METROPOLITAN SEWER DISTRICT

LOW PRESSURE SEWER SYSTEM DESIGN REQUIREMENTS

December 2009
Rev March 2014

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INTRODUCTION

To provide efficient, cost effective and reliable service to the customers of the Metropolitan St. Louis Sewer District (MSD), a sanitary low pressure sewer system (LPSS) will only be considered where a thorough study of all alternatives clearly indicate a gravity collection and disposal system with (or without) a central sewage pump station is not practical or feasible. The minimum size of a central pump station dedicated to MSD shall have an average daily influent flow rate of 6 gallons per minute (gpm) or greater.

Prior to the project design, it is the responsibility of the design engineer to contact MSD's Engineering (Plan Review) Department to determine the following:

1. Will the District allow the construction of a LPSS?
2. Are there additional requirements due to the project's location or force main size?
3. Does the designer have the latest version of the LPSS design requirements?

The following are general guidelines and standard specifications for regional sanitary low pressure sewer systems (LPSS) to be installed within the jurisdiction of The Metropolitan St. Louis Sewer District. These requirements are both a design guide and a supplement to the MSD Standard Construction Specifications.

DEFINITIONS

The following describes a low pressure sewer system. Unless all of the items listed are satisfied, a system will not be considered a LPSS and will not be governed by these design requirements. Refer to the current version of the Standard Pump Station Design and Construction Requirements for those pressurized sewers systems not meeting the LPSS criterion.

1. All pump stations are privately owned.
2. All pumps shall be grinder type only.
3. Any force main crossing property lines shall be public and located in proper easements.
4. All force mains from the private pump stations shall be private up to the valve junction box (see section 3 under RESPONSIBILITIES).
5. The maximum pipe diameter of a LPSS force main shall be 4 inches.
6. All private connections to a public force main are to be made through valve junction boxes (VJB). These assemblies provide the following:
    - A check valve at the discharge end of the customer's private line for the prevention of public sewage escaping onto their property should a break occur on their private force main. For isolation, a shut-off valve is also required in the private line between the check valve and public force main.
    - Two shut-off valves on the public force main for the purpose of isolating customers in the event of a force main failure. Customers upstream from

the failure can then direct their flow towards an emergency truck connection structure (see definition 7) while the customers downstream can continue to use the unaffected remainder of the force main in a normal manner. Refer to Section 3.6 and example details (Figures 1-5).

- New junction boxes used to accomplish house connections on existing (public) LPSS's are public and shall be noted as such on the plans.

7. An emergency truck connection structure is a 2-inch shut-off valve and a quick coupling. These structures are to be located at the upstream end of each force main branch and used as a convenient point to connect a tank truck during force main emergencies. The truck can keep isolated customers in service until the force main is repaired. See Section 3.6 and example detail Figure 6.

RESPONSIBILITIES

The Metropolitan St. Louis Sewer District (Pump Station Division of Operations) shall be responsible for each public portion of the low pressure sewer system (LPSS), including all repairs and operations of the public force main, valve boxes and valve box piping.

Responsibility for the private portion of the LPSS shall be as follows:

1. All permits, inspections and acceptances of each individual branch system shall be the sole responsibility of the St. Louis County Plumbing Department or appropriate city agency.
2. The individual property owners shall be liable for the maintenance and operation of their own individual branch systems. They are also responsible for obtaining MSD approval for all future pump station upgrades that include pump replacements or pump station replacements.
3. The property owners' branch system is considered to be:

    a. The branch pressure piping running from the pump station discharge to the check valve inside of the valve junction box. This includes the check valve.
    b. The individual pump station and all related appurtenances.
    c. The branch gravity system running from the private building to the pump station.

DESIGN SCENARIOS

The design engineer is reminded that an adequately designed LPSS has pumps that regularly and often provide sufficient force main flushing velocities to minimize problems with odors and clogging.

This specification will describe two design situations. The first is the construction of a new LPSS and the second is for the requirements of an additional private pump station or stations connecting into an existing LPSS.

New LPSS:

- For this scenario, the developer's engineer is responsible to design the low pressure sewer system to operate smoothly with the expected number of private pump stations and with the public sewer system it connects to.
- The design shall allow for any potential future growth on the system.
- Pay close attention to the velocity in the public force main. Calculations must show the selected pumps will regularly produce a minimum of two (2) feet per second (f.p.s.) velocity during normal operating conditions at all points of the force main.
- The engineer shall calculate the pump discharge flows in the full range of operating conditions.
- All assumptions made and all steps of the calculations shall be clearly documented.
- The range of head at the connection point to the existing public sewer system must be considered in the hydraulic calculations, if applicable.
- The engineer shall provide the expected average daily flow (ADF), and peak daily flow (PDF) for each customer.
- Pump size and pump type must be submitted for all customers on the LPSS.

Existing LPSS:

- This situation applies where a customer or customers propose to connect into an existing LPSS. "Customer" includes single family residences.
- The developer's engineer is required to provide MSD with pump discharge calculations. Engineers shall fully research and document the existing system to determine the number or type of pumps presently connected. Where necessary, MSD may assistance in this task by providing available information on the existing system.
- Velocity calculations must show the selected pumps will regularly produce a minimum of two (2) feet per second (f.p.s.) during normal operating conditions in the new public force main.
- The range of head at the connection point to the existing public sewer system must be considered in the hydraulic calculations, if applicable.
- The engineer shall provide the expected ADF and PDF for each customer.
- Pump size and pump type must be submitted for all customers of the LPSS.

SECTION 1 - PLAN REVIEW SUBMITTAL REQUIREMENTS

In addition to the normal submittals, the following material must be submitted to the Engineering Department for review of any proposed low pressure sewer system. Plans submitted to the District that do not have the required number of drawings and/or low pressure sewer system design report data shall be returned to the designing engineer with a "request for missing material." No attempt will be made to review incomplete submittals.

Upon completion of the review, the Engineering Department will forward all comments to the designing engineer. After the design engineer has had an opportunity to review

these comments, a meeting may be arranged with the Plan Review Engineer to clarify any questions that may arise.

1.1 LOW PRESSURE SEWER SYSTEM DESIGN REPORT

Three (3) copies of the low pressure sewer system design report shall be provided. In the case of a single family residence, only sections A, B.1, B.2, C, and F immediately below need be included. The report shall be typed and bound in 8-1/2 inch x 11 inch booklet form in the following format:

A. Title Page
   1. Project name and MSD Project (P) number
   2. Date
   3. The developer/owner
   4. Engineering firm preparing plans
   5. Seal of a Professional Engineer registered in the state of Missouri

B. Sewer System Information
   1. Introduction
      - Type, location and size of development.
      - Number of and range in size of lots or buildings to be serviced.

   2. Existing Sewer System
      - Location and type of sewer system the force main will discharge to. It is strongly preferred that LPSS systems discharge to gravity sewers by connection to manholes. Common force mains or pump stations placed in series shall be avoided.

   3. Future of Sanitary Sewer Service
      - State whether the entire development will be serviced by the proposed phase or if several phases will be involved.
      - State the number of lots this phase will encompass initially and finally (if future phases are to be constructed)
      - State whether other areas outside of the development may be tributary to the pump station.

C. Pump Station and Force Main Design Calculations (see Section 2).

D. Downstream Pump Station Detention Pipe Design Calculations
   Structural calculations shall be submitted verifying the minimum pipe materials specified in Sections 2.3 and 3.5 are adequate.

E. Design Summary
   Force Main Size, Material, Type or Class and Length

Force Main Test Pressure - This test pressure value is derived from the selected pump manufacturer's performance curve. It is the maximum pump head or shut-off head in psig, plus 50 psig. The pressure value shall be clearly indicated on each force main profile sheet as "FORCE MAIN TEST PRESSURE".

F. Manufacturer's Pump Specifications and Catalog Sheets

1. The manufacturer's specifications and catalog sheets for the pumps shall be included in the appendix of the Low Pressure Sewer System Design Report booklet.

2. The manufacturer's catalog sheets shall be marked to identify the applicable items selected.

3. Specifications and performance curves shall be included for each pump proposed by the design engineer.

1.2 DESIGN DRAWINGS

Three (3) copies of the design drawings shall be provided. The design drawings shall be individual 24 inch x 36 inch design plan sheets. Each sheet must indicate the MSD P or Project Number in the lower right corner and must be sealed by a professional engineer registered in the State of Missouri.

A. Cover Sheet

General Site Plan (1 inch = 50 ft scale)

1. All buildings and/or residences with top of foundation (TF) and basement floor (BF) elevations noted.

2. All sanitary sewers and storm sewers with their manholes identified.

3. All streets.

4. All low pressure sewer system force mains and the locations of all valve junction boxes, emergency truck connection structures, air/vacuum release valves and clean-outs.

C. Force Main Plan and Profile (1 inch = 50' ft scale horizontal and 1 inch = 10 ft vertical)

1. Identify the force main size, pipe material and over all length.

- Locate force main appurtenances, such as, clean-outs, combination air/vacuum release valves, valve junction boxes, emergency truck

connections and isolation valves. The distance between each appurtenance shall be indicated.

2. Locate mechanically restrained joints at angle points, tees, and valves when required by the pipe joint design. Indicate the number of restraining joints required both upstream and downstream from an angle point, tee, or valve. Thrust blocks are not allowed.

3. Show the force main test pressure on each profile sheet.

4. Show two typical Tuned Locator Marker locations on both the plan and profile and refer those locations to the locator marker note in Sections 3.2.G and H.

Miscellaneous Details

Provide a sheet that will contain details on items such as:

- Force main clean-outs
- Combination air/vacuum release valve chamber
- Valve junction boxes
- Force mains taps with their associated valve junction boxes
- Grinder pumps with pump curves, wetwells, and associated piping
- Include actual “pump off” elevation in grinder pump detail.
- Gravity manhole connection detail-call MSD at 314-768-6272 for this detail.

Refer to example details Figures 1-9.

SECTION 2 - PUMP STATION AND FORCE MAIN DESIGN CRITERIA

The design engineer shall submit calculations and rationale supporting the system design including non-residential wastewater loading and system flow calculations. Section 2.1A describes the wastewater loading requirement. This specification will have only general guidelines for the statistical approach to LPSS design. The calculations and rationale for that approach must be submitted for review.
Specifications for the worse case hydraulic design are outlined in this section beginning with 2.2.

2.1 METHODOLOGY FOR DETERMINING DESIGN FLOWS

A. Non-Residential Development Area

The average daily flow (excluding infiltration) for non-residential development areas shall be based on one of the following:

1. Actual Water Use Records of like facilities
2. The current Rules of the Department of Natural Resources Division 20, Clean Water Commission, Chapter 8. Design Guides (10CSR 20-8.021, 1.E.1).

