LOUISA COUNTY WATER AUTHORITY
AND
THE TOWN OF LOUISA

WATER AND SEWER UTILITY
STANDARDS

March 2026

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1 GENERAL CONDITIONS

1.1 General

A. These design standards have been prepared to assist engineers preparing plans for water and sanitary sewer projects for the Louisa County Water Authority and the Town of Louisa. These standards are for use by experienced design professionals. Variations will be permitted based solely on sound engineering practice and will be reviewed and approved by the Louisa County Water Authority (LCWA) or the Town of Louisa on an individual basis. Such variations must be requested in writing along with sufficient documentation supporting the request. *Please note that all requirements in these Standards are the same for both the Louisa County Water Authority and the Town of Louisa unless specifically noted.*

B. Designs shall be in accordance with the Latest Edition of the Virginia Health Department Waterworks Regulations and Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations (SCAT), Commonwealth of Virginia, and any other local, State, or Federal agencies having jurisdiction. The engineer shall also comply with the requirements of the Code of Louisa County or the Town of Louisa as it pertains to water and sewer systems. It is the responsibility of the engineer to inform developers of the contents as set forth in the applicable local ordinances as it relates to the project under review and consideration by the Louisa County Water Authority or the Town of Louisa.

C. Prior to construction of public works and/or sanitary sewer facilities, construction drawings for the proposed facilities must be submitted for review and approval by the Louisa County Water Authority, the Town of Louisa and if required by State Code or regulations, the Virginia Department of Health (water), and Virginia Department of Environmental Quality (sewer). The developer shall adhere to the Louisa County Water Authority and the Town of Louisa review process. The construction drawings must be in a form acceptable to the review agencies. Prior to the approval of any portion of a phased development, subdivision or site plan, the developer, or his agent, shall submit an overall Master Plan of proposed water and/or wastewater systems for the entire development for review and approval by the Louisa County Water Authority or the Town of Louisa. The Master Plan and associated construction plans shall be amended and submitted for review and approval if future development is not in accordance with the original Master Plan. At least one set of construction drawings must be submitted for review and approval by the Louisa County Water Authority or the Town of Louisa. Once Louisa County Water Authority or the Town of Louisa has approved the plans, at least one set of the construction documents must be submitted to the Planning and Zoning and Building Departments for Louisa County. The Louisa County Water Authority or Town of Louisa will require that the developer submit

two additional copies of the plans directly to the Louisa County Water Authority for its use prior to final plan approval.

D. It is recommended that for complex projects and projects which may require special considerations, the engineer arrange a meeting with the Louisa County Water Authority and/or Town of Louisa to discuss the approach to be taken to supply water and sewer service. All water and sanitary sewer systems must be located properly to serve entire service areas as determined by the Louisa County Water Authority or Town of Louisa.

E. It is recommended that the engineer confer with the Virginia Department of Transportation (VDOT), as appropriate, prior to preparing plans for a water main or sewer line extension in any public right-of-way so that location issues may be resolved prior to preparation and submittal of the plans.

F. It should be noted that where it is determined that water or sewer lines are necessary to serve properties beyond the subdivision or development being proposed , the developer will be required to design and construct the proposed system, at a size and location that will permit future extensions to be made at the limits of the subdivision or development in question. The system normally will terminate, at or within one lot from the adjacent and/or upstream properties to be served by the system in the future. Elevations of the sewer system must be designed such that future extensions are taken into consideration to allow service to all areas which naturally drain towards the existing sewer system. Public water systems must be designed and constructed s to allow for future extensions. Utilities easements must be provided to allow adjoining properties to connect to the system.

G. The developer must enter into a Utility Service Agreement with the Louisa County Water Authority or the Town of Louisa before a construction permit will be issued. All plan review and inspection fees must be paid, and performance bonds or surety posted before a construction permit will be issued. Work on utilities may not begin until a construction permit is issued by the Louisa County Water Authority or the Town of Louisa. All utility work must be performed by a Class A licensed Contractor and/or as deemed acceptable to the Louisa County Water Authority or the Town of Louisa and will be subject to inspection by the Louisa County Water Authority or the Town of Louisa.

1.2 Contacting Property Owners

A. Prior to performing any survey or design work on private property, the engineer or surveyor shall notify the landowner and obtain the landowners permission for all work being performed. In addition, the Lousia County Water Authority or the Town of Lousia may require that letters be sent to landowners with existing easements on their property prior to

any work being completed in the easement. If requested, copies of these letters shall be provided to the Louisa County Water Authority or the Town of Louisa.

1.3 Easements

A. Water and sewer utilities which will become the property of the Louisa County Water Authority or the Town of Louisa which do not lie fully within a public right-of-way, shall require easements dedicated to the Louisa County Water Authority or the Town of Louisa, and as follows:

1. Minimum easement widths shall be 20 feet for water mains and 20 feet for sanitary sewers. For trenches greater than 10 feet deep, 5 feet additional width shall be required for each 5 feet of additional depth. Increased easement widths may be required when determined by the Louisa County Water Authority or the Town of Louisa.

2. Easements dedicated to water or sewer utilities will preclude construction of permanent structures and fences within the easement.

3. Easements will be provided to allow adjacent properties access to water and sanitary sewer lines and to allow the extension of water and sewer lines.

4. In cases deemed necessary by the Louisa County Water Authority or the Town of Louisa, and in order to assure routine and emergency maintenance, access (ingress/egress) easements shall be provided.

5. Easements will be traversable for operation and maintenance.

1.4 Construction Drawings

A. Construction drawings shall contain the information necessary to construct the utilities shown. The information shall be presented in a clear and legible manner, to construct the utility. Drawings shall meet the requirements of the Virginia Department of Health, Virginia Department of Environmental Quality, and Louisa County Water Authority or the Town of Louisa, as applicable, as outlined in the appropriate checklist contained in these standards. Again, all water and sewer lines shall be sized properly to accommodate future extensions if required and all phasing must also be noted and approved.

B. The engineer shall coordinate the location of all proposed water and/or sanitary sewer lines within all existing and proposed road rights-of-way with regard to existing and proposed roads, and drainage structures. In addition, coordination shall be made with other appropriate utility companies and agencies regarding their existing easements, rights-of-way and facilities.

C. Where there is the possibility of conflicts with existing utilities, the Louisa County Water Authority or Town of Louisa reserve the right to require that the engineer secure accurate information on the horizontal and vertical location of such utilities through subsurface exploration prior to approving plans.

D. The engineer must submit a copy of the appropriate checklist with a certification that the plans reflect all applicable items on the checklist. The plans will be reviewed and a review letter will be given to the design engineer. Once the plans are revised to reflect issues outlined in the review letter the engineer must resubmit the plans for further review. A letter of approval will be sent when all Louisa County Water Authority or Town of Louisa criteria are met. If required, he Virginia Department of Health and Virginia Department of Environmental Quality will issue separate letters.

E. Vertical datum for surveys shall be noted on the plans. Vertical datum for surveys shall be National Geodetic Vertical Datum of 1929 (NGVD 29). Horizontal datum shall be North American Datum of 1983 (NAD 83).

1.4.1 Utility Master Plan Checklist

_____

Project Title

Yes	No	N/A		
___	___	___	1.	Plan scale is 1 ” = 200 ’, 1”=100’ or 1” = 50’.
___	___	___	2.	Plan sheet is on 24” x 36” paper. Half size set also submitted with plan set. PDF and CAD (.dwg) format submitted.
___	___	___	3.	Project vicinity map is provided.
___	___	___	4.	Owner/Developer and Consultant names and addresses are shown on plan.
___	___	___	5.	Water system is designed to provide adequate domestic service and fire protection.
				a. Average Domestic Design Flow _____
				b. Maximum Day Design Flow _____
				c. Fire Flow _____
				d. Peak Hour Design Flow _____
				e. Design Flow _____
				f. Residual Pressure @ Design Flow _____
___	___	___	6.	Sanitary sewer service area map is submitted with plan.
				Sanitary sewer analysis is shown on sewer shed map.
				_____ diameter line is required to adequately serve this project in accordance with the Authority’s standards.
				a. Average Design Flow _____
				b. Equivalent Residential Units _____
___	___	___	7.	Any and all existing connections to property are shown on plan.
___	___	___	8.	All proposed water and sewer lines connect to existing facilities that have been previously accepted by the Authority for operation and maintenance.
___	___	___	9.	All off-site easements necessary for completion of this project.

___	___	___	10.	Existing easements and road right-of-ways.
___	___	___	11.	Proposed construction and permanent utility easements and widths.
___	___	___	12.	North arrow is shown.
___	___	___	13.	Sanitary sewer system layouts complete with pipe sizes and manholes.
___	___	___	14.	Provisions to serve adjoining undeveloped properties.
___	___	___	15.	Hydraulic computations for interceptor sewers which will extend through the project to serve off-site areas.
___	___	___	16.	Estimated construction sequence by subdivision section.
___	___	___	17.	Approximately location of service laterals.
___	___	___	18.	Water distribution system layouts complete with pipe sizes and valves.
___	___	___	19.	Fire hydrants.
___	___	___	20.	Flushing hydrant appurtenances.
___	___	___	21.	Water quality monitoring stations.
___	___	___	22.	Provisions to serve adjoining undeveloped property.
___	___	___	23.	Provisions for connection to adjoining developed properties.
___	___	___	24.	Hydraulic computations for domestic and fire flow requirements.
___	___	___	25.	Approximate location of service laterals and meters.

1.4.2 Developer's Checklist for Utility Projects

The following steps must be completed before the Louisa County Water Authority or the Town of Louisa will permit the Utilities Contractor to start construction:

_____ 1 – All off-site and on-site easements, not included in a subdivision plat for the project, have been dedicated to the Louisa County Water Authority or the Town of Louisa. The deed book and page for all utility easements not included in a subdivision plat must be noted on the construction drawings prior to approval of the project.

_____ 2 – The Louisa County Water Authority or Town of Louisa Department of Public Works has reviewed and approved the plan.

_____ 3 – The project plan has been approved by all appropriate agencies as required (e.g. Virginia Department of Transportation; Virginia Department of Health; Virginia Department of Environmental Quality; Louisa County Planning & Zoning; Thomas Jefferson Soil & Water Conservation District).

_____ 4 – The developer has entered into an Utility Service Agreement (USA) with the Lousia County Water Authority or Town of Lousia. If the standard form of the USA is utilized, approval of the USA can be completed administratively. Allow one week for this to occur from the time that the USA has been submitted to the Lousia County Water Authority or Town of Lousia in a form acceptable to the Lousia County Water Authority or Town of Lousia. If a non-standard form of the USA is desired, the appropriate governing body must approve the USA. At least one to two months should be allowed for processing a non-standard USA as the Authority/Town Attorney's office must approve the non-standard USA prior to it being submitted to the governing body for approval. A Utilities Agreement can be completed once the plans are close to being ready for approval. Typically it is appropriate to submit the agreement shortly after revised plans have been submitted for review and approval. Contact the Lousia County Water Authority or Town of Lousia to obtain a copy of the current standard Utilities Agreement.

_____ 5 – All review and inspection fees have been paid. All bonds have been posted.

_____ 6 – Erosion control measures have been installed and approved by the Louisa County E&S Inspector.

_____ 7 – A pre-construction conference between the Contractor and the Louisa County Water Authority or Town of Louisa Department of Public Works has occurred. This meeting must be requested at least one (1) week prior to occurring.

1.4.3 Site Plan Requirements

(For Plans that involve utility connections only. See Checklist of Water and Sewer Plans for site plans also requiring utility extensions.)

A. The location and size of existing sewer lines and water mains must be shown on the site plan. The top and invert elevations of all existing manholes must be given.

B. The exact location of the existing sewer (lateral) connection and/or water service and meter box must be shown, making reference to the length depth and station location of the sewer lateral and the relationship of the water and sewer service and appurtenances with the existing, proposed and future buildings, etc. Also show a clean-out on the sewer service at the property line or easement line as appropriate.

C. Existing and proposed water and sewer line easements must be shown on the site plan with deed book and page for all easements noted. The engineer needs to make sure there are no buildings or other permanent structures encroaching onto easements. Also, if there are any other type of structures and/or activities proposed (e.g. storm sewers, retaining walls, grading, curb and gutter, concrete paving, obstacles garbage pads, light posts, and other utility lines), the engineer shall make site design changes and take appropriate measures to protect the existing sewer line and its appurtenances.

D. Existing plumbing from building to connection and/or water meter must be shown. Proposed plumbing from building to sewer connection and/or new water meter must be shown.

E. When the site plan reflects the installation of a new sewer connection, the appropriate notes outlining the Louisa County Water Authority/Town of Louisa Department of Public Works requirements for installing a connection must be shown on the plan. The point where the utilities contractor stops his work and the plumber begins needs to be clearly denoted on the plan.

F. Site plan needs to clearly reflect the proposed “Fill” and “Cut” areas. Engineer is to analyze how it will affect the existing and/or proposed water and/or sewers.

G. Adjustment of water and sewer appurtenances will require notes, for example, notifying the Inspector to inspect any adjustments, that an acceptable licensed Utilities Contractor perform all utility work, etc.

H. Engineer must be aware of where proposed and future water and/or sewer extensions are needed and show this information on the plans and reflect sufficient easement width for future water and/or sewer extensions.

I. Where additional Road right-of-way and/or widening is proposed, the site plan needs to reflect the extension of the existing sewer (lateral) connection and/or existing water service and meter box just inside the new right or way line or utility easement as appropriate.

J. Water meter sizing calculations must be submitted to the Louisa County Water Authority or Town of Louisa Department of Public Works for commercial, industrial and multi-family residential properties connecting to public water where existing and/or new services are proposed.

K. If the existing water meter size needs to be decreased or removed due to change in water demand, a letter from the Developer is required authorizing the Louisa County Water Authority or Town of Louisa to either replace the existing meter with a smaller meter or remove the meter at the Developer's expense.

L. Engineer shall provide all calculations necessary to show that both fire and domestic demands being placed on the site can be met.

M. If an underground fire line is proposed, the engineer must show the proposed water main tie-in and the proposed location of the double detector check valve assembly. The double detector check valve assembly is to be owned by and maintained by the owner and shall not be in a utility easement unless otherwise approved by the Lousia County Water Authority or Town of Lousia. If a sump pump is to be provided for the double detector check vault to provide drainage, the plans shall schematically show electric power being provided to the vault.

N. If an underground fire line is proposed, engineer must show the proposed water line tie-in and the proposed location of any additional associated structures.

O. Standard Utility notes included on plans or referenced.

P. If sealed by an engineer or surveyor, all seals signed and dated by the engineer or surveyor with original signature on the cover sheet.

1.4.4 Engineer's Site Plan Checklist

PROJECT _____

TAX MAP/ PARCEL NUMBER: _____ DATE: _____

UTILITIES

1. ____ The site plan shows the existing sewer and/or water lines and how this project will connect to the public sewer and/or water systems.
2. ____ Site Utilization Survey Form has been submitted.
3. ____ The plan needs to show the as-built location and information of the existing six inch sewer connection if one exists or a proposed six inch sewer connection if one does not exist.
4. ____ The site plan designates that a utilities contractor will install the sewer connection to the edge of the VDOT right of way or sewer easement and show the plumber starting his work from that point.
5. ____ Contact the Louisa County Water Authority or the Town of Louisa regarding each proposed change in size for an existing meter.
6. ____ If the existing water service on this property is to be abandoned, the owner/developer has submitted a letter authorizing this service to be removed.
7. ____ The site plan reflects any necessary adjustments of the existing manhole tops.
8. ____ The site plan shows the location of utility easements with the deed book and page for each easement noted on the plans.
9. ____ The engineer has furnished his calculations of fire flow and domestic water demands and has verified that the public water system will support these demands.
10. ____ Where industrial waste is a possible influent to the public sewer system, the engineer has incorporated appropriate measures on the plans, i.e., sampling points, metering stations, etc.
11. ____ Monitoring manholes are required for new facilities currently regulated by local or federal industrial waste pretreatment laws. Examples include restaurants, car washes, auto repair shops, and laundromats to name a few. A private monitoring manhole shall be provided to facilitate sampling.

1.4.5 Engineer's Checklist for Water and Sewer Plans

1. Title Page

_____A. Project Name

_____B. Engineer's or Class B Surveyor's Seal and Original Signature

_____C. Vicinity Sketch (complete in detail)

_____D. Title Block

_____E. Tax Map and Parcel Number

_____F. Magisterial District

_____G. Name, Address, and Phone Number of Developer/Owner

_____H. Legend of sanitary sewer and water mains, other utilities and structures, existing and proposed ground and pavement profile.

_____I. Water Resource Area

_____J. Responsible Land Disturber

2. General

_____A. The plan includes an overall plan of the water and sewer layout, including any phasing of the development. A separate Utility Master Plan may be submitted to meet this requirement.

_____B. Engineer and/or Surveyor has notified all property owners prior to performing and off-site design and/or surveying work.

_____C. Table of Estimated Quantities (including breakdown of type of pipe).

_____D. All sheets in set bear an appropriate signed and dated seal.

_____E. Water and Sewer Notes; as a minimum, reference has been made to Louisa County Water Authority/Town of Louisa Water and Sewer Utility Standards.

_____F. Vertical scale is 1" = 5' and horizontal scale is no greater than 1" = 50' unless otherwise approved by the Louisa County Water Authority/Town of Louisa Department of Public Works. A bar scale is shown on each sheet.

_____G. All water and sewer designs conform to the latest County, State, and Federal regulations and standards.

_____H. Plan and Profile sheets are on 24" x 36" paper unless otherwise approved by the County/Town (2 full size sets and ½ size set plans submitted with each plan package, pdf and CAD (.dwg) format).

3. Plans

A. Utility Plans

_____1. All water, sewer, road and drainage structures are shown on one plan sheet.

_____2. All plan sheets include:

_____a. Existing water and sewer lines are properly labeled with size and with horizontal and vertical distances referenced on the plan.

_____b. At least two vertical benchmarks are shown on the plan.

_____c. Horizontal and vertical scale shown on each sheet (scale should be same on plan and profile)

_____d. All existing easements are shown accurately, and proposed utility easements are shown on the plans. The existing easements reflect accurate recordation information.

_____e. All existing and proposed storm sewer lines, gas telephone, power, and other utility lines, which cross or run parallel to the sewer lines are shown with horizontal and vertical separation where applicable.

_____f. Adjacent road and drainage projects are shown as required.

_____g. Consideration has been given to areas where roads and drainage structures may be lowered in the future.

_____h. Road names, state route numbers, and right-of-way widths are shown.

_____i. Plan and profile are drawn in the same direction. Stations shall ascent from left to right.

_____j. Proposed sewer lines are shown with reference distances from right of way, boundary, buildings, other utility lines, etc.

_____k. All property lines and property markers (stones, rods, pins, pipes, monuments, etc.) are shown.

_____l. Location of existing houses, building, fences, wells, and other structures are shown on plans. In lawn of kept areas, tree and shrubs in the easements are shown (size and type).

_____m. All designs conform to the latest local Soil and Water Conservation District, County, and State erosion control and sedimentation rules, regulations, and ordinances. Louisa County and Thomas Jefferson Soil & Water Conservation District must approve an erosion and sediment control plan.

_____n. The engineer understands that he/she is responsible for coordinating the utility design and construction work with other engineers where their projects connect or are affected by other projects.

_____o. Locations of special features (conc. encasement, riprap stabilization at creek crossings, clay dams, etc.) are shown on the plans. Details have been provided as appropriate or reference is made to standard details.

_____p. Detail drawings of all stream crossings and storm sewer outlets, with elevations of the streambed and high (25 year flood elevation) and normal water elevations.

_____q. Proper labeling of subdivision (lot, block, street names, subdivision boundaries, etc.)

_____r. Adjacent property owner name(s) are on the plans.

_____s. All fill and cut areas are shown within the area of existing and proposed water and/or sewer lines.

_____t Necessary easement plats onsite and/or off-site have been recorded. Deed book and page where easement is recorded is shown for each easement.

_____u. Pavement replacement details, boring detail, etc. are shown on all plans of reference is made to standard details.

_____v. Location and dimensions of all water and sewer service connections are shown.

_____w. Proposed, and original ground elevations are shown on profiles.

_____x. Municipal, subdivision and/or drainage area boundaries are shown.

_____y. North Arrow is reflected on all plan sheets.

_____z. Virginia 811 notation is shown.

_____aa. Engineer understands that any changes made to the road, drainage, water, and/or sewer design will require a submittal to the Louisa County Water Authority/Town of Louisa Department of Public Works for review and approval of the revised sewer plans reflecting those changes.

_____bb. All revisions include an explanation either on the plans or by separate transmittal.

_____cc. Plans have been submitted to State Health Department for review and approval. A copy of transmittal letter is attached to plans when they are submitted for approval.

_____dd. If horizontal bore is require, bore location, length of bore, pit location (average 20' x 40') are shown on relation to all existing and /or proposed utilities on plan and profile.

_____ee. Clay dams or other acceptable designs are shown at the appropriate locations to avoid water from creek and/or lake being diverted along pipe bedding.

_____ff. Utility plans reflect those conditions as approved by the Planning Commission/Board of Supervisors/Town Council.

_____3. Sanitary Sewer Plans

_____a. All sanitary sewer plans are labeled with size, grade, length, and type and class of pipes (with backup calculations on the type and class pipe needed, where applicable)

_____b. Manholes are labeled with top and invert elevations, and locations, size and inverts of drop stacks when a vertical drop exceeds 2 feet.

_____c. Deflection angles at all manholes or bearings of all lines are shown on plans.

_____d. Minimum finished floor elevations and basement elevations are to shown on plans, where applicable. If gravity sewer service cannot be provided to a lot it should be noted on the plans.

_____e. A sewerage drainage area map with hydraulic analysis is included in plans.

_____f. The engineer has field verified the inverts of existing manholes(s).

_____g. All manholes are designed to an elevation above the 100-year flood plain set forth in the design standards unless otherwise approved by the Louisa County Water Authority/Town of Louisa Department of Public Works.

_____h. Ground coverage over sewer pipe meets minimum criteria.

_____i. All finished floor connections are located above the top elevation of the closest receiving manhole. Engineer has put a notation that a backwater valve is to be used where the building with a finished floor elevation of the

building is below the top elevation of the nearest upgrade manhole from the building connection.

_____j. A note stating that the contractor must field verify the inverts of all existing manholes, gas lines, and other utility lines prior to the start of construction.

_____k. All "%" slopes are divisible by 4 to the nearest hundredth, where possible.

_____l. All pipe between manholes are of like material and class.

_____m. All temporary and/or permanent silt basins are BMP facilities are shown and the sewer lines and manholes have been designed around these structures.

_____n. All existing sewer laterals are shown on the plans, with station, length and depth, as depicted on the as-built plans.

_____o. All sewer lines are designed with the entry into the manhole by the proposed sewer lines at an angle of 90 degrees or greater to the downstream line, unless an exception is given.

_____p. Whenever connecting a sewer lateral to an existing sewer line, engineer has put on plans the proper notation that "the Contractor must use a mechanical hole cutter when tapping the existing sewer line and that an approved saddle or Inserta-Tee shall be used" and the appropriate lots affected by this have been identified in the note.

_____q. Where new manholes are proposed over existing lines, distance from the new manhole to the two existing manholes is shown; inverts of the manhole and each existing manhole are shown; slope of existing line from new manhole to upstream and downstream existing manholes is shown.

_____r. Where future extensions are necessary, these lines are reflected on the plans.

_____s. Monitoring manholes are required for new facilities currently regulated by local or federal industrial waste pretreatment laws. Examples of these commercial facilities include restaurants, car washes, auto repair shops, and Laundromats to name a few. A private monitoring manhole shall be provided to facilitate sampling.

_____4. Water Plans

_____a. All sanitary sewer plans are labeled with size, grade, length, and type and class of pipes (with backup calculations on the type and class pipe needed, where applicable)

_____b. All conflicts with storm sewers and other utility lines are shown with appropriate design changes shown.

_____c. A minimum of eighteen (18) inches of vertical clearance has been designed and obtained at all crossings of other utilities, or as specified by other utility agencies, or otherwise approved by the Louisa County Water Authority/Town of Louisa Department of Public Works.

_____d. All water lines have a minimum of 3.5 feet of cover.

_____e. Fire hydrants and air relief valves are shown on plans and profiles.

_____f. Hydrants or blow-off valves are designed at major low places in the line, where possible, and air release valves are designed at the high points.

_____g. Flushing hydrants or hydrants are designed at the end of all lines in cul-de-sacs.

_____h. All water services are shown.

_____i. Plans show all connections to the existing mains, etc.

_____j. Engineer has designed water system in accordance with available pressures and has provided fire flow and pressure calculations.

_____k. Pipe sizes noted on plans.

_____l. Ditch lines are shown on the plan and depths of ditch(s) are shown on the profile at the fire hydrant locations and service lines, where necessary.

_____m. Water line stubs for future extensions are designed to be installed beyond the edge of pavement.

_____n. Locations of water meter boxes are shown outside of vehicular traveled areas. Where it is not possible to locate the boxes out of the driveways, and/or vehicular traveled areas, a cast iron box is specified.

_____o. For water line tie-ins, the engineer has shown the valve to be used for cut off during the tie-in. Where tapping the main line verses cutting in a tee is applicable, the engineer has evaluated which method will be used as outlined in the Louisa County Water Authority/Town of Louisa Design Standards.

_____p. Sequence of Construction, Testing, and Flushing of New Waterlines Notes are on the plan.

_____q. Backflow prevention devices, including size, type and location are included on the plan.

_____r. Water meter size has been coordinated with Louisa County Water Authority.

_____s. Water services for commercial development are one standard size larger than the proposed water meter.

_____t. Adequate fire protection is met, i.e. hose lay and amount of fire hydrants.

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2 WATER SUPPLY SYSTEM DESIGN

2.1 Hydraulic Design for Water Mains

A. Water distribution systems shall be designed to provide adequate flow and pressure for both domestic supply and fire flow based on sound hydraulic analysis. Design shall be based on a maximum flow velocity at peak flows (excluding fire flow) of 5 feet per second and a Hazen-Williams "C" Value of 120. Values of existing demand and supply pressures shall be coordinated with the Louisa County Water Authority or Town of Louisa. If required, the engineer shall contact the Louisa County Water Authority or the Town of Louisa to schedule a fire flow test. The Louisa County Water Authority/Town of Louisa must be present during any test but will not provide equipment or manpower for a test. Louisa County Water Authority or Town of Louisa is not responsible for the results of any test or for any design made on the basis of any test. Louisa County Water Authority/Town of Louisa does not imply or warrant that conditions occurring during a test are necessarily representative of the system's ability to provide water under all or even normal conditions.

B. The engineer shall submit with all water plans, information and calculations on fire flows and domestic water demands for the project. The engineer shall provide a detailed analysis for evaluation by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health to ensure that the specifications of this section have been followed and that the proposed water system design meets these specification and satisfies maximum day demands plus fire flow requirements or peak hour demands, whichever flow condition is more difficult to meet. The engineer shall provide this information with all water plans submitted for review. The engineer is responsible for ensuring that the design as proposed meets the requirements of these Standards. If the design does not meet any part of these Standards; the engineer is responsible for notifying the Louisa County Water Authority or the Town of Louisa of all deficiencies.

C. The water distribution system and any extensions thereto shall be designed to supply the demands of all customers (the greater of maximum day plus fire flow, or peak hour domestic demand) while maintaining the 20 psi at all points in the system.

D. The following criteria shall be used in estimating average daily demands. Daily demands may require modification if irrigation systems are being considered. Prior to design, consult with the Louisa County Water Authority or the Town of Louisa.

Table 2.1 – Average Daily Demand Estimates by Land Use

Land Use	Gallons per Day per Acre	Equivalent Persons per Acre
Residential - 1 to 2 dwellings/acre	600	6
Residential - 2 to 4 dwellings/acre	1,000	10
Residential - 4 to 8 dwellings/acre	1,600	16
Residential - Low	600	6
Residential - Medium	1,000	10
Residential - High	1,600	16
Agricultural	1,000	10
Commercial	1,000	10
Industrial - Light Water Use	500	5
Industrial - Medium Water Use	1,500	15
Industrial - Heavy Water Use	2,500	25

Where site specific determinations can be made, flow may be determined by using the following design information:

Table 2.2 – Average Daily Demand Estimates by Facility Type

Discharge Facility	Design Units	Flow gpd
Single Family Residential	3 people/unit	300
Three Bedroom Apartment	3 people/unit	300
Two Bedroom Apartment	3 people/unit	300
One Bedroom Apartment	2 people/unit	200
Three Bedroom Condo	3 people/unit	300
Two Bedroom Condo	3 people/unit	300
Elementary School	per person	10
High School	per person	16
Motels and Hotels	per room	130
Trailer Courts	per trailer	300
Restaurants	per seat	50
Service Station	per vehicle serviced	10
Factories	per person per 8 hour shift	25
Shopping Centers	per 1,000 sq. ft.	250
Hospitals	per bed	300
Nursing Homes	per bed	200
Homes of the Aged	per bed	100
Medical Center	per 1,000 sq. ft.	500
Laundromats	per washing machine	500
Theaters	per seat	5
Bowling Alleys	per lane	75
Office Buildings	per 1,000 sq. ft.	200

Flows for other uses may be determined by using demands approved by the Louisa County Water Authority/Town of Louisa.

E. To determine maximum daily demands and peak hourly demands, the engineer shall reference the Virginia Department of Health Waterworks Regulations Part III along with use data provided by Louisa County Water Authority or the Town of Louisa . All factoring must be approved by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health prior to design.

F. To determine maximum daily demands and peak hourly demands the following multipliers shall be used:
   a. Maximum Daily Demand (residential) = 1.8 times Average Day Demand
   b. Maximum Daily Demand (non-residential) = 1.3 times Average Day Demand
   c. Peak Hourly Demand = 2.7 times Average Day Demand

G. Minimum pipe size shall be 8 inch, except that dead-end water mains may be four (4) inches in diameter if there is not a fire hydrant on the line and six (6) inches in diameter if there is a single fire hydrant on the line and design flow and residual pressures can be maintained. Dead-ends shall be eliminated by looping whenever feasible. The Louisa County Water Authority or the Town of Louisa may require a project to increase the size of its water mains above the size required to meet the specific needs of the project in order to meet the overall needs of the Town or County or to improve system performance or reliability. Typically, the Louisa County Water Authority or Town of Louisa will require a project to extend regional water mains through its interior and along its public street frontage in order to meet the overall needs of the Town or County or to improve system performance or reliability. Wherever possible, at least two supply points shall be provided for subdivisions containing more than 50 lots. In addition, “looping” will be the preferred method and multiple feed points.

H. The Louisa County Water Authority or Town of Louisa may require a project to include offsite improvements to the Authority’s existing water system if such improvements are required to meet the needs of the project.

2.2 Water Main Locations

A. All water mains located along VDOT owned and maintained roads shall be located in an easement outside the VDOT right-of-way. The water main shall be a minimum of 5 feet off the VDOT right-of-way line. All water mains located in existing or proposed streets which are not owned and maintained by VDOT shall be constructed in one of the following ways as determined by the site constraints and approved by the Louisa County Water Authority and/or the Town of Louisa: (1) in the road at least 5 feet off the edge of pavement, (2) located in a utility strip between the curb and sidewalk, (3) located at least 5 feet off the back of the sidewalk.

B. Where water mains are to be installed in roads expected to be widened in the future, they shall be located in easements unless the future road cross sections are known and location of water main is designed to avoid future relocation. Waterlines shall be designed so that they will not need to be lowered when the road is widened or driveways are installed.

C. Water mains shall be designed so that changes in alignment are made by deflecting successive lengths of pipe whenever possible. Joint deflection shall be limited to one-half of the pipe manufacturer's maximum allowable deflection. No joint deflection or curving of pipe will be allowed for PVC pipe. Joint deflection limits apply to vertical as well as horizontal curves. Bends with approved thrust blocks or approved joint restraint systems shall be used when deflecting the pipe is not practical.

D. In subdivisions, water mains will be permitted in easements only when there is no other feasible alternative and prior written approval is obtained from the Louisa County Water Authority or the Town of Louisa. Easements shall be wide enough to provide sufficient space for both installation and maintenance. The minimum utility easement width shall be as dictated in Section 1.3.

E. The engineer shall consider the location of existing and proposed sanitary sewer and storm drainage systems and all other underground structures and utilities that could affect the location and types of material for the water main. The selection location should avoid conflicts and facilitate future maintenance. Water mains shall be located above sanitary and storm sewers whenever possible.

F. In subdivision streets that have curb and gutter, water mains should generally be located 5 feet in front of the face of curb (3 feet from the gutter pan) except in streets less than 30 feet in width from face of curb to face of curb where the water main may be located behind the curb at least 3 feet if there is also sewer located in the street. In subdivision streets without curb and gutter or along existing subdivision streets, water mains should be located 3 feet to 5 feet off of the edge of pavement or behind the ditch line if there is sufficient right-of-way to allow this. Future widening of the roadway shall be considered during the design of the water main

G. Where the possibility of major conflicts with existing utilities and/or other structures exist, the Louisa County Water Authority or the Town of Louisa may require that the engineer obtain accurate information on the horizontal and vertical location of such utilities through subsurface exploration and reflect this information on the plans.

H. The engineer shall meet the requirements for separation of water and sanitary sewer facilities and shall use the same requirements stated in Section 4.3, Sanitary Sewer Location, of these standards.

I. Normally where storm sewers or other utilities other than sanitary sewers pass over or under waterlines, a minimum of 18" of separation should be maintained. The Louisa County Water Authority or the Town of Louisa, in conjunction with Virginia Department of Health may allow the separation to be reduced to 0.50' on a case by case basis, however, ductile iron pipe must be utilized when the separation is less than 1.0'.

J. Water main crossings of railroads, major roadways, and other major structures shall be contained in a casing pipe. Design of railroad crossings shall comply with the requirements of the American Railway Engineering Association Specifications (latest revision). The engineer or developer shall be responsible for obtaining required railway permits and/or agreements for the County, paying any fees, and posting any required construction bonds for the railway crossing prior to beginning construction on any part of the project. A copy of the permit and or agreement shall be provided to the Louisa County Water Authority or Town of Louisa prior to a Construction Permit being issued for the project.

K. Water mains entering or crossing streams shall be fully restrained ductile iron pipe (Class 52 minimum). The tops of these mains shall be a sufficient depth below the natural bottom of the streambed to protect the pipe. In general, a minimum of 4 feet of suitable cover is required. The pipe and joints shall be designed, constructed, and protected against anticipated hydraulic and physical, longitudinal, vertical, horizontal loads, erosion and impact. Reasons for requesting less cover shall be given in writing to the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health prior to plan submittal. The trench above the pipe in streams must be stabilized through the use of rip-rap, concrete, gabion mats, or other approved materials.

L. Subaqueous water main installations will be permitted only when it can be demonstrated that no other practical alternative exists. The pipe shall be of special construction, having flexible watertight joints. Special attention shall be directed to foundation conditions and thrust restraint for the pipe.

M. For both the aboveground and subaqueous crossings, the design shall provide valves at both ends of the crossing so that the section can be isolated for tests and repairs. The valves shall be easily accessible and not subject to flooding.

N. Water mains constructed in fill shall be ductile iron pipe (Class 52 minimum) with restrained joints unless a licensed geotechnical engineer can furnish a certification that the fill has been compacted so that settlement of the main will not occur.

O. Water mains constructed on piers will be permitted only when it can be demonstrated that no other practical alternative exists. The engineer shall submit a design for the piers, pier foundation and pipe that will demonstrate the structural integrity of the proposed system. Aboveground water pipes shall be adequately supported, protected from damage by freezing, accessible for repair or replacement, and be located above the 100-year flood elevation.

P. Water mains installed on bridges shall be designed for such an application and an allowance for expansion and contraction shall also be provided within the design. This typically means that an expansion coupling shall be provided. Isolation valves on either side of the crossing will be required.

2.3 Depths of Water Mains

A. Standard minimum cover shall be 42 inches and maximum cover shall be 8 feet. Water pipes shall not be laid at excessive depths. Water lines shall not be laid at depths of greater than 8 feet without the permission of the Lousia County Water Authority or Town of Louisa. All water mains shall be constructed to a depth that will provide protection against freezing and thawing and ensure adequate cover over valves and other appurtenances. New installations of water mains adjacent to roadways shall have a minimum of 42 inches of cover from the existing/proposed edge of pavement. Greater depths shall be required where street grades will possibly be lowered in the future. Clearance shall be provided for enlargement of undersized drainage structures. Any earthwork which takes place over an existing water main shall be required to maintain the water main at a maximum depth of 8 feet below finished grade and a minimum depth of 42 inches below finished grade. Where the depth of the water main will exceed 8 feet, the water main shall be raised. Where the depth of cover is less than 42 inches, the water main shall be lowered. Water lines shall not be installed within the zone of influence of the foundation of a building or other structure.

2.4 Water Main Appurtenances

A. Valves boxes, air relief valves, fire hydrants, service lines, vaults and other appurtenances shall be constructed in accordance with Louisa County Water Authority or Town of Louisa standards and details.

B. Valves shall be located at least every 1,000 feet and at all changes in pipe diameter. Valves shall also be provided at all pipeline intersections so as to provide shut off for repairs of

smaller sections without causing interruption of service to large areas in addition to facilitate testing. Unless authorized otherwise by the Lousia County Water Authority or Town of Lousia, a minimum of three (3) valves shall be provided at tees and four (4) valves at crosses. However, an additional valve may be required at the discretion of the Louisa County Water Authority or the Town of Louisa. The valving of the water system will be designed so as to allow segments of the system to be isolated for repairs and maintenance while leaving the rest of the system in service. Valves shall be located as close to the fitting as practical. All valves are to be restrained to fittings by approved methods.

