ENGINEERING CALCULATIONS TO VERIFY PROPOSED RESTRAINED PIPE LENGTHS.

# DUCTILE IRON RESTRAINED PIPE LENGTH SCHEDULE

NO SCALE

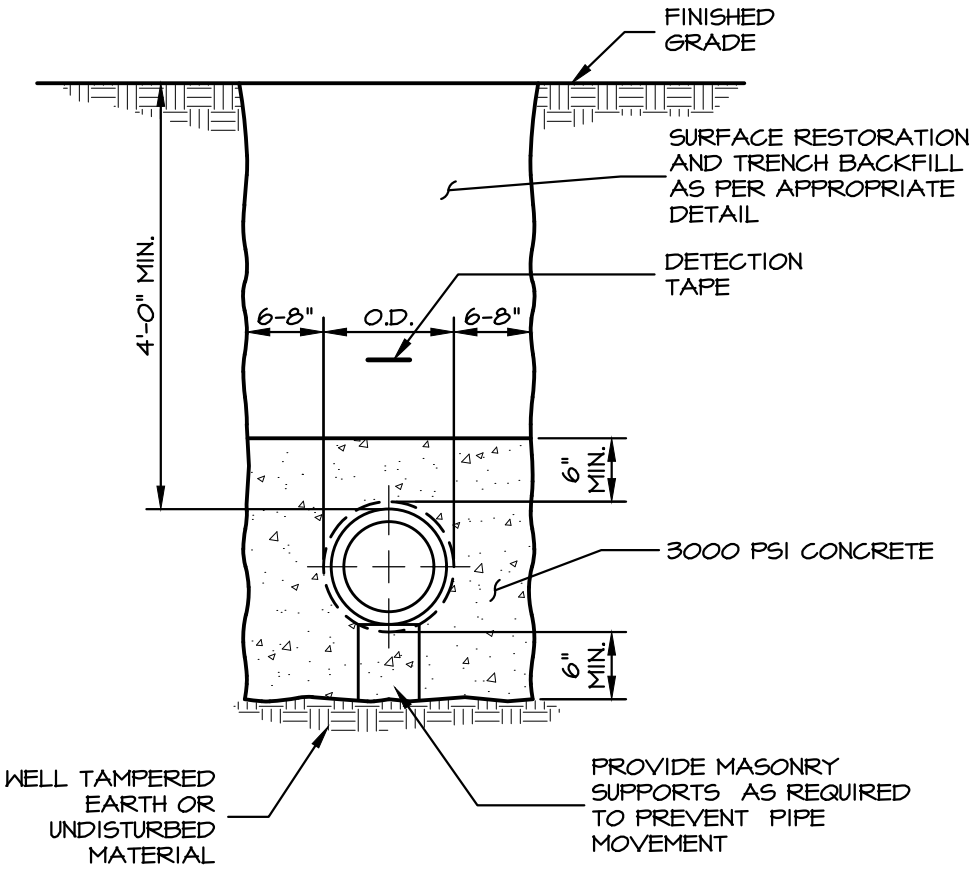
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DUCTILE IRON RESTRAINED PIPE LENGTH SCHEDULE
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
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NOTES:

1. CONCRETE ENCASEMENT TO BE USED WHERE MINIMUM CLEARANCE CANNOT BE OBTAINED BETWEEN WATER LINE AND SANITARY SEWERS AND STORM SEWER. ENCASEMENT SHALL BE INSTALLED AS DIRECTED BY THE ENGINEER IN THE FIELD.

2. THE CONTRACTOR SHALL BE RESPONSIBLE TO PREVENT FLOATATION OF THE PIPE WHEN CONCRETE IS POURED.

# CONCRETE ENCASEMENT

NO SCALE

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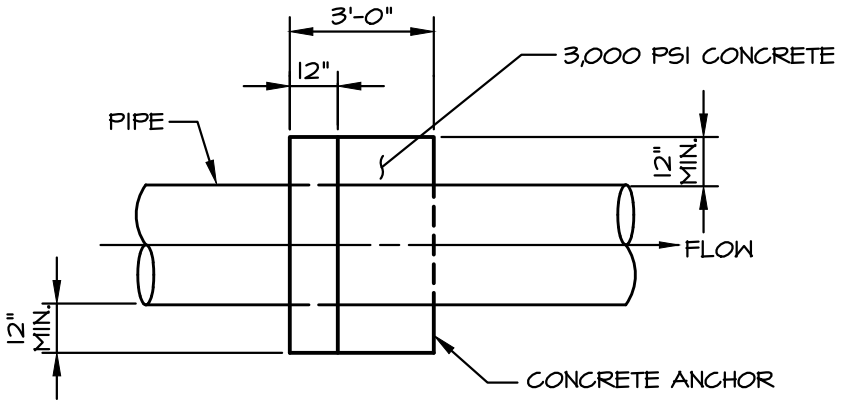
CONCRETE ENCASEMENT
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