3. Industry Standards

B. Residential Development Area
The average daily flow (excluding infiltration) shall be based upon the methods outlined in the latest edition of the MSD Rules and Regulations and Engineering Design Requirements for Sanitary Sewer and Stormwater Drainage Facilities.

C. Future Development
In designing all components of the force main, consideration must be given to the potential need to expand or modify the facility to accommodate the future development of areas tributary to the system. As a minimum the following items should be considered:

1. The ultimate flow should be considered in selection of the pumps.

2. The ultimate flow should be considered in sizing the force main.

2.2 HYDRAULIC DESIGN

The design engineer shall perform the analyses shown in the table immediately below for the hydraulic design of an LPSS with multiple pumps. In LPSS's with just one pump, analyze both old and new pipe roughness.

Hydraulic Design Cases

Design Case	No. of pumps on simultaneously	Hazen-Williams pipe roughness	Notes
Maximum Flow Case	See Method for estimation table below	Old (see next pg)	Include pumps farthest from system discharge
Average Flow Cases	See paragraph at the bottom of this page	Old (see next pg)	Include pumps farthest from system discharge
Minimum TDH Case	One	New (see next pg)	Include the pump under the least head

The goals of the hydraulic design are to check that each grinder pump station can easily handle the peak daily inflow in all cases, while maintaining force main velocities between 2 and 8 feet per second in the Maximum and Average Flow cases. Further guidance for the estimation of the Maximum Flow Case is indicated in the table below.

Method for estimation of system flow in Maximum Flow Case

Type of pump	Method
Centrifugal	Formula Q=0.5N+20, in Ch. 2 of USEPA Pub. 625/1-91/029
Pos. displacement (PD)	Statistical maximum number of pumps on simultaneously

In the absence of other guidance, for PD pumps assume that the Average Flow Case results from one less pump on simultaneously than in the Maximum Flow Case. For centrifugal pumps, assume "N-1" instead of "N" in the USEPA formula shown above.

Pump run out will be checked in the Minimum TDH Case. ("N" is the number of homes served and "Q" is design flow in gallons per minute.)
At the discretion of MSD, the Maximum Flow Case may be modified.
In those systems with multiple grinder pumps, the minimum 2 feet per second velocity shall be achieved with only one pump in operation as often as possible. The hydraulic calculations are to be based on the following procedure:

Total Dynamic Head (TDH)

TDH (feet) = Static head plus friction losses in new or existing force main and station piping = Hs + Lf + Ls

Estimate the TDH for each private pump station in the LPSS in accordance with the Hydraulic Design Cases above.

1. Static Head (Hs) for each private pump station
   Eh = Maximum elevation in new and existing force main
   E1 = Wet well low water elevation (Pump Off)
   Static head Hs (feet) = Eh - E1

2. Head loss (Lf) from friction in each section of new and existing force main to the gravity sewer discharge point
   Length = Total length of force main pipe, plus equivalent length of valves and fittings (feet)
   Lf (feet) = Length x Friction Factor/100

   Where: Friction Factor = Friction head loss (feet) per 100' pipe = 0.2083 x (100/C)^1.85 x Q^1.85/d^4.8655 (Hazen and Williams formula)

   Where: d = Inside diameter of pipe (inches), C = C-Factor (see 4. below) and Q = FLOW (GPM) through that section
   Note: Losses can also be calculated by adding Hazen-Williams pipe loss to separately calculated valve and fitting losses. The valve and fitting losses may be calculated by use of the formula head loss = KV^2/2g, with V equal to velocity in feet per second and g equal to the acceleration of gravity, which is 32.2 ft per second^2. Use reasonable K values accepted by the industry.

3. Head loss (Ls) from friction in each private station piping
   Length = Total length of the station piping, plus equivalent length of valves and fittings (feet)
   Ls (feet) = Length x Friction Factor/100

4. The following Hazen and Williams C-Factors shall be used for computation of friction losses:

Unlined iron or steel pipe-old, new	C=100, 140
All other pipe (incl. Plastic and lined DIP)-old, new	C=120, 150

5. TDH (feet) = Hs + Lf + Ls

Adjust the flows from each pump station until the TDH of each station matches the discharge head on its manufacturer's pump performance curve.

A computer model such as EPANET or PIPE-FLO can be used in the hydraulic design. When using a computer model, pumps can be iteratively sized in order to achieve the hydraulic goals of the design (see the previous page). A clearly labeled computer model node diagram showing addresses and lot numbers shall be included in the hydraulic report along with system head and pump curves, estimated velocities, and estimated maximum system pressures.

2.3 STORAGE REQUIREMENTS

If the low pressure sewer system discharges to an existing MSD sewer system that terminates at a public pump station with detention reservoirs instead of a back up generator, that station's 24 hour detention capacity must be increased to match the new incoming flow. It is the LPSS developer's responsibility to make that upgrade.

Twenty-Four Hour Storage Volume Requirements:

The volume of the detention reservoirs in gallons (Vs) is:
Vs = ADF (GPD) x 1 Day = Cylindrical Volume of detention reservoir pipe used.

The volume of the incoming gravity lines or wet well shall not be considered in sizing of the twenty-four hour storage. Only the volume of the detention reservoir shall be used.

NOTE: The lowest development elevation <u>must</u> be above the elevation of the highest point of the detention chamber plus two (2) feet.

It is the responsibility of the developer's engineer to check the capacity of the existing sewer system and to coordinate with MSD in the expansion of the existing sewer system, if required.

2.4 FORCE MAIN DESIGN

During normal operations, a minimum cleansing velocity of two feet per second shall be attained on a regular basis. Maximum velocity in the system should not exceed eight feet per second.

The minimum permissible inside diameter of a public force main is 2 inches. Exceptions to this rule are at the discretion of MSD.

High points on the force main shall be avoided wherever possible by varying force main depth.

Pressures greater than or equal to 0 psig must be maintained throughout all force mains at all times.

2.5 GRINDER PUMP SYSTEM RECOMMENDED DESIGN

A minimum of 50 gallons of storage shall be included in the grinder pump station wetwell between the invert of the incoming lateral and the “pump off” elevation. Include protection from uplift as required.

A quick disconnect with a suitable isolation valve and connecting piping to the pump station discharge shall be included for the purpose of emergency pumping and to serve as a cleanout.

A runtime meter and a visual and audible high water alarm should be provided and installed.

The minimum permissible inside diameter of a private residential force main is 1.25 inches.

Grinder pump motors shall be non-overloading throughout the pump curve.

2.6 ODOR CONTROL

Odor control may be required. Odor control methods may include chemical dosing facilities, cartridge filters, or other devices/measures as approved by MSD.

SECTION 3 - PIPING AND VALVES

The following specifications shall be used for installation of piping and valves. Flanged or grooved end piping shall be acceptable means of connecting valves and piping.

All pipes within structure walls shall have six-inch minimum clearance from the inside face of the structure to the first fitting to allow for proper maintenance access.

3.1 PIPE MATERIAL AND CONNECTIONS

A. Internal piping includes a maximum of four feet (4') outside a structural wall. The following materials shall be used for internal piping:

1. Four Inch (4") Diameter:

- Ductile iron pipe specified in this section shall be cement lined mortar in accordance with ANSI A21.4/AWWA C104 and buried portions must be polyethylene encased per ANSI A21.4/AWWA C105.

- Ductile iron fittings shall be cement lined and have an alkyd-phenolic primer coating or equal.

- Flange Joints

  Ductile iron pipe Class 53 ANSI A-21.51 (AWWA C -151). All bolts and nuts for flange connections must be 316 stainless steel (minimum). All flange gaskets must be full faced1/8 inch thick red rubber.

- Grooved End Joints

  Ductile iron pipe Class 53 ANSI A-21.51 (AWWA C-151) with rigid radius grooves for end preparation in accordance with AWWA C606. Mechanical couplings shall be of ductile iron conforming to ASTM A-536, Grade S nitrile gasket compounded to conform to ductile iron pipe surfaces with 316 stainless steel nuts and bolts.

2. Three inch (3") Diameter and smaller:

- Solvent-Weld Joints

  ASTM 1785 Schedule 80 PVC, ASTM D2855 Practice for making Solvent Cemented Joints, and ASTM F402 Practice for safe handling of Solvent Cements, Primers, and Cleaners

- Grooved Joints

  ASTM 1785 Schedule 80 PVC roll grooved pipe in accordance with C-606. Mechanical couplings shall be of ductile iron conforming to ASTM A-536, Grade T or S nitrile compound gaskets conforming to ASTM D-

2000 designation 5BG615A14B24 with 316 stainless steel nuts and bolts.

3. With a high density polyethylene (HDPE) force main there is no transition required to enter a structure regardless if the internal installation is grooved or flanged.

4. Fasteners

- All installed fasteners shall be 316 stainless steel
- The threaded portion of the stainless steel fasteners shall be coated with a stainless steel anti seize compound.

B. The following materials shall be used for the force main piping:

1. Four inch (4") Diameter:

- AWWA C-900 PVC Class 150 (DR-18)
- HDPE Pipe. See specifications in Section B.2.
- AWWA C-909 PVCO

2. Three inch (3") Diameter and smaller:

- PVC pipe meeting ASTM D2241 (SDR 21) with integral bell and gasket joint design meeting the requirements of ASTM D3139 and F477. Solvent weld pipe joints meeting ASTM D2672 and Solvent cements meeting ASTM D2564. Minimum pressure class shall be PC 150.
- HDPE Pipe. Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-99 with a cell classification of PE: 345464C. Pipe shall have a manufacturing standard of ASTM F714. Pipe shall be IPS DR 11 unless otherwise specified on the plans.

HDPE fittings and accessories material specification as follows:

- Butt Fusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Fabricated or molded fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be factory manufactured.
- Electrofusion Couplings and Restraints - Couplings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Electrofusion Couplings shall have a manufacturing standard of

ASTM F-1055. Couplings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Electrofusion Restraints shall be made of the same specified material and to the same standards as the Electrofusion Couplings.

- Contractors must have their HDPE butt fusion installers qualified with training from the pipe distributor or a manufacturers' representative.
- Connections to non-HDPE Material –

HDPE Flanged, Grooved and Mechanical Joint Adapters – Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D-3350. Flanged, Grooved and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D-3261. Flanged and Mechanical joint adapters shall use a ductile iron back up ring or gland; grooved adapters shall use a stainless steel IPS roll groove transition. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

Mechanical Type Couplings – Mechanical couplings used to connect HDPE pipe or fittings to non-HDPE material or used for repair shall create a restrained joint with a pressure rating equal to that of the HDPE pipe or fittings.