C. When connecting to an existing water main, utilization of aa main line valve and tee shall be required as opposed to a tapping sleeve unless approved. In addition, a valve is required when there are long distances between main line valves (greater than 1000 feet) or even in the distance is less than 1000 feet if directed by Louisa County Water Authority or the Town of Louisa. Therefore, it is important that each project be carefully evaluated by the engineer with the Louisa County Water Authority's or Town of Louisa's assistance to determine if a main line valve is needed and/or if a cut-in tee is practical, taking into consideration how many residences, businesses, hospitals, etc. may be without water when the main line valve and tee are cut in.

D. Pressure reducing valves shall be installed on the customer side of the meter by builder or property owner, to be operated and maintained by the customer, when the service connection system pressure will be greater than 80 psi. The pressure reducing valve shall be owned, operated and maintained by the owner of the property and shall be inspected by the Louisa County Water Authority or the Town of Louisa.

E. Water mains shall be provided with air release valves, blowoffs, and water quality monitoring stations at suitable locations to allow testing, disinfection and flushing of the main. Fire hydrants shall be installed on all dead-end mains; utilization of flushing hydrants rather than fire hydrants must be preapproved.

2.5 Fire Hydrant Locations

A. Hydrants in residential areas should generally be located at street corners or in mid-block at lot lines. Hydrants should generally be located on the right hand side of the road, before the turn, based on the route that would be taken by a truck dispatched from the nearest fire station. The exact location of hydrants must be approved by the Louisa County Water Authority or the Town of Louisa. The maximum spacing between hydrants shall be 500 feet along water mains. The hose laying length to any residential lot shall be no more than 300 feet from at least one hydrant. New water systems in residential areas shall be designed to provide a minimum fire flow of 1000 gallons per minute with a residual pressure of 20

psi being maintained in the system unless otherwise approved by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health. Reductions of fire flow down to 500 gallons per minute will be considered on a case-by case basis by the Louisa County Water Authority or the Town of Louisa.

B. Hydrants in commercial and industrial areas should generally be located at street corners or in mid-block at lot lines. Hydrants should generally be located on the right hand side of the road, before the turn, based on the route that would be taken by a truck dispatched from the nearest fire station. The exact location of hydrants must be approved by the Louisa County Water Authority or the Town of Louisa. The maximum spacing between hydrants shall be 500 feet along water mains. The hose laying length to any outside wall of a structure shall be no more than 300 feet from at least one hydrant. New water systems in commercial and industrial areas shall be designed to provide a minimum fire flow of 2000 gallons per minute with a residual pressure of 20 psi unless otherwise approved by the Louisa County Water Authority and the Virginia Department of Health. For the Northeast Creek Service Area, reductions in fire flow should be approved by the Virginia Department of Health, Louisa County Water Authority and/or the Town of Louisa. If it is not possible to obtain a fire flow of 2000 gallons per minute, reductions down to 500 gallons per minute will be considered on a case-by case basis. If a facility is to have an automatic fire suppression (sprinkler) system that requires a fire department connection, there shall be a dedicated fire hydrant within 100 feet of the fire department connection. This hydrant cannot be utilized for meeting the building coverage requirements outline above. Sections of state regulations 12VAC5-590 that pertain to fire hydrants must be incorporated into all selections of fire hydrants types and fire hydrant locations.

2.6 Flushing Hydrants

A. A fire hydrant or flushing hydrant (blow-off) shall be provided at low points on mains 12-inches and larger to facilitate flushing. On lines smaller than 12", fire hydrants shall be located at low points whenever possible, to facilitate flushing. If it is not possible to place a hydrant at the low point, a flushing hydrant (blow-off) may be used on lines 12" and smaller.

B. The engineer should use the following guidelines with regard to location of flush points, air release valves, blowoffs, etc. during the design of the water main extension.

1. Access to flush points by the Louisa County Water Authority or the Town of Louisa personnel shall be provided. Flush points serve no purpose if the access to the flush points cannot be obtained.

2. Emphasize (through appropriate notes) to the Contractor to maintain good erosion control and flushing procedures. Erosion control and environmental impact consideration must be taken into account whenever a flush point is chosen, therefore, certain controls may be needed at the time water main is installed.

3. Attempt to locate the flush points as near to the roadways or at a stream (keeping in mind the adverse effects to downstream ponds, etc.)

4. Minimize the number of flushing hydrants, and strategically place them so that proper flushing can be performed.

5. Minimizing number of air release valves, taking into consideration the depth that the water main is to be placed.

C. Sections of state regulations 12VAC5-590 that pertain to flushing and yard hydrants must be incorporated into all selections of hydrants types and hydrant locations.

2.7 Services

A. Services and meters shall be sized and locations designed in accordance with the Standard Details. Minimum service size shall be 3/4" pipe with 5/8" x 3/4" meter, unless there is the potential for an irrigation system to be fed by the service or the residential water service is 60 feet or greater from the main to the meter. In such instances the minimum service size shall be 1" pipe. Services shall be shown and detailed on the plans for both residential and commercial developments. When a service is located in a VDOT right of way it shall be placed in a casing pipe. When a water service crosses under a VDOT right of way, the Town reserves the right to require copper service line installation in lieu of casing pipe, depending on conditions and approval by the Town of Lousia. All services connected to an irrigation system must have an RPZ backflow preventor to protect the connection and associated infrastructure from potential cross connections, in accordance with VDH Regulations, 12VAC5-590-610.

Note that service connections shall be required when a water main is within 100 feet of a property line.

The sizing of the meter shall be coordinated with the Louisa County Water Authority and shown on the plans.

2.7.1 Cross Connection and Backflow Prevention

A. All water connections shall adhere to the Lousia County Water Authority and Town of Lousia established cross connection and backflow programs. These are stand alone programs and are included in these standards by reference.

B. At a minimum the following facilities, conditions, or connections shall be considered potential cross connection hazards and require approved backflow prevention:

1. Auxiliary water systems.
2. Sewage treatment plants or pumping stations.
3. Premises handling process waters.
4. Premises handling dangerous or toxic substances.
5. Food and beverage processing plants.
6. Chemical plants and dyeing plants.
7. Metal plating industries.
8. Petroleum processing or storage plants.
9. Radioactive materials processing plants and nuclear reactors.
10. Car washes.
11. Lawn sprinkler systems and irrigation systems.
12. Fire service systems.
13. Slaughterhouses and poultry processing plants.
14. Farms where water is used for other than household purposes.
15. Others specified by the authorized Town representative where potential backflow or cross-connection hazard can be shown.

2.7.1.1 Installation and Maintenance of Backflow Prevention Devices

A. Approval of backflow prevention devices and the type of protection required shall be in accordance with the requirements and standards provided in the Virginia Department of Health Waterworks Regulations, latest revision.

2.8 Fire Department Connections

A. Fire sprinkler systems shall be equipped with an approved double detector check valve assembly. Installation of double detector check valve assembly must be approved by the Louisa County Water Authority or the Town of Louisa prior to design. The property owner will own and be responsible for the maintenance of the valves and double check assembly. Fire department connections shall be located a minimum of 40’ from the building and placed on the outlet side of the double detector check valve assembly and shall have a dedicated hydrant located within 100 feet of the connection. Fire department connection locations shall be approved during design.

2.9 Water Pump Stations

A. Water pump stations are a special project and specific project standards and plans will be prepared by the engineer and submitted to the Louisa County Water Authority or the Town of Louisa for review and approval. Water pump stations will only be allowed when approved by the Louisa County Water Authority or the Town of Louisa.

B. The design requirements for a water pump station shall be determined through discussions with the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health **PRIOR TO INITIATING THE DESIGN**. After the design criteria have been determined, the engineer shall prepare a preliminary engineering report for approval by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health. The preliminary engineering report shall address all issues requested by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health and meet the requirements of the Virginia Department of Health.

C. The pump station design shall be in accordance with the approved preliminary engineering report and all requirements of the Virginia Department of Health. At a minimum, the following information shall be provided in the construction plans:

1. Structural design and calculations, including reinforcing drawing where applicable, for the facility.

2. Hydraulic design for the equipment selected, including scaled drawings.

3. Electrical and mechanical drawings and specifications for the equipment selected.

4. Project specifications.

5. Pump and system head curves

The construction plans shall be approved by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health.

3 WATER SUPPLY MATERIAL SPECIFICATIONS

All products must comply with the Materials Specifications as referenced in this section and the Louisa County Water Authority or Town of Louisa's Standard Details. All references to ASTM, AWWA, and other standards shall include latest revisions.

3.1 Water Pipe

3.1.1 Ductile Iron Pipe

A. Ductile iron pipe shall be centrifugally cast in accordance with ANSI/AWWA Specification C151/A21.51. The joints shall be rubber gasket as per ANSI/AWWA Specification C111/A21.11, push-on type, unless mechanical joints are specified on the plans. Mechanical joints shall conform to ANSI A21.10 and AWWA C110. The pipe shall have an interior cement lining with asphaltic seal coating shall be in accordance with ANSI/AWWA Specification A21.51/C104. The exterior coating, asphaltic coating per ANSI/AWWA Specification C151/A21.51.

B. All DIP shall be Class 52 unless otherwise noted on the plans. The bolts for mechanical joint fittings shall be high strength cast iron having an ultimate tensile strength of 75,000 psi and a minimum yield point of 45,000 psi. Exposed pipe and fittings shall have flanged joints conforming to the requirements of AWWA C115. Bolts shall be high strength cast iron having an ultimate tensile strength of 75,000 psi and a minimum yield point of 45,000 psi.

C. A minimum of 5% of the pipe furnished shall be gauged for roundness full length and so marked. Pressure class of pipe shall be increased if the specific installation warrants it.

3.1.2 Polyvinyl Chloride Pipe (PVC)

A. The Louisa County Water Authority and Town of Louisa prefer the use of PVC pipe for new installations except when required for road, stream, or other utility crossings.

B. Polyvinyl Chloride Pipe 4 inch in Diameter and Larger - PVC pipe in sizes 4 inch diameter and above, shall meet the requirements of AWWA C900, latest issue, and U.L. approved, and shall have dimensions as described in AWWA C900 Table 2, "Outside Diameters of Cast Iron Pipe." Each pipe shall be stamped or marked with the NSF-PW certification. Joint shall be the push-on type with rubber ring gaskets conforming to ASTM D3139 and ASTM F477 such as Ring Tite or equal. All pipe shall be Class 150 psi unless otherwise noted on the Drawings.

3.1.3 High Density Polyethylene (HDPE)

A. Will be considered for installation for transmission lines only with no branches or taps allowed. Its general installation will be reviewed on a case-by-case basis when normal open

trench construction and/or jack and bore casing pipe with internal carrier pipe is not practical. The design engineer shall specify the particular pipe and the rating shall meet or exceed 150 psi operating pressure. These installations will generally be by directional drilling.

3.2 Pipe Fittings

A. All fittings for DIP and PVC Pipe shall be compatible with the pipe specified herein (meeting the specifications as included in the above pipe specifications and per ANSI/AWWA Specification A21.10/C110.

B. All fittings shall be cast or ductile iron and shall utilize mechanical joints in accordance with the requirements of ANSI/AWWA A21.11/C111. DIP in buildings, tanks, and to a point 5 feet outside these premises shall be flange fitted unless mechanical joints are approved by the Louisa County Water Authority or the Town of Louisa. Gaskets shall be plain rubber, of heavy section and high durometer, single molded. Lubricant used to facilitate assembly of joints shall be a non-toxic, tasteless, odorless grease that will not support bacteria.

C. Fittings shall have a cement-mortar lining and a bituminous seal coating.

3.3 Gate Valves

A. Gate valves that are 2” to 12” shall be iron body type, resilient seated wedge type, non-rising stem, and shall be designed for 250 psi working pressure and a 400 psi test pressure. The valves shall conform to the requirements of the AWWA Specifications for "Resilient-Seated Gate Valves" C509, and turn counter-clockwise to open. The valve shall have no metal to metal wedging and the disc wedge shall have the same configuration and design on both sides. The valve shall have an unobstructed water way when fully opened equal in diameter to the nominal valve size.

B. All internal and external bolts, including the bonnet bolts, shall be a minimum Type 304 stainless steel.

C. All internal and external surfaces shall be coated with epoxy to a minimum thickness of 8 mils. Said coating shall be non-toxic, impart no taste to water and shall conform to AWWA C550. Said coating shall be applied prior to assembly such that all exposed external areas, including end connection bolt holes, body to bonnet bolt holes, etc. shall be coated with epoxy. Valves shall be provided with two O-ring stem seals with one O-ring located above and one O-ring below the stem collar. The stem shall be permanently lubricated. All seals between valve parts such as body and bonnet, bonnet and bonnet cover, shall be O-rings.

The stem shall be provided with an external dirt and weather seal independent of the O-ring pressure seal. Valves shall have mechanical joint ends, unless flanged ends are called for in the Drawings, in which case the flanges shall be faced and drilled to the ANSI, Class 125 Standard. All valves shown to be located in valve boxes shall have 2 inch square operating nuts. The Contractor shall furnish the Owner with two "T" handled operating wrenches for these valves. Where the valves are shown to be located in buildings or enclosures they shall be equipped with hand-wheels, indicating the direction of turn to open or close the valve. The valves shall be as manufactured by Mueller, American Flow Control, Kennedy, or Clow.

3.4 Butterfly Valves (16” – 72”)

A. All butterfly valves shall conform to the latest revision of AWWA Standard C-504, Class 150-B unless otherwise indicated and meet the following:

1. Valve bodies shall be cast iron, ASTM A-126 Class B or ductile iron per ASTM A-536 grade 65-45-12. Body ends shall be flanged with facing and drilling in accordance with ANSI B16.1, Class 125 or mechanical joint in accordance with AWWA Standard C-111 or ANSI A21.11. All mechanical joint end valves shall be furnished complete with joint accessories (bolts, nuts, gaskets and glands), and is for underground use only. All valves shall conform to AWWA C-504, Table 3, Laying Lengths For Flanged Valves and Minimum Body Shell Thickness for all Body Types.

2. Valve disc shall be cast iron, ASTM A-126 Class B or ductile iron ASTM A-536, grade 65-45-12. Valve disc shall be of the offset or symmetrical design providing 360 degree uninterrupted seating. For sizes 30" and larger disc shall be of the flow through type, cored, or domed with ribs parallel to flow.

3. The resilient seat shall be BUNA-N located in the valve body mechanically retained by epoxy or 18-8, Type 304 stainless steel retaining ring secured by 18-8, Type 304 stainless steel screws. The seat shall be capable of mechanical adjustment in the field and field replaceable without the need for special tools on 24" and larger valves. Valve mating seat shall be 18-8, Type 316 Stainless Steel.

4. Valve shaft shall be 18-8, Type 304 stainless steel. Valves shall have either one piece (through shaft) or two piece (stub shaft). The shaft should be attached to the disc by means of O-ring sealed taper pins with lock nuts on 30" and larger valves.

5. Taper pins should be either 304 stainless steel or 416 stainless steel heat treated for added strength.

6. The valve assembly shall be furnished with a factory set thrust bearing designed to center the valve disc at all times.

7. Shaft bearing shall be contained in the integral hubs of the valve body and shall be of non-cold flowing phenolic backed, PTFE or corrosion resistant self-lubricated sleeve type.

8. Valve shaft seal shall consist of Split-V ring. Where the valve shaft projects through the valve body for the actuator connection, the Split- V ring packing seal shall be field replaceable without valve disassembly. Connection to the actuator shall be provided by means of at least two (2) bolts for 16-inch to 24-inch valves and at least four (4) bolts for 30-inch and larger valves.

9. Valves shall open counter-clockwise.

10. When required, manual actuators shall be amply sized for line conditions. All manual actuators should be traveling nut or wormgear type. All 16" through 72" butterfly valve manual actuators shall be capable of withstanding 450 foot pounds of input torque against the open or closed stops. All actuators shall have adjustable mechanical stop limits. The closed position stop mayor may not be externally adjustable.

11. All valves shall be coated with AWWA Standard Epoxy Coatings or asphalt varnish equal, in conformance to AWWA Standard C-550 or C-504, latest revision. All interior ferrous surfaces, including disc, shall be coated a nominal 10 mils thick for long life; and body exterior shall have a minimum 8 mils thickness of hand applied epoxy or 3-5 mils thickness fusion bonded epoxy coating in order to provide protection in shipment and storage, and to afford a superior base for field-applied finish coats.

3.5 Valve Key Extensions

A. The extension shall be 1-1/2 inch solid core steel with the upper operating nut and bottom coupling welded to the stem.

B. The 2 inch square operating nut on top shall be welded to form a complete box with no openings.

C. 2-1/2 inch square socket section on the bottom shall be tapped on four sides for minimum 5/16 inch N.C. socket head stainless steel set screws and screws shall be provided.

D. Valve extensions shall be coated with oil-based enamel or other rust preventative coating.

E. The operating nut of the valve shall be drilled on all four sides to allow insertions of the setscrews.

F. A 4-1/2 inch diameter steel plate, ¼ inch thick centering disc, shall be welded to the stem 2 inches below the bottom of the top operating nut.

3.6 Tapping Valves

A. Tapping valves shall meet above specifications as referenced in Section "3.3 Gate Valves" above except, the body seat rings shall have a clear inside opening sufficient to pass a cutter of full diameter and equal to the nominal size of the valve. The outlet end shall be suitable for use with the type of pipe being utilized.

B. Tapping valves will be suitable for use with all approved manufactured tapping sleeves without modification.

3.7 Tapping Sleeves

A. The use of tapping sleeves and valves on the Louisa County Water Authority's or the Town of Louisa's water system will be considered where it can be shown that installation of a tee and line valve on the existing water main will not be beneficial to the Town or Authority.

B. The stainless steel or fabricated steel tapping sleeves may be used for any approved tap on PVC or ductile iron water main.

C. The stainless steel or fabricated steel tapping sleeves may be used for all approved taps on asbestos-cement pipe (except 16" size) and for size-on-size or one size down taps on all other pipe material.

D. The fabricated steel tapping sleeve may be used for approved two (or more) size down taps on PVC, cast iron or ductile iron water main.

3.7.1 Tapping Sleeves (Fabricated Steel)

A. Fabrications shall be Type 304 (18-8) stainless steel per ASTM A240. The flange shall be Type 304 (18-8) stainless steel or A36 carbon steel per AWWA C115. The bolts and nuts shall be Type 304 (18-8) stainless steel per ASTM A193 and A194 for sleeves with stainless steel flange and low alloy steel bolts and nuts per ASTM A325 and ASTM A563 for sleeves with carbon steel flange. Stainless steel hex nuts shall be furnished with fusion bonded coating to prevent seizing and galling. The branch gasket shall be dual o-ring design incorporating both hydrostatic and mechanical forces to affect a dynamic seal. The shell gasket shall be 1/4" thick Nitrile (Buna-N, NBR) Chek-O-Seal with multi o-ring sealing ribs from 100% new rubber to ensure performance under vary pressures with superior storage characteristics and suitable for oils, acids, alkalies, most hydro-carbon fluids (aliphatic), potable water and many chemicals within a temperature range of -40˚F to 212˚ F (SBR may be substituted).

3.7.2 Tapping Sleeves (Stainless Steel)

A. The body of the tapping sleeve shall be of Type 304 stainless steel. The flange shall be ductile iron, meeting or exceeding ASTM A536, Grade 65-45-12, or Type 304 stainless steel. All flanges in accordance with ANSI class 125 and 150 drillings and recessed to accept tapping valve. The gaskets shall be virgin SBR rubber compounded for water and sewer service in accordance with ASTM D 2000 MAA 610, with specially designed grid pattern and tapered ends to assure seal around full circumference of pipe. A reinforced ring at outlet provides hydrodynamic seal. Bolts shall be 5/8"-11 UVC thread track head, Type 304 stainless steel per ASTM A193. Nuts shall be 5/8" heavy hex, Type 304 stainless steel per ASTM A194. Nuts shall be coated to prevent galling.

3.8 Fire Hydrants

A. Hydrants shall be cast iron body, bronze mounted, suitable for a working pressure of 200 psi and a test pressure of 400 psi, and shall be manufactured in accordance with AWWA Specification C502. Each hydrant shall be tested by the manufacturer to a hydrostatic pressure of twice the working pressure, with the valve in both the open and closed positions. Hydrants shall be constructed in a manner permitting withdrawal of internal working parts without disturbing the barrel. Hydrants shall be traffic type, that will not geyser, should the upper barrel and stem section be broken off. The main valve opening shall be 5-1/4" in diameter. Hydrants shall open left (counter clockwise), unless otherwise specified by the Owner. Hydrants shall have two 2-1/2" hose nozzles and one 4-1/2" pumper nozzle. All nozzle threading shall be National Standard. Nozzle caps shall be securely chained to the barrel. Operating and cap nuts shall be 1-1/2" pentagon, unless otherwise specified. Hydrants shall have 6" mechanical joint inlet connections unless otherwise approved by the Louisa County Water Authority or the Town of Louisa. All hydrants shall have guard valves between them and the system as detailed. After installation the hydrant shall be provided with two (2) coats of high quality enamel paint. Color shall be per Owner's instructions. Hydrants that will become the property of the Louisa County Water Authority shall be manufactured by Kennedy or Mueller. Hydrants that will become the property of the Town of Louisa shall be manufactured by Kennedy or Mueller.

3.9 Check Valves

A. Valves 4" and larger – Check valves 4 inches inches size and larger shall be iron body, bronze mounted, full opening swing check valves. Outside weight and lever or outside spring and lever check valves will be installed. These valves shall be furnished with the type ends required for the piping in which they are installed. Check valves shall generally conform to the requirements of the most recent version of AWWA C508.

3.10 Service Connections

A. All water services and plumbing shall conform to the Uniform Statewide Building Code. Water meter service piping shall be Polyethylene SDR 7 (200 PSI) pipe. Town of Louisa piping shall be copper pipe size (CTS). Louisa County Water Authority piping shall be iron pipe size (IPS). Service connections shall generally conform to the requirements of the most recent version of AWWA C508.

3.11 Water Meters

3.11.1 General Description

A. Meters furnished under these specifications shall be the product of a manufacturer with at least ten (10) years experience in meter manufacturing for the American Market. Meters shall be new, first line quality, positive displacement type for cold water service. Meters must be of the oscillating piston or rotating disc type. Multi-jet meters are not acceptable under this specification.

B. Meters shall comply with AWWA Standard C700 latest revision and the minimum specifications herein. They shall be designed for use with potable water below 120 degrees F.

C. Meters must be magnetically driven. Meters with stuffing boxes, spindles and packing glands will not be acceptable. Meters shall be Elster AMCO Water, Inc. C-700 Positive Displacement Water Meters or approved equal.

3.11.2 Registration Accuracy

All meters shall meet the following flow requirements:

Table 3.1 – Water Meter Size and Flow Requirements

Size	Low Flow GPM @ 95%	Normal Flow GPM 98.5% - 101.5%	Continuous Flow GPM
5/8"x3/4”	1/8	2 – 20	15
3/4"	1/4	3 – 30	15
1"	1/2	¾ – 50	25
1 ½"	1 ½	5 – 100	50
2"	2	8 – 160	80

3.11.3 Main Cases

A. The body main case shall be bronze with raised markings to indicate the direction of flow and size. All meter main cases shall include a bottom plate made of bronze and held in

place with stainless steel bolts with integral washer heads. All bottom plates shall be isolated from the potable water by a full rubber liner.

B. Cases must be capable of withstanding working pressures of one hundred fifty (150) psi. Thread protectors shall be supplied for the connection ends.

3.11.4 Register and Remote Module

A. The register must be of the straight reading type and have a full test dial on the face of the register. It shall read in gallons and be capable of direct visual reading at the meter. The direct read numeral wheel assembly shall be located at the bottom of the dial face with reading obtained from left to right. All reduction gearing shall be contained in a permanently hermetically sealed, tamperproof enclosure made of a corrosion resistant material.

B. The register shall be secured to the main case by means of a tamper-resistant locking screw so that the register cannot be removed by non-utility personnel. The register must be field replaceable by utility personnel with the use of a manufacturer-supplied field tool. The field tool must not be commercially available. Seal wiring or a frangible head seal screw is not acceptable.

3.11.5 Measuring Chambers

A. Measuring chambers shall be of a suitable engineering polymer. The chamber shall be separate from the outer casing and so secured in the main case that the accuracy of the meter will not be affected by any distortion of the case. All wear prone surfaces shall be reinforced with a nylon material.

B. All measuring chamber assemblies shall operate smoothly and be capable of sustaining long-term accuracy. All motion from the piston or disc shall be transferred to the register via magnetic drive.

3.11.6 Pistons and Discs

A. Pistons and discs shall be made of high impact polymer with a specific gravity approximately equal to that of water.

B. Piston oscillations or disc nutations must not exceed the figure recommended in Table One (1) of AWWA Standards C-700 latest revision for the size of meter being bid.

3.11.7 Strainers

A. All meters shall be provided with a strainer screen installed in the meter. Strainer screens shall be rigid, fit snugly, be easy to remove and have an effective straining area at least three times that of the main case inlet.

3.11.8 Warranties

B. All meters shall be guaranteed to be free from material and workmanship for a period of one (1) year and to meet AWWA New Meter Accuracy Standards for a period of five years from the date of purchase.

3.12 Water Meter Boxes (Lousia County Water Authority)

3.12.1 Meter Boxes

A. Standard boxes of appropriate size, (10 1/2" x 18"), complete with covers as manufactured by Ford (CB111-233) or approved equal shall be furnished and installed around all curb stops and meters as indicated on the attached Plans. Boxes shall be of the type approved by OWNER.

3.12.2 Corporation Stops

A. At the location indicated on the Plans and where directed, corporation stops of sufficient size or compression couplings 3/4-inch FB-1001 as manufactured by Ford Company, or approved equal, shall be furnished and installed in accordance with applicable standards and Specifications.

3.12.3 Connections and Valves

A. Within all meter boxes and on all service connections the corresponding Inlet Ball Valve, Brass Outlet, and necessary fittings to connect to service piping and meter shall be supplied, as manufactured by the Ford Company or approved equal.

3.12.4 Saddles

A. Saddles must be Ford FC202-CC4 epoxy coated or approved equal.

3.13 Water Meter Boxes (Town of Lousia)

3.13.1 Meter Boxes

A. Standard boxes of appropriate size, (10 1/4" x 15" x 24”), complete with cast iron covers as manufactured by Mid-States Plastics, Inc. (MSBC1015-18) or approved equal shall be furnished and installed around all coppersetters and meters as indicated on the attached Plans. Flip top lids are not acceptable. The box shall allow for installation of a ball valve prior to the meter, which allows for isolation and repairs of the meter setter in the event of leaks. Boxes shall be of the type approved by OWNER.

3.13.2 Corporation Stops

A. At the location indicated on the Plans and where directed, corporation stops and stiffeners for Iron Pipe Sizes of sufficient size or compression couplings F-1001 as manufactured by

Ford Company, or approved equal, shall be furnished and installed in accordance with applicable standards and Specifications.

3.13.3 Coppersetters

A. Within all meter boxes and on all service connections, a dual check valve coppersetter, and necessary fittings to connect to service piping and meter shall be supplied, as manufactured by the Ford Company (V72-12W-41-33) or approved equal.

3.13.4 Saddles

A. Saddles must be Ford FC202 epoxy coated or approved equal.

3.14 Valve Boxes

A. The Contractor shall furnish and install cast iron valve boxes for all buried valves at the locations shown on the Drawings. They shall be adjustable telescope sliding action units, HS-20 rated, suitable for use under heavy traffic. The covers shall be marked "WATER" and bases shall be the round type. All valves deeper than 4 feet shall have valve stem extenders pinned at the valve. All valves shall be capable of being operated by a 48 inch valve wrench. All valve boxes shall be placed so as not to transmit shock or stress to other valve and shall be centered and plumb over the operating nut of the valve.

3.15 Air Release Valves

A. In developed locations, the use of a fire hydrant in lieu of an air release valve is preferred by the Louisa County Water Authority and the Town of Louisa.

B. Air release valves shall be constructed of cast iron body and cover (ASTM No. A48, Class 30), bronze trim (ASTM No. B143), stainless steel floats (ASTM No. A240) with shockproof synthetic seats for 150 psi maximum pressure. The air release valve orifices shall be sized by the design engineer. The piping used for the installation shall be Schedule 40 stainless steel, the cut-off valve and hose bib shall be of bronze construction, 150 psi rated.

3.16 Flushing Hydrants

A. In developed locations, the use of a fire hydrant in lieu of a flushing hydrant is preferred by the Louisa County Water Authority and the Town of Louisa.

B. Flushing Hydrants shall have a brass 2" FIP inlet and be of compression-type, closing with the water pressure. Water pressure alone shall close valve. All working parts and operating rod shall be of brass and be removable from above ground with no digging. Bury depth shall be as shown on the plans. Hydrants shall be of the non-draining type and will operate by the use of a portable top stock with integral sampling tap which will couple to the hydrant at or near the ground line. Each hydrant shall be installed underground in a meter box as shown on Louisa County Water Authority/Town of Louisa Flushing Hydrant detail. One (1) purging

pump (bilge pump) shall be provided. Brass thread protector will have a 2" square nut. Flushing/Sampling hydrants shall be Model 2000-B as manufactured by Kupferle Foundry.

3.17 Valve Manholes

A. Valve manholes shall be concrete meeting the requirements of ASTM C-478. Diameters shall be as shown on plans but in no case shall they be less than 4 feet in inside diameter except for manholes for butterfly valves which shall have a minimum inside diameter of 6 feet. Manhole frame and covers meeting the requirements for sanitary manhole frame and covers shall be utilized except that the covers shall have the word "WATER" cast on them.

3.18 Joint Restraint Systems

A. When gray cast or ductile iron fittings are used with AWWA C900 PVC pipe in sizes up to 12" or ductile iron pipe in sizes up to 48" an approved joint restraint system shall be installed.

B. All valves should be as close to a tee as possible and restrained to that tee, using approved joint restrainers. Where the valve cannot be installed and restrained at a tee, the valve must be restrained using an approved joint restraint system.

C. When joint restraint systems are required due to the specific application(s), special design considerations, or poor soil conditions the engineer shall provide the calculations used in determining the required length of pipe on either side of the fitting to be restrained. Also, the engineer shall provide special plan details for each necessary joint restraint system.

D. Joint restraint systems require that sufficient lengths of pipe be restrained, in addition to the fittings. The standard length of pipe requiring restraint varies from application to application and is designed based on variables such as soil bearing capacity, soil condition, pipe size, pipe material, pressure and fittings.

E. All restraint devices must be V.L. listed and F.M. approved. Restraints are acceptable for PVC and ductile iron pipe.

F. Mechanical joint restraint device shall have a working pressure of at lest 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG or approved equal.

G. All construction plans shall include a restrained joint table when restrained joints will be used in the project.

3.19 Cast Couplings

3.19.1 Center Sleeve

A. Made of ductile iron, Spec ASTM-A536, and coated with an enamel shop coat, sized to

accommodate all AWWA pipes of the same nominal size.

3.19.2 End Ring

A. Made of ductile iron Spec ASTM-A536, and color coded with an enamel shop coat to easily identify its use on various types of pipe.

3.19.3 Gaskets

A. SBR rubber compound, Grade 30 per Spec ASTM D-2000 for normal water service and an extended shelf life.

3.19.4 Bolts

A. High strength low alloy steel bolts with heavy hex nuts, per AWWA C-111.

3.20 Casing Spacers

A. Casing Spacers shall be bolt on style with a shell made in two sections of heavy T -304 stainless steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner .090" thick with 85-90 durometer or neoprene rubber. All nuts and bolts are to be 18-8 stainless steel. Runners shall be made of ultra high molecular weight polymer (UHMW) or glass reinforced plaster. Runners shall be supported by risers made of heavy T-304 stainless steel or 10 gauge welded steel. The supports shall be mig welded to the shell and all welds shall be passivated or 3/8" diameter stud welded to band and locked with a locking fastener. The height of the supports and runners combined shall be sufficient to keep the carrier pipe at least .75" from the casing pipe wall at all times.

3.21 Tracing Wire System

3.21.1 Detection Wire

A. Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG. Detection wire shall be buried directly above piping, including service lines to the meter, at a distance not to exceed twelve (12) inches above the top of pipe. The wire shall extend continuously and unbroken, from point of access to point of access. The ends of the wire shall terminate with a minimum of three (3) feet of wire, coiled, remaining accessible in each test station box. The wire shall be exposed at the connection between contact A & B until the connection can be made to the wire by the last contractor to make the pipe connection.

3.21.2 Test Station Box

A. Test station box shall be plastic for corrosion protection. The plastic shaft shall be a minimum of 18” long with cast iron lid and collar. Collar shall be a minimum of 2” deep. The lid shall be bolted to collar with brass bolts, and shall be imprinted with the wording “TEST”. Contractor shall install 24”x24”x4” concrete pad around test station box. Test station boxes shall be installed at intervals no greater than 1000 feet, unless approved by owner. All connections at the main line must be electrically sound and physically secure

with screw connections or clamps. All connections must be taped with electrical tape and sealed with an electrical coating sealant.

3.21.3 Markers/Witness Posts

A. All markers shall have one of the applicable decal description to reflect the following:
   1. Upper decal, white and blue 2 7/8 inches x 11 inches standard, worded "CAUTION WATER PIPELINE" or,

   2. Upper decal, white and blue 2 7/8 inches x 11 inches standard, worded "CAUTION WATER VALVE".

B. In addition, the lower decal shall contain the following:
   1. Lower decal, white and blue 2 7/8 inches x 1-3/4 inches standard, worded "BEFORE DIGGING CALL Virginia 811".

C. Total height shall be 60 inches with the above mentioned decal on both sides of the marker.

D. Basic markers shall be white in color for valves and blue in color for lines or fittings.

3.22 Marking Tape

A. Polyethylene plastic and metallic core or metallic-faced, acid-and alkali resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED WATER LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	**Gas, Oil; Dangerous Materials**
Blue:	**Water**
Green:	**Sewer**

3.22.1 Warning Tape for Metallic Piping

A. Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi otherwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

3.22.2 Detectable Warning Tape for Non-Metallic Piping

A. Polyethylene plastic tape conforming to the width, color and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection. Color coded tape shall be installed flat with color side up to 12 inches to 24 inches over all installed utility lines including main line and service lateral or service connection.

4 SEWER COLLECTION SYSTEM DESIGN

4.1 Hydraulic Design for Sanitary Sewers

A. The quality of sewage for design purposes shall be determined by the requirements of the total drainage area which is tributary to the section of sewer under consideration in its built out condition, unless otherwise approved by the Louisa County Water Authority or the Town of Louisa and Virginia Department of Environmental Quality.

B. Average quantities of sewage, including an infiltration allowance, shall be computed using the following:

Table 4.1 – Average Daily Flow Estimates by Land Use

Land Use	**Gallons per Day per Acre**	**Equivalent Persons per Acre**
Residential - 1 to 2 dwellings/acre	600	6
Residential - 1 to 4 dwellings/acre	1,000	10
Residential - 4 to 8 dwellings/acre	1,600	16
Agricultural	500	5
Commercial	1,000	10
Industrial - Light Water Use	500	5
Industrial - Medium Water Use	1,500	15
Industrial - Heavy Water Use	2,500	20

C. Where site specific determinations can be made, sewage flows may be determined by using the following specific design information:

Table 4.2 – Average Daily Flow Estimates by Facility Type

Discharge Facility	**Design Units**	**Flow gpd**
Single Family Residential	3 people/unit	300
Three Bedroom Apartment	3 people/unit	300
Two Bedroom Apartment	3 people/unit	300
One Bedroom Apartment	2 people/unit	200
Three Bedroom Condo	3 people/unit	300
Two Bedroom Condo	3 people/unit	300
Elementary School	per person	10
High School	per person	16
Motels and Hotels	per room	130
Trailer Courts	per trailer	300
Restaurants	per seat	50
Service Station	per vehicle serviced	10
Factories	per person per 8 hour shift	25
Shopping Centers	per 1,000 sq. ft.	250
Hospitals	per bed	300
Nursing Homes	per bed	200
Homes of the Aged	per bed	100
Medical Center	per 1,000 sq. ft.	500
Laundromats	per washing machine	500
Theatures	per seat	5
Bowling Alleys	per lane	75
Office Buildings	per 1,000 sq. ft.	200

D. Flows for other uses may be determined by using flow information approved by the Louisa County Water Authority or the Town of Louisa.

E. Peak flows shall be utilized for design of sanitary sewers. Peak flows shall be determined as follows:

1. For average daily flows (Q_A) greater than 0 mgd and less than 0.50 mgd, peak flows (Q_P) will be 4.0 times the average daily flows. ($Q_P = 4.0 \times Q_A$)

2. For average daily flows greater than 0.50 mgd but less than 6.00 mgd, the peak flow in mgd, will be equal to $(4.136-(0.273 \times Q_A)) \times Q_A$, where Q_A is in mgd.

3. For average daily flows greater than 6.0 mgd, peak flows shall be 2.5 times the average daily flow. ($Q_P = 2.5 \times Q_A$)

4.2 Design Criteria

A. The engineer should ensure that the following design criteria are adhered to:

1. Sewers shall have a continuous slope, straight alignment and uniform pipe material between manholes. Pipe material may transition from DIP to PVC when drop connections are utilized one joint of pipe away from the drop connection.