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|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
| DATE: | AUGUST 2023 |

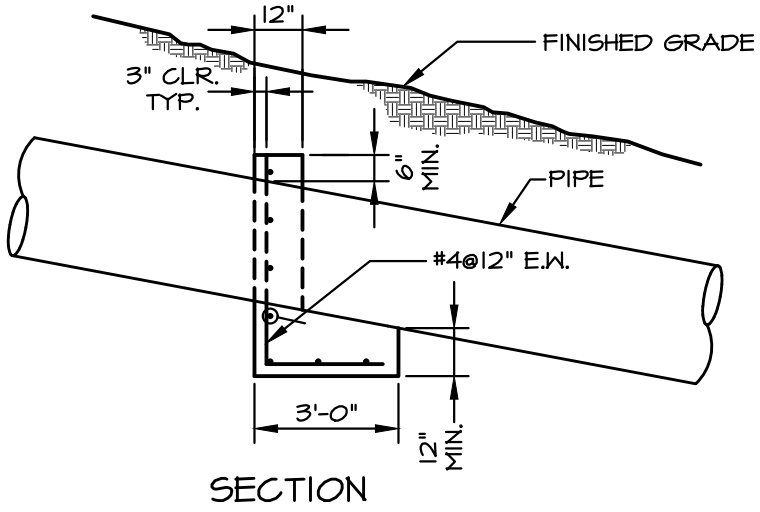
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SPACING: GRADES 20% UP TO 35% - NOT OVER 36FT C.T.C.
GRADES 35% UP TO 50% - NOT OVER 24FT C.T.C.
GRADES 50% AND OVER - NOT OVER 16FT C.T.C.




PLAN




SECTION

# TYPICAL CONCRETE ANCHOR (8" THRU 36" SEWERS)

NO SCALE

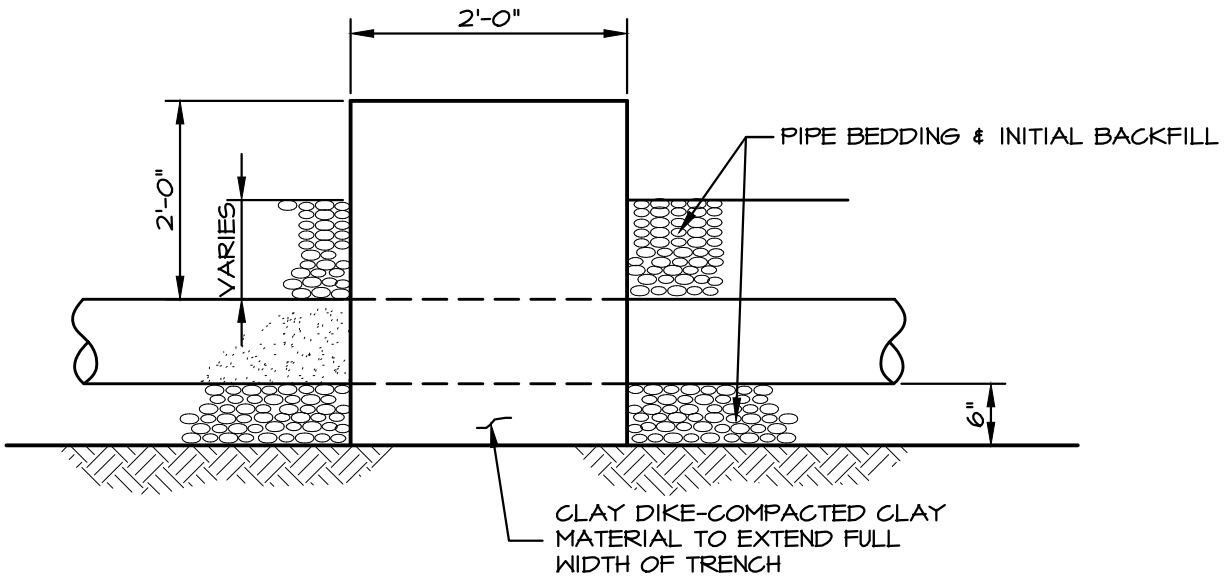
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TYPICAL CONCRETE ANCHOR (8" THRU 36" SEWERS)
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
| DRAWN BY: | TMO |
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DRAWING: S-37