3.2 FORCE MAIN REQUIREMENTS & APPURTENANCES

The following elements shall be included in the force main system design:

A. Air Relief / Vacuum Valves (ARV)
Automatic combination vacuum air relief valves shall be placed at high points in the force main as required.

1. The valve shall be equipped with all backwash accessories.

2. ARVs that will regularly operate at pressures less than 5 psig shall be designed for proper operation at these pressures.

3. The 60 inch diameter ARV pre-cast set-over structure shall be identical to the 60 inch structures described for the valve junction boxes. The structure shall be vented where required by MSD. See Section 3.6 and Figure 7.

4. Odor control devices may be required as determined by MSD.

Acceptable Manufacturer: ARI D-025P or approved equal

B. Connection to Gravity System

Force mains shall discharge to the gravity sewer system at a manhole. The point of connection shall be no more than one foot above the flow line of the receiving manhole. Inside drops will not be permitted. The connection shall include an approved flexible seal. Odor control devices may be required as determined by MSD.

C. Gravity Manhole Rehabilitation

The sides and bottom of the force main discharge manhole and a minimum of five (5) manholes downstream of the point of connection shall be lined. The lining shall be a solventless, 100% solids corrosion resistant epoxy coating or multiple layers of structural fiberglass molded to the existing structure with a non-porous diaphragm bonded between the fiberglass layers.

Acceptable Manufacturer: Sikagard 62, Terre Hill Composites Multiplex Liner THC-610-SL-68, or approved equal.

D. New Manhole Construction

When a new manhole is to be constructed at the point of connection to the gravity system, the manhole shall be manufactured with a flexible sheet liner with locking extensions. The bottom of the new manhole shall be treated with the epoxy coating specified above.

Acceptable Manufacturer: Ameron Protective Lining Division, Amer-Plate T-Lock, or approved equal.

E. Mechanically Restrained Joints

Force mains that are not of solvent weld joint or fusion weld joint design shall be fitted at all angle points, tees and valves with mechanically restrained joints designed to withstand the thrust developed under the test pressure plus 50 psi. The required number of mechanically restrained joints from the angle point, tee, or valve shall be determined by the design engineer and shown in plan and profile (see Section One).

F. Clean-Outs

At least one clean-out is required on any public force main. They shall be placed at major changes in direction and where one public force main connects to another. The maximum clean-out spacing shall be 400 feet. Refer to Figures 8 and 9 for clean-out configuration examples. The emergency truck connection shown in Figure 6 is counted as a clean-out.

G. Tuned Locator Markers

Tuned locator markers shall be placed over the top of the force main during force main installation. These locator markers shall be buried at a minimum depth of two and one-half feet (2.5') and a maximum depth of four feet (4'). A minimum six-inch (6") separation shall be maintained between the top of the force main and the locator marker.

Acceptable Manufacturer: "Green Sanitary marker" model 1424-XR/iD locator ball, manufactured by the 3M Dynatel Company, or approved equal.

H. Location of Tuned Locator Markers
Tuned Locator Markers shall be installed:
- Every 100 feet along force main runs.
- Five (5) feet back from the pavement edge on both sides of a road crossing
- Fifteen (15) and five (5) feet back from each side of an angle point.
- Or as otherwise directed by MSD.

I. Provide and bury warning tape one foot (1') over all public force mains.

J. Provide a minimum cover of three feet (3') over all public force mains.

K. Pipe installation:
- 2-1/2 inch and smaller PVC or HDPE pipe with solvent cement, fuse-welded, and/or restrained joints shall be "snaked" in the trench to allow for expansion and contraction.
- 3 inch and larger pipe solvent cement, fuse-welded, and/or restrained joints shall be analyzed by the designer to determine if there is a need for expansion fittings.
- Single elbows greater than 45 degrees shall not be used on force mains to accomplish horizontal and vertical turns, except on pump station discharge piping.
- Assemble solvent weld joint pipe in accordance with manufacturer's recommendations

L. Force Main Taps:
1. Where a public force main terminates into an existing force main that is not a low pressure sewer system, a wet tap into the existing line is permissible to avoid disruption of service.

- The minimum tap size shall be 2 inch.
- Use brass or stainless steel tapping saddles or sleeves specific for the tapped force main type. The tap connection shall be flanged or with a type CC female thread that only accepts a CC male thread on a corporation stop tapping valve.
- The corporation stop shall have a CC type inlet and a female threaded outlet. From the threaded outlet use a threaded brass nipple and a brass full faced flange to mate with a PVC or HDPE flange on the force main.
- Use a flanged cast iron resilient wedge valve for 4 inch taps.
  Acceptable Manufacturer: American Flow Control Series 2500
- The tap valves may be buried after the tap is made.
- Install a valve junction box containing a shut-off valve and a check valve in close proximity to the tap. The junction box shall be a 48 inch or 60 inch pre-

cast concrete set-over structure identical to the structures described for the valve junction boxes. See Section 3.6 and Figure 1-5.

2. Where a public force main terminates into an existing force main that is a low pressure sewer system, make the connection with a valve junction box. See Section 3.6 and Figures 1-5.
3. Where two branches of a low pressure sewer system meet install a valve junction box but with no check valve. See Section 3.6 and Figures 1-5.

M. Bored Road Crossings:

- A HDPE force main may be directionally bored without the use of a liner pipe or casing. SDR 11 pipe must be used, and the owner of the road must give permission.
- All PVC pipe at a bored road crossing must be installed inside a liner pipe. Refer to and follow the Metropolitan St. Louis Sewer District Construction Specifications Section M but do not use grout to fill the space between the liner and the carrier pipe. Use casing spacers as directed by their manufacturer.

Acceptable Manufacturer: Raci by Public Works Marketing, Inc.

N. Hatch access lids and frames for 60 inch diameter precast concrete structures.

- Inside of right of way

1. Gray iron construction with stainless steel spring, fasteners, and gray iron hinges. Suitable for high density traffic (H-20) loading.

2. Spring assist opening, spring to be attached to lid, with hold open arm. Spring shall move out of the clear opening of the frame when the lid is open.

3. Provide 30”x30” opening and lid with non-skid surface

4. Provide positive means of holding lid down

Acceptable Manufacturer: Neenah R-6662-PS or approved equal

- Outside of right of way

1. Aluminum construction with stainless steel spring, fasteners, and hinges.

2. Spring assist opening with-hold open arm

3. Provide 30”x30” opening and lid with non-skid surface

4. Provide positive means of holding lid down

Acceptable Manufacturer: Halliday H1R3030 or approved equal

3.3 TRANSITION PIPING

When PVC pipe (See Section 3.1) is used for force main a transition pipe must be used to make the transition between the internal structure piping and the force main outside the structure. The following methods shall be used:

A. Four Inch (4") Diameter
The D.I.P. internal structure piping shall pass through the set-overs of the structure wall and attach to the PVC force main by a long pattern sleeve mechanical joint with Mega-Lug retainer glands.

B. Three Inch (3") Diameter and Smaller

Transition the Schedule 80 PVC internal structure piping to the SDR-21 PVC force main with a PVC coupling outside of the structure wall.

3.4 SHUT-OFF AND CHECK VALVES

Approved shut-off and check valves shall be placed in each valve junction box. The check valves shall be located on the customer side of the private shut-off valve. Refer to Figures 3 and 4 for proper valve location within the valve junction box.

All valves shall be rated so as to withstand normal working pressure plus allowances for water hammer and all field installed fasteners shall be 316 stainless steel.

A. Shut-off Valves 3 inch and 4 inch
Shut-off valves shall be plug type and shall be of cast iron body, ASTM A126 Class B, or ductile iron ASTM A536. Valve plugs shall be cast iron ASTM A126 Class B, or ductile iron meeting ASTM A536, Grade 65-45-12, covered with a Buna-N Rubber compound. The seats are to be a corrosion resistant alloy either 304 stainless steel or nickel.

1. Flange Valves
Flange valves shall be in accordance with ANSI B16.1 Class 125 standards.

2. Grooved End Valves
Grooved end valves shall have end-to-end dimensions in conformance with AWWA C-509 with the grooved ends conforming to AWWA C-606 rigid grooving dimensions.

3. Sleeve type bearings shall be utilized in both the upper and lower trunions. Bearings shall be corrosion resistant and have a low coefficient of friction.

4. Valves shall be able to pass a sphere not less than 80% of the diameter of the valve size.

5. Valve Operators
Valves shall be provided with a two-inch (2") square operating nut and wrench head.

6. Valves shall be rated at 175 pounds.

Acceptable Manufacturer: Valves are to be Milliken, fig. #601-N, Victaulic Series 365, or approved equal.

B. Shut-off Valves 3 inch for use on cleanouts
Shut-off valves shall be ball type and shall be of ductile iron body and endcap, ASTM A395, with grooved ends. Valve stem and ball shall be chrome plated carbon steel. Seats shall be PTFE. Provide lever handle.

Acceptable Manufacturer: Ball valves shall be Victaulic Series 726 or approved equal.
Note: Install lever handle so that the valve opens upwards.

C. Check Valves 3 inch and 4 inch
Check valves shall be of the swing check type with iron body and bronze trim. Check valves shall be flanged end type or grooved end type with outside spring and lever or weighted arms.

Acceptable Manufacturer: Check Valves shall be Clow Fig. F5340, Victaulic Series 317 or approved equal.

D. Shut-off Valves 2-1/2 inch and Smaller (also see section E. below)
Shut-off shall be threaded bronze Milwaukee BA-100 ball valves or Victaulic Series 721 standard port ball valve with ductile iron body, ASTM A-536, Grade 65-45-12, and Type 316 stainless steel ball and stem, TFE seats, 600 psi (4130 kPa). Shut-off for air release valves shall be 2-inch diameter Milwaukee BA260 ball valve with stainless steel body, ball and stem, threaded ends, lever handle, TFE seats, minimum 600 psi (4130 kPa), or approved equal.

E. Check Valves 2-1/2 inch and Smaller
Check valves shall be Hammond IB904 threaded bronze or equal or Victaulic Series 712 check valve with working pressure to 300 psi, ductile iron body, ASTM A-536, Grade 65-45-12, and Type 316 stainless steel clapper with Nitrile Bumper and Bonnet seals. The Victaulic check valve shall have rigid grooves to specification ANSI/AWWA C606.