2. At all junctions where a smaller diameter sewer discharges into a larger one, and at all locations where the line increases in size, the invert of the larger sewer shall be set so that the energy gradients of the sewer at the junction are at the same level. Generally, this condition will be met matching the crowns of the two pipes. If this is not possible, the 0.8 depth of flow in each sewer should be placed at the same elevation.

3. Sewers shall be designed to be free flowing with the hydraulic grade below the crown of the sewer and with hydraulic slopes sufficient to provide an average velocity, when flowing full, of not less than two feet per second. Computations of velocity of flow shall be based on a value of "n" = 0.013 as used in Manning's formula for velocity of flow unless otherwise approved by the Louisa County Water Authority or the Town of Louisa.

4. The following are minimum slopes in feet per hundred feet to be provided for sewer lines. Slopes greater than minimum are desirable, sewers shall be placed at 1% slope or greater whenever possible. Slopes less than this should be utilized when required to serve upstream areas. Pipe size shall not be increased solely to reduce required slope unless approved by the Louisa County Water Authority or the Town of Louisa.

Table 4.3 – Minimum Slopes for Gravity Sewer

Pipe Size	8"	10"	12"	15"	18"	21"	24"	27"	30"	36"
Slope (%)	0.40	0.28	0.22	0.15	0.12	0.10	0.08	0.067	0.058	0.046

A minimum slope of 0.52% shall be maintained for terminal 8" lines not to be extended.

5. Minimum pipe sizes for all sewers between manholes shall be 8".

6. In cases where sewers are to be constructed on steep grades for which high velocities are anticipated, the maximum permissible velocity at average flow (before applying peak flow factor) should not exceed 15 feet per second. Suitable drop manholes shall be provided to break the steep slopes and to limit velocities to not more than 15 feet per second in the connecting sewer pipe between manholes.

   Where drop manholes are impracticable for reduction of high velocity, the sewer shall be of solid wall PVC pipe or other abrasion resistant material.

7. Miscellaneous head losses at manholes, curves and junctions shall be estimated and allowed for as follows:

   In sewers 24" and less in diameter, allow head loss equal to at least 0.10 feet at each manhole. The Louisa County Water Authority or the Town of Louisa may allow this to be reduced to 0.05 feet under special circumstances.
   At transitions and intersections of sewers larger than 24" in diameter, allow $0.5V^2/(2g)$, where "V" is the velocity in the pipe assuming pipe full conditions.

8. In general the pipe diameter should be continually increasing with the increase in tributary flow. Where steep ground slope make possible the use of a reduced pipe size and substantial economy of construction costs is thereby indicated, the pipe size may be reduced but hydraulic allowances shall be made to provide for head loss at entry, increased velocity and effect of velocity retardation at the lower end where the flow will be on flatter slopes. In no case shall pipe size be reduced more than one nominal size in diameter.

B. Hydraulic computations shall be submitted to the Louisa County Water Authority or the Town of Louisa. The engineer shall submit with all sewer plans information and calculations on sewer flow demands, sewer shed drawing including tributary areas, sewer capacities for the project, and if requested, an analysis of downstream capacity of existing improvements to the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Environmental Quality for approval.

C. The Louisa County Water Authority or the Town of Louisa may require a project to include off-site improvements to the Authority's or Town's existing sewer system if such improvements are required to meet the needs of the project.

4.3 Sanitary Sewer Locations

A. All sanitary sewers located along VDOT owned and maintained roads shall be located in an easement outside the VDOT right-of-way. All sanitary sewers located in existing or proposed streets which are not owned and maintained by VDOT shall be constructed along the center of the street or center of the travel lane except when this space has been previously used by another utility or when the width of the street justifies two lines. Exceptions to this specified location will be allowed only when it has been shown and agreed to by the Louisa County Water Authority and/or the Town of Louisa that it is not practicable to adhere to the standard location. All sanitary sewers shall be laid on a straight line and grade between manholes.

B. In a parallel installation, sanitary sewer lines and/or manholes shall be located at least 10 feet horizontally from any water main whenever possible. The distance shall be measured edge to edge between the structures and/or pipes.

C. Minimum horizontal separation shall be provided whenever possible. The designer should consider alternate alignments and/or locations for water mains and sewer lines if required to provide the required horizontal separation. If it is not possible to obtain the specified horizontal separation based on specific local conditions then, in accordance with the Virginia Department of Health's requirements and Virginia Department of Environmental Quality's requirements, a sanitary sewer may be closer to a water main provided that:

1. The bottom of the water main is at least 18" above the top of the sewer.

2. Where the water main cannot be located at least 18" above the top of the sewer, the sewer shall be constructed of AWWA approved water pipe and shall be pressure tested to assure watertightness prior to backfilling. The test pressure shall be 5 psi, or a pressure greater than the pressure exerted by a column of water equal to the depth of the deepest section of the sewer being tested, whichever is greater. The test pressure shall be held for a minimum of 2 hours.

3. Sanitary sewer manholes, located within 10 feet of water mains shall be of watertight construction and be tested in place by vacuum of 2 hours.

D. In a crossing installation, sanitary sewers crossing water mains shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer whenever possible. Sanitary sewer lines shall be constructed of ductile iron pressure pipe (appropriate class for diameter) and maintain a minimum of 10 feet of separation from

any existing wells. Minimum vertical separation shall be provided whenever possible. The designer should consider alternate alignments and/or locations for water mains, sewer lines, and storm sewers if required to provide the required vertical separation between sanitary sewers and water mains. If it is not possible to obtain the specified vertical separation based on specific local conditions then, in accordance with the Virginia Department of Health's requirements, the following criteria must be met:

1. Sewers passing over or under water mains shall be constructed of AWWA approved water pipe and shall be pressure tested to assure watertightness prior to backfilling. The test pressure shall be 5 psi, or a pressure greater than the pressure exerted by a column of water equal to the depth of the deepest section of the sewer being tested, whichever is greater. The test pressure shall be held for a minimum of 2 hours.

2. In addition, water mains passing under sanitary sewers shall be protected by providing:
    a. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water mains.

    b. Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking of the water mains.

    c. A full section of water pipe centered at the point of crossing so that the joints will be equidistant and as far as possible from sewer.

E. Normally where storm sewers or other utilities pass over or under sanitary sewers, a minimum of 18" of separation should be maintained. The separation to be reduced to 6" on a case by case basis, however, ductile iron pipe must be utilized when the separation is less than 12".

F. Where the sanitary sewer is installed parallel to a storm sewer, there shall normally be a minimum of 5 feet of horizontal separation, measured edge to edge, between them. Under unusual conditions, this requirement may be reduced. If a sanitary sewer is located more than 5 feet below the bottom of a parallel storm sewer, the distance between the two pipes may be increased.

G. Carrier pipes within bores for sanitary sewer installation shall generally be ductile iron (Class 52 minimum) sewer pipes with restrained joints. All casing pipes shall have an exterior corrosion protective coating.

H. Where a sewer pipe is located within 2,000 feet downstream of the discharge end of a force main, the pipe shall be constructed of PVC materials whenever possible. If ductile iron pipe is required within 2,000 feet of the discharge end of a force main because of lack of cover, lack of separation, or any other reason, the pipe shall have a special interior coating

restraint to corrosion by hydrogen sulfide. The special coating shall be approved by the Louisa County Water Authority or the Town of Louisa. If in the Louisa County Water Authority's or the Town of Louisa's judgment, corrosion by hydrogen sulfide will continue to be a problem for more than 2,000 feet, corrosion restraint materials shall continue to be used for an appropriate distance for the discharge end of the force main.

I. All sanitary sewer line crossings of railroad, major roadways, and other major structures shall be contained in a casing pipe. Design of railroad crossings shall comply with the requirements of American Railway Engineering Association Specifications, Part 5 – Pipelines (latest version). The developer shall be responsible for obtaining required railway permit and/or agreements for the Louisa County Water Authority or the Town of Louisa, paying and fees, and posting any required construction bonds for the railway crossing prior to beginning construction on any part of the project. A copy of the permit and/or agreement shall be provided to the Louisa County Water Authority or the Town of Louisa prior to a Construction Permit being issued for the project.

J. Ductile iron (Class 52 minimum) sewer pipe shall be used for sanitary sewers when crossing storm sewers or other rigid underground conduits with less than 12" of vertical separation.

K. The tops of all sewers entering or crossing streams shall be a sufficient depth below the natural bottom of the streambed to protect the sewer line. Typically, sewers crossing streams shall have a minimum of 3 feet of cover from the natural stream bottom. Less cover will be considered if no other option is available and the proposed sewer is ductile iron pipe, encased in concrete, and the sewer will not interfere with future improvements to the stream channel. The sewer trench within the stream bed shall be protected from erosion by the use of rip-rap, concrete, gabion mats, or other appropriate measures. The developer shall be responsible for obtaining all required environmental permits for the stream crossings and construction activities. All conditions of any environmental permit must be acceptable to the Lousia County Water Authority or the Town of Lousia. It is the developer's responsibility to obtain the Lousia County Water Authority or the Town of Lousia's approval of any conditions prior to accepting any environmental permit.

Sanitary sewers located under paved channels, concrete channels, rip-rap lined channels, or other lined channels shall be at least 2 feet below the bottom of the channel lining.

Sanitary sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Construction methods and materials of construction shall be such that sanitary sewers will remain watertight and free

from change in alignment or grade due to anticipated hydraulic loads, physical loads and erosion.

Sanitary sewers will normally not be allowed to be constructed under lakes, estuaries, or stormwater facilities. When constructed adjacent to such features, the sanitary sewer shall be located far enough away from the water surface that the sewer can be excavated without entering the water body for maintenance purposes.

L. All sewer pipe within a 100-year floodplain, where cover is less than 4.0 feet, shall be checked for flotation assuming the pipe is empty. Non-float pipe shall be utilized if appropriate. Other anti-flotation methods or devices will be considered on an individual basis.

M. Clay dams shall be utilized in the trench where the possibility exists that ground or surface water will follow the sewer trench, causing damage or undermining of pipe bedding.

N. Sewer lines located under paved channels or concrete channels shall be located at least 2 feet below the bottom of the channel pavement.

O. Sanitary sewers constructed in fill shall be of ductile iron sewer pipe (Class 52 minimum) with manholes founded on original ground unless a licensed geotechnical engineer furnishes a written certification that the fill has been sufficiently compacted so that settlement of the sewer and/or manhole will not occur.

P. Sanitary sewers shall be designed to remain fully operational during the 100-year flood. Sewers and their appurtenances located along streams shall be protected against the normal range of high and low water conditions, including the 100 year flood. Sewers located along streams shall be located outside of the streambed and sufficiently removed from the stream channel to provide for future possible channel widening and meandering. Sewers located adjacent to streams and swales shall be located deep enough so that adjoining areas on the opposite side of the stream or swale can be served by the sewer while maintaining the minimum cover requirements for stream crossing outlined earlier.

Q. Sanitary sewer crossing streams, estuaries, lakes, or reservoirs shall be constructed for watertight pipe. The pipe and joints shall be tested in place and shall exhibit zero infiltration. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternatives exist. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade due to anticipated hydraulic and physical loads, and erosion.

R. No sewer line shall pass within 50 feet of a drinking water supply well, source, or structure unless special construction and pipe materials are used to obtain adequate protection. The proposed design shall identify and adequately address the protection of all drinking water supply wells, sources, and structures up to a distance of 100 feet of the sewer line installation.

S. In cases where sanitary sewers are to be constructed on steep grades and velocities greater than 15 feet per second are indicated, only solid-walled PVC pipe or other abrasion resistant material shall be used.

T. Whenever possible sanitary sewers shall not be laid at a slope greater than 20 percent. If no other alternative exists, sewers may be laid at grades greater than 20 percent with the prior approval of the Louisa County Water Authority or the Town of Louisa. Sanitary sewers laid on a slope of 20 percent or greater shall be anchored securely with concrete anchors or other approved means. Suggested minimum anchorage is as follows but shall be determined by the engineer:

1. Not over 36 feet center to center on grades 20 percent to 35 percent.

2. Not over 24 feet center to center on grades 35 percent to 50 percent.

3. Not over 16 feet center to center on grades 50 percent and over.

U. Details of anchorage must be shown on the construction plans before the plans will be approved by the Louisa County Water Authority or the Town of Louisa, and the Virginia Department of Environmental Quality.

V. Sanitary sewers not located in public right-of-ways shall be located in utility easements. Easements shall be wide enough to provide sufficient space for both installation and maintenance and shall have a minimum width of 20 feet. The Louisa County Water Authority or the Town of Louisa may require wider easements for sewage greater than 24" in diameter and/or greater than 12 feet in depth.

4.4 Depth of Sanitary Sewer Lines

A. All PVC sewer lines within existing or proposed streets or areas subject to traffic shall be designed to provide a minimum cover of 6 feet over the pipe. Where less than 6 feet of cover is provided is areas subject to traffic, the sewer shall be constructed of ductile iron sewer pipe (Class 52 minimum). Sewers in areas subject to traffic shall have no less than 3 feet of cover unless otherwise approved by the Louisa County Water Authority or the Town of Louisa. Greater depths shall be provided to serve low properties, where street

grades may be lower in the future, where there is a possibility of future extensions of the sewer line to serve adjoining areas, to maintain separation from waterlines, to maintain separation between sewer services from waterlines, or where clearance must be provided for other utilities. Adequate clearance shall be provided for the future enlargement of undersized drainage structures. Sewers and sewer services shall generally be located at least 18" below water mains unless it can be demonstrated that no other practical alternative exists.

B. All sewer lines in easements not subject to Louisa County Water Authority or the Town of Louisa shall be provided with a minimum of 3 feet of cover unless otherwise approved by the Louisa County Water Authority or the Town of Louisa. The Louisa County Water Authority or the Town of Louisa and the Virginia Department of Environmental Quality may approve sewers with as little as 2 feet of cover, provided no practical alternative exists, the sewer is constructed of ductile iron sewer pipe (Class 52 minimum), and a concrete cap, pavement, gabions, geotextile fabric and/or other appropriate stabilization measures are utilized to protect the sewer.

C. When sewer lines have more than 15 feet of cover, the engineer shall verify the type of pipe material proposed, particularly PVC pipe, is appropriate for the intended installation based on the soils, loading, and bedding conditions. If appropriate, the engineer shall provide special details showing how the pipe is to be bedded. Generally, class 52 ductile iron pipe is recommended in installations with greater than 15 feet of cover and may require written verification that such an analysis has been completed. However, regardless of whether written verification is requested by the Lousia County Water Authority or Town of Lousia, and regardless of sewer depth, the engineer is responsible for the design.

D. If a sanitary sewer line is to have more than 20 feet of depth as measured from the final grade above the sewer line to the invert of the sewer pipe, the pipe shall have a corrosion-resistant interior coating such as epoxy, Griffin H_2Sewer Safe sewer pipe, Protecto 401 lining, or other coating as approved by the Lousia Couty Water Authority or Town of Lousia.

4.5 Sewer Structural Design

A. Structural requirements must be considered in the design of all sanitary sewers and appurtenances. This is a matter of detail design and is not subject to generalization. The following general criteria should be considered by the design engineer at a minimum:

1. Special Structures; Whenever possible sanitary sewer structures shall be built as shown in the standard details. Structures other than those shown in the standard details shall be considered special structures and shall be designed and detailed by a professional engineer licensed in the Commonwealth of Virginia.

2. Pipe Foundation; In all cases the proper strength sewer pipe shall be specified for the proposed depth, width of the trench and bedding condition. Soil conditions should be considered with samples being obtained where necessary to verify pipe selection and foundation design.

3. Flotation; Sewer shall be designed to resist flotation where such conditions may reasonably be expected to exist.

4.6 Sanitary Sewer Manholes

A. Manholes shall be constructed in accordance with the Louisa County Water Authority/Town of Louisa standard details.

B. Manholes shall be located at the end of each line, at all changes in pipe size, at all changes in grade, changes in alignment and at sewer junctions. Maximum spacing between manholes on straight suns shall be 400 feet for sewers 15 inches or less in size and 500 feet for sewers 18 inches or larger.

C. Manholes in residential neighborhoods shall not be installed near the middle of front or rear yards. Manholes in residential yards shall be located near or at the side property lines. This limits the possibility of the manhole being in conflict with future improvements of the homeowner.

D. The angle between any incoming and outgoing pipe in a manhole shall not typically be less than 90 degrees. Manhole diameters shall be determined in the design and are based on pipe diameters and intersecting angles per Drawing MAN-1A and MAN-1B. Minimum separation between pipes shall be 6 inches unless approved by the Lousia County Water Authority or Town of Lousia. Depth shall also be considered when sizing manhole diameters as depths over 20 feet generally require upsizing of the manhole diameter per MAN-2.

E. It is preferred that sewer service laterals tie to a proposed manhole on new construction when feasible. Manholes shall be limited to the intersection of 4 lines (3 in and 1 out). This includes sewer service laterals.

F. Manholes subject to flooding shall have watertight manhole covers. All manhole rims shall be 6 inches above the 100 year flood elevation, except where the rim would be more than 4 feet above the existing grade in which case watertight covers shall be used and the manhole top set at a height of 18 inches above final ground elevation.

G. The Louisa County Water Authority or the Town of Louisa may require, at its discretion, the use of vandal-proof manhole lids for manholes located in easements. Unless otherwise approved by the Louisa County Water Authority or the Town of Louisa, rims of manholes in easements shall be placed at between 12 inches and 18 inches above final ground elevation.

H. Drop manholes are to be avoided whenever possible. Their use may be approved on a case by case basis when required to avoid excessive depth on a connecting sewer (greater than 12 feet). Drop manholes shall only be used when the invert elevation of the incoming sewer line exceeds the invert elevation of the outgoing sewer line by 2 feet or more. If the proposed distance is less, the incoming pipe shall be lowered to the appropriate invert elevation at the base of the manhole unless this is not feasible due to elevation conflict with another crossing utility. Exterior drop connections shall be utilized whenever possible.

I. Unvented sections of sewer shall not exceed 1,000 feet in length.

J. If a manhole is located within 2,000 feet of the discharge end of a force main, the manhole shall have an interior coating or liner resistant to corrosion by hydrogen sulfide. Coating and liners utilized shall be approved by the Louisa County Water Authority or the Town of Louisa. If, in the Louisa County Water Authority's or the Town of Louisa's judgment, corrosion by hydrogen sulfide will continue to be a problem for more than 2,000 feet, corrosion resistant materials shall continue to be used for an appropriate distance end of the force main.

K. Standard and vandal proof manhole frame and covers provide adequate venting for most sanitary sewers. When watertight manhole frames and covers are utilized on sanitary sewers, unvented sections of sanitary sewer shall not exceed 1,000 feet in length. If watertight frames and covers must be utilized on runs of sanitary sewer longer than 1,000 feet in length, air vents must be provided at manholes at increments spaced no more than 1,000 feet apart. Where it is not feasible to set the air vents above the 100-year floodplain die to excessive height they shall be equipped with a backwater valve.

L. The angle between any incoming or outgoing pipe in a manhole shall typically not be less than 90 degrees.

M. Monitoring manholes shall be provided for all facilities producing non-domestic wastewater. These include industrial facilities, eating establishments, grocery stores, bakeries, automobile service stations, gasoline stations, hospitals, animal hospitals, cleaners, machine shops, photographic finishers, printing shops, laboratories, funeral homes, and other such facilities as determined by the Louisa County Water Authority or

the Town of Louisa. Monitoring manholes are owned by the property owner and shall not be located in utility easements wherever possible. Monitoring manholes shall be easily accessible and the Louisa County Water Authority or the Town of Louisa shall be given the right of access to monitoring manholes at all times.

4.7 Service Connections

A. Service connections shall be provided in accordance with the County or Town ordinances, and these standards. Plugged service connections are to be provided to the easement, property line or right-of-way, as appropriate, for all lots and parcels within new developments unless otherwise approved by the Louisa County Water Authority or the Town of Louisa.

Note that service connections shall be required when a sanitary sewer main is within 100 feet of a property line.

B. The minimum diameter pipe to be used for a service connection is 4". The minimum slope for service connections shall be 2 percent for a 4" service and 1 percent for 6" service. A cleanout is to be provided on all service connections at the easement, property line or right-of-way by the plumber when the service extended. The Louisa County Water Authority or the Town of Louisa will own and maintain the sewer service from the main sewer line to the easement, property line, right-of-way, or clean-out as applicable. The remainder of the sewer service, including the clean-out, is the property owner's responsibility to own, operate, and maintain. The Louisa County Water Authority or the Town of Louisa shall have the right to utilize the clean-out for inspections and maintenance of its lines. The Louisa County Water Authority and the Town of Louisa have final approval of the design and coordination of the connection from the property line/easement boundary to the main line or manhole.

C. Grease traps shall be provided on the private portion of the service connection for all facilities with the potential to deposit grease in the sewer system. Grease traps shall be installed on all service lines serving restaurants, food preparation establishments and other businesses or industries identified by the Louisa County Water Authority and/or Town of Louisa. Domestic waste should not be plumbed through the grease trap, but should connect to the grease trap outlet prior to the monitoring manhole. The size of grease traps shall be indicated on the plans and is subject to approval by the Louisa County Water Authority, Town of Louisa, and/or the Building Department. Monitoring manholes shall be provided downstream of all grease traps. Grease traps and monitoring manholes shall be privately owned and maintained.

4.8 Sanitary Sewer Structural Design

A. Structural requirements must be considered in the design of all sanitary sewers and appurtenances. This is a matter of detail design and is not subject to generalization. The following general criteria should be considered by the design engineer at a minimum:

1. Special Structures – Whenever possible sanitary sewer structures shall be built as shown in the Standard Details. Structures other than those shown in the Standard Details shall be considered special structures and shall be designed and detailed by a professional engineer licensed in the State of Virginia.

2. Pipe Foundation – In all cases the proper strength sewer pipe shall be specified for the proposed depth, width of trench and bedding condition. Soil conditions should be considered with samples being obtained where necessary to verify pipe selection and foundation.

3. Floatation – Sewer shall be designed to resist floatation where such conditions may be reasonably expected to exist, i.e. – large diameter PVC pipe in high groundwater areas.

4.9 Sewage Pump Stations and Force Mains

A. Public sewage pump stations will only be allowed when approved by the Louisa County Water Authority or the Town of Louisa. Sewage pump stations will be used when it has been determined by the Louisa County Water Authority or the Town of Louisa that a pump station is the only practical way to provide sanitary service based upon a finding that:

1. It is economically impractical to extend a gravity sewer and the use of a pump station will not adversely affect the Louisa County Water Authority's or the Town of Louisa's ability to serve the area with a gravity sewer at a future time; and

2. The proposed design and plan for the pump station and connecting lines do not adversely affect the current financial status of the Louisa County Water Authority's or the Town of Louisa's utility system or the future ability of the Louisa County Water Authority or the Town of Louisa to install a gravity sewer; and

3. The proposed design of the pump station permits replacement of the pump station with a gravity sewer without significant capital outlay at a future time; and

4. The pump station will not overload existing sewage facilities and will not otherwise negatively affect the Louisa County Water Authority's or the Town of Louisa's ability to efficiently manage the sewer system.

B. The design requirements for a sewage pumping facility shall be determined through discussions with the Louisa County Water Authority or the Town of Louisa and the Virginia

Department of Environmental Quality **PRIOR TO INITIATING THE DESIGN**. A minimum peaking factor of 2.5 shall be utilized in the design of all sewage pump stations. Sometimes a larger peaking factor may be warranted and may be required at the discretion of Louisa County Water Authority or the Town of Louisa or Virginia Department of Environmental Quality. After the design criteria have been determined, the engineer shall prepare a preliminary engineering report for approval by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Environmental Quality. The preliminary engineering report shall address all issues requested by the Louisa County Water Authority or the Town of Louisa and meet the requirements of the Virginia Department of Environmental Quality.

C. The pump station design shall be in accordance with the approved preliminary engineering report and all the requirements of the Virginia Department of Environmental Quality. At a minimum, the following information shall be provided in the construction plans.

   1. Structural design and calculations, including reinforcing drawing where applicable, for the facility.

   2. Hydraulic design for the equipment selected, including scaled drawings.

   3. Electrical and mechanical drawings and specifications for the equipment selected.

   4. Project specifications.

   5. Pump and system head curves

   6. Site Plan

D. The construction plans shall be approved by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Environmental Quality.

E. Sanitary sewer force mains shall be ductile iron pipe (Class 52 minimum), with a corrosion resistant coating, PVC AWWA C-900 pipe, or other pipe approved by Louisa County Water Authority or the Town of Louisa. Force mains are designed with a minimum flow velocity of 2.0 feet per second and a maximum flow of 8.0 feet per second. A Hazen-Williams "C" value of 130 shall be used for design. Minimum force main size will be 4" in diameter. A constant grade shall be used where feasible. Valves and air releases will be provided at appropriate locations. Minimum cover for force mains shall be 3.0 feet.

F. Manhole receiving the discharge from force mains shall be designed in accordance with the standard details. In addition, special acid resistant manholes and sanitary sewer pipe may be provided downstream for a minimum of 2000 feet, as directed by the Louisa County

Water Authority or the Town of Louisa. On existing systems, manholes shall receive an approved PVC liner or other liner approved by the Louisa County Water Authority or the Town of Louisa.

5 SEWER SYSTEM MATERIAL SPECIFICATIONS

All products must comply with the Materials Specifications as referenced in this section and the Louisa County Water Authority or Town of Louisa's Standard Details. All references to ASTM, AWWA, and other standards shall include latest revisions.

5.1 Sanitary Sewer Pipe

5.1.1 Cement Lined Ductile Cast Iron Pipe (for Gravity Sewer)

A. Ductile iron pipe, centrifugally cast, per ANSI/AWWA Specification C151/A21.51. Thickness Class 52 Sewer per ANSI/AWWA Specification C150/A21.50. Ductile iron pipe shall be manufactured by Griffin Pipe Products Co., U.S. Pipe and Foundry Co., Atlantic States Cast Iron Pipe Co., or approved equal.

B. Where exposure to high levels of hydrogen sulfide is not anticipated, the interior lining shall be cement lining with asphaltic seal coating per ANSI/AWWA Specification C104/21.4. The exterior coating shall be asphaltic coating per ANSI/AWWA Specification C151/A21.51 with PE wrap.

C. Where exposure to high levels of hydrogen sulfide are anticipated or the installation depth (to the invert of the pipe) exceeds 20 feet, pipe shall have corrosion resistant interior coating such as epoxy, Griffin H_2Sewer Safe, Protecto 401 lining, or other coating approved by the Lousia County Water Authority or Town of Louisa.

5.1.1.1 Fittings

A. Fittings shall be standard mechanical joint fittings in accordance with AWWA/ANSI C-110-93/A21.10 and AWWA/ANSI C-111-90. All fittings shall be cement mortar lined inside in accordance with AWWA/ANSI C104-90/A21.4. Cast iron or ductile iron fittings shall be manufactured by Griffin Pipe Products Co., U.S. Pipe and Foundry Co., or approved equal. All ductile cast iron pipe and fittings shall be carefully checked and tested on the job for correct dimensions, coating and sand holes before placing pipe.

5.1.1.2 Joints

A. Joints may be mechanical or rubber (or synthetic rubber) gasket push on type meeting all applicable requirements of AWWA/ANSI C-111-90/A21.11 or Federal Specification WW-P-421C. Joints may be compression gasket per ASTM C 564-7-0.

5.1.2 PVC Flexible Sewer Pipe

The Louisa County Water Authority and Town of Louisa prefer the use of PVC pipe for new installations except when required for road, stream, or other utility crossings.

5.1.2.1 Pipe 4 Inches Through 18 Inches

A. PVC pipe shall meet SDR-35 requirements for ASTM D 3034 (4 inches through 15 inches pipe) and ASTM F 679 (18 inches through 27 inches pipe) Type PSM Poly Vinyl Chloride sewer pipe and fittings with a minimum tensile modules of 500,000 psi (ASTM D 1784). The fittings and pipe shall be of a gasket push on joint type meeting ASTM D 3212. Fittings shall meet and/or exceed all of the requirements of ASTM D-3034 PSM SDR 35, or current revision, for heavy wall PVC as manufactured by Johns-Manville Corporation, Certainteed, or approved equal.

5.1.2.2 Pipe 21 Inches Through 48 Inches

A. Large dia. PVC pipe 21 inches through 48 inches shall meet the following specification: materials ASTM D 1784, impact, resistance ASTM D 2444 with 30 lb plate and 220 ft. lbs, impact fittings ASTM D 2855, joint tightness D3212. This pipe shall be Carlon Vylon H.C. –a.k.a. Lamson pipe (21”-48”) (Minimum total wall thickness 0.17”) or accepted equal.

5.1.2.3 Joints

A. PVC pipe shall be joined by bell and spigot type connections. The pipe joint shall be tightly sealed against infiltration and exfiltration by means of a locked-in rubber-sealing ring conforming to ASTM D-3212-89, or current revision. The connection shall also permit the thermal expansion or contraction of the pipe. PVC pipe joints (seals) shall meet ASTM F 477.

5.1.3 High Density Polyethylene Pipe (HDPE)

A. HDPE Pipe will be considered for installation for sanitary sewer force mains only. Its general use will be reviewed on a case-by-case basis for all of the applicable methods of installation, i.e. normal open trench construction or horizonal directional drilling when jack and bore casing pipe with internal carrier pipe is not practical. The design engineer shall specify the particular pipe and the rating shall meet or exceed 150 psi operating pressure.

5.2 Joint Deformation

A. Rubber gaskets shall be the O-ring type, made of neoprene. The gasket shall not be stretched more than 20 percent when placed on the spigot of the pipe. The gasket shall be of such size that, when the joint is off-center sufficiently to cause the outer surface of the tongue end of the pipe and the inner surface of the groove end of the adjacent pipe to come into contact at some portion of their periphery, the deformation in the stretched rubber gasket will not exceed 50 percent at the point of contact. At the diametrically opposite point across the pipe, the deformation will not be less than 20 percent of the normal diameter or thickness of the gasket before deformation. The gasket shall be the sole element depended upon to make the joint watertight.

5.3 Gaskets

A. Gaskets for sewer pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber free of porous areas, foreign material or visible defects. Rubber gaskets shall conform to all applicable provisions of AWWA C111-90 or current revision.

B. Gaskets shall be protected from exposure to excessive heat, cold, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

5.4 Manholes

A. Manholes shall be constructed of precast reinforced concrete manhole sections in accordance with requirements of ASTM C478 and as shown on the Standard Details. Manholes shall be manufactured in accordance with the latest ACI Building Code, Chapter 13, for Class A, Air-Entrained Concrete or as approved by UCC.

B. A maximum of two lift holes per manhole section may be provided.

C. Provide tongue and groove joints in manhole sections with a performed groove in the tongue for placement of an O-ring type round, rubber gasket or Press Seal, Inc.'s Profile RS gasket. Other sealing systems will be considered and approved in writing by Louisa County Water Authority or Town of Lousia on a case-by-case basis.

   Gaskets shall comply with requirements of ASTM C361 or C443, as applicable to the application of the structure and joint being sealed, i.e. horizontal and/or vertical.

   Butyl-mastic shall comply with ASTM C990.

D. Gasket shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure. Additional sealing material may be used on the exterior for the joints with the approval of Lousia County Water Authority or Town of Lousia. External sealing bands (joint wraps) shall be applied with a primer and conform to ASTM C877. Gasket shall comply with requirements of ASTM C361.

E. Provide flexible pipe connections to manholes for pipes 21 inches in diameter and smaller in size. Materials shall consist of EDPM and elastomers designed to be resistant to water, sewage, acids, ozone, weathering and aging. Use neoprene conforming to ASTM C443 and ASTM C923 and all stainless steel elements of the connector shall be totally non-magnetic Series 304 Stainless Steel, excluding the worm screw for tightening the steel band around the pipe which shall be Series 305 Stainless. The worm screw for tightening the steel band shall be torqued by a break-away torque wrench available from the precast manhole supplier, and set for 60-70 inch/lbs.

Cast or core drill openings in manholes to receive connectors. Connectors shall be suitable for field repair or replacements. Connectors not suitable for field replacement are unacceptable.

The assembled connectors shall allow at least an 11 degree angular deflection of the pipe and at least 1 inch of lateral misalignment in any direction and be suitable for a normal variation in diameter or roundness for the pipe material used.

F. Manhole steps shall be corrosion resistant and shall be ½ inch grade 60 steel reinforcing rod encapsulated in a copolymer polypropylene. The steps shall conform with ASTM C478 paragraph 11. Steps shall be M.A. Industries, Inc. or approved equal.

G. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 30. Castings shall not be coated. Seating surfaces between frame and cover shall be machined. The dimensions and weights shall conform to the requirements shown on the Standard Details. The word "SEWER" shall be cast into the cover.

H. Sealant for manhole frames shall be a one-component polyurethane sealant similar to Sika "Sikaflex" type 430 or bitumastic material.

I. Sealant for flexible pipe connections shall be a two-component polysulfide sealant similar to Sika "Sikaflex" type 412 with primer type 419.

J. All manholes shall be watertight.

K. Coal tar coating are required on the exterior of manholes only. Coal tar coatings are not allowed in the interior of manholes.

5.4.1 Joints

A. The joints between manhole sections shall be tongue and groove with an "O" ring rubber gasket or "STEP" section with sliding flap seal ring as manufactured by Forsheda, or approved equal conforming to ASTM designation C-443-79 or latest revision. Jointing of the precast manhole sections shall conform to the manufacturer's published recommendations and specifications. A flexible joint sealant such as a "Ramneck", or approved equal, may be required between precast manhole sections.

5.4.2 Connections

A. Connections shall be precast and supplied with a flexible connection boot similar to the KOR-N-SEAL or approved equal. The boot shall be of neoprene secured to the manhole

by a water tight compression ring seal to provide a flexible joint. The joint shall be of neoprene rubber. The boot shall be installed in accordance with the manufacturer's instructions.

5.4.3 Cone Section

A. The uppermost section of the manhole shall be tapered eccentrically and shall be a minimum of three (3) feet in height. Where field connections dictate "flat top" manhole sections can be utilized with the approval of the Louisa County Water Authority or the Town of Louisa. The height of the lower section shall be at least three (3) times the inside diameter of the largest sewer pipe entering the section and in no case less than two (2) feet.

5.4.4 Inverts

A. The use of precast inverts is encouraged; however no additional compensation will be afforded the contractor for replacements of bases caused by line relocation to avoid existing utilities or structures.

5.4.5 Grout

A. Grout for inverts shall comply with Section 217 of the VDOT Road and Bridge Specifications and other Sections, as applicable.

5.5 Manhole Frame and Cover

A. Manhole frames and covers shall be heavy duty, traffic resistant, gray cast iron. Frame and cover castings shall conform to the details and dimensions shown in the standard details and shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects in positions affecting their strength and value for the use intended. They shall be sand blasted or otherwise cleaned and scaled so as to present a smooth, clean, and uniform surface.

B. Standard manhole covers shall have one pick hole and the marking "Sewer" cast in their body. Four (4) anchor bolts shall be placed in the cone section to secure the manhole frame to the concrete. Bolt diameters shall be as specified by the manufacturer. Standard manhole frames and covers shall be Neenah Foundry Company Model R-1642 or approved equal.

5.5.1 Frame Sealant

A. The manhole frame shall be sealed to the concrete manhole section using a bed of mortar on either side of butal rubber sealant such as "Ramneck" or approved equal. In addition, the frame and cover shall be mortared to the outside of the concrete manhole section.

5.5.2 Inflow Protector

A. All manholes shall include a corrosion proof, shock-resistant inflow protector. The material shall be plastic or stainless steel. Stainless steel inflow protectors shall be used within VDOT right-of-ways, and in locations where the Louisa County Water Authority or the Town of Louisa deems stainless steel necessary. Otherwise plastic inflow protectors may be used. Stainless steel and plastic inflow protectors shall have a ventilation system which relieves gas pressure at a minimum of 1 psi, and shall have a water leak-down rate no greater than 5 gallons per 24 hours.

5.6 Corrosion Resistant Manholes

A. In addition to the requirements above, corrosion resistant manholes shall have a lining system meeting one of the following additional requirements:

1. All concrete utilized in manhole shall have ConShield admixture added in accordance with the manufacturer's recommendations. The precast supplier shall provide written certification that ConShield was added per manufacturer's recommendation to all acid resistant manholes delivered. This certification shall be given to the Inspector prior to delivery. All sections of manhole with ConShield shall be clearly marked by the supplier at the plant so that the Inspector and contractor can identify those manholes with ConShield admixture. The certification provided by the supplier shall indicate the method utilized for marking manholes with ConShield admixture at the plant.

2. Raven 405 epoxy coating as manufactured by Raven Lining Systems, Inc. applied at a thickness of 80 to 100 mils. Coating shall be applied in accordance with all requirements of the manufacturer. All defects shall be repaired in accordance with the manufacturers' recommendations.

3. Sikagard 62 High-Build Protective Coating as manufactured by Sika Corporation. Surface of manhole shall be prepared per manufacturer recommendation, including but not limited to the filling of all bug-holes and pores to achieve a uniformly consistent surface. Coating shall be applied in accordance with all requirements of the manufacturer.

4. PermaCast or PermaForm lining with ConShield admixture applied in accordance with manufacturer's recommendations.

5. Other coating systems as specifically approved by the Louisa County Water Authority or the Town of Louisa.

B. HDPE and PVC lined manholes are not acceptable on new installations.

5.7 Sewage Air/Vacuum Valves

A. The sewage air/vacuum valve shall be designed to automatically exhaust large quantities of air during filling of a system. It shall also allow air to enter the pipe system when the line is being emptied. All this shall be accomplished through the functioning of a compound lever system in conjunction with a large and small orifice in one integral body casting.