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NOTE:

CLAY DIKE SHALL CONSIST OF CLAY CONTAINING NO MORE THAN 15% (BY VOLUME) STONE NO LARGER THAN TWO (2) INCHES IN DIAMETER. CLAY SHALL BE PLACED IN SIX (6) INCH LIFTS AND COMPACTED BY A MECHANICAL TAMPER TO NOT LESS THAN 95% OF MAXIMUM DENSITY AT OPTIMUM MOISTURE CONTENT.

# CLAY DIKE

NO SCALE

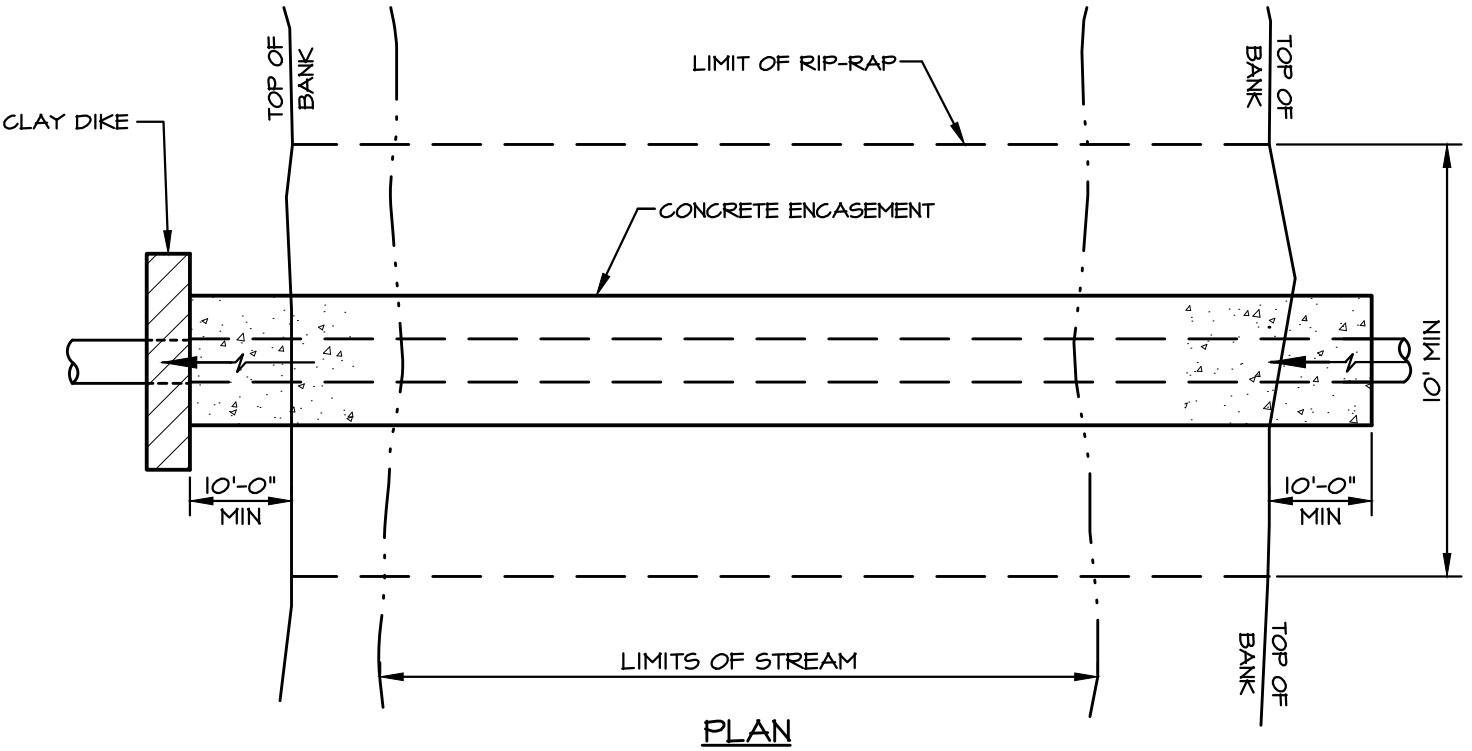
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CLAY DIKE
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