Note: Use brass pipe nipples when installing brass and bronze valves.

3.5 DETENTION PIPE

Detention pipe(s) required by Section 2.3 shall be a minimum of ASTM C76 Class III, B wall minimum, O-ring type reinforced concrete pipe. No lift holes shall be allowed unless otherwise permitted by the District. Designer shall submit calculations for uplift and anchor detention pipes as required.

The detention pipe ends shall be sealed using pre-cast bulkheads with O-ring gaskets. Also, an "A-lok" gasket shall be installed for the 12 inch outfall pipe.

3.6 VALVE JUNCTION BOX, ARV, AND EMERGENCY TRUCK CONNECTION STRUCTURE REQUIREMENTS

All private pump stations must be connected into the LPSS force main through a valve junction box as specified below. In addition to the valves located in the valve junction box, it is recommended each private pump station should have its own check valve and shut-off valve. Emergency truck connection structures shall be located at the upstream end of all public force branches unless otherwise directed by MSD.

1. Valve junction boxes on 2-inch diameter force mains and emergency truck connection boxes shall be a minimum of 48 inch diameter pre-cast concrete riser sections with pipe opening slots. A MSD approved manufacturer must produce these pre-cast structures. A standard size 26 inch cast iron frame and cover shall be centered over a reinforced pre-cast concrete top section. See Figure 1. A design must be submitted for all structure tops subject to vehicular loading.

2. All ARV (air/vacuum release valve – see Figure 7) structures, and all valve junction boxes on 3-inch and larger force mains, shall be a minimum of 60-inch diameter precast concrete riser sections with pipe opening slots. A MSD approved manufacturer must produce these pre-cast structures. A standard size square hatch access lid and frame with a 30-inch x 30-inch opening shall be centered over a reinforced precast concrete top section. See Figures 4, 5 and 7 and LPSSDR section 3.2.N. A design must be submitted for all structure tops subject to vehicular loading.

3. The interior piping and valves shall be installed so there is a 12 inch clear space between the piping and the rock filled base. Valves and piping shall be securely supported from below with concrete blocks.

4. The valve junction box and emergency truck connection structures shall be set on standard pre-cast bases, to be firmly rested on a 2 ft deep base of 3/4-1 inch clean rock. The concrete bases shall have the same diameter as the precast concrete structures and have 24 inch diameter holes in their centers. Filter fabric shall be used to line the excavation and placed over each pipe opening slot before placement of the rock base. See Figures 1, 2 and 6.

5. Stamped aluminum or engraved phenolic identification tags must be attached to each valve inside the valve junction box interior with plastic wire ties. The tags shall identify the force main valves as MSD “UPSTREAM” or MSD “DOWNSTREAM” and the valve on the private lateral as “PRIVATE SERVICE”. The address of the building being serviced by the lateral shall be clearly identified on the private shut off valve tag.

6. The 2 inch ball valve of the emergency truck connection station shall be supported to the wall of the structure by two 1-1/2 inch x 1-1/2 inch x 3/8 inch stainless steel angle brackets. See Figure 6.

SECTION 4 – SUBMITTALS, INSPECTION AND ACCEPTANCE REQUIREMENTS

In addition to the normal construction inspection by MSD Inspectors, Operations personnel shall make a final inspection of the low pressure sewer system (LPSS) construction. The contractor responsible for constructing the LPSS shall give twenty four (24) hour notice to the Development Inspection Department of MSD when the facility is ready for this inspection. Failure to have the inspection performed at the proper time during the construction process could result in the District requiring the removal and reconstruction of the completed work.

4.1 Pre-construction Submittals

Before the beginning of construction of the LPSS, the contractor shall submit the following to MSD for approval (contact Mike Shelton, Division Inspector, Development Inspection - phone 314-768-6387).

1. Shop drawings of valve vaults (before manufacture).

2. Manufacturer catalog sheets and information on pipe, fittings, valves and pipe joint restraint.

3. Proof of training for HDPE pipe butt fusion installers, if applicable.

4. Grinder pump curves.

5. Detention Pipe Joints

4.2 Final Construction Inspection

This inspection shall be performed after one hundred percent (100%) of the LPSS has been completed, and all submittals have been reviewed and approved.

A. Post-Construction Submittal Requirements
Prior to requesting this inspection the following items shall be submitted to MSD Pump Station Division and also (separately) to MSD Development Inspection:
MSD Development Inspection:

- As-Built mylars and four sets of as-built prints of the LPSS site prepared by a professional engineer or land surveyor registered in the state of Missouri, certifying that all structures and sewers were built in accordance with the approved plans and located within existing easements
- A complete set of Record Drawings in approved CADD format, to include an additional electronic set of Drawings in .PDF format

MSD Pump Station Division

- One set of as-built prints of the LPSS site prepared by a professional engineer or land surveyor registered in the state of Missouri, certifying that all structures and sewers were built in accordance with the approved plans and located within existing easements

- A complete set of Record Drawings in approved CADD format, to include an additional electronic set of Drawings in .PDF format

- Developer's Engineer shall, prior to preparation of portion of final Record Drawing that encompasses force mains, coordinate directly with Pump Station Engineer (Jay Kniker, 314 436-8703 or jkniker@stlmsd.com), and District
  Personnel will then assist in locating force main immediately prior to Developer's Engineer surveying force main for Record Drawing generation. Location, and Record Drawing preparation, process will be performed prior to requesting a 100% inspection."

B. Final Inspection Process

1. MSD Development Inspection will, on request of Contractor, perform preliminary inspection on LPSS components, for purposes of developing preliminary deficiencies list. MSD Development Inspection personnel will then provide Pump Station Division Engineer (Jay Kniker, 314 436-8703, or jkniker@stlmsd.com) contact information to Contractor, for purposes of scheduling final 100% Inspection. Final 100% Inspection, strictly for the purposes of accepting the new assets for Operations and Maintenance by the District, will be performed by Pump Station Division/Operations Department personnel. This inspection will not constitute the final Dedication inspection of the project to the District and will comprise only the LPSS components of the project.

2. Pump Station Division Engineer will schedule final inspection and provide a deficiencies list to Development Inspection personnel for further follow up.

4.3 Re-inspection of Work

The District will perform one final inspection and one re-inspection of the construction at no charge to the Owner. The Owner shall be responsible for all costs associated with the additional re-inspections due to the failure of the Contractor to satisfactorily correct the identified deficiencies.

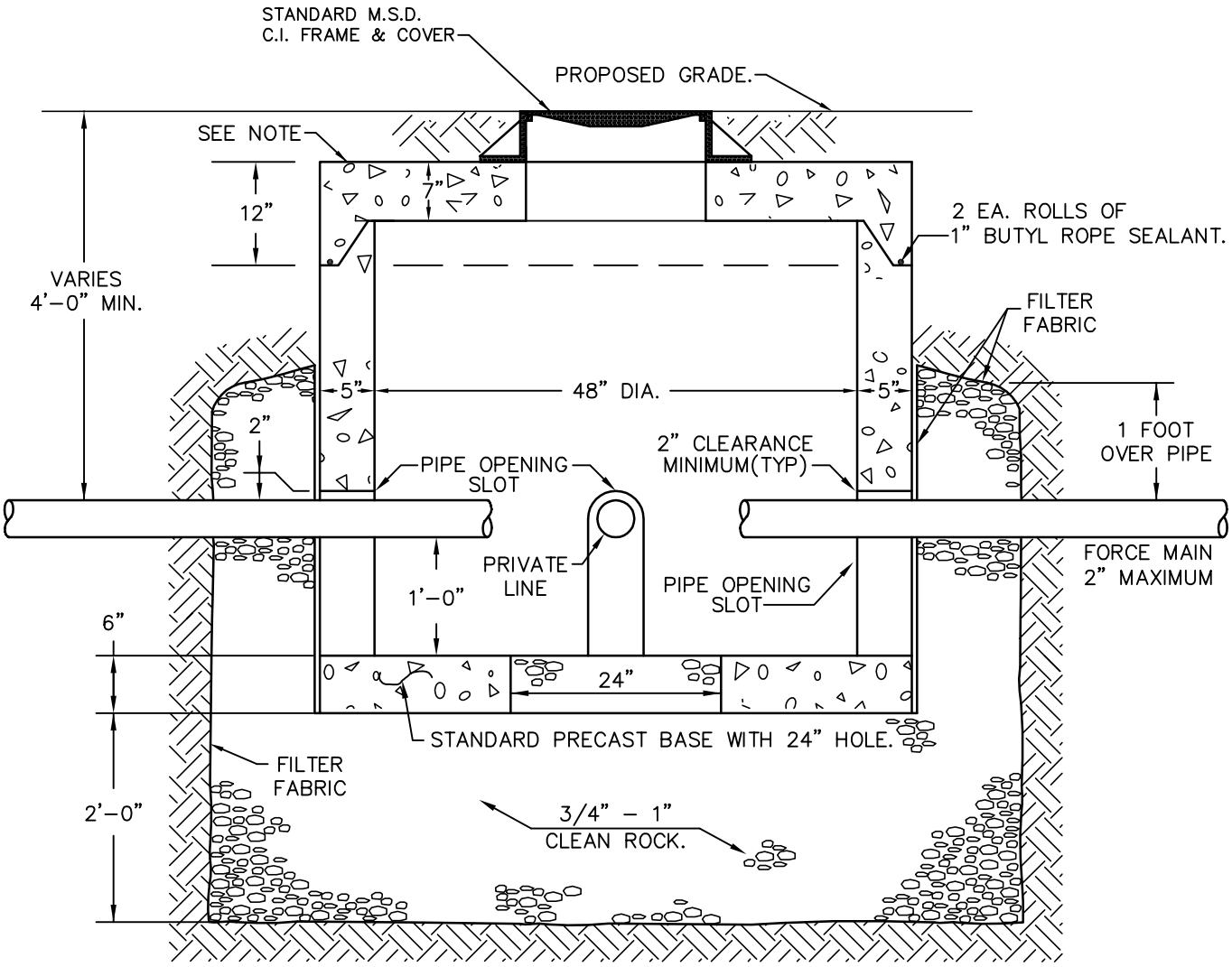
1. "Once the 100% Pump Station Division/Operations Department final 100% inspection, or re-inspection(s), are complete, all defective items corrected, and all required documentation is in the possession of the District, MSD Operations will issue a notification to MSD Engineering Department accepting the asset(s), strictly for the purposes of Operations and Maintenance, and identifying the effective date of that acceptance. MSD Operations Department will begin operating and maintaining the public portions of the LPSS system effective this date.