B. This device shall have only orifices and no mechanical leverage, other than the weight of a stainless steel float ball.

C. It shall automatically provide for the escape of the air to the atmosphere without the loss of water when the float ball moves away from the orifice seal.

D. The body of the valve shall be cast iron and shall be coated with fusion bonded epoxy or teflon or other approved coating to withstand moist abrasion and corrosive conditions.

E. The valve shall have a float with Buna-N seal for positive seating.

F. Rigid stainless steel valve plug shall be provided to seal off the outlet orifice.

G. Wherever possible, valve shall have elongated bodies to minimize the problem of clogging by permitting the use of a long float stem. However, where height restrictions do not permit the use of the standard height valve, a short body valve can be applied.

H. Sizes 1" through 3" shall have N.P.T. inlets and outlets. Larger sizes shall have flanged inlets conforming to ANSI class 125 or 250 and shall have N.P.T. outlet as standard. Flanged outlet or protective hood shall be optional. It shall have a minimum of 3/32" outlet orifice for an operating pressure of 0-150 psi and 1/8" outlet orifice for an operating pressure range of 0-300 psi.

I. Valve shall be suitable for 300 psi working pressure at a minimum.

J. All flushing attachments shall be provided with each valve.

5.8 Sewage Combination Air Release Valves

A. Combination valves shall be designed to have the operating features of both air and vacuum valves and air release valves. It shall purge air from the system at start-up, vent small pockets of air while the system is pressurized and running, and prevent critical vacuum conditions during draining. They shall be installed at all the high points in the pipe line where air would naturally tend to rise during filling and collect during operation and/or

where vacuum would tend to form when the system is drained.

B. The device shall have only orifices and no mechanical leverage, other than the weight of a stainless steel float ball.

C. The body of the valve shall be cast iron, stainless steel, or other approved material and shall be coated with fusion bonded epoxy, Teflon or approved coating to withstand moist, abrasion and corrosive conditions.

D. The valve shall have a float with Buna-N seal for positive seating.

E. Rigid stainless steel valve plug shall be provided to seal off the outlet orifice.

F. Wherever required, a combination of the sewer air and vacuum valve and sewer pressure air release valve shall be made with appropriate piping arrangement to accommodate the specific application.

G. Sizes up to 3" shall have N.P.T. inlets and outlets. Larger sizes shall have flanged inlets conforming to ANSI class 125 or 250 and shall have N.P.T. outlet as standard. It shall have a minimum of 3/32" outlet orifice for an operating pressure of 0-150 psi and 1/8" or 1/16" outlet orifice for an operating pressure range of 151-300 psi.

H. Valve shall be suitable for 300 psi working pressure.

I. All flushing attachments shall be provided with each valve.

5.9 Sewage Air Release Valves

A. The sewage air release valve shall be designed to automatically exhaust small amounts of air accumulated at a system's high point. This shall be accomplished while the system is in service and under pressure. They shall be installed at high points in the system where air naturally tends to collect.

B. The device shall have only orifices and no mechanical leverage, other than the weight of a stainless steel float ball.

C. The body of the valve shall be cast iron with stainless steel trim and shall be coated with fusion bonded epoxy, teflon or approved coating to withstand moist, abrasion and corrosive conditions.

D. The valve shall have a float with Buna-N seal for positive seating.

E. Sizes up to 3" shall have NPT inlets and outlets as per ANSI B2.1. Larger sizes shall have flanged inlet conforming to ANSI B16.1 class 125 as standard. It shall have a minimum of 3/16" orifice for an operating pressure of 0-150 psi and 1/8" outlet orifice for an operating pressure range of 151-300 psi.

F. Valve shall be suitable for a working pressure of 300 psi.

5.10 Sewage Plug Valves

A. All sewage plug valves shall be of the non-lubricated, eccentric type with resilient faced plug and round ports of no less than 90%, or rectangular ports of no less than 80%, of the connecting pipe area, except valves of 24" or larger size shall have port areas of no less than 70% of the connecting pipe area.

B. Valves shall be for buried underground service as well as plant service and shall be rated for 175 psi up to 12" and 150 psi for sizes 14" and larger. Drop-tight shut off shall be provided at full rated working pressure in the standard flow direction and 50 psi in the reverse direction, except when full-rated sealing is required in both directions.

C. Valves 6" and larger shall be equipped with geared actuators with a 2" square operating nut. Handwheel and power actuated valves shall also include a 2" square operating nut for emergency operation.

D. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts and washers shall be zinc plated.

E. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals.

F. All exposed nuts, bolts, springs and washers shall be stainless steel.

G. Valves shall open left (counterclockwise) and shall have mechanical joint end connections, or as specified by the Louisa County Water Authority or the Town of Louisa.

H. Valve bodies and all other cast iron parts shall conform in all respects to the American Society for Testing Materials' Standard Specifications of Gray Iron Castings, ASTM Specification Designation A-126, Class B. The castings shall be clean and perfect without blow or sand holes or defects of any kind. No plugging or stopping of holes will be allowed.

I. Body ends shall be flanged with facing and drilling in accordance with ANSI B 16.1, Class 125 or mechanical joint in accordance with AWWA Standard C-111 or ANSI A21.11. All mechanical joint end valves shall be furnished complete with joint accessories (bolts, nuts, gaskets and glands).

J. Valve bodies shall be furnished with a raised seat surface completely covered with 90% pure nickel to ensure that the resilient plug face contacts only nickel, or a one-piece 304 stainless steel seat ring threaded to the body. The nickel seat must be welded to the valve body or the body seat ring to produce a metallurgical bond with interpenetration to the base metal with a bond strength equal to or greater than the valve body or seat ring material. The nickel or stainless steel seat must be machined to a finish of not more than 16 micro-inches to achieve minimal friction and wear to the resilient plug face during valve operation. Whether welded or screwed, the valve seat shall be designed to provide uniform contact with the resilient plug face and to prevent the plug face from contacting any cast iron surface. Resilient seats or seats attached to the body by screws or any other method not specified herein are not acceptable. Plated or sprayed nickel seats or epoxy seats are not acceptable.

K. Valve bodies shall be furnished with an adjustable closed position stop. The seat end and standard flow direction shall be cast onto the valve body.

L. Resilient faced plug/operating shaft shall be of a one piece design of ASTM A126 Class B cast iron with a seating surface eccentrically offset from the center of the plug shaft, and shall have a precision molded resilient facing of chloroprene (Neoprene), Buna-N (nitrile) or nitrile-butadiene (Hycar). With the valve in the open position, all surfaces of the plug/shaft shall be substantially out of the fluid flow path.

M. Valve shaft journal bearings shall be sleeve type, sintered, oil impregnated, permanently lubricated, type 316 ASTM A 7 43 grade CF -8M or AlSI type 317 L stainless steel, or phenolic backed Teflon. Thrust bearings shall be located in the upper and lower journal areas and shall consist of stainless steel, Teflon, or a combination of those materials. Grit seals shall be provided in the upper and lower journals to prevent abrasive material from entering the bearing and seal areas.

N. Valve shaft seals shall conform to AWWA Standard C504-87, Section 3.7 and shall be of the bronze cartridge type utilizing O-rings, or the adjustable multiple V -ring type and shall be replaceable without disassembling the valve, while the valve is under system pressure.

O. Valve interiors and exteriors shall be coated according to AWWA Standard C509 with a two-component high build epoxy suitable for potable water service, with interior surfaces receiving 8 - 10 mils (dry film thickness) and exterior surfaces receiving 3 - 5 mils (dft) or 8 - 10 mils (dft) hand-applied epoxy coating. For buried or submerged service, 8 - 10 mils (dft) of asphalt varnish may be substituted for the exterior coating.

P. Valve testing shall be conducted per AWWA C504-87 Section 5, covering rubber seated butterfly valves. Each valve shall be performance tested per paragraph 5.2 assuring valve operation.

Q. Eccentric plug valves for wastewater service shall be as approved by the Louisa County Water Authority or the Town of Louisa.

5.11 Tracing Wire System

5.11.1 Detection Wire

A. Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG. Detection wire shall be buried directly above piping, including laterals to the cleanout, at a distance not to exceed twelve (12) inches above the top of pipe. The wire shall extend continuously and unbroken, from point of access to point of access. The ends of the wire shall terminate with a minimum of three (3) feet of wire, coiled, remaining accessible in each test station box. The wire shall be exposed at the connection between contact A & B until the connection can be made to the wire by the last contractor to make the pipe connection.

5.11.2 Test Station Box

A. Test station box shall be plastic for corrosion protection. The plastic shaft shall be a minimum of 18” long with cast iron lid and collar. Collar shall be a minimum of 2” deep. The lid shall be bolted to collar with brass bolts, and shall be imprinted with the wording “TEST”. Contractor shall install 24”x24”x4” concrete pad around test station box. Test station boxes shall be installed at intervals no greater than 1000 feet, unless approved by owner. All connections at the main line must be electrically sound and physically secure with screw connections or clamps. All connections must be taped with electrical tape and sealed with an electrical coating sealant.

5.11.3 Markers/Witness Posts

A. All markers shall have one of the applicable decal description to reflect the following:
   1. Upper decal, white and blue 2 7/8 inches x 11 inches standard, worded "CAUTION SEWER PIPELINE" or,

   2. Upper decal, white and blue 2 7/8 inches x 11 inches standard, worded "CAUTION SEWER MANHOLE".

B. In addition, the lower decal shall contain the following:
   1. Lower decal, white and blue 2 7/8 inches x 1-3/4 inches standard, worded "BEFORE DIGGING CALL VIRGINIA 811".

C. Total height shall be 60 inches with the above mentioned decal on both sides of the marker.

D. Basic markers shall be green in color for all sewer lines or appurtenances.

5.12 Marking Tape

A. Polyethylene plastic and metallic core or metallic-faced, acid-and alkali resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED SEWER LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	**Gas, Oil; Dangerous Materials**
Blue:	**Water**
Green:	**Sewer**

5.12.1 Warning Tape for Metallic Piping

A. Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi otherwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

5.12.2 Detectable Warning Tape for Non-Metallic Piping

A. Polyethylene plastic tape conforming to the width, color and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a

minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection. Color coded tape shall be installed flat with color side up to 12 inches to 24 inches over all installed utility lines including main line and service lateral or service connection.

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6 CONSTRUCTION SPECIFICATIONS

6.1 Requirements of Regulatory Agencies

A. Construction as shown on the plans or stated herein shall be performed in accordance with current and applicable requirements as established by the Louisa County Water Authority, the Town of Louisa, the Virginia Department of Environmental Health (VDH), the Virginia Department of Environmental Quality (VDEQ) or any other agencies having jurisdiction. Where conflicts arise between the construction documents and previously mentioned requirements, the more restrictive shall apply. If such requirements require a change in the work as stated herein or shown on the plans, the Contractor shall stop work and notify the Louisa County Water Authority or Town of Louisa immediately for further direction. These specifically include stormwater run-off and erosion and sediment control, as well as, applicable safety regulations.

6.2 Permits

B. The contractor must obtain all required licenses and permits and pay all charges and expenses connected with the work. The contractor is responsible for adherence to the conditions and requirements of the permits. This shall include Louisa County Water Authority or Louisa County Land Disturbance, VDOT, and/or Town of Lousia where applicable. Misunderstanding or negligence on the part of the contractor will not be considered as a valid excuse for his failure to secure the necessary permits.

6.3 General

A. Construction on any utility project will not be allowed to begin until all criteria of the design review and approval process have been satisfied and a Construction Permit has been issued.

B. A pre-construction meeting will be required unless waived by the inspector.

C. The contractor is reminded that prior to the installation of water mains, unless waived by the inspector, a licensed engineer or surveyor must certify in writing that:

1. All pavement and shoulder areas within the right-of-way are graded to within 6 inches of subgrade.

2. All ditches and slopes to 1 foot outside the right-of-way have been graded to final grade.

D. The contractor shall be required to comply with erosion and sediment control requirements before beginning clearing or construction and the requirements of the project's Land Disturbance Permit, if one is required.

E. It shall be the responsibility of the developer or his agent to acquire all off-site easements necessary for water or sewer installation. Easements shall be obtained, recorded, and the deed book and page noted on the plans prior to the plans being approved.

F. These specifications are to be used in conjunction with the Standard Details; Louisa County Water Authority or Town of Louisa approved materials list, County's materials specifications, and the approved plans. If there is a discrepancy between these documents, the Louisa County Water Authority or Town of Louisa shall make the final determination as to which standard is to be enforced.

G. Connections to the Louisa County Water Authority or Town of Louisa 's water or sewer system shall only be made by a state licensed Class A utility contractor that has been authorized to make such connections by the Louisa County Water Authority or Town of Louisa.

6.3.1 Materials and Workmanship

A. It is the intent of the Louisa County Water Authority or Town of Louisa 's specifications to describe in general and broad terms the character of materials and workmanship required with regard to all ordinary features and to require first-class work and materials in all particulars. For any unexpected features arising during the progress of the work and not fully covered in the specifications, the Louisa County Water Authority or Town of Louisa shall require first- class work to be performed and first-class materials to be used by the contractor. The Louisa County Water Authority or Town of Louisa reserves the right to employ an independent testing laboratory to conduct tests in addition to those to be completed by the developer and/or contractor of materials, soils, workmanship, facilities, etc. as the Louisa County Water Authority or Town of Louisa may deem necessary to assure complete compliance with the requirements of these specifications. The developer and contractor shall offer full cooperation with personnel in the employ of the Louisa County Water Authority or Town of Louisa in taking these tests. If any such test completed by the Louisa County Water Authority or Town of Louisa shows that substandard work has been performed or substandard materials provided, the developer shall be charged by the Louisa County Water Authority or Town of Louisa the costs for completing these tests. "Tentative Acceptance" for any part of the water or sewer system serving the project shall not be issued until all such charges have been paid.

6.3.2 No Deviation from Plans, Specifications, Etc. by the Contractor

A. The contractor shall not deviate from the plans, profiles, cross-sections and specifications without the approval of the Louisa County Water Authority or Town of Louisa. If deviation occurs on the part of the contractor, he shall correct the error at his expense in a manner satisfactory to the Louisa County Water Authority or Town of Louisa.

6.3.3 Other Plans and Working Drawings (Shop Drawings)

A. The Louisa County Water Authority or Town of Louisa may require at its sole discretion, the submission of shop drawings for materials and equipment to be provided for any project. **Shop drawings will not normally be required for regular water and sewer line construction projects but will normally be required for water or sewer pump stations, water storage tanks, control valves, special structures, and other special projects.**

B. When required, the contractor shall submit to the engineer and/or the inspector for their approval, such additional detailed shop or working drawings as may be required for the construction of any part of the work. Pending the approval of such drawings, any work done or materials ordered shall be at the contractor's risk.

C. Working drawings shall consist of such detailed drawings as may reasonably be required for successful execution of the work and which are not included in the plans furnished by the engineer. These may include drawings for anchor bolts, centering and form work, masonry, layout diagrams, etc.

D. It is expressly understood that the approval of working drawings relates to the general concept, and not the detail, and such approval will not relieve the contractor from any responsibility for errors or omissions in dimensions or quantities.

E. It is understood that shop drawings or working drawings processed by the engineer are not change orders; that the purpose of shop or working drawing submittals by the contractor is to demonstrate that the contractor understands the design concept, to demonstrate his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

F. If deviation, discrepancies, or conflicts between shop drawing submittals and the plans and specifications are discovered either prior to or after Shop Drawings submittals are processed, the approved construction plans and these specifications shall control and

shall be followed unless otherwise authorized by the Louisa County Water Authority or Town of Louisa . All shop or working drawings and blueprints shall be made at the expense of the contractor and/or developer.

6.3.4 Discrepancies

A. Any discrepancies found between the plans and the County's specifications and site conditions or any inconsistencies or ambiguities in the plans or specifications shall be immediately reported to the engineer, in writing, who shall promptly correct such inconsistencies or ambiguities in writing after obtaining the Louisa County Water Authority or Town of Louisa 's approval. Work done by the contractor after his discovery of such discrepancies, inconsistencies or ambiguities prior to Louisa County Water Authority or Town of Louisa approval shall be done at the contractor's risk.

6.3.5 Correction of Work

A. The contractor shall promptly remove from the premises all work rejected by the engineer or Louisa County Water Authority or Town of Louisa for failure to comply with these specifications, whether incorporated in the construction or not, and the contractor shall promptly replace and re-execute the work in accordance with these specifications and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

If the contractor does not take action to remove such rejected work within 10 days after receipt of written notice, the Louisa County Water Authority or Town of Louisa may remove such work and store the materials at the expense of the developer.

6.3.6 Qualifications of Workmen and Equipment

A. The contractor shall employ superintendents, foremen and workmen that are careful, experienced, and competent. The Louisa County Water Authority or Town of Louisa reserves the right to issue a "stop work" order for any utility project if a contractor fails to employ or utilize qualified personnel.

B. The Contractor must hold all required and current licenses, certifications, and permits necessary to perform work within VDOT right-of-way or on roadways, in compliance with applicable regulations.

6.3.7 Superintendent

A. The contractor shall personally supervise the work and when not personally present shall be represented by a superintendent who shall have full authority to act as the contractor's representative and all orders and instructions given to the superintendent shall have the same force and meaning as if given to the contractor in person. The superintendent or contractor shall be on duty at all times while construction work is being done.

6.3.8 Responsibility of Contractor

A. The contractor shall take all responsibility for the work and take all precautions to prevent injuries to persons and property in or about the work. Until tentative acceptance of the work by the Louisa County Water Authority or Town of Louisa, it shall be under the charge of the contractor and he shall take every care and necessary precaution against injury or damage to the work or any part thereof by the action of the elements or any other cause whatsoever, whether arising from the execution or the non-execution of the work. The contractor shall rebuild, repair, restore and make well at his expense all injuries or damage to work occasioned by any of the above causes before it will be accepted.

B. The Contractor shall have at least one employee on-site who is capable of communicating effectively in English, consistent with VDOT language requirements.

6.3.9 Work in Bad Weather

A. During stormy or inclement weather, no work shall be done except as can be done satisfactorily and in a workmanlike manner to secure first-class construction throughout. If in the Louisa County Water Authority or Town of Louisa 's opinion satisfactory work is not being performed due to inclement weather, the Louisa County Water Authority or Town of Louisa may issue a "stop work" order.

6.3.10 Work Outside Regular Hours

A. If the contractor desires to perform work outside normal working hours, or on Saturdays or Sundays, he shall request permission to work such hours at least 48 hours in advance to allow arrangements to be made for proper inspection. The Louisa County Water Authority or Town of Louisa may refuse the contractor permission to work outside of normal hours and may require that the developer agree to reimburse the Louisa County Water Authority or Town of Louisa any expenses it incurs due to work occurring outside of normal business hours in addition to the normal inspection fees. Reasonable efforts shall be made by the contractor to avoid undue noise during the night and on Sundays if it is necessary to work at such times. Under all conditions, the contractor is responsible for complying with the Louisa County Water Authority or Town of Louisa 's noise ordinance. Under normal circumstances the contractor will not be permitted to work on Sundays or County holidays.

B. The Louisa County Water Authority or Town of Louisa reserves the right to schedule the contractor to work outside normal working hours in the interest of public safety or convenience. Normal working hours are defined as 7:00 A.M. to 5:00 P.M., Monday through Friday.

6.3.11 Use of Water

A. No water shall be drawn from the Louisa County Water Authority or Town of Louisa 's facilities for testing or other purposes until suitable arrangements have been made with the Louisa County Water Authority or Town of Louisa 's Utility inspector.

6.3.12 Job Safety

A. The Louisa County Water Authority or Town of Louisa shall not be responsible for the contractor's safety precautions or for means, methods, techniques, sequences or procedures required for the contractor to perform his work; such precautions include but are not limited to shoring, scaffolding, underpinning, temporary retainment of excavation and any erection methods and temporary bracing.

6.3.13 Existing Structures

A. The location of existing sewers, water and gas pipes, conduits, other utilities, and structures across or along the line of the proposed work may not be shown on the plans, and if shown, the location, depth and dimensions of such structures may only be approximately correct. The contractor shall have a working pipe locator on the job at all times and utilize hand excavation to locate existing underground facilities as appropriate. The contractor shall dig test holes for the purpose of locating existing underground structures as required to protect existing underground structures. Such excavation shall not be undertaken without 48 hours prior notice to the County or owner of the existing facility.

6.3.14 Care of Existing Structures

A. The contractor shall be liable for all damage done to any structure or property arising through his negligence or carelessness. He shall take care of and maintain all underground, overhead or surface utilities encountered in the performance of the work.

   Prior to commencing work contractor shall contact the Utility Information Center for marking of existing underground utilities.

   The contractor shall observe all precautions with respect to fire and avoid the indiscriminate mutilation or cutting down of trees. Any damage to property not in the work area or easements will be the contractor's responsibility to repair and restore.

6.3.15 Inspectors

A. The inspector is authorized to inspect all materials and equipment to be utilized and work done. In case of any dispute arising between the contractor and the inspector as to materials furnished or the manner of performing the work, the inspector will have the authority to reject material or suspend work until the question at issue can be resolved to the satisfaction of all parties.

The County shall have access at all times to all parts of the work being done for the purpose of inspection, measurements, and establishments of lines and grades.

6.3.16 Final Inspection

A. Before final inspection of the work, the contractor shall clean up the site of the work including all rights-of-way, leaving it in as clean, neat and sanitary condition as originally found and shall remove all machinery, tools, surplus material, temporary buildings, and other structures from the site of the work. Disturbed areas shall be stabilized and/or restored. Final Inspection should be requested by the owner in writing to the assigned Utility Agent.

6.3.17 Notification to Property Owners

A. When working in off-site easements, the contractor and/or developer shall notify, **in writing**, all adjoining property owners, at least two weeks prior to the start of any construction, that work will be taking place in the easement. Copies of the letters shall be presented to the Lousia County Water Authority or Town of Lousia at the pre-construction conference.

6.3.18 Waterline Tie-Ins

A. All waterline tie-ins to the existing distribution system including vertical and horizontal relocations shall be coordinated with the Lousia County Water Authority or the town of Lousia. Tie-ins shall be scheduled Monday thru Thursday from 9:00 a.m. to 4:00 p.m. Tie-ins may be required outside of this time and/or during nighttime hours.

B. The Lousia County Water Authority or Town of Lousia reserves the right to require the contractor to perform tie-ins outside of the normal working hours detailed above in the interest of public safety or customer service. No claim for additional compensation shall be made by the contractor when such occasions occur.

C. Proper preparation including field verification of the plans shall be accomplished to minimize shutdown time and prevent the tie-in from exceeding scheduled shutdown time. Sufficient personnel, equipment and materials shall be on-site prior to the water being shut off. Where applicable, excavation and preassembling of fittings shall be performed, and if in the opinion of the inspector sufficient resources are not available, the tie-in will be cancelled and rescheduled.

D. Tie-ins to asbestos cement pipe shall be made to rough barrel pipe. Tie-ins to the machined section of asbestos pipe will not be permitted. Where asbestos cement pipe couplings have been removed, the machined end of the pipe shall be removed. Abandonment of asbestos cement pipe shall be per state and federal requirements.

E. Tie-ins involving fittings shall include provisions for temporary blocking until concrete blocking has cured unless mechanical restraint systems are used. All pipe and fittings used for a tie-in are to be swabbed with a one percent (1%) chlorine solution prior to connection.

F. Before a tie-in will be allowed, all new valves, including fire hydrant valves, shall be accessible and verified fully open by the contractor unless there are valves designated as "normally closed". Prior to tie-in, the inspector shall verify that all valves, including fire hydrant valves are fully open and accessible. Immediately after a tie-in has been made, all valves used during the shutdown shall be verified fully open by the inspector. All fire hydrants shall be checked by the inspector to ensure water is available and each hydrant is in working order.

6.4 Trenching, Backfilling and Compaction

6.4.1 General

6.4.1.1 Quality Assurance

Work shall conform to Lousia County Water Authority and Town of Lousia requirements. Where construction is within the State or Town of Lousia right-of-way, the requirements of the Virginia Department of Transportation or the Town of Lousia shall apply.

6.4.1.2 Safety

The contractor is responsible for job site safety. The contractor shall comply with all applicable safety rules and regulations of OSHA, VOSHA and other agencies having jurisdiction over the work. All safety measures related to, but not necessarily limited to trenching, confined space, traffic control and other applicable safety measures, shall be strictly adhered to and enforced by the contractor.

6.4.1.3 Job Conditions

1. Protection of Existing Utilities: It shall be the responsibility of the contractor to conduct the work in such a manner as to avoid damage to, or interference with, any utility services. If such damage, interference, or interruption of service occurs as a result of his work, the contractor shall promptly notify the Lousia County Water Authority or Town of Lousia and utility owner of the occurrence. The contractor must immediately repair (or cause to be repaired) the damage at his own expense to the satisfaction of the Lousia County Water Authority/Town of Lousia and the owner of the utility. Further, the contractor is to uncover and expose the location of all service connections to avoid damage or interruption of service. If damage occurs, the contractor shall make the necessary repairs in accordance with the above requirements. It is also the responsibility of the contractor to determine in advance of beginning his construction effort the exact location of all utilities, and the effect

they will have on his work by contacting "Miss Utility" 48 hours prior to starting work.

2. Protection of Persons and Property:

    a. Barricades for open excavations or work area shall be provided. All such barricades shall be in accordance with the requirements of the authorities or agencies within whose jurisdiction the design exists.

    b. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by work or other operations in the area.

3. Equipment used for this work shall meet all local, state and federal safety standards and any other applicable standards governing this work. All power machinery shall have adequate mufflers to keep noise to a minimum. The contractor is responsible for complying with the requirements of the local noise ordinance.

6.4.1.4 Compaction

The contractor is responsible for the correct bedding of utility lines, backfill of pipe trenches, and compaction of backfill as outlined in this section, shown on the construction plans, included elsewhere in this Standard, or as required by the applicable permits. Where, in the inspector's opinion, excavated material is not suitable for backfill, select backfill shall be used.

The Lousia County Water Authority or Town of Lousia may require that the contractor have density and compaction tests performed by a certified independent laboratory verifying that the trench backfill has been compacted as required. Any material not compacted as required shall be removed and replaced, re-compacted and retested. Verbal results of tests should immediately be given to the inspector. Two written copies of all reports by the independent laboratory confirming the field results shall be given to the inspector within 48 hours of the field tests. Requirements for compaction are covered in further detail later in this section.

6.4.2 Products

6.4.2.1 Soil Materials

A. Unsuitable Soil Materials: Soil that is too wet to permit proper compaction or not appropriate for the use intended as determined by the inspector.

B. Non-cohesive Soil Materials: Non-cohesive soil materials include gravels, sand- gravel mixtures, and gravelly-sands.

C. Cohesive Soil Materials: Cohesive soil materials include clay and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands.

D. Backfill and Fill Materials:

1. Approved excavated or borrow materials must be free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, organic and other deleterious matter.

2. Approved materials must be at a moisture condition suitable for compaction at required density.

3. Fill shall be provided where required to raise the subgrade to the elevations shown on the Drawings. The material used, the maximum thickness of each layer prior to compaction, and the percent of maximum density required at optimum moisture content as determined by AASHTO T 99, shall be as stated hereinafter in this Specification.

4. No fill shall be placed until the subgrade has been checked and approved by the Louisa County Water Authority or the Town of Louisa, and in no case shall fill be placed on a subgrade that is muddy, frozen, or that contains frost.

5. The approved materials shall be placed in successive horizontal layers of loose material not more than 6 inches thick where compaction is by rollers or vibrators and 4 inches thick where mechanical tamping is required. If sands or poorly graded gravels (either of which contains less than 15 percent passing the No. 200 sieve) are used, they shall be placed fully saturated to prevent bulking. Well graded gravel shall be placed at the optimum moisture content. For all other materials, each layer shall be wetted or dried by aeration to a moisture content within 2 to 4 percent of optimum.

6.4.3 Execution

6.4.3.1 Inspection

Examine the areas and conditions under which excavating, filling, and grading are to be performed and remedy any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Lousia County Water Authority or Town of Lousia.

6.4.3.2 Excavation

A. Excavation consists of removal and disposal of material encountered when establishing required trench elevations. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Lousia County Water Authority or Town of Lousia.

B. Unsuitable soil shall be removed to a depth determined by the inspector and replaced with No. 57 stone or other material approved by the inspector which shall be uniformly and thoroughly compacted.

C. Sheeting, Shoring and Bracing: Provide sheeting, shoring, and bracing as necessary to prevent cave-in of excavation or damage to existing structures on or adjoining the site.

1. Requirements that are established for trench shoring and bracing should comply with codes and authorities having jurisdiction over the work being performed. The contractor's attention is called to Rules and Regulations Governing the Safety and Health of Employees Engaged in Construction as adopted by the Safety and Health Codes Commission of the State of Virginia and all latest revisions thereto and issued by the Department of Labor and Industry.

   The contractor shall perform all construction operations in accordance with the U.S. "Occupational Safety and Health Act of 1970", the Standards of the U.S. Department of Labor, Occupational Safety and Health Administration and the latest amendments thereto.

2. Sheeting, shoring and bracing may be left in place with the approval of the Lousia County Water Authority/Town of Lousia, but must be cut off to a depth of not less than 2 feet below the surface.

D. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area. Dewatering can be accomplished by ordinary pumping methods, by the use of under drains or deep well points, whichever will produce the above results. In order to ensure the continuous dewatering, duplicate units of the selected system incorporated with emergency power should be employed so that a reliable operation may be obtained.

1. Do not allow water to accumulate in excavation. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations. Dewatering shall continue until backfilling has been completed.

2. Convey groundwater and surface water removed from excavations to collection or run-off areas approved by the County. Trenches shall not be used as temporary drainage ditches.

3. All dewatering shall comply with the requirements of the latest edition of the Virginia Erosion and Sediment Control Handbook.

4. Lower the ground water level a minimum of 3 feet below sub-foundation grade or as recommended by Geotechnical Engineer prior to sub-foundation preparation and placement of foundation materials. During the placement and compaction of fill or bedding materials, the water level at every point within the limits of fills being placed shall be maintained a minimum of 3 feet or greater or as recommended by Geotechnical Engineer below fill placement level in order that the required compaction can be achieved.

5. Where conditions are such that running or standing water occur in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps and suitable means such as well points or previous under drain bedding until the pipe has been installed and the backfill has been placed to a sufficient height to prevent pipe flotation.

6. No installation will be permitted in trenches unless the subgrade is dry. If, in the opinion of the Louisa County Water Authority or the Town of Louisa, the contractor has failed to obtain an absolutely dry trench bottom by use of all known methods of trench dewatering, the Louisa County Water Authority or the Town of Louisa may then order the contractor to excavate below grade and place sufficient selected fill material over the trench bottom.

7. The disposal of all water from the dewatering and control of water operation and surface drainage shall be accomplished in a manner to have no detrimental effect on any of the new or existing facilities. The method and location of disposal of all water shall be subject to the approval of the Louisa County Water Authority or the Town of Louisa; in addition, no water shall be drained into work completed or under construction without prior consent of the Louisa County Water Authority or the Town of Louisa. All Commonwealth of Virginia erosion and sediment control requirements shall be met.

E. Stability of Excavations:

1. Slope sides of excavations to comply with local, State and Federal codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or because of the instability of the material being excavated.

   Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

F. Material Storage:

a. Stockpile approved excavated materials in approved areas, until required for backfill or fill.

b. Place, grade, and shape stockpiles for proper drainage.

c. Locate and retain soil materials away from edge of excavations.

d. Dispose of excess soil material and waste materials as hereinafter specified.

e. Stabilize soil stockpiles with temporary seeding as required.

G. Excavation for Trenches and Structures:

1. Trenches shall be opened only so far in advance of pipes being laid as the Lousia County Water Authority/ Town of Lousia will permit and in no case will this distance exceed 300 feet. The width of the trench at and below the top of the pipe shall not exceed the outside diameter of the pipe plus 24 inches except that for pipe 18 inches or less in diameter, the trench width shall not exceed 42 inches. The trench walls above the top of the pipe may be sloped or the trench above the top of the pipe may be widened as necessary for bracing, sheeting and shoring. Where these trench widths are exceeded, the contractor will be required to mechanically tamp an approved backfill material from the bottom of the trench to 6 inches above the top of the pipe as directed by the County and the trench re-excavated to the proper dimension.

2. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to the indicated flow lines and invert elevations plus the required bedding material, if applicable.

3. Grade bottom of trenches as indicated. For pressure lines, notch under pipe bells to provide solid bearing for the entire body of the pipe.

4. Cold Weather Protection: Protect excavation bottoms against freezing.

5. Excavation for structures shall conform to the lines and grades as shown, established or as necessary. Where the bottom of the excavation is in unsuitable material, such material shall be excavated to a depth of 1 foot below the bottom of the structure or to a depth required by the Lousia County Water Authority or Town of Lousia and replaced with No. 57 stone, coarse sand, or other material approved by the Lousia County Water Authority or Town of Lousia. Bottoms shall be covered with appropriate fabric if necessary to prevent the mixture of earth with the backfill material. All sheeting, bracing, and shoring required for safety shall be installed in conformity with applicable rules and ordinances.

6.4.3.3 Hardpan Excavation

Hardpan is classified as indurated clay, shale or sand with a cementitious material, which requires loosening with an air spade or blasting before it can be removed from the trench. The same clearances shall be made between the pipe or structure and hardpan material as is described hereinafter for rock excavation.

6.4.3.4 Rock Excavation

A. Definition: Rock excavation shall comprise solid rock in the original bed or well defined ledges and which can only be removed by blasting and/or drilling or by the use of jack hammers and shall include all boulders or detached pieces of rock one-half cubic yard or more in content.

B. Pipe Trench: Rock shall be excavated a minimum of 6 inches below the bottom of all pipes. The pipes shall be laid on a cushion of #57 stone or other approved material, of sufficient depth to provide the proper grade. A minimum clearance of 6 inches shall be provided between the vertical walls of the trench and the bell of the pipe.

C. Structures: Rock excavation for structures shall extend a minimum of 8 inches below the bottom or base of structure and suitable bedding shall be provided. A minimum clearance of 6 inches shall be provided between the rock and the exterior face of the structure when forming is not used. The minimum clearance shall be 2 feet when forming is used.

6.4.3.5 Blasting

A. Blasting operations shall be in strict accordance with "Rules and Regulations Governing Manufacture, Storage, Handling, Use and Sale of Explosives" issued by the Department of Labor and Industry of Virginia and any County ordinances. All blasting shall be done at the sole risk of the contractor and shall be done only by experienced licensed personnel. **Occupants of nearby structures shall be notified prior to beginning blasting operations.**

B. When blasting is required, the contractor shall conform to the following requirements:

1. Blasting shall not be permitted before 9:00 A.M. or after 5:00 P.M. on Monday through Friday unless otherwise authorized by the County.

2. Blasting on Saturdays, Sundays or holidays shall not be permitted unless specifically authorized by the Lousia County Water Authority or Town of Lousia.

3. The contractor shall, each day when necessary to blast, set up an approximate schedule of blasting operations and provide 24 hours notice to the County and property owners with occupied buildings within 1,000 feet of blasting.

4. The contractor shall use mats to minimize noise and control flying debris.

5. The contractor shall obtain all required permits including a permit from the Lousia County Fire Department.

6.4.3.6 Backfill for Trenches

A. After the installation of the pipe has been field inspected the trenches shall be backfilled as specified and shown in the Lousia County Water Authority and Town of Lousia's Standard Details.

B. Sewer pipe shall have minimum bedding as shown on the Lousia County Water Authority and Town of Lousia Standard Details. Pipe bedding shall be VDOT #57 stone or other material approved by the Lousia County Water Authority or Town of Lousia. Large clods, sticks, stones, and other unsatisfactory material must be excluded from the initial backfill around and to 12 inches above the pipe. Approved soil materials may be used for ductile iron and concrete pipe for the initial backfill. For plastic pipe VDOT #57 stone (or other approved material) must be used for initial backfill to the top of the pipe. The next foot of the initial backfill must be approved soil materials or VDOT #57 stone.

C. The backfill material for ductile iron pipe shall consist of material which has been excavated from the trench. Backfill for PVC pipe shall be compacted VDOT #10 stone/gravel dust to 12 inches above the top of the pipe and then material which has been excavated from the trench. Rubbish, frozen material, broken pavement or other debris, stones greater than a maximum dimension 6 inches, organic muck, or other materials considered deleterious by the Louisa County Water Authority or the Town of Louisa shall not be put back in the trench. Backfill of all pipes within the pavement structure area shall be select backfill minimum CBR20.

D. The initial backfill shall be carefully compacted by hand or pneumatic tamping methods under the pipe, on both sides of the pipe, and above the pipe.

E. After the initial backfill has been placed, the remainder of the backfilling may be done by hand or with mechanical equipment in lifts no greater than 12 inches.

F. Where settlement occurs, the trench shall be refilled contoured and compacted by an approved method to conform to the surface of the ground.

G. Sheeting and bracing shall, in general, be removed as the backfilling progresses and in such a manner as to avoid caving of the trench. Voids left by the withdrawal of the sheeting or shoring shall be carefully filled and rammed. Where, in the opinion of the County, damage is liable to result from the withdrawal of the sheeting it shall be left in place.