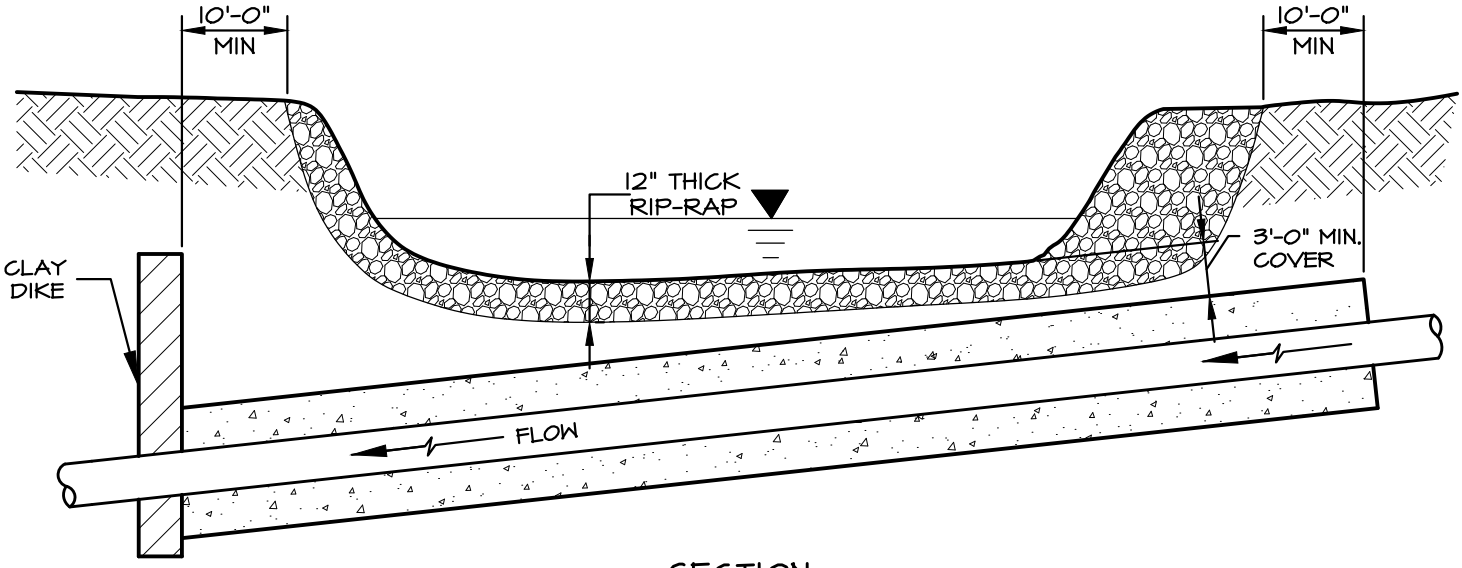
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| DATE: | AUGUST 2023 |

DRAWING: S-38

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PLAN




SECTION

# STREAM CROSSING-GRAVITY SANITARY SEWER

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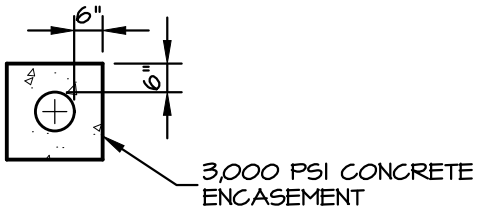
## STREAM CROSSING - GRAVITY SANITARY SEWER

STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

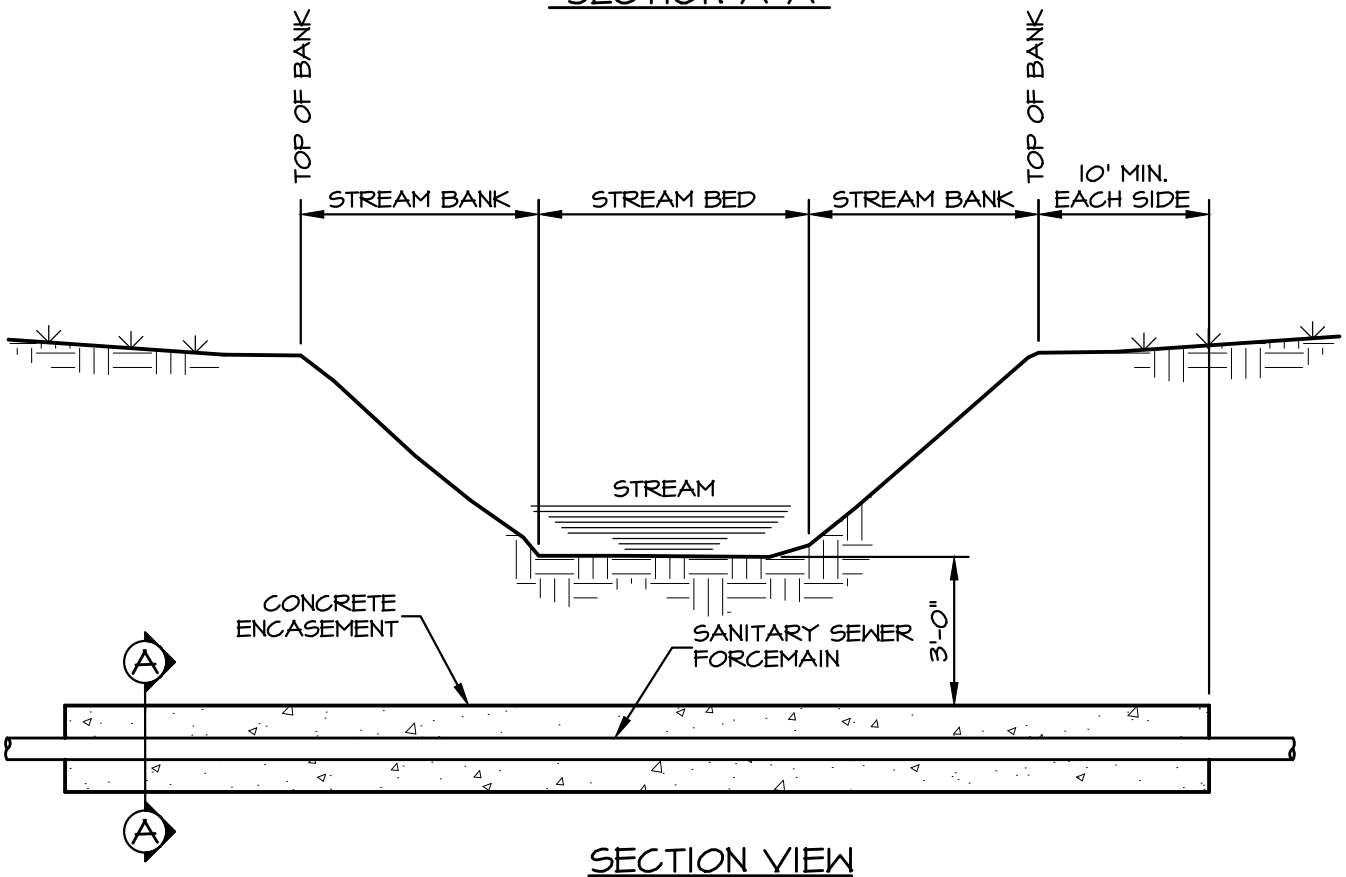
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## SECTION A-A




## SECTION VIEW

NOTES:

1. ALL NECESSARY CHAPTER 102 AND 105 PERMITS SHALL BE ACQUIRED PRIOR TO INSTALLATION. CONTRACTOR SHALL IMPLEMENT ALL BEST MANAGEMENT PRACTICES AS SET FORTH WITHIN SAID PERMITS.
2. CONTRACTOR SHALL CONDUCT AN ONSITE MEETING WITH THE AUTHORITY PRIOR TO ORDERING MATERIALS FOR THE STREAM CROSSING.
3. ANY CHANGES TO THE DESIGN OR LAYOUT OF THE STREAM CROSSING SHALL BE APPROVED BY THE AUTHORITY PRIOR TO INSTALLATION.
4. ALL HORIZONTAL AND VERTICAL BENDS SHALL HAVE ADEQUATE CONCRETE THRUST BLOCKING OR RODDED PIPE RESTRAINT.

# STREAM CROSSING - FORCEMAIN

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STREAM CROSSING - FORCEMAIN
STRASBURG BOROUGH AUTHORITY STANDARD DETAIL

| | |
|---|---|
| SCALE: | NO SCALE |
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| DATE: | AUGUST 2023 |

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