C. Odor Control

The Owner shall make provisions for odor control (such as adding fresh water to grinder pump station wetwells, minimizing wetwell detention time, chemical addition, etc) in those LPSS systems that are in the early construction stages before ultimate development. An Odor Control Plan, for any project that is being constructed in phases, shall be submitted to Pump Station Division Engineer, along with request for Final Inspection. It is strictly in the discretion of the District to waive this requirement.

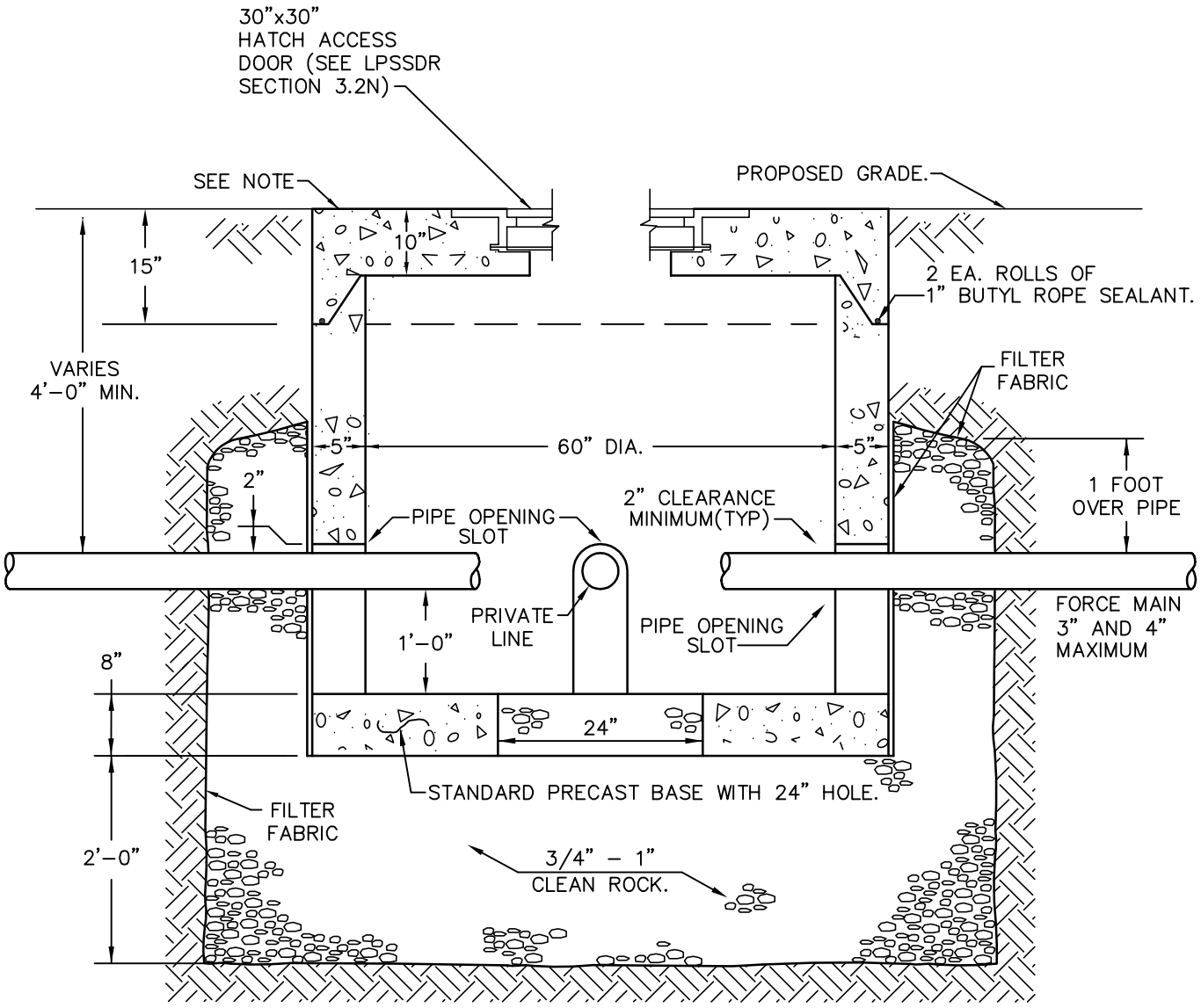
4.4 Construction Acceptance

Acceptance of the project for Dedication to the Metropolitan Sewer District shall be subject to the satisfactory completion of all items noted above, as well as the satisfactory completion of all required site restoration.



NOTE: ALL TOPS MUST BE REINFORCED (SUBMIT DESIGN FOR ALL STRUCTURE TOPS SUBJECT TO VEHICLE LOADING).

SECTION VALVE JUNCTION BOX 2" FORCE MAIN	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R Ch. S.D.K.	2009	FIGURE 1



NOTE: ALL TOPS MUST BE REINFORCED (SUBMIT DESIGN FOR ALL STRUCTURE TOPS SUBJECT TO VEHICLE LOADING).

SECTION VALVE JUNCTION BOX 3" and 4" FORCE MAINS	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R Ch. S.D.K.	2009	FIGURE 2

① 2" PVC PIPE SCHEDULE 80 GRV X PE

② 2" SDR 21 PVC

③ 2" SCHEDULE 80 PVC COUPLING

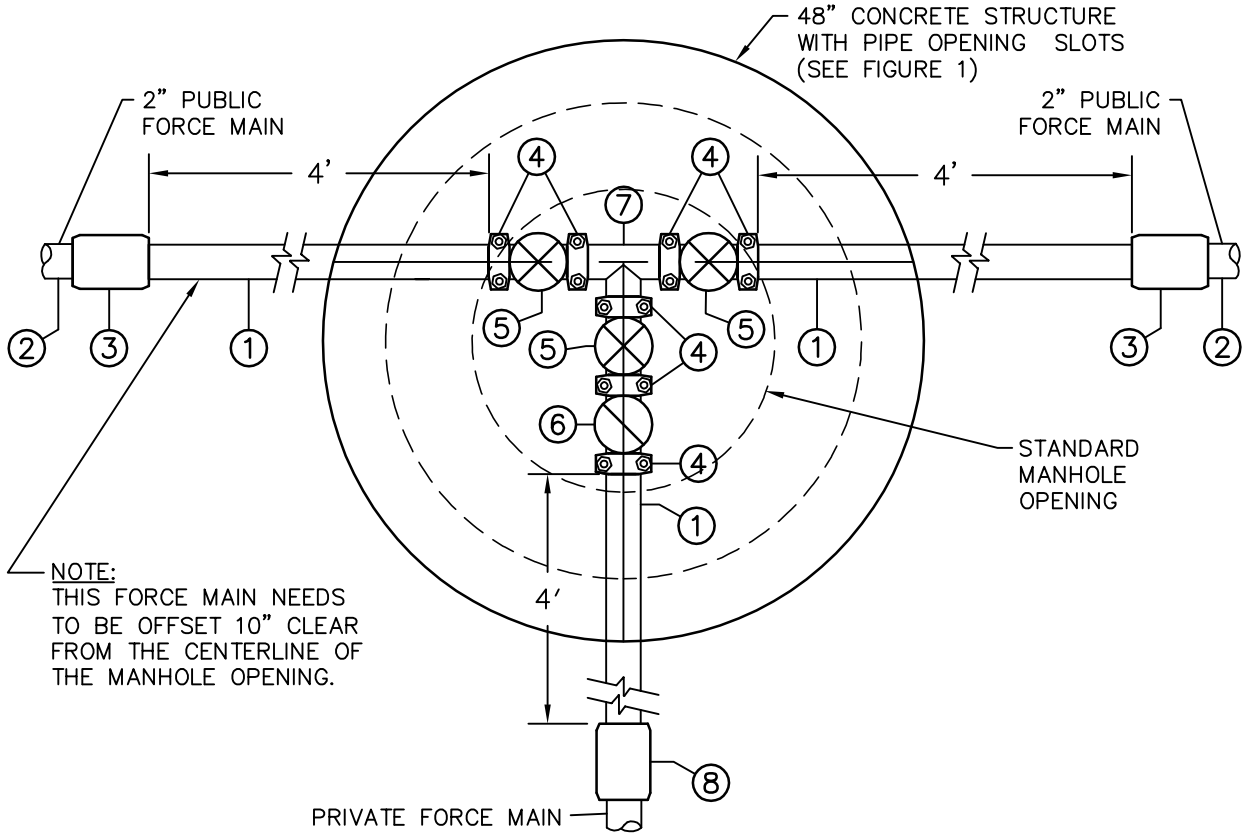
④ 2" VICTAULIC NO. 75 FLEXIBLE COUPLING

⑤ 2" VICTAULIC NO. 726 BALL VALVE

⑥ 2" VICTAULIC NO. 712 CHECK VALVE

⑦ 2 X 2 TEE IPS VICTAULIC NO. 20 TNM 140

⑧ 2" SCHEDULE 80 SOLVENT WELD COUPLING WITH REDUCER BUSHING TO LATERAL SIZE



NOTES:

1) USE STAINLESS STEEL BOLTS AT ALL FLANGED CONNECTIONS.
2) STAMPED ALUMINUM IDENTIFICATION TAGS MUST BE WIRED TO EACH VALVE. THEY ARE TO IDENTIFY THE 2" VALVES AS "MSD UPSTREAM" ,"MSD DOWNSTREAM" AND "PRIVATE SERVICE". THE ADDRESS OF THE LATERAL SHALL BE CLEARLY STAMPED ON THE PRIVATE VALVE TAG.