H. No large rocks should come in contact with pipe.

I. When, in the opinion of the Louisa County Water Authority or the Town of Louisa, the excavated material is not satisfactory for use as backfill, the material shall be disposed of under direction of the Louisa County Water Authority or the Town of Louisa. Select

material shall be brought in by the contractor. No extra payment will be made for disposing of unsatisfactory material or bringing in select material.

J. Backfill shall be completed in 12-inch layers with the following percentage of maximum density at optimum moisture content as determined by ASTM D698.

    1. 95 percent under pavements, road shoulders and other structures.

    2. 90 percent in all other areas.

K. Under Existing Roadways and Pavement: Backfill for trenches under roadways and other paved areas shall be in accordance with the requirements specified above or, if more stringent, the requirements of the Virginia Department of Transportation or the Town of Lousia.

L. Clay dams: Where required, clay dams shall be installed in the trench to prevent groundwater from flowing down the trench and damaging the subgrade as directed by the inspector. Clay material with an imperviousness of 1x10-3 cm/sec shall be used in clay dams. Dams shall be constructed as shown on DRWG. NO. SEW-9.

M. Remaining trench backfill material shall be compacted as indicated in paragraph A above. inspector shall approve clay material prior to use.

6.4.3.7 Backfill for Structures

Around and adjacent to structures, backfill shall be of material of suitable stability and permeability. Backfill shall be placed in 6 inch lifts, each lift being compacted by an approved method. No backfill shall be placed against a structural wall until all connecting structural members are in place. It shall be the contractor's responsibility to provide compaction to 95 percent per ASTM D 698. The contractor shall provide adequate protection to all structures during backfilling and use every precaution to avoid damaging or defacing them.

6.4.3.8 Construction in Public Streets, Roads and Alleys

Unless superseded by other specifications, the requirements of the Town of Lousia, or the permit requirements of the Virginia Department of Transportation (VDOT) the following shall apply: The contractor's operations in public streets, roads or alleys shall be confined to as small a space as is practicable, so as not to cause undue inconvenience to the public or abutting properties, and shall be subject at all times to the approval of the Lousia County Water Authority or Town of Lousia. Unless otherwise directed by agency controlling the public street, road or alley in which work is occurring, the contractor shall perform proposed construction within public streets, roads and alleys as follows:

A. Typically, water and sewer lines are to cross roadways at right angles and/or to parallel roadways. Uncased utility lines are to be designed to have sufficient strength to withstand dead

loads and superimposed live loads. All restoration materials and workmanship shall conform to the latest edition of the "Virginia Department of Transportation Road and Bridge Specifications" in addition to permit requirements. The contractor is responsible for obtaining all highway permits and forwarding a copy to the County. Method of construction (trenching, boring, tunneling, jacking, etc.) must be shown on permit and plans. The contractor is responsible for identifying, locating, adjusting and/or relocating existing utilities, structures and survey markers (including making all the arrangements necessary to coordinate the work to be performed). **To avoid unnecessary construction delays, the contractor needs to make application for a highway permit at least 10 working days prior to anticipated start of construction**.

Nothing contained herein is intended nor should be construed to relieve the contractor in any manner whatsoever of his responsibility for maintaining trenches, pavement structure, shoulders and generally the work site in an acceptable manner. Prior to the actual open cut, the Department of Public Utilities and the agency within whose jurisdiction the road exists is to be notified 48 hours in advance to arrange a meeting with their representative and the inspector.

B. Wherever pavement is permitted to be cut, not over one-half of the road width shall be disturbed at one time unless an approved method of detouring traffic is reviewed and approved by the agency within whose jurisdiction the road exists. The first opening shall be in drivable condition before the second half can be opened.

C. Where contractor is granted approval to open cut a road by VDOT or the Town of Lousia, the following requirements shall be complied with unless specific permit requirements are more restrictive:

1. VDOT or Town of Lousia, as appropriate, is to be notified 48 hours prior to any open cut work being performed.

2. Work within the roadway shall be done between the hours of **9 A.M. and 3 P.M** unless otherwise approved by VDOT or the Town of Lousia.

3. Utilize proper sign layout and channelization devices (i.e., cones, plastic barrels, pavement marking, etc.) during construction, according to the latest edition of VDOT's "Virginia Work Area Protection Manual", as amended.

4. The area of the open cut shall be restored in accordance with one of the following applicable standards:

    a. Asphalt Road

1. If the average daily traffic count (A.D.T.) is greater than 2,000 vehicles, then the pavement design will be determined by engineer depending on route and location.

b. Asphalt Road

1. Backfill entirely with #21-A or #21 stone (95 percent compaction)
2. Apply tack material to all joints before placing surface mixture.
3. Install minimum 12 inches of BM-25.0 asphalt concrete in 4 inch lifts (see Standard Detail).
4. Overlay a minimum of 25 feet on both sides of trench with 2 inches of surface mix asphalt (SM-9.5A or other approved mixture).
5. Seal all joints with liquid bituminous sealer.

c. Asphalt Road Base with a Surface Treatment Seal

1. Backfill entirely with #21-A or #21-B stone (95 percent compaction).
2. Apply tack coat for all edges and existing surface asphalt (see Standard Detail).
3. Install 1.5 times the thickness of existing pavement or a minimum of 6 inches BM-25 (base mix) flush with existing pavement.
4. Surface treat a minimum of 10 feet on both sides of trench with blotted seal coat type C: The initial seal and final seal shall conform to the requirements of AASHTO M208 @0.17 gal./sq.yd. with 15 lbs. of No. 8P stone per sq. yd. each.

d. Surface Treated Road (Tar and Gravel)

1. Backfill entirely with #21-A or #21-B stone (95 percent compaction).
2. Apply tack coat for all edges and existing surface asphalt (see Standard Detail).
3. Install 4 inches of BM-25 (base mix) in trench flush with existing pavement.
4. Surface treat a minimum of 10 feet on both sides of trench with blotted seal coat type C: The initial seal and final seal shall conform to the requirements of AASHTO M208 @
5. 0.17 gal./sq. yd. with 15 lbs. of No. 8P stone per sq. yd. each.

e. Dirt/Gravel Road or Aggregate Shoulders

1. Select backfill compacted to 95 percent maximum density (6 inch lifts).
2. Backfill trench with 10 inches of #21-A or #21-B stone (95 percent compaction).
3. Apply fresh application of #21-A or #21-B stone to all disturbed areas of the road.
4. The pavement cut shall be covered with a temporary or permanent asphalt patch on the same day that excavation is made.

5. One travel lane will be maintained at all times.

D. Where the contractor is granted approval to open cut the road for parallel installation within the pavement and service crossings, pavement replacement shall be in accordance with the details reflected in these Standards, the approved plans, or the highway permit; whichever is more stringent.

E. Placement of all plant mix and surface-treated courses shall be rolled where possible with a unit having a manufacturer's rating of 10 tons and rolled until the aggregate is keyed into the bitumen. Where rolling is not possible a mechanical tamp will be used. The stone is to be placed in the trench daily up to 1,500 feet at which time the trench shall be covered with a temporary or permanent asphalt patch. If the application of the bituminous layer is delayed for adverse weather conditions, the contractor shall provide and maintain a base course that is acceptable to the Virginia Department of Transportation and/or the Town of Lousia until such time as the appropriate pavement patch can be applied and accepted.

F. Upon completion of the installation of the water and sewer lines (not necessarily all testing completed), contractor shall restore pavement in the manner prescribed on the VDOT or Town of Lousia permit within 10 days. All trenches and repaving shall be maintained in accordance with the highway permit. The existing pavement surface adjacent to the excavated trench shall be milled and repaved with bituminous concrete asphalt (SM-9.5.A or SM-9.5D) to a minimum thickness of 1-1/2 inches (1.5"). This operation shall cover the full width of the trench and extend:

- 12 inches (12") beyond the edge of the trench for longitudinal open cuts, and
- 25 feet (25') beyond the trench centerline for perpendicular open cuts, or
- As otherwise directed by the LCWA or Town of Louisa.

G. Site Maintenance and Restoration: Road connections and private entrances are to be kept in a satisfactory condition. Entrances are not to be blocked and sufficient provisions made for safe travel to adjacent property at all times. When entrances are disturbed, they must be restored to original condition or to a condition satisfactory to VDOT and/or the Town of Lousia, and the property owner. Road drainage is not to be blocked. The pavement, shoulders, ditches, general roadside and drainage facilities shall be left in as good of a condition as found (consistent with adjoining sections of the highway), maintained in a satisfactory condition and establish positive drainage in the ditches. All loose material shall be swept from hard surface immediately after backfilling. Calcium chloride before sweeping or approved alternate shall be used to settle dust whenever necessary. Concrete walks and curbs shall be replaced in entire sections. During rainy periods all trenches shall be watched closely for settlement. If an emergency situation arises under any circumstances, repairs will be made at the contractor's expense. Additionally, after paving is complete, the contractor shall be responsible for any settlement of trenches requiring additional fill, pavement or other corrective measures until the permit or road is accepted (this includes future State or Town roads currently developer owned).

H. Work Zone Protection: The contractor shall immediately correct any situation which may arise as a result of construction that the Louisa County Water Authority or Town of Lousia or any other Agency having jurisdiction over the work area, deems hazardous to the traveling public. The contractor shall comply with the requirements of the agency that issued a permit for the construction.

I. Traffic is not to be blocked, rerouted or otherwise impeded without written permission from the appropriate agency. Placement and type of traffic control, warning devices and personnel shall be in accordance with VDOT "Work Area Protection Manual". Where one way traffic is permitted, contractor shall perform proper flagging for the duration of the project. The contractor will notify the proper agency at least 24 hours before starting work. If traffic is impeded in any way, the same notice must be given to the fire department, rescue squad, VDOT, police department, sheriff and school board. All open trenches, pits, etc. shall be secured with barricades and any other necessary equipment to protect the public. The State of Virginia, Town of Lousia, Lousia County, and Lousia County Water Authority shall not be liable for any damage resulting from construction.

6.4.3.9 Disposal of Waste Materials

A. Removal From Project Site: Remove waste materials including unacceptable excavated material, trash, and debris and dispose of it legally off the project site.

B. Dust Control: Water, calcium chloride or approved alternate shall be periodically applied to alleviate problems associated with dust.

C. Disposal of asbestos cement pipe shall be done in accordance with AWWA Manual 16, "Work Practices for Asbestos Cement Pipe".

6.5 Sanitary Sewer Systems

6.5.1 General

6.5.1.1 Requirements of Regulatory Agencies

Construction as shown on the approved plans, or stated herein, shall be performed in accordance with current and applicable requirements as established by the Lousia County Water Authority, Town of Lousia and the Virginia Department of Environmental Quality or any other agencies having jurisdiction over the construction being performed. Where conflicts arise between the contract documents and previously mentioned requirements, the more restrictive shall apply. If such requirements require a change in the work as stated herein or shown on the plans, the contractor shall stop work and notify the County for further direction.

6.5.2 Products

6.5.2.1 Approved Materials

All materials shall conform to the Lousia County Water Authority and/or Town of Lousia "Approved Materials and Manufacturers" list. All materials shall be new, virgin material. If requested by the Lousia County Water Authority or Town of Lousia, the contractor shall submit a statement from the supplier and/or manufacturer stating that all materials being supplied for the work meet AWWA, ASTM and/or County Standards and, if requested by the Lousia County Water Authority/Town of Lousia, the contractor shall submit the manufacturer's literature for the materials being proposed.

In addition, the contractor may be required to submit shop drawings for approval. If required, the information needs to be sent as far in advance as possible (at least 14 days) to avoid any unnecessary delays in beginning the project. The Lousia County Water Authority or Town of Lousia will require two sets of all approved shop drawings for its use. The certification and/or shop drawings must include manufacturer's name, type of product, location of plant, project name and number, etc. for each product.

6.5.3 Execution

6.5.3.1 Installation of Sanitary Sewer Systems

A. Excavating and Backfilling:
   1. Contractor shall remove any and all materials encountered in the course of excavating for all underground utility systems. After the pipe is in place, backfill with suitable material, free from frozen earth, rocks, organic materials, etc.
      i. Provide all necessary shoring required for the protection of excavations, existing utilities and workmen and do all necessary pumping required to keep excavation and pipe free from water from any source at all times.

      ii. Provide sufficient barricades, etc., adjacent to excavations to safeguard against injury to workmen and the public. Provide and maintain sufficient warning lights at walks, roadways, and parking areas to provide safety at all times.

      iii. Where roots of live trees are encountered in excavations, they shall be carefully protected during construction.

      iv. Exercise special care in backfilling trenches to guard against disturbing the joints.

      v. Remove and dispose of any material not used for backfill.

b. Removal of subsurface obstructions which are uncovered during excavation for installation of the sanitary sewer systems shall be by the contractor at his expense. This shall include removal of existing concrete or brick from existing building foundations, footings, abandoned utility piping, wires, structures, rock boulders, etc., which may not be visible from surface investigations before construction, but will interfere with new installations. If such obstructions are encountered, they shall be removed 2 feet from around the area of new work and the excavation backfilled with a suitable material as specified.

B. Pipe Handling

1. Take all precautions to ensure that pipe and related items are not damaged in unloading, handling and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

2. Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling and placing in trench. Flushing lines shall be required of the contractor when directed to do so by the inspector.

3. Survey Line and Grade:

   a. Line and grade shall be maintained by the contractor and the County provided with cut sheets unless the Lousia County Water Authority or Town of Lousia waives this requirement.

      1) Control point shall be set at a minimum of 50 foot intervals. Line and grade of the laser shall be checked at a maximum of 100 foot intervals.

      2) Standard cut sheet shall be provided to the County showing center line cut each 25 feet where payment for installation is on a cut increment basis and hub cut at each 50-foot station.

      3) The level vial on the grade instrument of the laser shall be checked at a minimum of each 30 minutes of use or more frequent if equipment is being used around the grade instrument that could cause the instrument to become unlevel.

      4) A blower shall be used when required to keep a uniform air temperature in the pipe to prevent any bending of the light beam.

   b. Contractor shall have level or transit in good working order on the job set up at all times to periodically check line and grade of pipe.

4. Sewer Pipe Laying:

   a. Laying of sewer pipe shall be accomplished to line and grade as indicated on the County approved plans and in the trench only after it has been dewatered and the

foundation and/or bedding has been prepared. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surfaces.

b. All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipe shall be laid to conform to the prescribed line and grade shown on the drawings. After completion the pipe shall exhibit a full circle of light at one manhole when viewed from the next.

c. The sewer pipe shall be laid upgrade from point of connection to the existing sewer or from a designated starting point. If the starting point is at an existing stub, it shall be removed and a full length of pipe installed. The sewer pipe shall be installed with the bell end forward or upgrade. When pipe is not being laid the forward end of the pipe shall be kept tightly closed with a watertight plug or cap. When the upstream end of a sewer does not terminate at a manhole, it shall be plugged and its location marked in a manner approved by the inspector.

d. The pipe shall be fitted and matched so that when installed it will form a smooth, uniform invert.

e. Prior to joining the pipe, all surfaces of the pipe to be joined and the surfaces of factory made jointing materials shall be clean and dry. Lubricants, primers, adhesives, etc., shall be applied and the pipes joined as recommended by the manufacturer's specifications. Sufficient pressure shall be applied in making the joint to assure that the pipe is "home", or the pipe is inserted until the home line is even with the edge of the pipe bell. The interior of the pipe shall be cleaned of all foreign material as the work progresses. At the end of the work day, the last pipe laid shall be blocked to prevent creep and closed with a watertight plug or cap.

f. Joining Pipe:

    1) Ductile iron pipe is to be joined in accordance with the requirements of AWWA Standard C600 and the manufacturer's recommendations. All ductile iron pipe shall have an exterior asphaltic coating with PE wrap.

    2) Polyvinyl chloride (PVC) pipe shall be joined in accordance with ASTM Standard D 2321.

    3) Other type pipe shall be joined in accordance with the manufacturer's recommendations and the requirements of the County approved plans and specifications.

g. All visible leaks shall be corrected prior to testing.

h. Pipe laying and joining for force mains shall be the same as the requirements for waterlines.

i. PVC pipe shall be provided with anti-flotation ballast where cover is less than 3 feet.

j. Required polyethylene encasement shall be installed as shown on the plans and in accordance with the manufacturer's recommendation, AWWA C105, and applicable publications and Standards by the Ductile Iron Pipe Research Association (DIPRA).

C. Manhole Installation

1. Manholes shall be constructed to the elevations indicated on the Louisa County Water Authority or the Town of Louisa approved plans in accordance with the Standard Details.

a. Set manhole base section on bed of #57 stone with a minimum depth of 8 inches. Stone shall be thoroughly compacted and carefully leveled to the excavated earth wall.

b. Join all manhole risers, cone top sections, and any other sections by the use of rubber gaskets.

c. Install pipe stubs in manholes where called for on the plans. All stubs shall extend beyond the manhole as reflected on the plans and shall be sealed with a watertight plug or cap.

d. Install flexible manhole connections for all pipes sizes 6 inches to 24 inches, inclusive and apply sealant to completely fill joint between manhole barrel and flexible connection for the full thickness of the manhole barrel.

e. Plug lift holes from the outside with non-shrink grout and repair any defects in manhole.

f. For manhole frame and covers set flush with final grade, set adjusting rings in Portland cement mortar bed or in a bitumastic material (minimum of 1/4 inch thickness). Parge 1/8 inch to 1/4 inch thickness on inside and outside of manhole with Portland cement.

For manhole frames and covers set above grade. Adjusting rings are not allowed. The manhole frame shall be attached to the concrete manhole by the use of two 1/2 inch diameter stainless steel epoxied anchor bolts, two 1/2 inch diameter stainless steel wedge anchors, or two 1/2 inch diameter stainless steel

stud anchors which extend no more than two inches above the top of the manhole frame flange when installed. Stainless steel washers and nuts shall be utilized to firmly attach the frame to the manhole.

The flange of the manhole frame shall be drilled neatly with two 5/8 inch+ holes on opposite sides of the frame which align with the anchor bolts. A bitumastic material shall be placed between the manhole frame and the top of the concrete manhole to seal this space. The exterior of the manhole frame shall have Portland cement neatly placed around it which shall cover the top of the anchor bolts. Where frames and covers are located in off-street areas, they shall be placed raised 12" to 18" above finished grade.

Watertight manhole frame and covers per DRWG. NO. MAN-12 shall be attached with four bolts in addition to the requirements above and be equipped with a Cretex, or approved equal, manhole chimney seal sized to fit the field application.

g. Rings in paved roadways or walkways shall permit upward or downward adjustment of manhole frame. Maximum height of rings shall not exceed 12 inches otherwise the cone section will require removal and a new manhole riser installed to allow for the upward and downward adjustment as stated above.

h. Construct bench of concrete.

1) Elevation of bench at the channel shall be at the spring line of the incoming and outgoing pipe.

2) Bench shall be 3 inches lower at channel than at manhole wall.

3) Where bricked up openings or stubs are provided for future pipe connections, bench and invert shall be so formed.

4) Use Type II sulfate-resistant cement for concrete or mortar on all manholes bench construction.

5) Where sealant is used, bench shall not be in contact with pipe or flexible pipe connection.

6) All inverts shall be smooth.

c. All visible and known leaks shall be corrected prior to testing.

D. Service Connections: Place a tee fitting with 6 inch outlet in the sewer where service connection is to be constructed. Lay 6 inch PVC or ductile iron pipe from the connection to the property line or easement limits on a grade of not less than 1/4 inch per foot unless otherwise shown on plans. Where connections are laid out of manholes, contractor shall use a laser beam. Terminate service connection at the property line with an approved watertight plug and mark the end with a two inch by 4 inch board installed plumb from bottom of 6 inch plug to 2 feet above ground. Service connection shall be of same type of pipe as sewer unless otherwise approved by County. When making a service connection to an existing sewer, the contractor shall use a mechanical hole cutter and approved saddle or Inserta-Tee gasketed fitting.

E. Existing Manhole Tie-In: Core drilling and a flexible pipe-to-manhole connector shall be used in the connection of the sewer pipe to manholes, where stubs or bricked up opening do not exist. DPU inspector shall approve alternative tie-in techniques when the existing manhole cannot be cored due to construction methods or condition. All ties to existing manholes shall be watertight to prevent groundwater for entering the sewer system.

The connector shall be Kor-N-Seal assembly or approved equal.

The connector shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connector manufacturer.

The connector shall be of a size specifically designed for the pipe material and size being utilized on the project. All materials must conform to the approved products reflected in these Standards.

Where bricked up openings exist, a PVC manhole adapter shall be used in the connection of the sewer pipe to precast manholes and installed using the proper conventional methods such as the process established for the "GPK PVC Manhole Adapters" or equal.

6.5.3.2 Testing of a New Sanitary Sewer System

A. Testing Technique for Sanitary Sewer System:

1. Sanitary sewer lines 42 inches in diameter and smaller shall be tested after backfill using a low-pressure air test in accordance with ASTM C828, latest edition. Sewer lines larger than 42 inches in diameter shall be tested by infiltration/exfiltration test. Manholes shall be vacuum tested as directed by DPU inspector. All testing shall be conducted in the presence of the County's inspector. All labor, materials, tools, and equipment necessary to make the tests shall be provided by the contractor. All equipment and methods used shall be acceptable to the Lousia County Water Authority

or Town of Lousia. All monitoring gauges shall be subject to calibration if deemed necessary.

2. Low-Pressure Air Test:

    a. Summary of Method: Plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line. Use the quantity and rate of air loss to determine the acceptability of the section being tested.

    b. Preparation of the Sewer Line: If required by Lousia County Water Authority or Town of Lousia, flush and clean the sewer line prior to testing and cleaning out any debris. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line that is being tested. Give special attention to laterals.

    c. Ground Water Determination: If a line is located below the water table the elevation of the water table must be determined prior to testing. To determine the elevation of the water table the following procedure shall be utilized unless another procedure is approved by the inspector. Install a 1/2 inch capped galvanized pipe nipple, approximately 12 inches long through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.

    d. Procedures: Determine the duration for the section under test by computation from the applicable formulas shown in ASTM C828, latest edition. The pressure-holding time is based on an average holding pressure of 3 psi gage or a drop from 3.5 psi to 2.5 psi gage.

        Add air until the internal air pressure of the sewer line is raised to approximately 4.0 psi gage. After an internal pressure of approximately 4.0 psi is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

        When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gage, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psi. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gage during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psi drop has not occurred.

The test procedure may be used as a presumptive test which enables the installer to determine the acceptability of the line prior to backfill and subsequent construction activities.

If the pipe to be tested is submerged in ground water, the test pressure shall be increased by 1.0 psi for every 2.31 feet the ground water level is above the invert of the sewer.

e. Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. A force of 250 lbs. is exerted on an 8 inch plug by an internal pipe pressure of 5 psi. It should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

   As a safety precaution, pressurized equipment shall include a regulator or relief valve set at no more than 10 psi to avoid over- pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3. When requested by DPU, manholes shall be tested for watertight connections using the negative air pressure test (vacuum) in accordance with ASTM C 1244, latest edition. Manholes will be visually inspected after backfilling. contractor may backfill before testing with the understanding that any repairs will be made from the exterior of the manhole.

   Manholes shall be vacuum tested and shall have 10 inches of mercury applied to the manhole and the time measured for the vacuum to drop from 10 inches to 9 inches of mercury. Vacuum equipment shall be approved by County prior to its use. See Drawing SEW-10 for minimum allowable test times for manhole acceptance at the specified vacuum drop.

   Test times for structures other than manholes will be based on the times for manholes of the nearest equivalent volume or as directed by the inspector.

   Written verification must be furnished that the following steps are followed:

   a. The test method is only to be applied to precast concrete manholes.

   b. Stub-outs, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

c. If a manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test.

4. Test for leakage of gravity sewers using either the infiltration or exfiltration test:

a. Allowable leakage shall be 50 gallons per inch of pipe diameter per mile per 24 hours up to a maximum of 2,400 gallons per mile per 24 hours for gravity sewers greater than 42 inches in diameter.

b. Use infiltration test when ground water is at least 4 feet above pipe crown along entire length of line to be tested. Plug the pipe at the upper manhole. Install suitable measuring device at the next downstream manhole. Measure the amount of water flowing through the outlet after flow has been stabilized. Test shall be conducted in accordance with ASTM C-654.

c. Ground Water Determination: Use same procedure as "low-pressure air test" above.

d. Exfiltration test shall be accomplished by plugging the sewer at the downstream end and filling the upstream manhole with water to the top of the manhole.

B. Testing Requirements for Sewer Force Mains:

1. All pressure testing shall conform to the requirements as established for Water Systems or as directed in the specific contract documents.

C. Testing of Manholes

All manholes shall be tested by vacuum testing.

1. Vacuum Test
All vacuum testing shall be performed prior to backfilling around all manholes.

All pipe openings shall be plugged by pneumatic or mechanical plugs and braced to sustain 10" mercury vacuum. The rim to cone joint shall be tested on all manholes. No one shall be inside the manhole during testing. The test shall be at 10 in. mercury.

Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer.

Minimum time to hold 1 in Mercury Drop

MH Dia.	MH Height	Hg	Time (Minimum)
4'	10' or less	1 in	1 min. 0 sec.
4'	10' – 15'	1 in	1 min. 15 sec.

4’	15’ – 25’	1 in	1 min. 30 sec.

For manholes five feet in diameter, add an additional 15 seconds and for manholes six feet in diameter, add an additional 30 seconds to the time requirements for four-foot diameter manholes.

If a manhole joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

6.5.3.3 Tracer Wire and Locating Tape

Force mains shall have a tracing wire and locating tape installed.

A tracing wire of 12 gauge copper or Trace-Safe by Neptco, 19 gauge conductor shall be installed and taped directly on top of the pipe in a manner that a continuous trace results. Wire is to be run through all force main appurtenance manholes or boxes and shall be accessible for test hook-up at all manholes, boxes, and test stations. The tracing wire must be completely insulated from ground. The tracing wire will be attached to the top of the pipe using duct tape at an interval no greater than 16 feet. Tracing wire within test stations, appurtenance manholes, or other boxes shall be stripped 3/4 inch from the end and capped with a wire nut to minimize electrical ground contact. All connections at the main line must be electrically sound and physically secure with screw connections or clamps. In addition all connections must be taped with electrical tape and sealed with an electrical coating sealant. Test stations shall be installed at intervals of no greater than 1,000 feet along force mains. Concrete pads, as detailed, shall be provided for test stations on force mains and a line marker/witness post installed per Section 6.5.3.4 when located outside of a right of way. Tracing wire for force mains shall be color coded green. See Section **Error! Reference source not found.** for further details.

Locating tape shall be installed in the trench approximately 12 inches below finish grade. Tape shall be polyethylene with metallic core, two inches in width, with continuous printed message “Caution - Force Main Buried Below". Tape shall be manufactured by the Seton Name Plate Corp. or approved equal.

See Sections **Error! Reference source not found.** and **Error! Reference source not found.** for more information on tracing wire and marking tape.

6.5.3.4 Line Markers/Witness Post

In easements and in undeveloped wooded areas, plastic markers shall be installed every 200 feet, and at all manholes, valves, and fittings. Markers shall be as manufactured by Carsonite or approved equal. Exceptions are where sanitary gravity and force main lines are installed in "kept" yards where the property owners may object to the placement of these markers. Contractors will

be required to properly install the markers per manufacturer's recommendations, parallel to the sewer line facing roadway, or as additionally directed by the County.

6.5.3.5 Abandonment of Sanitary Sewer Service

Excavate at the main and expose the lateral connection. Sever the lateral pipe in the vicinity of the main and cap both ends of the pipe as approved by the inspector. If it is impractical to excavate the lateral at the main due to depth or location, e.g. a highly travelled road, then the service shall be abandoned using an inserted expandable plug, (Zurn is an acceptable manufacturer) which is inserted down the service to the vicinity of the main and then grout filled behind to seal the pipe. The sewer main shall be inspected with CCTV to verify that it was not affected by the work prior to tentative acceptance being granted by the Lousia County Water Authority or Town of Lousia.

6.5.3.6 Abandonment of Sanitary Sewer Mains and Manholes

Sanitary sewer mains and manholes to be abandoned shall be permanently disconnected from the remaining system. Details of special abandonment shall be approved by the Department on a case-by-case basis and per Drawing MAN-15.

All open ends on abandoned pipe to be permanently sealed by plugging with a pipe plug or cap unless otherwise approved. Salvageable items shall be returned to the Louisa County Water Authority or Town of Lousia.

6.5.3.7 Clean-up

Upon the completion of the installation of the sanitary sewer system and prior to tentative acceptance by the County, sediment and debris shall be removed from the system. Unless waived by the inspector, the contractor shall flush the sewer system and install proper devices to capture debris flushed from the sewer system so that it does not enter the County’s existing sewer system prior to the County issuing Tentative Acceptance for the project. The work area shall be restored to its original condition and pavement replaced to the satisfaction of VDOT, the Town of Lousia and, and/or the County. All trash and debris shall be removed and properly disposed. Areas not otherwise stabilized shall be seeded and mulched and a good stand of grass established.

6.5.3.8 Deflection Test for PVC Gravity Pipe

All PVC pipe with a stiffness of 200 psi or greater may be excluded from the deflection test (Manufacturer shall certify stiffness in excess of 200 psi). Deflection tests shall be a test on installation and be performed no sooner than 30 days after final full backfill has been placed. The contractor shall test the pipe for deflection by means of a GO-NO-GO mandrel to assure that a deflection of 5 percent has not been exceeded. The mandrel, one for each size pipe, shall be a nine

arm mandrel, with proving ring, sized at 5 percent less than the ASTM dimension for the pipe in accordance with TABLE II.

The mandrel shall be pulled through the sewer line manually. Ten percent of all sewer line shall be tested at locations specified by the Louisa County Water Authority or the Town of Louisa. Should any of the 10% fail the test, it shall be corrected until it does pass the test, at the contractor's expense. Additional sewer shall be tested at the discretion of the Louisa County Water Authority or the Town of Louisa, and any sewer not passing the test shall be corrected until it does pass the test.

Table 6.1. Deflection Test for PVC Gravity Pipe

TABLE II

Nominal Diameter (inches)	L (inches)	PVC-SDR 35 ASTM D3034 D (inches)
8	8	7.50
10	10	9.33
12	12	11.16
15	15	13.60
18	18	16.60

L = Mandrel Arm Length

D = I.D. of Proving Ring

6.6 Water Distribution System

6.6.1 General

6.6.1.1 Requirements of Regulatory Agencies

Construction as shown on the plans or stated herein shall be performed in accordance with current and applicable requirements as established by the Lousia County Water Authority, Town of Lousia and the Virginia Department of Health or any other agencies having jurisdiction over the work being performed. Where conflicts arise between the construction documents and previously mentioned requirements, the more restrictive shall apply. If such requirements require a change in the work as stated herein or shown on the plans, the contractor shall stop work and notify the County immediately for further direction.

6.6.2 Products

6.6.2.1 Approved Materials

All materials shall conform to the Lousia County Water Authority and Town of Lousia "Approved Equipment Manufacturers" list. All materials shall be new, virgin material. If requested by the Lousia County Water Authority or Town of Lousia, the contractor shall submit a statement from the Supplier and/or Manufacturer stating that all materials being supplied for the work meet AWWA, ASTM and/or Lousia County Water Authority and/or Town of Louisa Standards. If requested by the Louisa County Water Authority and/or the Town of Louisa, the contractor shall also submit the manufacturer's literature for the materials being proposed.

Shop drawings, as defined in the General Section, and operation manuals are required on projects where there are special structures, and on Pump Stations, Tanks, Pressure Reducing Vaults and Treatment Plant projects. This requirement includes, but is not necessarily limited to pipe and accessories, manholes and appurtenances, valves, and other assorted products, etc. Shop drawings shall be submitted by the contractor to the Lousia County Water Authority or Town of Lousia for approval. The information needs to be sent as far in advance as possible (at least 14 days) to avoid any unnecessary delays in beginning the project. The contractor shall submit 4 more copies than he wants returned for review and approval by the engineer and Lousia County Water Authority and/or the Town of Lousia. The contractor shall submit an electronic pdf and hard copy of all approved shop drawings in a three-ring binder format.

The certification and/or shop drawings must include manufacturer's name, type of product, location of manufacturing plant, project name and number, etc. for each product.

6.6.3 Execution

6.6.3.1 Installation of New Water Systems

A. Excavating and Backfilling:

1. Contractor shall do all excavating of any and all materials encountered in the course of excavating for all underground utility systems. After the pipe is in place, backfill with suitable earth free from rocks, organic material, etc.

   a. Provide all necessary shoring required for the protection of excavations, existing utilities and workmen and do all necessary pumping required to keep excavation and pipe free of water from any source at all times.

   b. Provide sufficient barricades, etc., adjacent to excavations to safeguard against injury to workmen and the public. Provide and maintain sufficient warning lanterns at walks, roadways, and parking areas to provide safety at all times.

   c. Where roots of live trees are encountered in excavations, they shall be carefully protected during construction.

   d. Exercise special care in backfilling trenches to guard against disturbing the joint.

   e. Remove and dispose of any material not used for backfill.

2. Removal of subsurface obstructions which are uncovered during excavation for installation of the water systems shall be removed by the contractor at his expense. This shall include removal of existing concrete or brick of existing building foundations, footings, abandoned utility piping, wires, structures, rock boulders, etc., which may not be visible from surface investigations before construction, but will interfere with new installations. If such obstructions are encountered they shall be removed 2 feet from around the area of new facility and backfilled with a suitable material as specified.

B. Pipe Installation:

1. Take all precautions to ensure that pipe and related items are not damaged in unloading, handling and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged materials.

2. Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling and placing in trench. contractor shall be responsible for plugging or capping line at the end of each day.

3. Do not lay pipe when weather or trench conditions are unsuitable.

4. Line and grade hubs shall be set by a registered surveyor at intervals to accurately insure proper location of waterline and appurtenances. This shall include finished grade centerline stakes for fire hydrants, stakes at all fittings referencing all property pins, etc. Cut sheets are required where the waterline is to be laid to a grade according to the profiles in the plans, or where the future road grade is not yet to within six (6) inches of its final location.

5. Water Pipe Laying:

   a. Laying of water pipe shall be accomplished only after the trench has been dewatered and the foundation and/or bedding has been prepared. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surfaces.

   b. All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipe shall be laid to conform to the prescribed line and grade shown on the plans and shall include digging out for bell ends.

   c. Water pipe runs intended to be laid straight shall be so laid. Deflection from a straight line may be made by deflecting the joints only when permission has been given. Joint deflection in pipe shall not exceed one-half that recommended by AWWA Standards or the manufacturer whichever is less (ductile iron installations only). Changes in grade or alignment which cannot be made by deflecting pipe joints shall be made by use of proper bends, offsets or special fittings as required (ductile iron only). PVC pipe joint deflection is not permitted per Section 6.6.3.1.B.j.2.a.5.

   d. The water pipe, unless otherwise approved by the inspector, shall be laid upgrade from point of connection of the existing water main or from a designated starting point. Water pipe shall be installed with the bell end forward or upgrade. When pipe is not being laid, the forward end of the pipe shall be kept tightly closed with a watertight plug or cap; plywood or plastic is not acceptable.

   e. The pipe shall be fitted and matched so that when laid in the work, units will form a smooth, uniform invert.

f. Prior to joining the pipe, all surfaces of the pipe to be joined and the surfaces of factory made jointing materials shall be clean and dry. Lubricants, primers, adhesives, etc., shall be applied and the pipes joined as recommended by the manufacturer's specifications. Sufficient pressure shall be applied in making the joint to assure that the pipe is "home". The interior of the pipe shall be cleaned of all foreign material as the work progresses. At the end of the work day, the last pipe laid shall be blocked to prevent creep, and closed with a watertight plug or cap.

g. For waterlines, if dirt that, in the opinion of the Louisa County Water Authority or the Town of Louisa, will not be removed by the flushing operation enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a 5 percent hypochlorite disinfecting solution.

h. If the pipe laying crew cannot put the pipe in the trench and in place without getting earth into the pipe, the Louisa County Water Authority or the Town of Louisa may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size be placed over each end left there until the connection is to be made to the adjacent pipe.

i. Trenches shall not be left open for more than 500 feet in advance of the completed pipe laying operation.

j. Joining Pipe
   1) Ductile iron pipe to be joined as follows:

      (a) Mechanical joint pipe:

         (1) When installing PVC pipe into M.J. fittings, the beveled end of the pipe must be cut off to allow for maximum insertion depth and sealing area to avoid leaks. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter from the joint. Paint the bell and spigot with soap solution (1/2 cup granulated soap dissolved in 1 gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

         (2) Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around

the joint. The gland is moved into position, bolts inserted and nuts turned finger tight.

Tighten all nuts to torque listed below:

Bolt Size (inches)	Torque (ft - lbs)
5/8	40 -60
3/4	60 - 90
1	70 - 100
1 - 1/4	90 - 120

(3) Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed, and torque value is reached.

(4) Permissible deflection in mechanical joint pipe shall not be greater than one-half of that listed in AWWA C600.

(b) Push-on joint ductile iron pipe:

(1) Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to the gasket and spigot end of the joining pipe.

(2) Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.

(3) Permissible deflection in push-on joint pipe shall not be greater than 1/2 of that listed in AWWA C600.

2) Polyvinyl chloride (PVC) pipe shall be joined in accordance with the manufacturer's recommendations.

(a) Polyvinyl Chloride (PVC) Push-on Joint Pipe:

1) Thoroughly clean inside of the bell and 1 inch beyond the reference mark on the spigot end of the joining pipe. Make

certain the bell and rubber gasket have no foreign material that could interfere with the proper assembly of the pipe spigot.