PLAN VIEW VALVE JUNCTION BOX 2" FORCE MAIN	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R. Ch. S.D.K.	2009	FIGURE 3

① 4" AWWA DIP GRV X PE PIPE

② 4" C900 PVC

③ 4" MJ SLEEVE
W/WEDGE TYPE RETAINER GLANDS

④ 4" VICTAULIC NO. 307
TRANSITION COUPLING

⑤ 4" VICTAULIC NO. 365
AWWA PLUG VALVE

⑥ 2" VICTAULIC NO. 726 BALL VALVE

⑦ 2" VICTAULIC NO. 712 CHECK VALVE

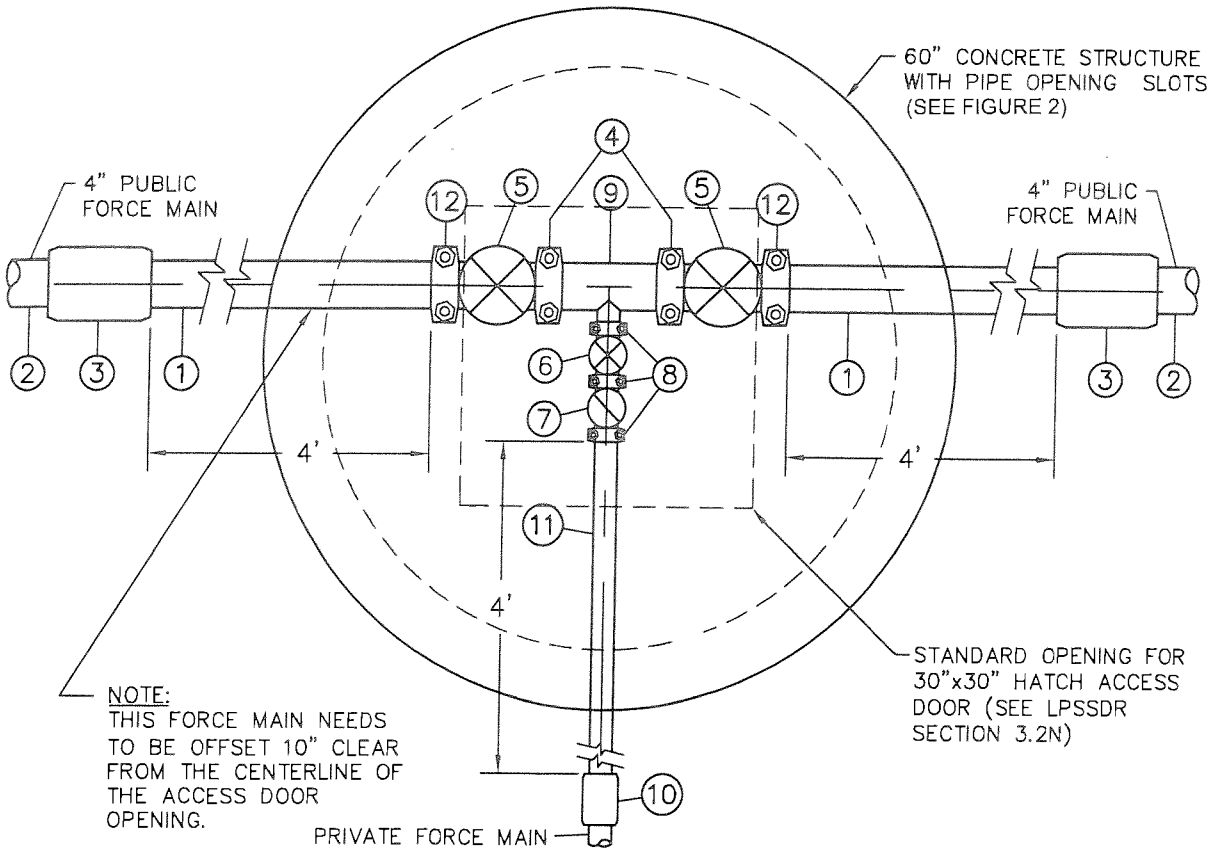
⑧ 2" VICTAULIC NO. 75
FLEXIBLE COUPLING

⑨ 4 X 2 TEE IPS
VICTAULIC NO. 25 TNM 140

⑩ 2" SCHEDULE 80
SOLVENT WELD COUPLING
WITH REDUCER BUSHING
TO LATERAL SIZE

⑪ 2" SCHEDULE 80 PVC GRV X PE

⑫ 4" VICTAULIC NO. 31 COUPLING



NOTES:

1) USE STAINLESS STEEL BOLTS AT ALL FLANGED CONNECTIONS.
2) STAMPED ALUMINUM IDENTIFICATION TAGS MUST BE WIRED TO EACH VALVE. THEY ARE TO IDENTIFY THE 4" VALVES AS "MSD UPSTREAM" ,"MSD DOWNSTREAM" AND THE 2" VALVE AS "PRIVATE SERVICE". THE ADDRESS OF THE LATERAL SHALL BE CLEARLY STAMPED ON THE PRIVATE VALVE TAG.

PLAN VIEW VALVE JUNCTION BOX 4" FORCE MAIN	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R. Ch. S.D.K.	2009	FIGURE 4

① 3" PVC PIPE SCHEDULE 80 GRV X PE

② 3" SDR 21 PVC

③ 3" SCHEDULE 80 PVC COUPLING

④ 3" VICTAULIC NO. 307
TRANSITION COUPLING

⑤ 3" VICTAULIC NO. 365
AWWA PLUG VALVE

⑥ 2" VICTAULIC NO. 726 BALL VALVE

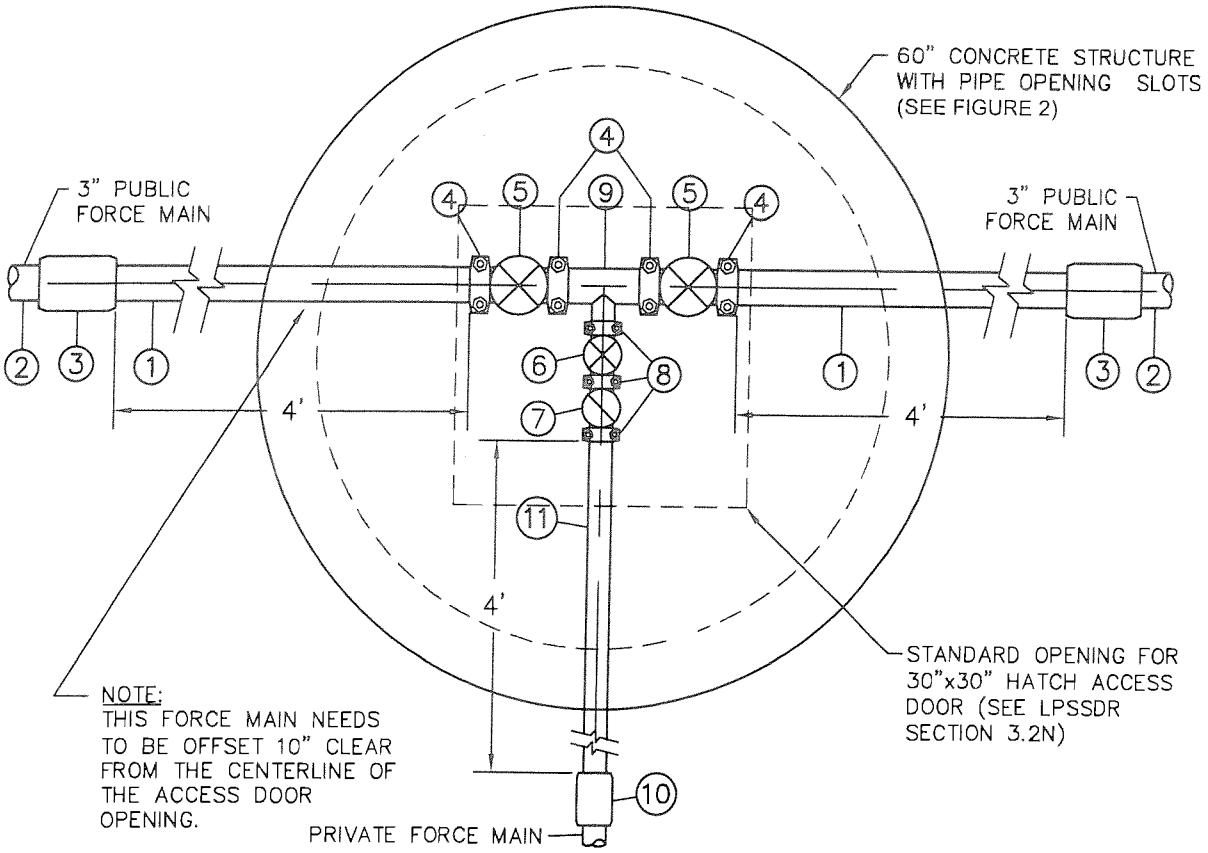
⑦ 2" VICTAULIC NO. 712 CHECK VALVE

⑧ 2" VICTAULIC NO. 75
FLEXIBLE COUPLING

⑨ 3 X 2 TEE IPS
VICTAULIC NO. 25 TNM 140

⑩ 2" SCHEDULE 80
SOLVENT WELD COUPLING
WITH REDUCER BUSHING
TO LATERAL SIZE

⑪ 2" SCHEDULE 80 PVC GRV X PE



NOTES:

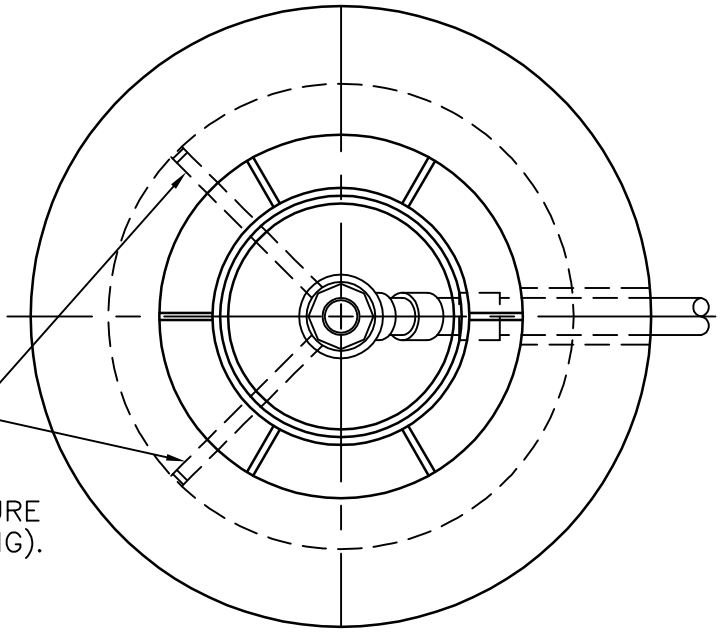
1) USE STAINLESS STEEL BOLTS AT ALL FLANGED CONNECTIONS.
2) STAMPED ALUMINUM IDENTIFICATION TAGS MUST BE WIRED TO EACH VALVE. THEY ARE TO IDENTIFY THE 3" VALVES AS "MSD UPSTREAM" ,"MSD DOWNSTREAM" AND THE 2" VALVE AS "PRIVATE SERVICE". THE ADDRESS OF THE LATERAL SHALL BE CLEARLY STAMPED ON THE PRIVATE VALVE TAG.