2) Lubricate the gasket and spigot end of the pipe, using lubricant supplied by pipe manufacturer.

3) Insert the spigot end into the bell. Align the pipe sections and push the spigot end in until the reference mark on the spigot end is flush with the end of the bell. Use a bar and block of wood to push pipe home.

4) Field cut pipe shall be square cut and beveled to insure proper assembly. Use a factory finished beveled end as a guide to produce an equivalent angle and length of taper.

5) Deflection of the joint or the length of pipe by bending is strictly prohibited for PVC pipe. PVC pipe is to be laid on a straight line and all deflections made using the appropriate degree bend.

Waterline bend locations shall be included in the construction stake out.

3) Asbestos Cement Transition:

1) When connecting PVC or Ductile Iron pipe to existing asbestos cement pipe, the transition coupling is to be applied to the rough barrel of the asbestos cement pipe and not to a factory or machined end of the asbestos cement pipe.

k. A tracing wire shall be installed and taped directly on top of the pipe in a manner that a continuous trace results. Wire is to be wrapped around hydrants, blow offs and corporation stops and shall be accessible for test hook-up at all water meter boxes, and test stations. The tracing wire must be continuous and completely insulated from ground. The tracing wire will be attached to the top of the pipe using duct tape at an interval no greater than 16 feet. Tracing wire within test stations and meter boxes shall be stripped 3/4 inch from the end and capped with a wire nut to minimize electrical ground contact. Test stations shall be installed within 2 feet of all fire hydrants and at intervals no greater than 1,000 feet. All connections at the main line must be electrically sound and physically secure with screw connections or clamps. All connections must be taped with electrical tape and sealed with an electrical coating sealant. Tracing

wire for water mains shall be color coded blue. See Section 3.3.1 for further details.

l. Place underground warning tape directly above all water mains, 12 inches below finished grade. Tape shall be polyethylene tape with a metallic core, two inches in width, with the continuous printed message “Caution - Waterline Buried Below”. Tape shall be manufactured by the Seton Name Plate Corp. or approved equal.

m. See Section **Error! Reference source not found.** for more information on marking tape.

n. In easements and in undeveloped wooded areas, plastic markers shall be installed every 200 feet and at all manholes, valves, and fittings. Markers shall be per Section **Error! Reference source not found.** for further details.

Exceptions are where waterlines are installed in "kept" yards where the property owners may object to the placement of these markers. Markers are required to be properly installed per manufacturer's recommendations parallel to the waterline and facing the roadway. Generally for waterline construction, the Lousia County Water Authority or Town of Lousia will install the necessary markers. If the contractor is going to be required to install the markers, the requirement will be specifically called out on the plan.

o. Required polyethylene encasement shall be installed as shown on the plans and in accordance with the manufacturer’s recommendation, AWWA C105, and applicable publications and Standards by the Ductile Iron Pipe Research Association (DIPRA).

C. Installation of Valves, Fitting, Hydrants

1. General: Valves, fittings and hydrants shall be set and joined to the piping system as specified for cleaning, laying and joining pipe.

2. Valves and Valve Boxes: Cast iron valve boxes shall be firmly supported, centered and plumb over the operating unit of valve. Box cover shall be set flush with the surface of finished pavement or at such other level as may be directed by the inspector. Valve rod extension with guide shall be required to maintain a maximum distance of two-feet-four-inches from operating nut to top of box and per Drawing WAT-12. All valves shall be properly restrained.

Valve boxes not located in pavement or concrete shall have a two foot square by 4 inches thick concrete pad poured around them. Concrete pad

shall be neatly formed with a troweled finish. Concrete shall be minimum 3,000 psi concrete. In limited circumstances, such as when the valve box is located in a narrow ditch bottom (a situation that should be avoided if possible) and pouring the pad would require widening the ditch, the inspector may waive the requirement for the concrete pad or reduce the dimensions of the concrete pad.

Butterfly valves in paved areas shall be installed in a manhole per DRWG. NO. MAN-14.

3. Cross Connections: Drainage branches or blow-offs shall not be connected to any sewer, submerged in any stream or installed in any manner which in the opinion of the inspector will constitute a contamination or cross-connection hazard.

4. Hydrants:

Connection to Main: Each hydrant shall be restrained and connected to the main as shown in the Standard Details. Each hydrant shall be provided with a minimum six inch diameter ductile iron branch, controlled by an independent six inch resilient seat gate valve.

Setting of Hydrants: When hydrants are set, a drainage pit 2 feet in diameter and 2 feet below the bowl of the hydrant shall be excavated. *Hydrants shall be located and installed in accordance with current VDH regulations.*

All hydrant valves shall be restrained to the hydrant tee on the main line.

The pit shall be filled with coarse gravel or #57 clean stone, mixed with coarse sand, to a level of 6 inches above the weep hole. No hydrant drainage pit shall be connected to a sewer. The bowls of all hydrants shall be restrained to the pipe with approved restraint systems. All hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

5. Anchorage of Fittings: All fittings (i.e., each bend, tee, plug, valve and cap) shall be prevented from moving by means of adequate thrust reaction blocking and/or mechanical restraints as shown in the Standard Details and approved by the inspector.

6. In easements and in undeveloped wooded areas, plastic markers shall be installed every 200 feet and at all valves and fittings. Markers shall be per Section **Error! Reference source not found.**. Exceptions are where

waterlines are installed in "kept" yards where the property owners may object to the placement of these markers. Markers are required to be properly installed according to the manufacturer's recommendations parallel to the waterline and facing the roadway. Generally, for waterline construction, the Lousia County Water Authority or Town of Lousia will install the necessary markers. If the contractor is going to be required to install the markers, the requirement will be specifically called out on the plan.

D. Installation of Fabricated Steel Tapping Sleeves:

1. General: The following testing and conditions apply to all sleeves:
   i. The tapping sleeve shall be tested in place to a minimum of 200 psi, for a minimum of 10 minutes with no loss of pressure.

   ii. If the sleeve fails the 200 psi pressure test, the original failed sleeve shall be replaced with an entirely new sleeve.

   iii. Tapping sleeves 16 inches and larger shall be supported by a concrete pedestal support, as approved by the inspector.

2. For Rockwell Tapping Sleeves in addition to the conditions outlined in 1 above, the following procedures must be followed by the contractor:
   i. Clean pipe surface thoroughly, particularly in the area where the gasket will seal. The contractor shall wipe the pipe in the area where the tap is to be made with a 1 percent chlorine solution prior to installing the sleeve.

   ii. Lubricate pipe and gasket with soap and water. Under no condition shall antifreeze be used.

   iii. Mount body halves on pipe. Contractor shall ensure gasket is secure in gasket groove.

   iv. Insert bolts and hand tighten nuts, keeping equal gaps between body halves.

   v. Prior to tightening nuts, position outlet as required to suit the installation. Contractor shall ensure test connection is accessible.

   vi. Tighten bolts, alternating from one side to the other to equalize the gap between halves. Continue to tighten bolts until sleeve halves conform to the contour of the pipe and all bolts are to a uniform tightness. The required torque for dry threads will be 70-100 ft. lbs. (Lubricated threads 35-50 ft. lbs.). On thin wall or badly corroded pipe care should be taken to prevent crushing or collapsing of the pipe.

vii. A pressure test is required prior to tapping to test the sleeve and valve in place.

Prior to pressure testing, the inspector shall obtain a reading of line pressure in the system, either from a hydrant or a service. The pressure test should be at 2-1/2 times line pressure or 200 psi, whichever is **greater**. The duration of this pressure test shall be a minimum of 10 minutes. If the sleeve fails the pressure test it shall be completely removed and returned and a new sleeve used. The tapping sleeve, valve and tapping machine assembly is to be adequately supported during the tapping operation to prevent movement or rotation of the tapping sleeve.

viii. Proceed with tapping operation.

Contractor shall complete tapping procedure and perform the necessary checking as required. Contractor shall furnish the inspector with the tap coupon.

ix. Check the bolts for tightness and re-torque, if required.

E. Installation of Services:

1. 3/4 inch and 1 inch:

a. Taps shall be made on a 45 degree angle and utilizing a saddle.

b. Corporation stops shall have "cc" thread inlet and compression fitting outlet.

c. Tap shall be made with a tapping machine equipped with a bit designed for the type of pipe being tapped.

d. Distance between taps or from a joint or bell shall be a minimum of 18 inches.

e. Service pipe shall be SDR-7.

f. Services shall be installed with 42 inches minimum cover up to meter yoke where yoke shall be installed so that meter will set 12 inches to 18 inches below finished grade.

g. Meter yokes shall be from approved materials list and be installed with a tail piece SDR-7, approximately 18 inches long.

h. Meter yoke and box shall be set 1 foot inside right-of-way or easement or as directed by the inspector. Meters shall be installed on reasonably level ground or conform to the angle of the slope. Meter locations shall be staked

by a licensed surveyor in order to assure that they are properly located in reference to the right-of- way boundary, utility easement boundaries, and adjacent properties' separating boundary line.

i. Backfill shall be hand tamped up to service pipe at tap to prevent corporation stop from being broken off during backfilling.

j. Water meter boxes in areas subject to vehicular traffic to be constructed of cast iron.

k. A corporation stop of the same size of the service line shall be installed upstream of the meter yoke inside the water meter box.

2. 1-1/2 inch and 2 inch Services:

a. Services shall be made utilizing a four inch branch tee with a 4 inch gate valve and 4 inch ductile iron "service" line to the edge of the pavement or behind the curb. 4 inch service line is to end with a restrained tapped cap where service will transition to 2 inch SDR-7 to the proposed meter. All piping shall be restrained joint from the tee to the cap. See DRWG. NO. MET-8B for further details and alignment of appurtenances.

b. Coupler shall have iron pipe thread (IPT) c inlet and compression outlet.

c. Service pipe shall be SDR-7.

d. Services shall be installed with 42 inches minimum cover up to meter yoke where yoke shall be installed so that meter will set 12 inches -18 inches from finished grade.

e. Meter setters shall be from approved materials list and be installed with a valved bypass and a tail piece of SDR-7, approximately 18 inches long.

f. A corporation stop of the same size of the service line shall be installed upstream of the meter yoke inside the water meter box.

g. Meter setters and box shall be set 1 foot inside right-of-way or easement or as directed by the inspector. Meters shall be installed on reasonable level ground or conform to the angle of the slope. Meter locations shall be staked by a licensed surveyor in order to assure that they are properly located in reference to the right-of- way boundary, utility easement boundaries, and adjacent properties' separating boundary line.

h. Backfill shall be hand tamped up to service pipe at tap to prevent corporation stop from being broken off during backfilling.

F. Installation of Water Mains and Water Meter Boxes Related to Sidewalks

1. Sidewalks and waterlines shall be constructed to accommodate at least a four foot horizontal separation between the sidewalk and the public water main(s).

2. When sidewalks are constructed with a proposed project, the street side of all water meter boxes shall be installed 3 feet behind the house side of the sidewalk or to the right-of-way line, whichever is greater. If meter is located outside of the public right-of-way, then an appropriate sized utility easement must be provided and proper coordination with all other utilities accounted for. Coordination and consideration shall also be given to conflicts between public water facilities and required streetscape, if applicable.

6.6.3.2 Testing of Water Distribution System

A. Testing Techniques for Water Distribution System:

1. Each properly isolated section of the piping system including all water services, shall be subjected to a pressure test of 150 psi, or 1-1/2 times the working pressure whichever is greater, measured at the high point of the system. Maintain this pressure for a minimum of two hours with zero allowable leakage. Prior to applying pressure to the lines, all reaction blocking, and/or mechanical restraints shall have been completed to the satisfaction of the inspector. As the pipes are being filled, all air shall be expelled from the pipes by providing manual air relief valves at the high points of the system. All testing shall be done in the presence of the Louisa County Water Authority or the Town of Louisa. The first mile or 20% of the total quantity, whichever is less, of waterline shall be tested prior to proceeding with the project. Thereafter, line testing shall be done in increments of one mile or 20% of the total quantity, whichever is less.

   Any defects discovered during this test shall be repaired and the test repeated until the results are satisfactory to the inspector. The contractor shall provide all equipment, materials and labor necessary to conduct the test. The contractor shall provide a suitable test pump and properly calibrated gauge or other means for measuring leakage which is satisfactory to the inspector.

2. Water from the public water system shall be used for flushing, sterilization and testing. Filling of water main may be performed provided permission has been obtained from the inspector who will be responsible for coordinating this activity with the Louisa County Water Authority or Town of Lousia and the

appropriate backflow prevention device is installed. Contractor is not permitted to operate valves on existing lines unless approved by the inspector.

3. Testing shall be performed in accordance with the AWWA Specifications, latest revision or as directed by the inspector.

6.6.3.3 Disinfection

A. Prior to being placed in service, the pipe line and appurtenances shall be disinfected in general accordance with ANSI/AWWA C651, latest edition; AWWA Standard for **Disinfecting Water Mains** and the supplemental procedures as set forth below:

1. Section 3 of AWWA C651 emphasizes six basic procedures in the disinfection process. These procedures are to:

   a. prevent contaminating materials from entering the water main during storage, construction, or repair;

   b. remove, by flushing or other means, those materials that may have entered the water main;

   c. chlorinate any residual contamination that may remain, and flush the chlorinated water from the main;

   d. protect the existing distribution system from backflow due to hydrostatic pressure test and disinfection procedures;

   d. determine the bacteriological quality by laboratory test after disinfection; and

   e. make final connection of the approved new water main to the active distribution system.

2. Preliminary Flushing:
   a. The main shall be flushed prior to disinfection at a velocity of not less than 2.5 ft/s unless the inspector determines that conditions will not permit the required flow. See Table 6.2 Flushing Schedule. Adequate provisions shall be made by the contractor for disposal and neutralization of flushing water so that no physical or environmental damage results. Contractor will find additional instructions on flushing in the supplemental procedures within this section.

3. Forms of Chlorine for Disinfection:

a. It is the contractor's responsibility to be familiar with and have available for his employees the "Product Data Safety Sheets" of any products used as a source of chlorine and to provide the proper safety instructions and personal protective equipment to the employees mixing and using materials for disinfection of the water facilities.

b. **Only liquid sodium hypochlorite (household and industrial strength bleach) are acceptable sources of chlorine for disinfection.**

   Sources of chlorine shall be in conformance with AWWA B300 Standard for Hypochlorites, and NSF 60 and 61.

c. The use of chlorine gas is hazardous and is **strictly prohibited** for use of disinfection of public waterlines.

d. The use of calcium hypochlorite pills affixed to the interior of water pipe for disinfection **shall not be an acceptable form of disinfection.**

e. The mixing of a source of chlorine to obtain a suitable disinfecting solution shall be as follows:

   1) Liquid sodium hypochlorite is supplied in strengths from 5.25 percent available chlorine (commercially available household bleach) to 15 percent available chlorine (industrial strength sodium hypochlorite). A water-sodium hypochlorite solution shall be prepared by adding liquid sodium hypochlorite to water.

   2) A water calcium hypochlorite solution shall be prepared by dissolving calcium hypochlorite granules containing 65percent available chlorine by weight in a pre-determined volume of water to make the desired water-calcium hypochlorite concentration. Disinfection of new mains by water calcium hypochlorite solution shall not be used unless a suction or in-line strainer is available on the solution pump to prevent any undissolved solids from entering the piping. An alternative method of straining the solution to remove undissolved granules may be approved by the inspector on a case-by-case basis.

4. Methods of Chlorine Application and Testing:

a. The continuous feed method of applying the disinfecting solution shall be as follows: Water from the existing distribution system or other approved sources of potable water supply shall flow through an approved backflow prevention device (see DRWG. NO. WAT-13 for further information) at a constant, measured rate into the newly-laid pipeline. The water shall be mixed with a chlorine-water solution as prepared above, also fed at a constant measured rate. The two rates shall be proportioned so that the chlorine concentration of the water and water/chlorine solution in the pipe is elevated to and maintained at a minimum of 50 mg/l available chlorine. Since the forms of preparation for a water-sodium hypochlorite or water-calcium hypochlorite concentration are a batch process, a method acceptable to the inspector shall be available to replenish the concentration being fed and mixed with the water flow, so there is no interruption of the flow of disinfection solution. To assure that this concentration is maintained, the chlorine residual shall be measured at intervals not exceeding 1,200 feet and at the end of all branch lines or cul-de- sacs in accordance with the procedures outlined herein. During the application of the chlorine-water solution, valves, hydrants and any other appurtenances shall be operated in order to be thoroughly disinfected. Chlorine-water solution application shall continue until the entire new main is filled with water having a residual of a minimum of 50 mg/l chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours. The free chlorine residual must be at least 10 mg/l after 24 hours in accordance with AWWA C651.

b. The owner or contractor will furnish the personnel and equipment for determining water-chlorine solution strengths and residuals.

c. After the applicable retention period, the heavily chlorinated water shall be flushed (low-flow) from the main until the chlorine residual of the water leaving the main is equal to the chlorine residual of the incoming system water. Additional instructions for disposal of the heavily chlorinated water are covered in Section 6.6.3.4, entitled “Flushing”.

5. Dechlorination:

a. Chlorinated water shall be de-chlorinated before disposal. Water shall not be allowed to flow into a waterway without neutralizing the disinfectant residual. See the appendix of AWWA C651, C652, and C653 for acceptable neutralization methods.

B. Bacteriological Tests:

1. After low-flow flushing, and before the water main is placed in service, samples shall be collected and tested for bacteriological quality. Two consecutive negative tests from the same location shall show the absence of coliform organisms. At least two samples shall be collected and tested by a State of Virginia certified laboratory at least 24 hours apart at intervals determined by the inspector (not exceeding 1,200 feet apart and at the end of all branch lines and cul-de-sacs).

2. Samples for bacteriological analysis shall be collected in approved sterile bottles or bags treated with sodium thiosulfate. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory and disinfection shall be repeated as prescribed above until the samples are satisfactory. Cleaning, disinfection and testing shall be under the direction of the inspector but remains the responsibility of the contractor. The contractor shall be responsible for any cost associated with the loading, hauling, discharging and dechlorination of the heavily chlorinated water.

6.6.3.4 Supplemental Procedures for Disinfecting, Testing, and Flushing

A. General:

1. All work shall be performed in general accordance with AWWA C651, latest edition.

2. The supplemental procedures are developed to compliment the AWWA C651 Standard, particularly with respect to flushing, testing and tie-in to the existing water distribution system.

3. These procedures and construction acceptance for final tie-in of a new water main are performance based, predicated on the new construction passing pressure and bacteriological testing. In order to best assure satisfactory bacteriological results, it is essential that all aforementioned preventive and precautionary measures be taken prior to and during construction to protect the interiors of pipe, fittings and valves against contamination. Failure to follow the precautionary measures increases the likelihood of unsatisfactory bacteriological tests and increases the construction requirements necessary for final acceptance. Refer to AWWA C651, Section 4, entitled “Preventive and Corrective Measures During Construction”.

4. No contaminated material or any material capable of supporting the growth of microorganisms or causing taste, odor, or other aesthetic water quality concerns

shall be used in sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation or sealing gaskets shall be as supplied by the pipe manufacturer and suitable for application in a potable water system. It shall be kept clean and applied clean with dedicated applicators.
Note: The Lousia County Water Authority and Town of Lousia will not accept completed waterlines that exhibit taste and odor conditions as a result of the use of unapproved lubricants.

5. Table 6.2 Flushing Schedule gives flushing flow rates and flushing mechanism sizes for water mains 6 inches through 24 inches in diameter. Specific flushing schedules for line sizes above 24 inches will be project and site specific and directions will be given on the project drawings.

B. Filling and Testing Procedures

1. Connection of the new water main to the existing distribution system for filling and testing shall be through a contractor furnished flushing mechanism. The contractor is to furnish the single gate valve, double check valve flushing assembly and all necessary fittings, reducers, increases and sleeves to make the piping connections. Assembly shall be approved by the inspector prior to its use. A suitable valved piping arrangement for the addition of the water-chlorine solution is to be available on the new line side of the flushing assembly. The assembly is to be furnished with 150 psi rated flange connections and installed in a manner approved by the inspector. See DRWG. NO. WAT-13 for further information.

2. System testing will not commence until all administrative items have been resolved and the project is ready for tentative acceptance pending the successful performance of all required testing.

3. Initial flush time is to be in accordance with the *Sequence of Construction, Testing, and Flushing of New Waterline* notes shown in Drawing. NO. DES-3.

4. Pressure test the line as noted in Section 6.6.3.2 of these specifications.

5. Make any necessary repairs and pressure test again until the line passes this test.

6. Disinfect the line in accordance with AWWA C651, Section 5. A water- chlorine solution prepared in accordance with Section 6.6.3.2 above shall be used for disinfection.

7. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine residual of the water leaving the main is equal to the chlorine residual of the incoming system water.

8. Bacteriological samples will be taken in accordance with AWWA C651, Section 7.

9. If unsatisfactory bacteriological test results are received, repeat steps 6, 7 and 8.

10. After receiving satisfactory bacteriological test results, the contractor shall coordinate with the inspector the connecting of the new main to the existing system. All connecting pipe and fittings shall be clean and free of debris and shall be swabbed or sprayed with a 1 percent sodium hypochlorite solution before they are installed. The contractor shall tie-in new waterlines to the existing water system within 10 working days of successful completion of all bacteriological tests; otherwise the disinfection process must be repeated.

11. Final flush of line to be in accordance with *Sequence of Construction, Testing, and Flushing of New Waterline* notes shown in Drawing NO. DES-3.

C. The Disinfection and Supplemental Procedures may be modified by inspector for site specific problems that do not physically allow for following the normal disinfection procedures. Modified instructions will be given in writing from the inspector and will be executed by the contractor in a manner that does not subject the existing distribution system to undue problems and assures that adequate disinfection and flushing will be given to the new main before placing it into service.

D. The procedure for the disinfection of short leads to fire hydrants and the connector pipe to fire suppression systems/double detector check assemblies shall be as follows:

Connector piping, fittings and valves from an existing main to a fire hydrant or to a fire system double detector check assembly, which does not contain domestic use branches and is equal to or less than 18 feet in length from the main may be spray disinfected or swabbed with a minimum 1 percent solution of chlorine just prior to installation, tied-in and flushed at a velocity of not less than 2.5 ft/sec. Bacteriological sampling will be taken downstream for confirmation of uncontaminated water. Connections to existing mains must be done within 10 working days of the successful completion of all bacteriological tests; otherwise, the disinfection process shall be repeated.

E. Flushing:

Water for filling the line and flushing will be taken from the public water system. The use of water for making the new water main available for service will be as follows:

1. Initial Flush:

See Table 6.2 “Flushing Schedule”. This is to be a high velocity flush through all sections of the new line. Since the large volume of water may have effects on the existing distribution system, the initial flushing is to be done only with the approval of and under the direction of the inspector. System demands may cause this flushing to be done at times when the existing distribution system demands are low.

Because of the large volume of water to be flushed from the fire hydrants or flushing hydrants, the contractor must inspect the areas of discharge and provide the necessary equipment or materials to prevent any environmental damage or erosion. Sufficient hose length and termination fittings are to be provided so as to discharge the water into stable, heavily vegetated areas, drainage ponds, storm sewers, paved ditches, etc. The contractor is to be responsible for any damage that may result from flushing.

2. Flush to remove disinfecting solution:

This is a low velocity, low flow, flush through fire or flushing hydrants to remove the disinfecting solution from the new line. The contractor is to provide sufficient hoses to connect from the hydrants to a suitable discharge point. The flushing of the disinfecting solution must not enter any streams or be discharged in a manner that causes any environmental damage. For site specific locations, the inspector may require the use of a neutralizing chemical and piping arrangement (see DRWG. NO. WAT-8 for further information). The expense of a neutralizing station is the responsibility of the developer/contractor.

3. Final Flush:

See the table below. The final flush is a medium velocity, medium flow flush to clear the line of any chlorine solution used in the tie-in and to provide for fresh water throughout the new lines.

Table 6.2 ***Flushing Schedule***

Main Size (Nominal)	Double Check Valve Single Gate Size (Note 1)	INITIAL FLUSH (Note 2) Min. Flow (gpm)	FINAL FLUSH (Note 2) Max. Flow (gpm)
6”	4”	220	88
8”	4”	400	160
12”	6”	900	350
16”	6”	1,500	624
20”	8”	2,450	978
24”	10”	3,525	1,410
30”	Designed by Consultant	5,505	2,202
36”	Designed by Consultant	7,935	3,174

Notes:

1. See description of "Preassembled Flushing Mechanism" Drawing NO. WAT-13 of these Specifications.

2. Approximation of flushing flows can be made by using either a pitot tube or a method of measuring the static discharge pressure from a hydrant used for discharge of the flushing water. See Drawing NO. WAT-7 "Discharge Flow Rates for Flushing" of these Specifications.

3. On a case-by-case basis, dependent upon such variables as length of new water main (<200’), space limitations or other unforeseeable obstacles, the inspector may authorize the use of a smaller flushing device if the use of this device will provide for adequate flushing of the new water main.

6.6.3.5 Testing of Double Detector Check Assembly

A. The inspector will be responsible for ensuring the appropriate test is performed up to the outside isolation valve located on the inlet side of the double detector check assembly.

B. The developer is responsible for having the double detector check assembly tested by an approved tester prior to service being authorized to the building. Tests on the double detector check assembly shall be conducted on an ongoing basis annually by a certified tester approved by the Lousia County Water Authority or the Town of Lousia. The results of the test shall be sent to the Lousia County Water Authority or the Town of Lousia

6.6.4 Wet Taps

A. All wet tap installations require a Town or County representative to be present at the time of the tap.

B. The tap shall require the approval of both the Town and the County.

C. Sleeve and valve assemblies shall be properly tested for 10 minutes before the actual tap is made.

D. Wet taps shall employ a ductile iron mechanical joint sleeve, or other fitting specifically designed for this purpose as approved by the Director (s).

6.6.5 Abandonment of Existing Facilities

6.6.5.1 Water Service

Excavate at the main and expose the corporation stop. Turn off the corporation stop and disconnect the service pipe from the corporation stop. If practical, the corporation stop should be removed and a screw plug installed in the hole. If it is not practical to remove the corporation stop, provide a screw plug for the corporation stop. Remove the meter box, yoke and service line. Deliver the meter to the Louisa County Water Authority or the Town of Louisa.

6.6.5.2 Water Mains

Water mains and hydrants to be abandoned shall be permanently disconnected from the remaining system. Details of the abandonment shall be approved by the Louisa County Water Authority or the Town of Louisa on a case by-case basis.

All open ends on abandoned pipe to be permanently sealed by plugging with masonry and/or mortar or plug. All valve boxes, fire hydrants, flushing hydrants (blow-offs) or other appurtenances shall be removed. Salvageable items shall be returned to the Louisa County Water Authority or the Town of Louisa.

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7 PUMP STATIONS

7.1 Scope

7.1.1 Intent

The sewage pumping station (SPS) design standards are intended to assist the developer in the development of plans and specifications. The materials, configurations, and features described here represent the minimum acceptable level of quality expected in pump station design and reflect the goal of standardizing Lousia County Water Authority and Town of Lousia equipment. These standards should not be construed as being a complete description of the necessary features for a particular pump station design. The Lousia County Water Authority, shall approve all deviations from these standards and has the final authority regarding the acceptability of any particular pump station design within Lousia County and Town of Lousia. See the typical pump station detail included in Appendix B.

7.1.2 Review and Approval

The Lousia County Water Authority and Town of Lousia have established a procedure for reviewing and approving eligible sewage pumping station. The developer shall meet with the Lousia County Water Authority before starting a pumping station design to discuss the Lousia County Water Authority and Town of Lousia procedures and requirements. The sewage pumping station plans shall include all of the structural, electrical, and mechanical design information and details necessary to construct the station.

7.1.3 Regulations

The developer shall design sewage pumping stations to be in conformance with the Sewage Collection and Treatment (SCAT) Regulations, as published by the Commonwealth of Virginia. The Lousia County Water Authority or Town of Lousia will not approve structures that are tributary to a proposed sewage pumping station for a water meter installation until the pumping station has been placed into Beneficial Use status, for a Developer constructed pump station, or a Certificate of Substantial Completion has been issued.

7.2 Required Meetings

The Lousia County Water Authority and Town of Lousia have established a procedure for the review of the sewage pumping station plans. The developer shall meet with the Lousia County Water Authority and/or the Town of Lousia prior to starting the design to go over the design procedures and requirements and shall schedule the following meetings during the design phase of all sewage pumping stations:

- Initial Planning/Kickoff Meeting
- Preliminary Design Report Presentation/Comment Review Meeting

- 100 percent Design Discussion Meeting/Comment Review Meeting
- Public Outreach Meetings (as required)
- Additional meetings as requested by Lousia County Water Authority

It is the responsibility of the developer to contact the Lousia County Water Authority for a list of Lousia County Water Authority and Town of Lousia attendees and to schedule the room. At the Initial Planning/Kickoff Meeting, the Lousia County Water Authority shall deliver to the developer the current SCADA system requirements to incorporate into the design documents.

7.3 General Requirements

Prior to final sewage pumping station plan approval and issuance of a Certificate to Construct (CTC), the Developer shall submit a construction schedule for review and acceptance. The schedule shall establish a start and completion date for the construction of the station. Prior to acceptance of the station by the Lousia County Water Authority or Town of Lousia, the Developer shall demonstrate through startup and testing that the station is fully functional and operational for its intended use. Following successful start-up and testing, the Developer shall provide the Design Engineer's certification that the station has been constructed in accordance with the approved sewage pumping station plan. As a pre-requisite to issuance of the Certificate to Operate (CTO), the Developer shall place the station in Beneficial Use within six (6) months of the Lousia County Water Authority or Town of Lousia providing written notice of its readiness to place the station in service.

The Developer shall provide new materials, fittings, appurtenances, and equipment, direct from the manufacturer, unused, and free of defects and shall submit proof of purchase to the Lousia County Water Authority. The Developer shall provide a list of all materials and product technical details to be used on the project. Developer shall provide a list of all materials and product technical details to be used on the project. Refer to Appendix A: Approved Equipment Manufacturer's List.

The Lousia County Water Authority or Town of Lousia will reject any materials found to be defective, damaged, improperly stored or handled, or determined to not meet the requirements of this Manual or current Lousia County Water Authority or Town of Lousia requirements.

The Developer is responsible for following and meeting all safety requirements as established by regulatory agencies with jurisdiction over workplace safety.

The Developer shall design and locate a permanent sewage pumping station to serve the entire sewer shed. A permanent sewage pumping station may not be initially constructed with capacity for the entire sewer shed; however, the Developer shall design and construct the major structures in the facility to accommodate the ultimate capacity of the station.

7.3.1 Location

The Developer shall locate sewage pumping stations above the level of the 100-year- flood/wave action. The Developer shall subdivide and convey the land parcel encompassing the sewage

pumping station to the Louisa County Water Authority or Town of Louisa as fee simple. The Developer shall fence and screen/landscape the sewage pumping station lot as required by the Lousia County Water Authority/Town of Lousia and in accordance with this Manual.

7.3.2 Alarm Systems

The Developer shall provide monitoring equipment for all pump stations in accordance with the Lousia County Water Authority/Town of Lousia SCADA system requirements. The Lousia County Water Authority/Town of Lousia shall establish all required alarm points that the Developer must tie into the SCADA system.

7.3.3 Instructions and Equipment

The Lousia County Water Authority/Town of Lousia and VADEQ, as required, shall review and approve the Operations and Maintenance Manual. The Developer shall submit two (2) copies of the approved Operations and Maintenance Manual to the Louisa County Water Authority and/or Town of Lousia prior to completion of the station in both hard copy and electronic format (PDF). The Operations and Maintenance Manual shall contain all necessary information documenting the sewage pumping station construction, equipment, and operations and at a minimum shall contain the following:

1. Introduction

    - Purpose and Scope of the Manual
    - Project Background and Parameters for the Pump Station Design
    - Permits and Waivers
    - References

2. Personnel Requirements

    - Outline of Responsibilities (e.g., Operators, Maintenance Crew, Supervisor)
    - Frequency of Personnel Station Monitoring

3. Facility Description

    - Pump Station Design
    - Design Criteria for the Pump Station, Force Main and Pumps
    - Manufacturers' Pump Curve for the Installed Pumps
    - Combined Pump and System Curve for the Pump Station
    - Description of Primary Equipment (e.g., Wet Well, Pumps, Controls, Check Valves, and Back-Up Power Supply)
    - Operational and Equipment Data Summary (e.g., Wet Well, Pumps, Controls, Flow Meter, Major Valves, Telemetry, and Generator)

4. Facility Operation

- Unit Operations (e.g., Pumps, Controls, Flow Meter, Telemetry, and Generator)
- Alarm List
- Start-up Procedures
- Commons Operating Problems
- Troubleshooting Guide
- Emergency Operations

5. Maintenance

- Introduction
- Maintenance Records
- Daily Maintenance Routine
- Spare Parts Inventory
- Corrosion Control
- Typical Forms

6. Records and Reporting

- Operating Logs
- Reporting Requirements
- State Agencies
- Other Contacts

7. Safety

- General
- Sewers
- Electrical Hazards
- Mechanical Equipment Hazards
- Explosion and Fire Hazards
- Bacterial Infection
- Oxygen Deficiency and Noxious Gases
- Potentially Hazardous Materials

8. Appendix A: Permits & Service Area

- Final Preliminary Engineering Report for the Pump Station
- Certificate to Construct
- Map Exhibit of the Sanitary Sewer Shed for the Pump Station

9. Appendix B: Record Drawings

- A Reduced Set of the Pump Station Plans
- As-built Drawings of the Pump Station and Force Main

- As-built of Electrical and Control Schematics

10. Appendix C: Arc Flash Study

11. Appendix D: Manufacturer's Operation & Maintenance Manuals

12. Appendix E: Equipment Warranties

7.4 Pump Station Selection Criteria

The Lousia County Water Authority/Town of Lousia will only accept suction-lift style pumping stations. In cases where ultimate flows are 150,000 gpd or less, consideration may be given to alternative pump station designs, subject to the Lousia County Water Authority or Town of Lousia.

7.4.1 Design Flow

The Developer shall design pump stations for the ultimate build-out peak flow from the drainage area, which is a minimum of 2.5 times the average daily flow unless otherwise directed by the Lousia County Water Authority or Town of Lousia. The Developer shall include pump curves, flow calculations, system curves and a drainage area map in the sewage pumping station plans.

All sewage pumping stations shall have a minimum of two (2) pumps and shall follow the SCAT regulations.

7.4.2 Design Limitations

The following design limitations should be observed for each style of station.

1. Site Configuration for Vehicle Access

    a. The pump station shall be configured to permit a 25-foot-long truck to exit the travel way and pull up to the security gate without stopping or impeding traffic.
    b. The station layout shall permit trucks with a minimum 42 foot turning radius the ability to ingress and egress the site and the ability to turn the truck around, if necessary, to re-enter the travel way.

2. Suction-Lift Pump Stations

    a. Definition:

    Suction-Lift stations are defined here as those where the pumps are positioned on top of in the wet well.

    b. Configuration:

    The Developer shall design suction-lift pumping stations with a pump room located above the wet well inclusive of the pumps, valves, piping, and process equipment. Sensitive electrical equipment such as the motor starters (VFDs, etc), distribution panels, and pump station control panel shall be located in a physically separate, non-process, climate-controlled electrical room.

A sluice gate shall be provided on the influent pipe of the wet well with the operating stem extended up to grade level, to isolate flows to the wet well.

The pump room shall contain the pump discharge shut-off and check valves along with the flow meter. Isolation valves shall be provided on either side of the flow meter to allow for removal for service. The Developer shall provide a surge relief valve on the discharge force main before the piping leaves the station. Surge relief valves and piping shall discharge to the wet well. All piping including vault piping and components shall be coated with suitable chemical resistant coating. An emergency generator shall be provided.

Aluminum hatches shall be installed at the top the wet well, outside of the pump room. Aluminum hatches shall be sized to remove the largest piece of equipment.

c. Special Conditions:

When site conditions prevent access of Lousia County Water Authority or Town of Lousia vehicles with mobile cranes, fixed or portable jib cranes with their associated mounting base shall be provided with the comminutor basin, wet well, and valve vault.

7.5 Design Criteria for Pump Stations

7.5.1 Pump Selection

7.5.1.1 Pumping Units

All pump stations shall have at least two (2) pumps providing 100 percent reliability in accordance with SCAT regulations. The Developer shall provide a non-prorated warranty from the pump manufacturer for all pumps against defects in workmanship and material for a period of five (5) years or 10,000 hours of operation under normal use, operation, and service, effective from the earlier date of acceptance by the Lousia County Water Authority or Town of Lousia or placement in Beneficial Use. The Developer shall provide Gorman-Rupp suction-lift pumps.

7.5.1.2 Pump Openings

All pumps shall have openings and passages large enough to permit the passage of a 3- inch-diameter sphere. All pumps shall have cleanout ports.

7.5.2 Wet Well

The Developer shall divide wet wells at stations three (3) MGD or larger into two (2) interconnected sections to facilitate repairs and cleaning. The effective capacity of the wet well should be so that one pump shall run continuously at least five (5) minutes of every 30-minute period at the minimum flow. The wet well fillets shall have a minimum slope of one-to-one to the hopper bottom and have a hopper bottom no larger than necessary for the proper installation and function of the inlet. The Developer shall design the wet well size and control settings to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention times. Provide a visual gauge for the wet well level.

7.5.3 Surge Analysis

In a pressurized Sanitary Sewer system, events that create pressure surges include:

- Pump power failure
- Pump shutdown/startup cycles
- Pipeline rupture.

When pumps cycle off or there is a power failure, transient surge pressures can damage piping. Reduced voltage solid state starters may be required to reduce surge pressures. As backup protection, a surge relief valve may be required at the pump station, to provide for events of power failure, or a failure of the soft start/stop equipment. The Developer shall perform a surge analysis of the discharge force main when the velocity exceeds 3.5 fps and/or the total dynamic head (TDH) imparted by the pumping system is anticipated to exceed 150 feet when the pump station is operating at peak flow (i.e., for a three-pump station using Variable Frequency Drives (VFDs), the TDH produced when two (2) pumps are operating at 100% speed and the wet well level calling for lag pump on is reached).

7.5.4 Valves and Piping

The Developer shall provide eccentric plug valves on the suction and discharge lines of each pump to allow the pump to be isolated. The Developer shall provide a check valve with an external arm and limit switch on each discharge line between the pump and the eccentric plug valve. Check valves for pumps shall have external limit switches for indication of open and/or closed indication back to PLC or control panel. Mounting of limit switches shall be separate from piping related to the check valves. Limit switches are to be mounted on 4 square metal plate, attached to channel with post base bolted to floor. Metal plate shall be mounted as to allow for adjustment to limit switch. Channel shall be extended above the center line of check valve to allow for future adjustments. All wiring from limit switches shall meet NEC standards.

The velocity in the suction line shall not exceed six (6) fps, and the velocity in the discharge line shall not exceed eight (8) fps. The Developer shall provide pressure gauges with isolation valves on the suction side of the pump and the discharge side of the check valve. The Developer shall provide gauge taps with valves on the suction and discharge side of each pump. Where necessary, the Developer shall provide a surge relief valve. The Developer shall install the surge relief valve with an isolation valve so that it can be taken out of service without shutting down the force main.

The emergency bypass connection shall be above ground and bypass connection size shall be in direct relationship with force main diameter with cam lock connection.

7.5.5 Lighting

Light-emitting diode (LED) lighting levels shall meet minimum building and electrical code requirements or as required during plan review. The Developer shall provide lighting fixtures rated for the environment in which they are installed. The Developer shall provide vapor-proof,

corrosion-resistant lighting mounted with stainless steel hardware/fasteners in comminutor basins, wet well/dry well configurations, and valve vaults. All lighting fixtures shall be located in an accessible areas for maintenance.

Interior lights, exterior pole lights, and lights around the control building shall be activated by an intrinsic exterior photoelectric switch. All exterior lights shall be wired to independent switches inside the control building that can manually keep the lights off. Lighting design is subject to the review and approval by the Louisa County Water Authority to account for the specific site conditions. When requested, the Developer shall provide shrouding around exterior lights and provide a lighting analysis documenting the lighting levels. All outside lighting shall be controlled from ONE photocell, in an accessible location, with an override switch. Lighting in the wet well areas shall be Class I, Division 2 LED fixture for hazardous locations.

7.5.6 Flow Measurement

The Developer shall provide a magnetic flowmeter that has an output of four (4) to 20 milliamperes direct current (mADC). All flowmeters shall have manufacturers' startup and calibration. The Developer shall provide valves and couplings on each side of the flowmeter, and a bypass around the flowmeter. The Developer shall provide a human-machine interface touchscreen that is designed to trend the flow data from the pumps and has the capability to chart and totalize the flows.

The Developer shall provide magnetic meters with grounding rings on each side of the sensor. The Developer hall locate flow metering equipment, except for the sensor, in the control building. The Developer shall retain the manufacturer's field service technician to seal the flowmeter termination, which shall prevent migration of groundwater through the raceway into the equipment. The flow meter shall be commissioned by the manufacturer's field service technician at the station.

7.5.7 Controls

The Developer shall provide pumps that are controlled by two submersible level transducers in a stilling well. Primary pump control shall consist of a Modicon M340 PLC with required memory and functional capacity to perform the specific sequence of operation with scheduled input and outpoint points in accordance with a human- machine interface touchscreen for backup control, in accordance with the Louisa County Water Authority SCADA requirements. The Louisa County Water Authority shall provide control narrative and all control and monitoring points that are required for the design.

7.5.8 SCADA Field-wired Circuits

The Louisa County Water Authority shall approve all control narratives and PLC specifications. All desired control and monitoring points to be provided and installed by the Developer.

7.5.9 Ventilation

The Developer shall provide ventilation for all pump stations for those periods when the station is occupied.

The Developer shall not use dampers on the exhaust or fresh air ducts, nor any fine screens or other obstructions in the ducts that may cause clogging. Ventilation equipment shall be a ducted style centrifugal fan, backward-curved, with the air flow path making a 90-degree turn inside the fan. Direct drive exhaust fans are preferred. The Developer shall provide a thermostat for Control building fans.

1. Pump Room

   Ventilation shall be sized for 12 air changes per hour.

7.5.10 Water Supply

The Developer shall extend public water to the pumping station for wash down and cleanup operations. The Developer shall provide water service into the station with either a 2-inch, SDR-7 service pipe or a 4-inch ductile iron service pipe and have a 1.5- inch water meter, provided by the Lousia County Water Authority or Town of Lousia set in accordance with the details of this Manual. If public water is not available, the Developer shall provide a non-potable well at the site and the Developer is responsible for securing all required regulatory permits. The Developer shall take appropriate cross-connection measures to ensure that no physical connection exists between any potable water supply and a sewage pumping station that, under any conditions, might contaminate the potable water supply. Developer shall provide an interior host bibb, exterior, frost-proof hose bibb, a hose rack located at each hose bibb, and two (2) 25-ft heavy-duty rubbers hoses.

7.5.11 Structures

The Developer shall provide a layout of the station for the Lousia County Water Authority or Town of Lousia for approval to accommodate working clearances to maintain or install equipment. The Developer shall locate access hatches in the station appropriately sized to facilitate the removal, installation and maintenance of equipment in the station without disrupting the operation of the facility. The Developer shall provide aluminum hatches with stainless steel hardware/fasteners, locking hasps, and automatic hold-open arms. The Developer shall include a floor drain in the pump room. Floor drains shall have a P-trap and shall discharge to the wet well and be installed with a check valve or flapper valve to prevent sewage from entering the structures if the wet well floods.

7.5.12 Control Building

The Developer shall provide or construct a precast or brick and block building as approved by the Louisa County Water Authority or other development conditions required by Louisa County or community association covenants. The Developer shall provide a building that is consistent with the architectural style of the community which is sized to accommodate all proposed equipment

and to provide adequate space for personnel to operate and repair the equipment in the building with the access doors closed. For precast buildings, a precast concrete roof shall be provided (penetrations through the precast concrete roof are not acceptable). A standing seam metal roof shall be provided for brick and block buildings with a 35-year finish warranty. The Developer shall provide thermostatically controlled cooling and heating equipment in the electrical room and locate the thermostats controlling all heating, ventilation, and air conditioning (HVAC) equipment in an easily accessible area. Equipment in the control building shall be electrically grounded separately from the lightning rod and telecommunication systems.

7.5.13 HVAC

The HVAC unit shall be size appropriately per the engineered heat load calculation and design for industrial corrosive environments. The equipment should have corrosion resistant coating on the evaporator coil & condenser coil, the coating should protect the coil from leakage and premature failure. The system shall be designed to operate and maintain ambient temperature of below 75F and humidity conditions ranging from between 30 and 60 percent.

The HVAC systems shall be tested and certified acceptable performance before placing it into normal operation.

7.5.14 Pump Starter

Pumping units shall be equipped with two methods of starting. Acceptable methods of starting a pump unit include Variable Frequency Drives (VFD), Reduce Voltage Soft Start (RVSS) for soft start/stop controls, and across-the-line starting as approved by the Louisa County Water Authority.

7.5.15 Reliability

All sewage pump stations shall be provided with a SCADA system in accordance with this Manual to permit the continuous monitoring by the Louisa County Water Authority. The SCADA system shall be integrated to the pump stations permanently mounted backup generator and automatic transfer switch as is required for all Reliability Class 1 stations.

All pumping stations shall have 100 percent back-up power reliability (Class 1 reliability) provided and installed by the Developer. The Developer shall provide electric power to the station by distribution lines and by a propane emergency generator. Diesel-powered generators will be considered on a case-by-case basis. The power sources shall provide sufficient power to operate the pumps, lighting, and ventilation systems during maximum design flow conditions. Pumps shall automatically restart upon loss of utility power, initiation of emergency power, and restoration of utility power; an Operator shall not be required to physically restart the pumps in any of these scenarios.

The Developer may opt to provide a propane-driven backup motor for one of the pumps in lieu of sizing a generator for pump operation. Pumps shall automatically restart upon loss of utility power, initiation of emergency power, and restoration of utility power; an Operator shall not be required

to physically restart the pumps in any of these scenarios. If the Developer chooses to provide this option, the emergency generator shall provide sufficient power to operate the ancillary systems including lighting and ventilation systems during maximum design flow conditions.

The distribution lines and the generator shall have a means of being disconnected before the generator switch gear. The generator shall automatically switch online in the event of a power failure. The pumps shall automatically restart when switching from utility power to generator power or from generator power to utility power. A push-button restart of the pumps in the event of a loss of power is not acceptable. The Developer shall provide generator switchgear that is fully automatic with the ability to sense a single-phase power condition and switch to the generator power system with a minimum time delay. The Developer shall protect both power sources with fuses or breakers before the transfer switch.

7.5.16 Pump Station Power System Design

The Developer shall protect the station's power supply and equipment from lightning by providing a lighting protection system with a separate and isolated ground. The Developer shall provide a final step-down transformer on each electric feed line with adequate physical separation between them to prevent a common mode failure. The Developer shall provide a separate buss for each power source. The electric transmission line and the emergency generator shall remain separate and form separate distribution substations up to the internal buss system transfer switch to preclude a common mode failure of both sources.

The Developer shall coordinate breaker settings or fuse ratings to effect sequential tripping so that the breaker or fuse nearest the fault shall clear the fault before the other breakers or fuses are activated. The Developer shall pad mount all lighting transformers and shall configure the load distribution panel so it is not an internal part of the transformer. The Developer shall provide an automatic transfer switch equipped with a manual bypass.

7.5.17 Electrical Equipment Type

The electrical equipment in the generator and control building and wet well shall comply with the appropriate requirements of the National Electrical Code as well as the Virginia Uniform Statewide Building Code in effect. Aluminum buss bars, wire, connectors, or lugs are not permitted.

The Developer shall protect three-phase motors and their starters from electric overload and short circuits on all three phases. All motors shall have a low-voltage protection device that shall cause and maintain the interruption of power to the motor upon the reduction or loss of voltage. The Developer shall provide temperature detectors in the stators and bearings of larger motors (50 hp or more) to indicate overheating.

All wires installed in underground conduits shall have moisture-resistant insulation as identified in the National Electrical Code. The Developer shall provide thermoplastic high-heat-resistant nylon (THHN) stranded wire for all wiring installed in raceways. The Developer shall provide all

Type-SO electrical cables with sunlight and ultraviolet protection. All four (4) to 20 mADC signal cables shall have shielding properly terminated on one end of the cable run.

The Developer shall provide control and operating equipment and safety devices constructed of corrosion-resistant materials; stainless steel, aluminum, or fiberglass. The Developer shall paint all surfaces not otherwise protected, such as concrete, using a two-step process: primer and then paint. Approved primer is Sherwin Williams Macropoxy® 646; approved paint is Sherwin Williams ACROLON™ 218 HS. The Developer shall include a painting schedule in the sewage pumping station plans.

The Developer shall provide Crouse Hinds cast device boxes constructed of non-corrosive materials for all surface-mounted electrical device boxes and small junction boxes subject to moisture. All boxes shall have mounting lugs; mounting holes drilled in the back of the box are unacceptable. The Developer shall provide covers with gaskets and stainless steel screws for all boxes and provide covers from the same manufacturer as the boxes. The Developer shall install all boxes with stainless steel hardware/fasteners.

Moisture-proof bell boxes are not acceptable.

The Developer shall provide a stainless steel wire mesh strain relief fitting that is properly sized for the cable for any cable subject to stress or strain. The Developer shall protect all cables from stress, crush, and abrasion. The Developer shall provide provisions to mitigate the migration of liquids and gases into the equipment from all cables installed in raceways.

The Developer shall size the emergency back-up power supply generators to provide 100 percent reliability to fully operate the station. The Developer shall provide an adjustable time delay between all functions and transitions for the generator, which shall include the capability of holding in the “neutral” position for an adjustable time period between all transitions. The Developer shall provide sound-attenuated enclosures for generators located outside the building. Developer shall fill the generator’s fuel tank after all startup testing is completed.

The Developer shall provide Cutler Hammer or Square-D for all electrical distribution equipment. The Developer shall provide electrical equipment that is protected by a Solid State Advanced Control Phase Monitor, PLMU11 or ATC/Diversified model SLU-100- ASA and be consistent with the Town of Louisa and/or Louisa County Water Authority SCADA Design & Configuration Standards.

The Developer shall provide NEMA 4 for indoor electrical enclosures, NEMA 4X for electrical enclosures below grade and outside, and explosion-proof and corrosion- resistant electrical enclosures located in a wet well. The Developer shall provide PVC coated pulling devices and junction boxes for wet well applications.

The Developer shall provide 0.75-inch diameter or greater conduit for all wiring conduit. Galvanized rigid conduit is permitted, except in the wet well, where PVC-coated rigid conduit is

required. The Developer shall size conduits to facilitate wiring for the ultimate design conditions. The Developer shall recoat PVC-coated rigid conduit, where the coating was removed during the installation of the conduit with PVC. The Developer shall provide PVC coated conduit straps for wet well applications and corrosion-resistant conduit straps for all other applications. The Developer shall provide aluminum, or other material approved by the Louisa County Water Authority, for channels used to mount electrical equipment or conduits. Rigid metal conduit shall be used meeting Class 1 Div. 2 requirements; however, EMT conduit or aluminum conduit shall not be used. Per the NEC Class 1 Div. 2 conduit shall be potted/sealed.

The Developer shall identify all foreign sources of electrical power entering a control cabinet or motor control cabinet and provide a means of disconnecting the power.

7.5.18 Electrical Equipment Location

The Developer shall install electrical switchgear and controls in the building. Any equipment remotely located from the distribution panel shall have a lockable service disconnect on the line side. The Developer shall locate the emergency back-up power supply generator on a concrete pad inside the pump station lot and provide a prefabricated sound-attenuated enclosure to protect the generator from the weather and a skid-mounted tank for storing its fuel. The Developer shall provide skid-mounted tanks that are double-walled for leak containment, sized to hold adequate fuel to run the generator for 24 hours at 100 percent load and which meets all VADEQ and U.S. Environmental Protection Agency regulations. The Developer shall provide a fuel storage level indicator in the control building and point tie it to the Louisa County Water Authority SCADA system for monitoring. The Developer shall equip the generator with a block coolant heater, battery charger, and an alarm indictor to display the cause of a generator failure. The Developer shall provide controls for starting the emergency generator completely independent of the normal electric power source. The Developer shall provide a starting system that is sufficient to start the generator a minimum of three times without recharging and be alarmed and instrumented to indicate a loss of readiness.

The Developer shall protect all motors and control enclosures from moisture, weather, and water under pressure in accordance with the manufacturer's recommendations. The Developer shall provide splash-resistant motors for indoor applications.

The Developer shall provide all equipment in accordance with the approved sewage pumping station plans and the manufacturers' recommendations. When laying out the location of the equipment in the control and generator building, the Developer shall consider the necessary separation between devices to provide adequate ventilation and the location of door, hatches, and panel covers to avoid conflicts among these items when they are opened and closed. The Developer shall provide provisions for housekeeping pads to keep equipment off the floor.

The Developer shall provide a moisture-proof, NEMA 4X enclosure constructed of non- corrosive materials for all equipment located outside the control building. The Developer is required to maintain the integrity of these enclosures.

7.5.19 Access and Security

The Developer shall provide a 12-foot-wide paved access road to the pump station. The minimum road section shall consist of a compacted sub-grade, 6-inches of VDOT 21-A stone, and 2-inches of compacted VDOT SM-2A bituminous concrete. The grade on the road shall not exceed 10 percent (10%). The Developer shall provide unrestricted ingress and egress to the Louisa County Water Authority from a public right-of-way to the pumping station. On long access roads, Developer shall provide, at the entrance to the access road from the public right-of-way, a locking gate that has been reviewed and approved by the Louisa County Water Authority.

An unrestricted, all-weather access road to the station is constructed and maintained by Developer until the permanent access road is complete and accepted by the Louisa County Water Authority. the Louisa County Water Authority staff shall have access to the station at all times.

The Developer shall provide an 8-foot-high black vinyl-coated chain link security fence topped with three strands of barbed wire, angled at 45-degrees away from the pumping station, around the pumping station lot. The requirement to use vinyl coating applies to all fabric, posts, ties, and fittings; galvanized fencing is not permitted. Privacy slats may be required to be provided and installed by the Developer depending upon the location and the application as determined by the Louisa County Water Authority. The Developer shall equip the fence with a top rail and a bottom tension wire. The Developer shall provide access to the station with a 12-foot wide, lockable gate. The Developer shall key all door locks and padlocks in the station to the Louisa County Water Authority standard keys as provided by the Louisa County Water Authority.

The Developer shall provide a minimum of 3.5-foot separation between the security fencing and structures or as required for building and grounds maintenance and future equipment removal and maintenance.

7.6 Testing, Acceptance, and Warranties for Sewage Pumping Stations

7.6.1 Pre-Testing, Start-Up, and Beneficial Use Inspections of Sewage Pumping Stations

For new sewage pump stations constructed for new development where there is no existing source of influent sewage, the Developer shall successfully complete the following testing and inspections requirements. Prior to beginning testing, the Developer must complete the following:

- Substantially complete all construction.
- Pass all building trade inspections and acquire all related permits from the governing authorities.

- Achieve Beneficial Use status for the sewage pumping station force main.
- Ensure all sanitary sewer mains receiving the force main discharge are placed in Beneficial Use status or are in a status of being owned and operated by the Louisa County Water Authority.

1. Pre-testing to prepare for start-up:

   a. Independently verify complete operation of the sewage pump station.
   b. Conduct successful pretesting of the SCADA system with the the Louisa County Water Authority.
   c. Acquire a start-up check list from the Louisa County Water Authority.
   d. Conduct required testing necessary for the Engineer to certify the station was built in conformance with substantial completion and operates as designed.

2. Start-up testing and inspection:

   a. Schedule and facilitate training of Louisa County Water Authority staff by the equipment manufacturers.
   b. Successfully tests all major pieces of equipment including pumps, generator, automatic transfer switch, flow meter, check valves, control system, and SCADA system to the satisfaction the Louisa County Water Authority.
   c. Verifies all sensors, alarms, SCADA, and start-up of equipment operate as designed for various operational scenarios.
   d. If the sewage pumping station is not placed into Beneficial Use within 90 days of successful start-up testing, the Developer must go through start-up procedures again before being placed into Beneficial Use.

3. Beneficial Use inspections to place the sewage pumping station into service:

   a. Provide written certification by the Engineer that sewage pumping station was built in substantial conformance with the plans and specifications.
   b. Acquire a CTO for the sewage pumping station.
   c. Submit a temporary flushing plan for the sewage pumping station to exercise the pumps and minimize the retention time in the force main.
   d. Deliver Operations and Maintenance Manuals for the sewage pump station.
   e. Transfer property and access rights for the sewage pumping station to the Louisa County Water Authority.
   f. Submit information for the sewage pumping station’s electrical account to the Louisa County Water Authority so that the account can be assigned to the Louisa County Water Authority.

The Developer has sixty (60) days to address all punch list items and to place sewage pumping station into Beneficial Use. If all punch list items are not addressed or the station is not placed into Beneficial Use within the sixty (60) days, a new and full inspection is required.

The Louisa County Water Authority will only permit a sewage pumping station to go into Beneficial Use status if tributary flows are to be delivered to the station within 60 days of Beneficial Use. The Louisa County Water Authority will not place a station into service via Beneficial Use nor commence the start of warranties until flows are delivered to the station and operations by the Louisa County Water Authority are necessary.

Sewage pumping stations are not eligible for Partial Beneficial Use status.

7.6.2 Five (5)-Day Acceptance Testing of Sewage Pumping Stations

When a new sewage pumping station is replacing an existing station or is to receive flow from an existing source of sewage, the Developer shall conduct a five (5)-day acceptance test prior to Beneficial Use inspections. Existing sewage flows are temporarily diverted to the new station to conduct testing by a controlled method.

The purpose of the five (5)-day acceptance test is to operate the sewage pumping station in an operational mode for five (5) days. The intent is to test all pumping station components, control systems, and SCADA system (including alarm notifications) under conditions as close as possible to normal operating conditions.

1. Following the successful completion of the start-up testing and inspection, the Developer shall submit a detailed plan for the five (5)-day acceptance test and obtain the Engineer's and Louisa County Water Authority approval of the detailed plan. After the testing plan is accepted by the Engineer and the Louisa County Water Authority, the Developer shall schedule a five (5)-day acceptance test for the sewage pumping station in coordination with the Engineer and the Louisa County Water Authority.
    a. The Developer shall not schedule the five (5)-day acceptance test during any
    b. observed Federal Holiday, weekend day, or during scheduled manufacturer training.
    c. The cost for the five (5)-day acceptance test is at the Developer 's expense.
    d. All major pieces of equipment shall be tested including pumps, generator, automatic transfer switch, flow meter, check valves, control system, and SCADA system.
2. A successful five (5)-day acceptance test, performed by the Developer, certified by the Engineer, and accepted by the Louisa County Water Authority, is required prior to placing the project into Beneficial Use status. A successful five (5)-day test shall include a detailed report indicating that:
    a. All the major equipment worked, as specified, for the duration of the five (5)-day acceptance test.
    b. The control systems worked, as specified, for the duration of the five (5)-day acceptance test.
    c. The SCADA systems worked, as specified, for the duration of the five (5)-day acceptance test.

7.6.3 Final Acceptance & Project Closeout

1. The conditions of final acceptance and project closeout shall include the following:

   a. Bond release shall not be requested until 6 months after Beneficial Use acceptance.
   b. Pump station functions as designed and no longer requires flushing.

2. The Developer must request and pass a final inspection for final acceptance by the Louisa County Water Authority.

   a. The Developer has sixty (60) days to address all punch list items from a final inspection. If all punch list items are not addressed within sixty (60) days, a new and full inspection is required prior to final acceptance.
   b. The Developer shall request re-inspection from the Louisa County Water Authority after addressing all punch list items.
   c. The Louisa County Water Authority shall issue a formal letter of acceptance once all punch list items have been satisfactorily addressed.

7.6.4 Sewage Pumping Station Warranty

1. The Developer shall warranty the pump station for a period of one year for all materials, equipment, and workmanship, effective at the date of Beneficial Use acceptance.
   a. The Developer shall repair or replace defective materials, equipment, or workmanship within 60 days of written notice by the Louisa County Water Authority at the cost of the Developer.
   b. New materials shall be used to repair or replace defects or equipment the by original equipment manufacturer or the Louisa County Water Authority approved qualified contractor.
   c. If the Louisa County Water Authority must immediately repair or replace defects or equipment to maintain operation of the sewage pump stations, the Developer shall pay all associated Louisa County Water Authority expenses.
   d. Final acceptance of the sewage pumping station by the Louisa County Water Authority, does not relieve the Developer of the one-year warranty responsibilities.
2. The Developer shall provide a five (5) year warranty for the pumps and the generator from the manufacturer. The Developer shall purchase an extended warranty from the manufacturer, as necessary, to provide a five (5) year warranty coverage from the date of Beneficial Use acceptance.
3. All written warranties from the equipment manufacturers shall be provided with the equipment manuals delivered with the Operation and Maintenance Manual.

7.7 Spare Parts, Supplies and Special Tools

The Developer shall supply all spare parts for all major equipment, as indicated on the spare parts list created by the Louisa County Water Authority after its review of the equipment submittals for

the pump station. The Developer shall provide all special tools required for a given station that uses special (non-standard) equipment. The Louisa County Water Authority or designee shall specify such special tools during its review of the pump station plans. The Developer shall provide the following list of supplies with the pump station:

- One (1) Push broom and dustpan
- One (1) 36-inch curved squeegees with 55-inch handle
- 25-feet of 5/8-inch heavy duty hose with fire hose type nozzle (two), with hose reel (outside near hose bib) and hose hanger (inside near hose bib)
- 55-gallon trash can with lid and dolly
- 50-feet of 12-gauge electrical extension cord
- Fire extinguishers (suitable for electrical fires in control panels; include minimum of one extinguisher per floor level)
- First Aid Kit, OSHA approved (one per floor level)

Appendix A –

Approved Equipment Manufacturer's List

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Approved Equipment Manufacturers

		Manufacturer	
Sewage Pumping Stations	1	2	3
Pumps	Gorman Rupp	-	-
Magnetic Flow Meters	ABB	Rosemount	
Plug Valves	GA Industries	DeZurik	
Check Valves	GA Industries	DeZurik APCO	
Surge Relief Valves	GA Industries	Cla-Val	
Air Release Valves	Vent-o-Mat	DeZurik APCO	ARI
Submersible Level Transducer	Endress-Hauser	Rosemount	
Water Booster Stations			
Pumps	Patterson	Flow Serve	Aurora
Magnetic Flow Meters	ABB	Rosemount	
Gate Valves	Kennedy	M&H	Mueller
Check Valves	GA Industries	DeZurik APCO	
Surge Relief Valves	GA Industries	Cla-Val	
Air Release Valves	Vent-o-Mat	DeZurik APCO	ARI
Fire Hydrants	Kennedy	Mueller	
Miscellaneous			
Generators/ATS	Caterpillar	Cummins	
Exhaust Fans	Greenheck	Loran Cook	
VFDs / Soft Starts	Allen-Bradley	Eaton/Cutler-Hammer	Benshaw
Electrical / MCC	Square D	Eaton/Cutler-Hammer	

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Appendix B –

Standard Details

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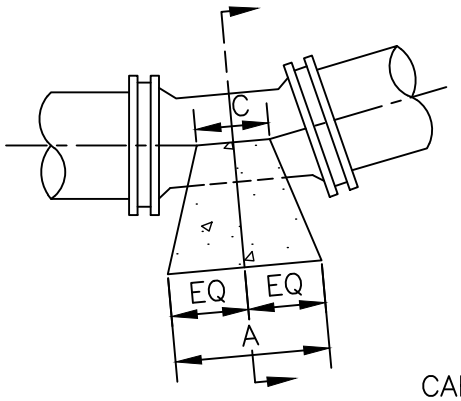
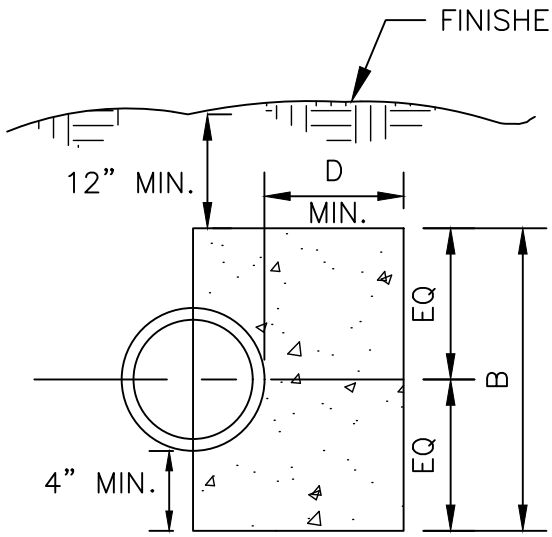
Standard Details

Detail Number	Detail Name
BLK-1	Blocking Detail Horizontal Bends
BLK-2	Blocking Detail Tees
BLK-3	Blocking Detail Plugs, Caps and Hydrants
BLK-4	Blocking Detail Lower Vertical Bends
BLK-5	Blocking Detail Upper Vertical Bends
CAS-1	Casing Pipe Requirements
CAS-2	Casing Detail Method for Gravity Sewer Lines
CAS-3	Casing Detail for Waterlines & Sewer Force Mains
CAS-4	Pipe Encasement Detail
DES-1	Standard Sewer and Water Notes
DES-2	Standard Sewer and Water Notes
DES-3	Standard Sewer and Water Notes
FIR-1	Typical Fire Hydrant
FIR-2	Private Central Fire System Plan View (1/3)
FIR-3	Private Central Fire System Fire Meter Assembly & Vault (2/3)
FIR-4	System Interconnection 3” Or Larger Double Check Assembly & Vault (3/3)
FIR-5	2” Or Smaller Double Detector Check Assembly and Vault
FIR-6	3” Or Larger Double Detector Check Assembly and Vault
FIR-7	Standard Yard Fire Department Connection (FDC)
MAN-1A	Manhole Sizing and Minimum Angle Table
MAN-1B	Manhole Sizing and Minimum Angle Detail
MAN-2	Standard Precast Concrete Manhole Sewers 8” To 24”
MAN-3	60”, 72”, 84” & 96” I.D. Manhole - I
MAN-4	60”, 72”, 84” & 96” I.D. Manhole - II
MAN-5	60”, 72”, 84” & 96” I.D. Manhole - III
MAN-6	1’-4” Or 2’-0” CONE (TYPE 1)
MAN-7	Standard Eccentric Cone
MAN-8	Standard Invert Details
MAN-9	Standard Outside Drop Connection
MAN-10	Standard Inside Drop Connection
MAN-11	Standard Manhole Frame and Cover
MAN-12	Watertight Manhole Frame and Cover
MAN-13	Vandalproof Manhole Frame and Cover
MAN-14	Standard Butterfly Valve Manhole (16” And Larger)
MAN-15	Abandonment of Manholes
MAN-16	Doghouse Manhole
MAN-17	Monitoring Manhole
MAN-18	Wastewater Access And Monitoring Chamber For Retrofit Applications Only
MAN-19	Typical Manhole Step
MET-1	Typical Water Meter Connection for ¾” and 1” Service
MET-2	Plastic Meter Box (5/8” and 1” Meters)
MET-3	Typical ¾” Water Meter Service Connection
MET-4	1-1/2” or 2” Meter Setting

Detail Number	Detail Name
MET-5	1-1/2” & 2” Meter Box
MET-6	Typical Master Meter Vault
MET-7	Vault Detail for 3” and 4” Water Meters
MET-8A	Water Service Installation Detail for 5/8” or 1” Meters
MET-8B	Water Service Installation Detail for 1-1/2” and 2” Meters
MET-8C	½” and 2” Meter 4”, 6” or 8” Detector Setting
MET-9	2” Compound Meter Setting
PAV-1	Typical Section for Repair of “Primary” Roadway Shoulders or Other Unpaved Traveled Areas for Water & Sewer Crossings
PAV-2	Typical Section for Repair of Open Cut After Placement of Sewer in Surface Treated Road Where a Base (Except Concrete or Plant Mix) is Present
SEW-1	Pipe Laying Condition Ductile Iron Pipe
SEW-2	Pipe Laying Condition Plastic Pipe
SEW-3	Air Vent
SEW-4	House Connection Details
SEW-5	Sewer Anchorage in Slopes Greater than 20%
SEW-6	Force Main Discharge
SEW-7	Inserta Tee
SEW-8	Kor-N-Tee
SEW-9	Clay Dam
SEW-10	Manhole Vacuum Test
SEW-11	Property/Easement Line Cleanout Detail
SEW-12	Pressure Sewer House Connection to Gravity Sewer Line
SEW-13	Pressure Sewer House Connection to Gravity Sewer Manhole
TEST-1	Allowable Leakage Test
TEST-2	Test Station Box
TEST-3	PVC Pipe Air Test Table
TEST-4	Deflection Test for PVC Gravity Pipe
WAT-1	1” Air Release Valve
WAT-2	2” Air Release Valve Assembly
WAT-3	Flushing Hydrant (for 4” and 6” Waterlines)
WAT-4	Typical 4” and Larger Blow-Off (for Waterlines 8” and Larger)
WAT-5	Small Valve Box
WAT-6	Lowering Water Main or New Installation
WAT-7	Discharge Flow Rates for Flushing
WAT-8	Neutralization Station (Dechlorination)
WAT-9	Allowable Deflection for Water Pipe
WAT-10	Typical Waterline Creek Crossings
WAT-11	Water Quality Monitoring Station
WAT-12	Valve Ket Extension
WAT-13	Double Check Valve Assembly for Isolating New Mains During Testing
PS-1	Typical Pump Station



PLAN



CARRY CONCRETE TO UNDISTURBED EARTH OR FIRM SUBGRADE

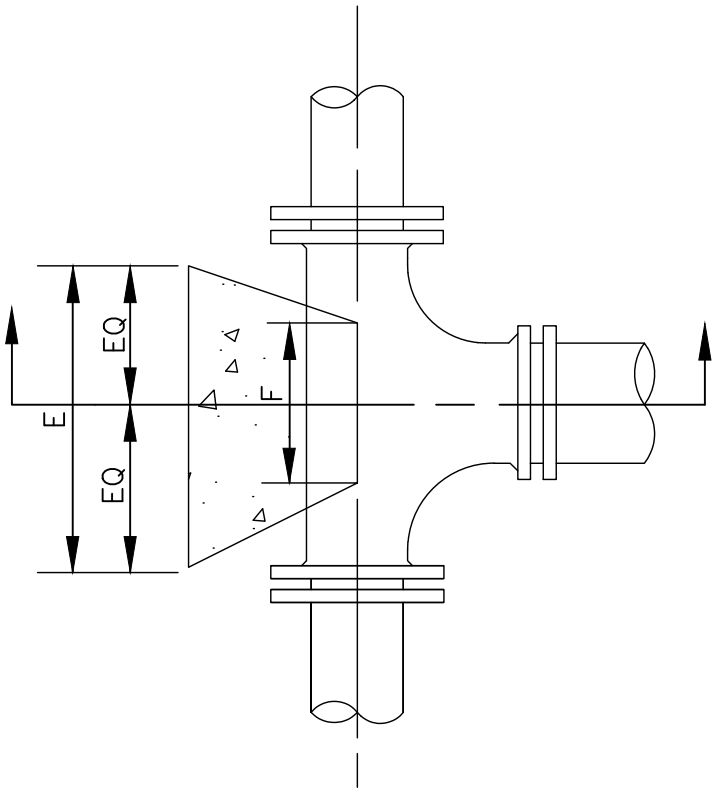
SECTION

PIPE SIZE	11–1/4° BEND				22–1/2° BEND				45° BEND				90° BEND			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
4"	6"	1'–0"	4"	6"	8"	1'–0"	6"	7"	1'–1"	1'–0"	6"	6"	1'–10"	1'–0"	6"	1'–0"
6"	8"	1'–2"	6"	7"	10	1'–2"	6"	8"	1'–4"	1'–2"	6"	8"	2'–3"	1'–2"	6"	1'–6"
8"	8"	1'–4	8"	7"	1'–4"	1'–4"	8"	8"	2'–0"	1'–4"	8"	9"	3'–3"	1'–4"	8"	1'–6"
10"	1'–1"	1'–6"	8"	8"	1'–7"	1'–6"	8"	10"	2'–6"	1'–6"	8"	10"	3'–9"	2'–0"	10"	1'–6"
12"	1'–4"	1'–8"	1'–0"	9"	2'–0"	1'–8	1'–0"	1'–0"	3'–3"	1'–8"	1'–0"	1'–0"	5'–0"	2'–0"	10"	1'–6"
16"	1'–9"	2'–0"	1'–0"	9"	2'–6"	2'–0"	1'–0"	1'–3"	4'–3"	2'–6"	1'–0"	1'–3"	6'–0"	2'–6"	1'–4"	1'–9"
18"	1'–9"	2'–6"	1'–0"	10"	3'–3"	2'–6"	1'–0"	1'–6"	6'–0"	2'–6"	1'–0"	1'–4"	8'–0"	3'–4"	1'–8"	1'–9"
20"	1'–9"	2'–6"	1'–0"	10"	3'–3"	2'–6"	1'–0"	1'–6"	6'–0"	2'–6"	1'–0"	1'–4"	8'–0"	3'–4"	1'–8"	1'–9"
24"	2'–0"	3'–0"	1'–0"	1'–0"	3'–9"	3'–0"	1'–0"	1'–6"	7'–0"	3'–0"	1'–0"	1'–9"	9'–9"	4'–0"	2'–0"	2'–0"
30"	2'–6"	3'–6"	1'–2"	1'–2"	4'–0"	3'–6"	1'–4"	1'–9"	7'–6"	4'–0"	1'–4"	2'–3"	9'–9"	5'–0"	2'–6"	2'–6"

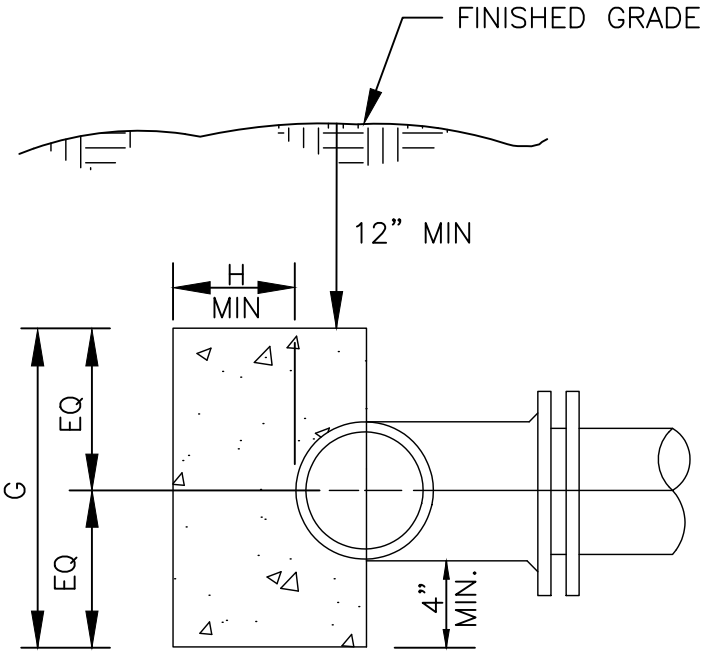
NOTES:

1. BLOCKING DIMENSIONS ARE SHOWN AT A MINIMUM.
2. BLOCKING DIMENSIONS ARE BASED ON A STATIC PRESSURE OF 150 PSI AND AN ALLOWABLE SOIL BEARING CAPACITY OF 2,000 PSF.
3. WHERE SOIL BEARING CAPACITY IS LESS THAN OR GREATER THAN 2,000 PSF, BLOCKING DESIGN CALCULATIONS ARE TO BE SHOWN ON THE PLANS.
4. FITIINGS TO BE WRAPPED IN 4 MIL POLYETHYLENE TO PROTECT NUTS AND BOLTS.