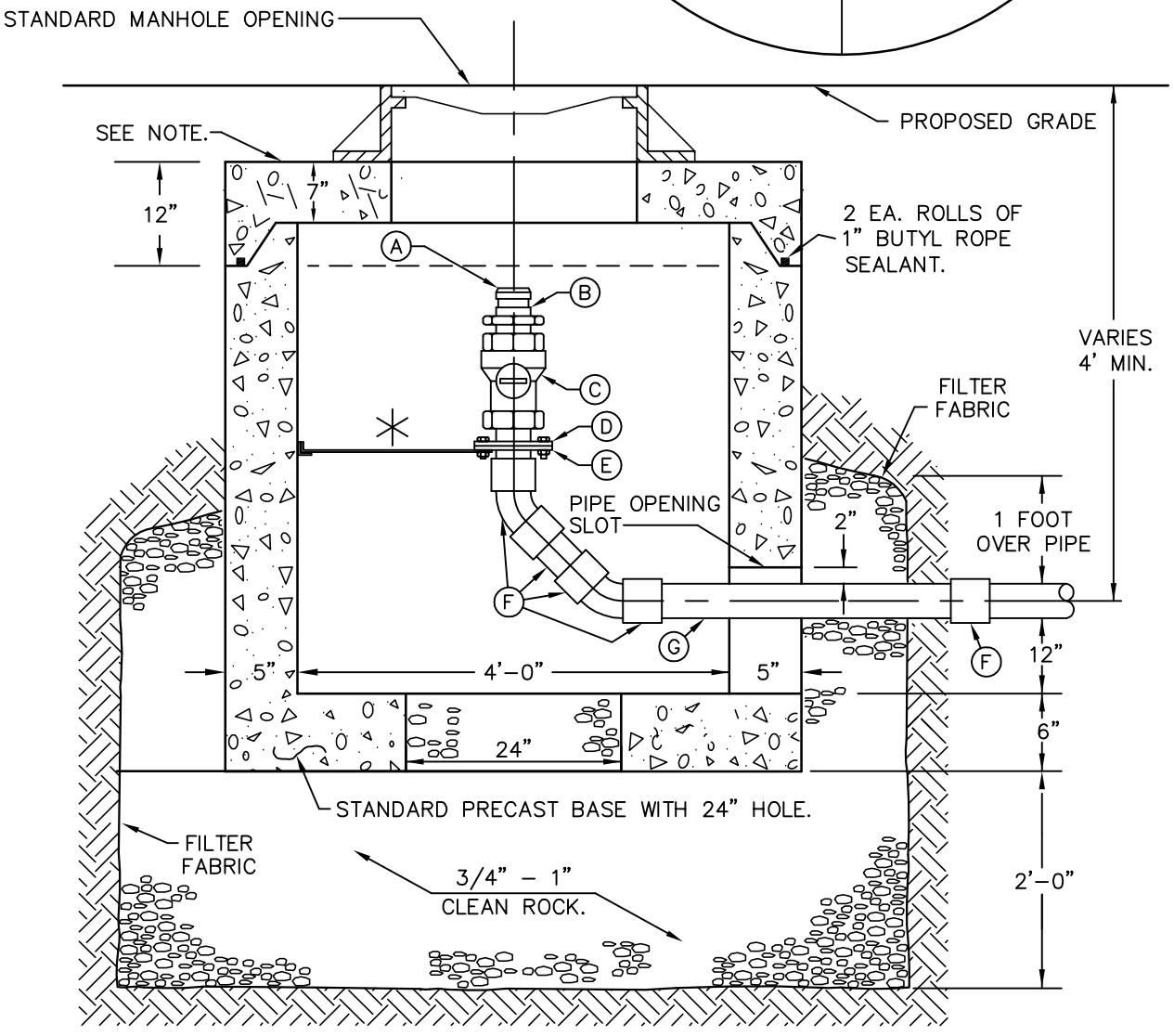
PLAN VIEW VALVE JUNCTION BOX 3" FORCE MAIN	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R. Ch. S.D.K.	2009	FIGURE 5

A. 2" LOCKDOWN QUICK COUPLING CAP
B. 2" QUICK COUPLING
C. 2" CURB STOP BALL VALVE
D. 2" BRASS FULL FACED FLANGE
E. 2" SOCKET FLANGE SCHEDULE 80 P.V.C.
F. 2" SCHEDULE 80 P.V.C. FITTINGS
G. 2" SCHEDULE 80 P.V.C. PIPE

✳ 1 1/2" x 1 1/2" x 3/8" S.S. ANGLE BRACE.

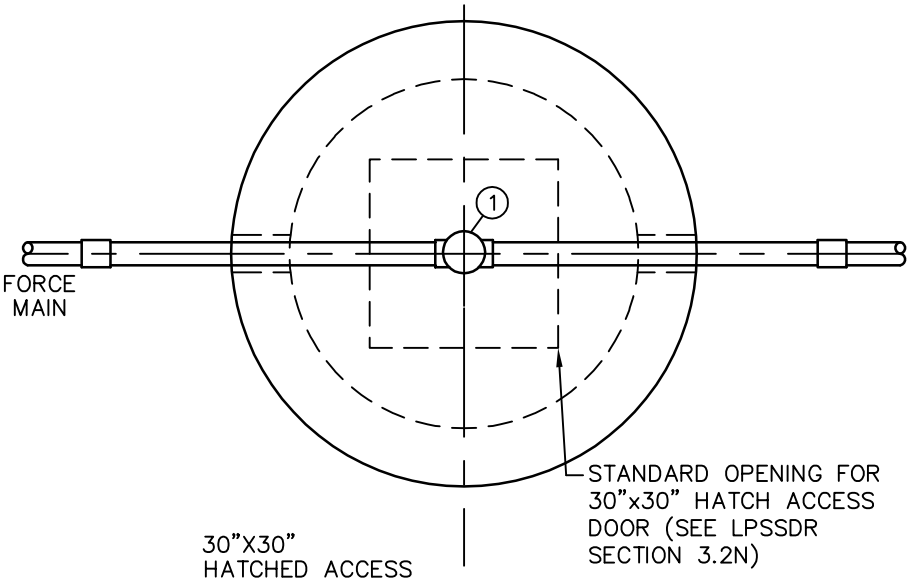
NOTE: ALL TOPS MUST BE REINFORCED (SUBMIT DESIGN FOR ALL STRUCTURE TOPS SUBJECT TO VEHICLE LOADING).





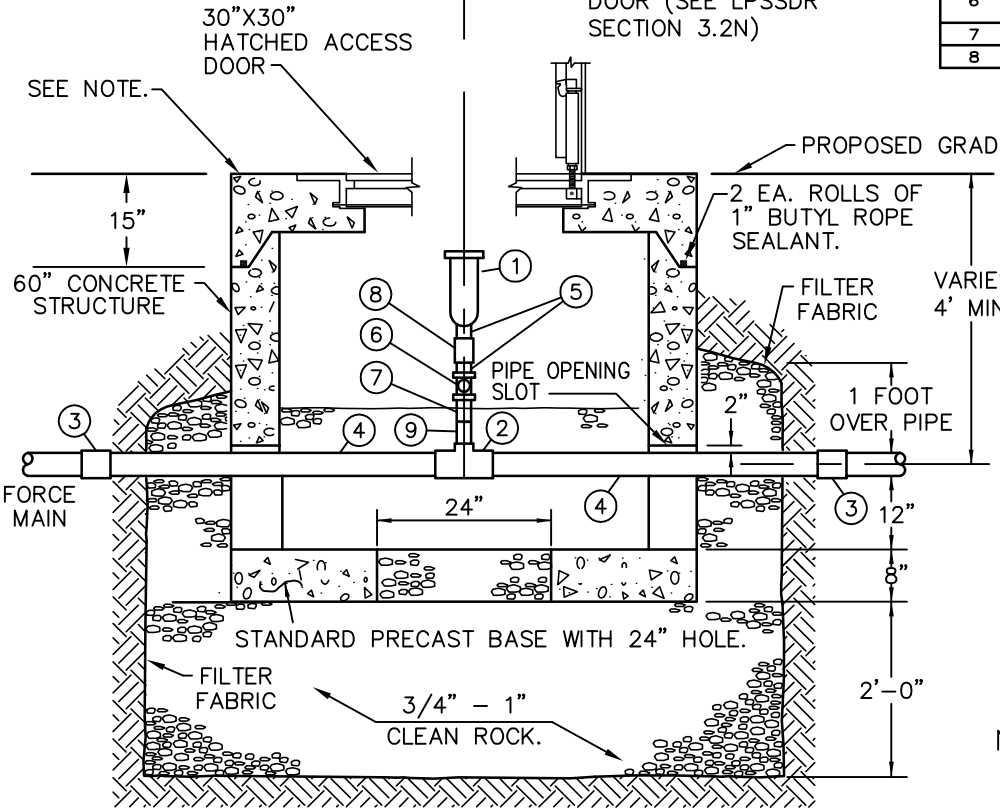
EMERGENCY TRUCK CONNECTION DETAIL	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R. Ch. S.D.K.	2009	FIGURE 6

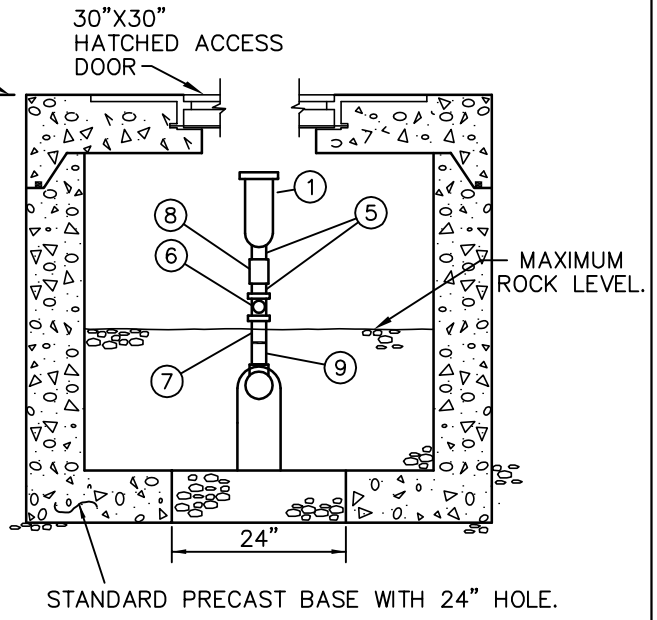
LOW PRESSURE SEWER SYSTEM AIR/VACUUM (COMBINATION) RELEASE VALVE DETAIL



2" AND 3" FORCE MAINS			
ITEM NO.	QUANT.	SIZE	DESCRIPTION
1	1	2"	ARI D-025 COMBINATION AIR VALVE
2	1	2"/3"x3"x2"	SCHEDULE 80 P.V.C. TEE / REDUCING TEE
3	2	2"/3"	P.V.C. COUPLING
4		2"/3"	SCHEDULE 80 P.V.C. PIPE
5	1	2"x6"	STAINLESS STEEL PIPE NIPPLE
6	1	2"	STAINLESS STEEL BALL VALVE, 1/4 TURN (SEE LPSSDR SECTION 3.4D)
7	1	2"x6"	STAINLESS STEEL PIPE NIPPLE
8	1	2"	STAINLESS STEEL COUPLING
9	1	2"	SOCKET TO FEMALE ADAPTER (THREADED)

4" FORCE MAINS			
ITEM NO.	QUANT.	SIZE	DESCRIPTION
1	1	2"	ARI D-025 COMBINATION AIR VALVE
2	1	4"x2"	D.I.P. M.J. TAPPED TEE
3	2	4"	LONG PATTERN SLEEVE MECHANICAL JOINT MEGA-LUG
4		4"	DUCTILE IRON PIPE
5	1	2"x6"	STAINLESS STEEL PIPE NIPPLE
6	1	2"	STAINLESS STEEL BALL VALVE, 1/4 TURN (SEE LPSSDR SECTION 3.4D)
7	1	2"x6"	STAINLESS STEEL PIPE NIPPLE
8	1	2"	STAINLESS STEEL COUPLING





NOTE: ALL TOPS MUST BE REINFORCED (SUBMIT DESIGN FOR ALL STRUCTURE TOPS SUBJECT TO VEHICLE LOADING).

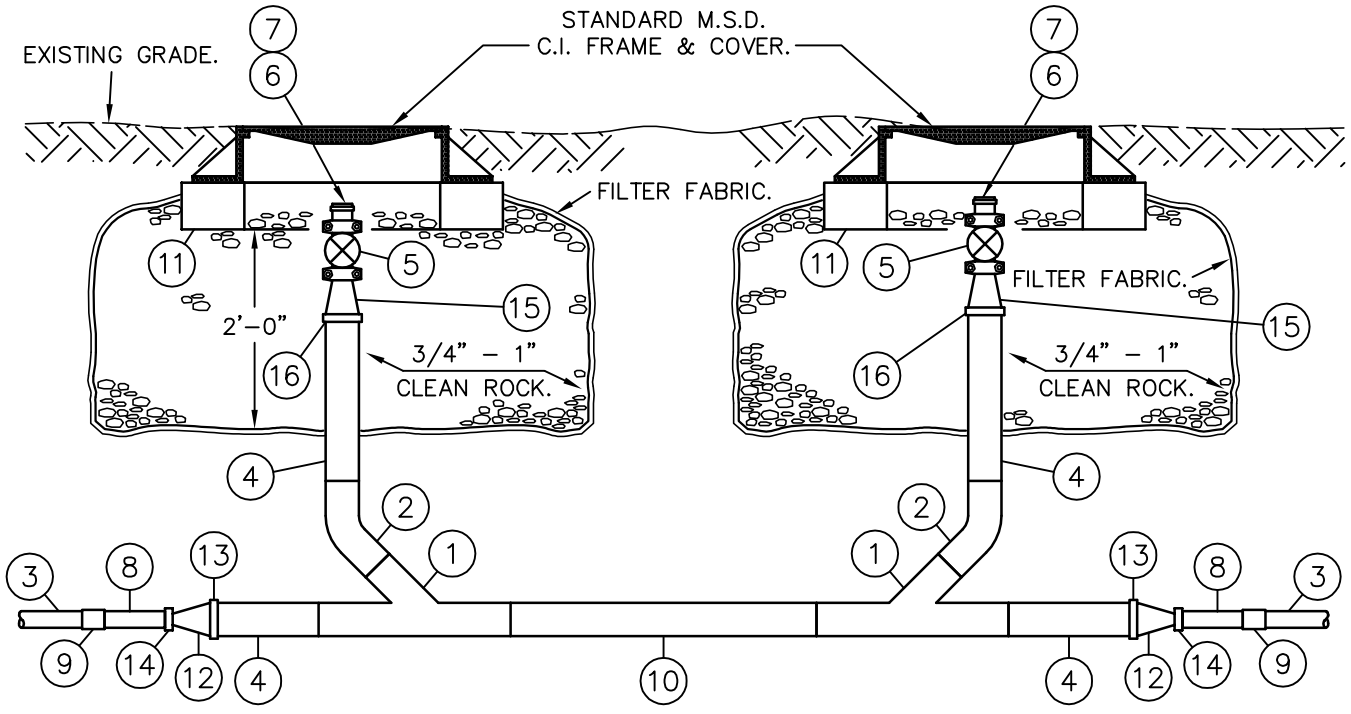
METROPOLITAN ST. LOUIS SEWER DISTRICT
Standard Details of Sewer Construction

Dr. D.H.R.
Ch. S.D.K.

2009

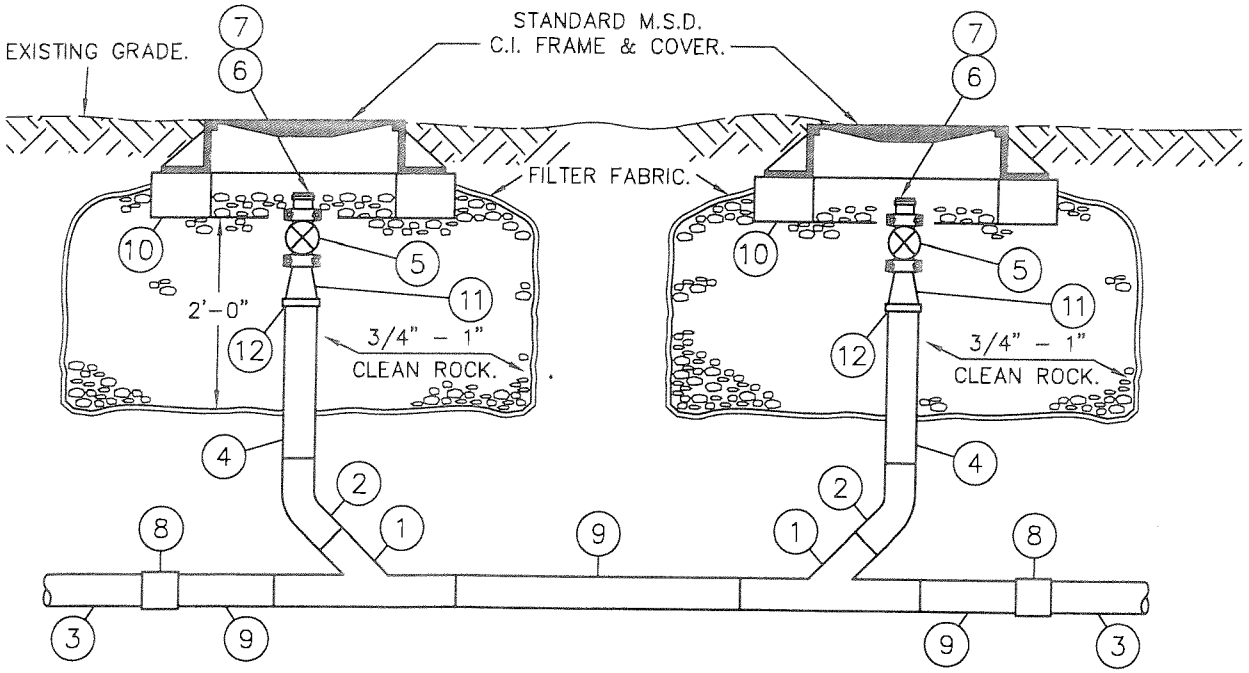
FIGURE 7

1 4" MJ WYE W/MEGA LUGS FOR DUCTILE IRON ON RUN AND BRANCH
2 4" MJ STREET (MJ X PE) 45° BEND W/MEGA LUGS FOR DUCTILE IRON
3 2"/3" SDR-21 P.V.C. FORCE MAIN PIPING TYPE
4 4" GROOVED BY PE DUCTILE IRON PIPE (VARIABLE LENGTH)
5 3" 1/4 TURN BALL VALVE (SEE LPSSDR SECTION 3.4B)
6 3" VICTAULIC STYLE 31 DUCTILE IRON COUPLING
7 3" VICTAULIC STYLE 60-C DUCTILE IRON CAP
8 2"/3" SCHEDULE 80 P.V.C. PIPE (VARIABLE LENGTH)
9 2"/3" SCHEDULE 80 P.V.C. SOCKET COUPLING
10 4" DUCTILE IRON PIPE
11 6" GRADE RING
12 4"x2"/4"x3" VICTAULIC STYLE 50 DUCTILE IRON CONCENTRIC REDUCER
13 4" VICTAULIC STYLE 307 DUCTILE IRON TRANSITION COUPLING
14 2"/3" VICTAULIC STYLE 75 DUCTILE IRON FLEXIBLE COUPLING
15 4"x3" DUCTILE IRON REDUCER
16 4" VICTAULIC STYLE 31 DUCTILE IRON COUPLING



LOW PRESSURE SEWER SYSTEM CLEAN-OUT DETAIL 2" AND 3" FORCE MAINS	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R. Ch. S.D.K.	2009	FIGURE 8

1 4" MJ WYE W/MEGA LUGS FOR DUCTILE IRON ON RUN AND BRANCH
2 4" MJ STREET (MJ X PE) 45° BEND W/MEGA LUGS FOR DUCTILE IRON
3 4" C-900 FORCE MAIN
4 4" GROOVED BY PE DUCTILE IRON PIPE (VARIABLE LENGTH)
5 3" 1/4 TURN BALL VALVE (SEE LPSSDR SECTION 3.4B)
6 3" VICTAULIC STYLE 31 DUCTILE IRON COUPLING
7 3" VICTAULIC STYLE 60-C DUCTILE IRON CAP
8 4" LONG PATTERN SLEEVE MECHANICAL JOINT MEGA-LUG
9 4" DUCTILE IRON PIPE
10 6" GRADE RING
11 4"x3" DUCTILE IRON REDUCER
12 4" VICTAULIC STYLE 31 DUCTILE IRON COUPLING



LOW PRESSURE SEWER SYSTEM CLEAN-OUT DETAIL 4" FORCE MAIN	METROPOLITAN ST. LOUIS SEWER DISTRICT *Standard Details of Sewer Construction*		
	Dr. D.H.R. Ch. S.D.K.	2009	FIGURE 9