DATE FEB 2026	BLOCKING DETAIL HORIZONTAL BENDS	DRWG. NO. BLK–1
LCWA/TOL		



PLAN



CARRY CONCRETE TO
UNDISTURBED EARTH
OR FIRM SUBGRADE

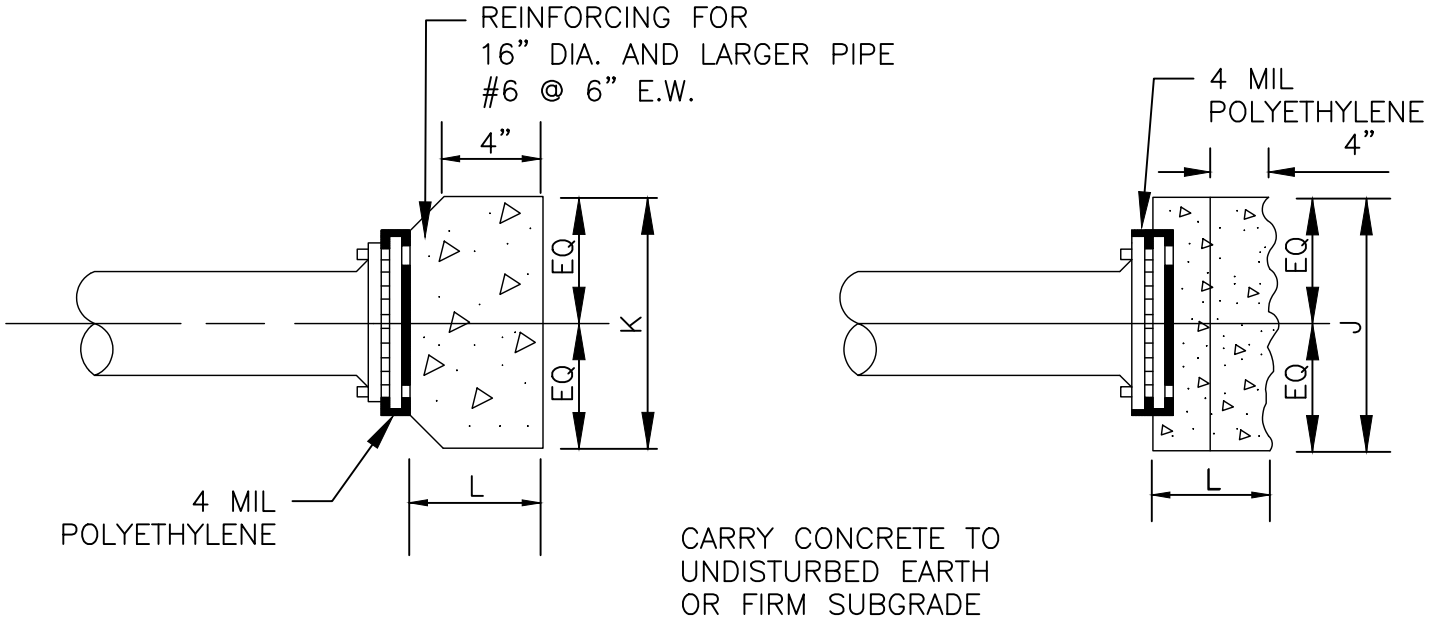
SECTION

BRANCH SIZE	E	F	G	H
4"	1'–0"	8"	1'–4"	6"
6"	1'–4"	1'–0"	1'–8"	8"
8"	1'–6"	1'–0"	2'–6"	9"
10"	2'–2"	1'–0"	2'–8"	10"
12"	2'–6"	1'–0"	3'–6"	1'–0"
16"	3'–4"	1'–4"	4'–8"	1'–2"
18"	4'–0"	2'–0"	6'–0"	1'–6"
20"	4'–0"	2'–0"	6'–0"	1'–6"
24"	5'–0"	2'–0"	6'–8"	1'–8"
30"	5'–0"	2'–6"	7'–0"	1'–10"

NOTES:

1. SEE APPLICABLE NOTES AS SHOWN ON BLK–1.

DATE FEB 2026	BLOCKING DETAIL TEES	DRWG. NO. BLK–2
LCWA/TOL		



PLAN

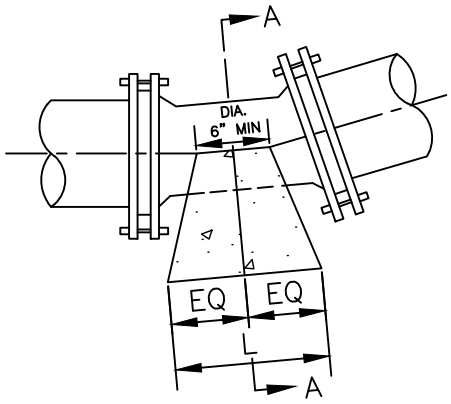
ELEVATION

BRANCH SIZE	J	K	L
4"	1'–0"	1'–0"	8"
6"	1'–6"	1'–6"	8"
8"	2'–6"	1'–6"	10"
10"	2'–8"	2'–2"	1'–0"
12"	3'–6"	2'–6"	1'–2"
16"	4'–8"	3'–4"	1'–4"
18"	6'–0"	4'–0"	1'–6"
20"	6'–0"	4'–0"	1'–6"
24"	6'–8"	5'–0"	1'–8"
30"	8'–0"	6'–8"	2'–0"

NOTES:

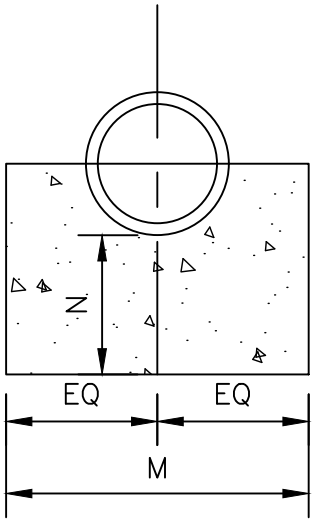
1. SEE APPLICABLE NOTES AS SHOWN ON BLK–1.
2. BLOCKING BASED ON PRESSURE OF 150 PSI AND ALLOWABLE SOIL BEARING CAPACITY OF 2,000 PSF.
3. CONCRETE TO BE 3,000 PSI.

DATE		DRWG. NO.
FEB 2026	BLOCKING DETAIL PLUGS, CAPS AND HYDRANTS	BLK–3
LCWA/TOL		



ELEVATION

CARRY CONCRETE TO UNDISTURBED EARTH OR FIRM SUBGRADE



SECTION A–A

PIPE SIZE	11–1/4° BEND			22–1/2° BEND			45° BEND		
	L	M	N	L	M	N	L	M	N
6"	6"	1'–2"	8"	10"	1'–2"	8"	1'–2"	1'–2"	8"
8"	8"	1'–4	8"	10"	1'–4"	8"	1'–9"	1'–4"	8"
10"	8"	1'–6"	8"	1'–3"	1'–6"	9"	2'–5"	1'–6"	1'–0"
12"	8"	2'–0"	8"	1'–4"	2'–0"	9"	2'–8"	2'–0"	1'–2"
16"	1'–1"	2'–4"	9"	2'–1"	2'–4"	1'–0"	4'–0"	2'–4"	1'–6"
18"	1'–5"	2'–8"	10"	2'–9"	2'–8"	1'–2"	5'–6"	2'–8"	2'–0"
20"	1'–5"	2'–8"	10"	2'–9"	2'–8"	1'–2"	5'–6"	2'–8"	2'–0"
24"	1'–10"	3'–0"	1'–0"	3'–7"	3'–0"	1'–4"	6'–0"	3'–6"	2'–6"
30"	2'–0"	3'–6"	1'–2"	3'–11"	3'–6"	1'–6"	6'–6"	3'–10"	2'–9"

NOTES:

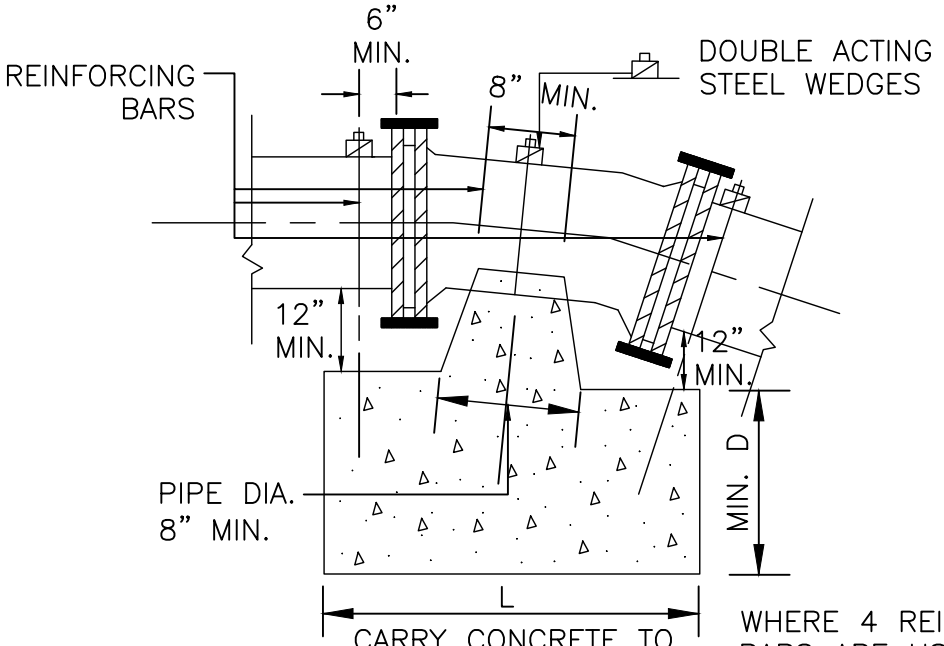
1. SEE APPLICABLE NOTES AS SHOWN ON BLK–1.
2. BLOCKING BASED ON PRESSURE OF 150 PSI AND ALLOWABLE SOIL BEARING CAPACITY OF 2,000 PSF.
3. CONCRETE TO BE 3,000 PSI.

DATE
FEB 2026

LCWA/TOL

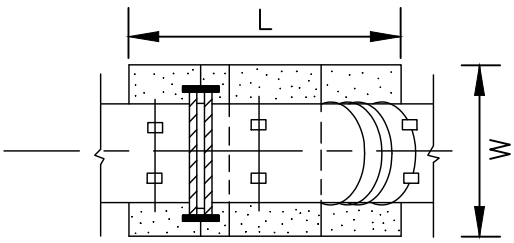
BLOCKING DETAIL
LOWER VERTICAL BENDS

DRWG. NO.
BLK–4



ELEVATION

EMBED REINFORCING BARS MIN. 36 DIAMETERS INCLUDING HOOK
PAINT EXPOSED REINF. BARS WITH 2 COATS OF BITUMINOUS PAINT



PLAN

WHERE 4 REINFORCING BARS ARE USED, PLACE 2 SYMMETRICALLY PLACED REINFORCING BARS AT BENDS AND OTHER 2 BARS AS SHOWN

PIPE SIZE	11–1/4° BEND				22–1/2° BEND				45° BEND			
	L	W	D	REINF. BAR # & SIZE	L	W	D	REINF. BAR # & SIZE	L	W	D	REINF. BAR # & SIZE
6"	2'–0"	2'–0"	1'–6"	3 # 7	2'–6"	2'–6"	2'–0"	3 # 7	3'–0"	3'–0"	2'–0"	3 # 7
8"	2'–0"	2'–0"	2'–0"	3 # 8	2'–9"	2'–9"	2'–3"	3 # 8	3'–6"	3'–6"	2'–6"	3 # 8
10"	2'–3"	2'–3"	2'–0"	3 # 8	3'–6"	3'–6"	2'–3"	3 # 8	4'–0"	4'–0"	2'–9"	4 # 8
12"	2'–6"	2'–6"	2'–3"	3 # 8	4'–0"	4'–0"	2'–6"	4 # 8	4'–6"	4'–6"	3'–0"	4 # 8
16"	3'–3"	3'–3"	2'–6"	3 # 8	4'–6"	4'–6"	3'–0"	4 # 8	6'–0"	6'–0"	3'–6"	4 # 10
18"	4'–0"	4'–0"	2'–6"	3 # 10	5'–6"	5'–6"	3'–6"	3 # 10	7'–6"	7'–6"	4'–0"	4 # 10
20"	4'–0"	4'–0"	2'–6"	3 # 10	5'–6"	5'–6"	3'–6"	3 # 10	7'–6"	7'–6"	4'–0"	4 # 10
24"	4'–6"	4'–6"	3'–0"	3 # 10	6'–0"	6'–0"	4'–0"	4 # 10	8'–6"	8'–6"	4'–6"	4 # 10

NOTES:

1. SEE APPLICABLE NOTES AS SHOWN ON BLK–1.
2. BLOCKING BASED ON PRESSURE OF 150 PSI AND ALLOWABLE SOIL BEARING CAPACITY OF 2,000 PSF.
3. CONCRETE TO BE 3,000 PSI.
4. FOR PIPES GREATER THAN 24", THE DESIGN ENGINEER TO SPECIFY RESTRAINT SYSTEM NECESSARY.

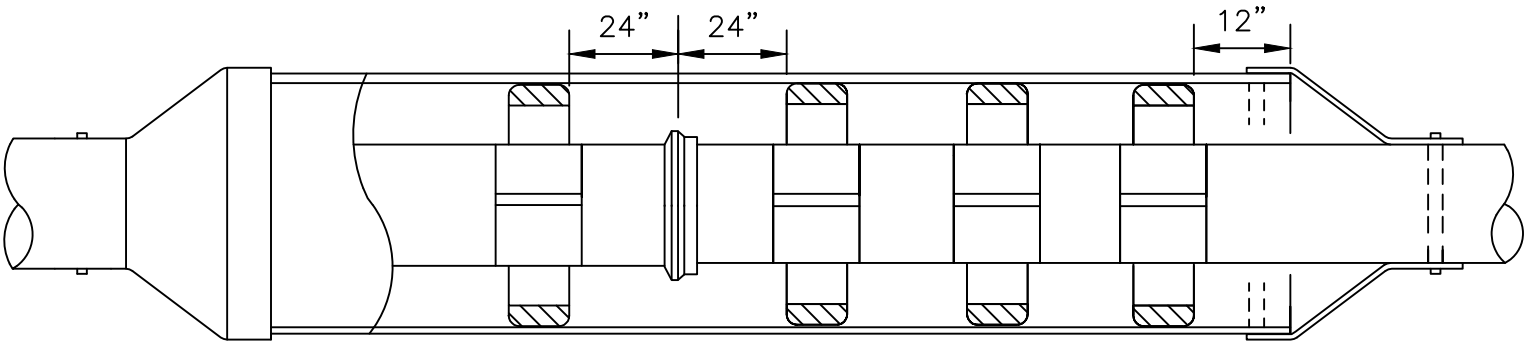
DATE FEB 2026	BLOCKING DETAIL UPPER VERTICAL BENDS	DRWG. NO. BLK–5
LCWA/TOL		

CARRIER PIPE DIA.	CASING PIPE		
	DIAMETER	MINIMUM WALL THICKNESS	
		CRITERIA WITHIN RAILROAD RIGHT OF WAY	CRITERIA WITHIN VDOT RIGHT OF WAY
		STEEL	STEEL
6”	16”	0.500”	0.500”
8”	20”	0.500”	0.500”
10”	20”	0.500”	0.500”
12”	24”	0.500”	0.500”
15”	24”	0.500”	0.500”
16”	30”	0.500”	0.500”
18”	30”	0.500”	0.500”
20”	30”	0.500”	0.500”
21”	30”	0.500”	0.500”
24”	36”	0.563”	0.500”
30”	42”	0.625”	0.500”
33”	42”	0.625”	0.500”
36”	48”	0.688”	0.500”
42”	54”	0.781”	0.500”

NOTES:

1. SLOPES THROUGH BORES SHALL NOT BE BASED ON MINIMUM GRADE UNLESS IT IS THE ONLY SLOPE AVAILABLE.
2. INCREASING THICKNESS OF CASING MUST BE CONSIDERED WHERE BORE LENGTHS EXCEED 125’.
3. CONTRACTOR SHALL MAKE AN EFFORT TO BORE IN THE APPROPRIATE DIRECTION BASED ON EXISTING SOIL CONDITIONS. ENGINEER MUST SHOW LOCATION AND SIZE OF BORE AND RECEIVING PITS, AND LOCATION AND SIZE OF PERMANENT AND CONSTRUCTION EASEMENTS.
4. WHERE RESTRAINING DEVICES ARE REQUIRED FOR THE CARRIER PIPE, THE CASING PIPE SHALL BE INCREASED AS NECESSARY.

DATE FEB 2026	CASING PIPE REQUIREMENTS	DRWG. NO. CAS–1
LCWA/TOL		



CASING DETAIL NOTES:

1. CASING SPACERS FOR GRAVITY SEWER LINES MAY BE USED ONLY WHEN THE SLOPE OF THE FINISHED WELDED CASING PIPE HAS BEEN COMPLETED AND CHECKED AND IS EQUAL TO THE SLOPE OF THE CARRIER PIPE.

2. THREE CASING SPACERS SHALL BE ATTACHED TO EACH JOINT OF CARRIER PIPE WITH ONE AT THE CENTER AND ONE NOT MORE THAN 24" FROM EACH END.

3. ONE CASING SPACER SHALL BE LOCATED NOT MORE THAN 12" FROM EACH END OF THE CASING PIPE.

4. CARRIER PIPE SHALL BE POSITIONED AND RESTRAINED WITHIN CASING TO COMPLY WITH GRADE REQUIREMENTS BY AN APPROVED CASING SPACER.

5. STEEL CASING SHALL HAVE A MINIMUM YIELD STRENGTH OF 35,000 PSI AND CORROSION PROTECTION.

6. LINES TO BE ENCASED UNDER STATE ROADS/RAILROADS WILL COMPLY WITH COUNTY AND ANY APPLICABLE VDOT/AMERICAN RAILROAD ENGINEERING SPECIFICATIONS, WHICHEVER IS MORE STRINGENT.

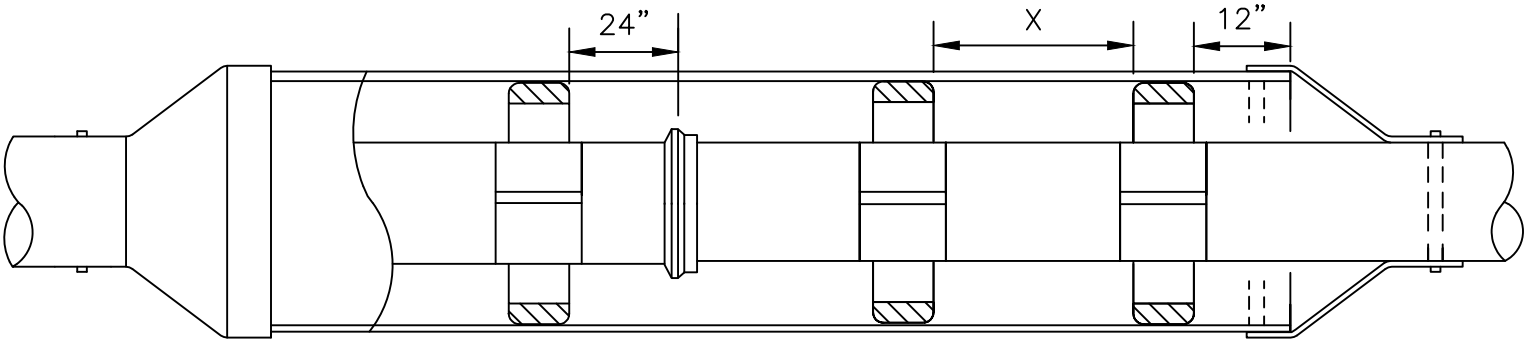
7. WHEN INSTALLING CARRIER PIPE, CONTRACTOR SHALL PUSH SO THAT PIPE JOINTS ARE ALWAYS BEING COMPRESSED.

8. REINFORCED CONCRETE CASING PIPE SHALL BE ASTM C-76, CLASS III. STEEL CASING PIPE SHALL BE ASTM-139, GRADE B.

9. CARRIER PIPE WITHIN BORES FOR SANITARY SEWER INSTALLATION SHALL BE DUCTILE IRON THICKNESS (CLASS 52) AND IS TO BE USED FROM MANHOLE TO MANHOLE.

10. CASING PIPE SHALL BE SEALED BY USE OF WRAPAROUND END SEALS OR WRAP ENDS OF CARRIER PIPE WITH TAR PAPER AND INSTALL 4" THICK BRICK AND MORTAR PLUG IN THE ANNULAR SPACE WITH A 1" WEEP HOLE.

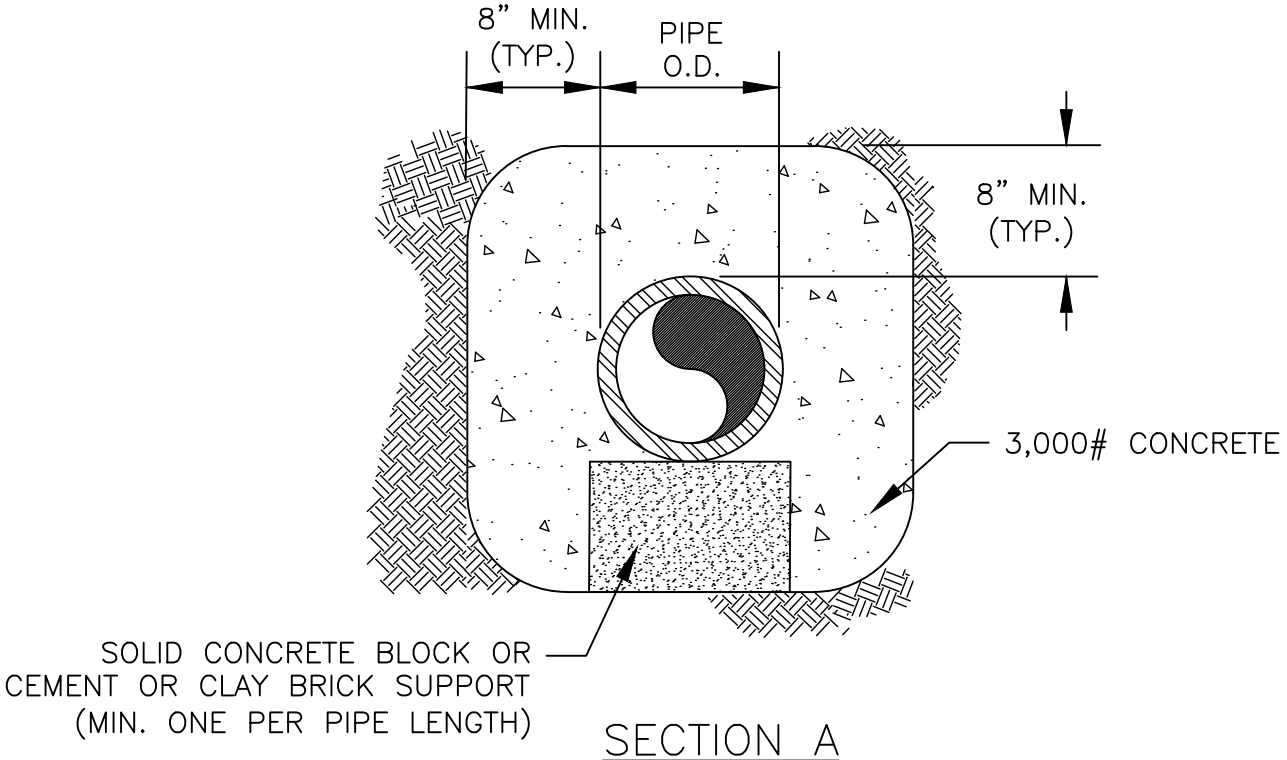
DATE FEB 2026	CASING DETAIL METHOD FOR GRAVITY SEWER LINES	DRWG. NO. CAS-2
LCWA/TOL		



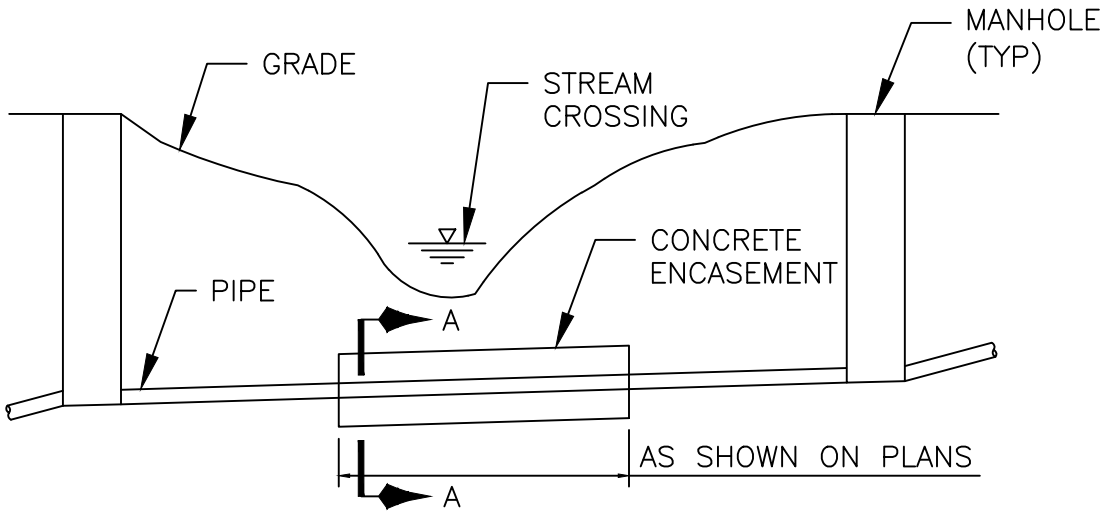
CASING DETAIL NOTES:

1. CARRIER PIPE SHALL BE CENTERED WITHIN CASING BY AN APPROVED CASING SPACER.
2. CASING PIPE SHALL BE SEALED BY USE OF WRAPAROUND END SEALS OR WRAP ENDS OF CARRIER PIPE WITH TAR PAPER AND INSTALL 4" THICK BRICK AND MORTAR PLUG IN THE ANNULAR SPACE WITH A 1" WEEP HOLE.
3. THREE CASING SPACERS SHALL BE ATTACHED TO EACH JOINT OF CARRIER PIPE WITH ONE AT THE CENTER AND ONE NOT MORE THAN 24" FROM EACH END.
4. ONE CASING SPACER SHALL BE LOCATED NOT MORE THAN 12" FROM EACH END OF CASING PIPE.
5. VALVES OR OTHER CONTROL/MAINTENANCE EQUIPMENT ATTACHED TO WATERLINE/SEWER FORCE MAINS SHALL BE LOCATED A MINIMUM FOUR PIPE LENGTHS FROM THE END OF THE CASING, OR AS APPROVED BY THE COUNTY.
6. STEEL CASING SHALL HAVE A MINIMUM YIELD STRENGTH OF 35,000 PSI AND CORROSION PROTECTION.
7. LINES TO BE ENCASED UNDER STATE ROADS/RAILROADS WILL COMPLY WITH COUNTY AND ANY APPLICABLE VDOT/AMERICAN RAILROAD ENGINEERING SPECIFICATIONS WHICHEVER IS MORE STRINGENT.
8. WHEN INSTALLING CARRIER PIPE, CONTRACTOR SHALL PUSH SO THAT PIPE JOINTS ARE ALWAYS BEING COMPRESSED.
9. REINFORCED CONCRETE CASING PIPE SHALL BE ASTM C-76, CLASS III STEEL CASING PIPE SHALL BE ASTM-139, GRADE B.
10. ALL WATERLINES AND FORCE MAINS IN CASING SHALL BE A MINIMUM OF THICKNESS CLASS 52 DIP WITH M.J. BELLS AND AN APPROVED JOINT RESTRAINT DEVICE AT EACH M.J. CONNECTION. MINIMUM 3 JOINTS OUTSIDE EACH END OF CASING SHALL BE M.J. DUCTILE IRON WITH RESTRAINED JOINTS.
11. ALL FORCE MAINS SHALL HAVE RESTRAINED JOINTS WITHIN THE CASING.

DATE FEB 2026	CASING DETAIL FOR WATERLINES & SEWER FORCE MAINS	DRWG. NO. CAS-3
LCWA/TOL		



SECTION A



TYPICAL PROFILE

NOTES:

1. CONTRACTOR SHALL PROTECT PIPE JOINTS AS NECESSARY FOR PORTIONS ENCASED. ALL CONCRETE ENCASEMENTS MUST BE FORMED AND INSPECTED BY DPU INSPECTOR PRIOR TO PLACING CONCRETE AND BACKFILLING.
2. CONTRACTOR SHALL USE VIBRATORY METHOD TO ENSURE COMPLETE ENCASEMENT. FLOTATION SHALL BE PREVENTED.
3. AT STREAM CROSSINGS, ENCASEMENT SHALL EXTEND A MINIMUM OF TEN FEET (10') ON EITHER SIDE OF THE CROSSING. PIPE LINES UNDER STREAMS SHALL TEST ZERO INFILTRATION.
4. PIPE TO BE DUCTILE IRON (CLASS 52) MANHOLE TO MANHOLE.
5. NOT ALLOWED ON WATER LINE PROJECTS.

DATE FEB 2026	PIPE ENCASEMENT DETAIL	DRWG. NO. CAS–4
LCWA/TOL		

GENERAL UTILITY NOTES:

1. ALL WATER AND SEWER CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE STANDARDS AND REQUIREMENTS OF THE LOUISA COUNTY WATER AUTHORITY/TOWN OF LOUISA. THE LCWA/TOL WATER AND SANITARY SEWER STANDARDS ARE INCORPORATED BY REFERENCE.

2. THE CONTRACTOR SHALL CONTACT THE LCWA/TOL INSPECTION DIVISION TO SCHEDULE A PRE-CONSTRUCTION CONFERENCE AT LEAST 48 HOURS PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITY ON WATER OR SEWER IMPROVEMENTS.

3. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED PERMITS FOR THE WORK.

4. A PERMIT FROM THE VIRGINIA DEPARTMENT OF TRANSPORTATION IS REQUIRED FOR ALL WORK WITHIN A PUBLIC ROAD RIGHT-OF-WAY. WITHIN THE LIMITS OF THE TOWN OF LOUISA, THE TOWN ISSUES THIS PERMIT FOR ALL ROADS EXCEPT 1-95.

5. WATERLINES 12" AND SMALLER SHALL BE DUCTILE IRON PIPE MEETING THE REQUIREMENTS OF AWWA C151 THICKNESS CLASS 52 OR PVC PIPE MEETING THE REQUIREMENTS OF AWWA C900; CLASS 150.

6. THE LOCATION OF EXISTING UTILITIES ACROSS OR ALONG THE ROUTE OF THE PROPOSED WORK IS NOT NECESSARILY SHOWN ON THE PLANS, AND WHEN SHOWN, IS ONLY APPROXIMATELY CORRECT. THE CONTRACTOR SHALL, ON HIS OWN INITIATIVE, LOCATE ALL EXISTING UNDERGROUND LINES, FACILITIES AND STRUCTURES AS REQUIRED. THE CONTRACTOR IS RESPONSIBLE FOR REPAIRING ANY UNDERGROUND LINES, FACILITIES AND STRUCTURES DAMAGED BY HIS ACTIVITIES.

7. CONTRACTOR SHALL CALL VIRGINIA 811 AT (800) 552-7001 PRIOR TO THE START OF CONSTRUCTION.

8. NO STRUCTURES OR TREES SHALL BE PERMITTED IN UTILITY EASEMENTS.

9. FINAL ACCEPTANCE OF WORK BY THE LCWA/TOL SHALL NOT BE MADE UNTIL ALL WORK SHOWN ON THE APPROVED PLANS IS COMPLETED.

10. TWO SETS OF PRINTS AND ONE ELECTRONIC COPY OF THE AS-BUILT DRAWINGS MUST BE SUBMITTED TO THE LCWA/TOL PRIOR TO TENTATIVE ACCEPTANCE OF THE WORK BY THE COUNTY.

11. WATER CONNECTIONS SHALL NOT BE BACKFILLED PRIOR TO APPROVAL BY THE LCWA/TOL.

12. ALL WATERLINES SHALL HAVE A MINIMUM OF 3.5 FEET OF COVER.

13. TESTING NOTES: PRESSURE: LEAKAGE SHALL NOT EXCEED THE MAXIMUM ALLOWABLE LEAKAGE SPECIFIED IN AWWA C600. MINIMUM TEST PRESSURE SHALL BE 150 PSI. BACTERIOLOGICAL: TWO SAMPLES FOR BACTERIOLOGICAL SAMPLING SHALL BE COLLECTED AT LEAST 24 HOURS APART. IF CONTAMINATION IS INDICATED, THEN THE DISINFECTION PROCEDURE AND TESTING SHALL BE REPEATED UNTIL SATISFACTORY RESULTS ARE OBTAINED.

14. THE CHLORINE IN HEAVILY CHLORINATED WATER FLUSHED FROM MAINS NEEDS TO BE NEUTRALIZED BEFORE DISCHARGE. CONTRACTORS MUST PROVIDE EQUIPMENT FOR NEUTRALIZING HEAVILY CHLORINATED WATER FLUSHED FROM MAINS DURING CONSTRUCTION PRIOR TO DISCHARGING THE WATER.

15. RESTRAINED JOINT PIPE AND FITTINGS SHALL BE UTILIZED AT ALL WATER LINE STUB-OUTS AND DEAD ENDS FOR A MINIMUM OF 90 FT OR BACK TO THE FAR SIDE OF THE NEAREST VALVE, TEE, OR CROSS, WHICHEVER IS SHORTER, UNLESS ANOTHER DISTANCE IS SPECIFICALLY CALLED OUT ON THE PLANS. IT SHOULD BE ASSUMED THAT EVERY FITTING WILL BE REQUIRED TO HAVE RESTRAINED JOINTS UNLESS OTHERWISE NOTED ON THE PLANS. WHERE CONDITIONS ALLOW OR WARRANT, CONCRETE THRUST BLOCKING MAY BE USED AS A SUBSTITUTE FOR RESTRAINED JOINTS OR MAY BE REQUIRED IN ADDITION TO THE RESTRAINT SYSTEM AS DECIDED BY THE LCWA/TOL INSPECTOR.

DATE FEB 2026	STANDARD SEWER AND WATER NOTES	DRWG. NO.
LCWA/TOL		DES-1

GENERAL UTILITY NOTES (CONTINUED):

16. MONITORING MANHOLES SHALL BE INSTALLED ON ALL SEWER LATERALS WHERE NON-DOMESTIC OR STRONG WASTE WILL POTENTIALLY BE DISCHARGED TO THE PUBLIC SEWER SYSTEM. IF MONITORING MANHOLES ARE NOT PROVIDED WITH THE INITIAL CONSTRUCTION, THE LCWA/TOL MAY REQUIRE THAT THE OWNER ADD A MONITORING MANHOLE, AT THE OWNERS COST, SHOULD THE USE OF THE FACILITY CHANGE, SHOULD THE CHARACTERISTICS OF THE WASTE DISCHARGED BE CHANGED, SHOULD REGULATIONS CHANGE, OR SHOULD THE LCWA/TOL DETERMINE FOR ANY REASON WHAT SO EVER, IN ITS SOLE JUDGEMENT, THAT A MONITORING MANHOLE IS NECESSARY TO PROTECT THE CENTRAL SEWER SYSTEM OR TREATMENT FACILITIES.

17. SEWER LATERALS SHALL BE NO MORE THAN 8 FEET DEEP AT THE EASEMENT OR PROPERTY LINE UNLESS OTHERWISE SPECIFICALLY SHOWN DEEPER THAN 8 FEET ON THE APPROVED PLANS.

18. WHENEVER CONNECTING A SEWER LATERAL TO AN EXISTING MANHOLE, CORE DRILLING AND A FLEXIBLE PIPE-TO-MANHOLE CONNECTOR SHALL BE USED. THE CONNECTOR SHALL BE KOR-N-SEAL ASSEMBLY OR APPROVED EQUAL. THE CONNECTOR SHALL BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.

19. WHENEVER CONNECTING A SEWER LATERAL TO AN EXISTING SEWER LINE, THE CONTRACTOR MUST USE A MECHANICAL HOLE CUTTER WHEN TAPPING THE EXISTING SEWER LINE AND AN APPROVED SADDLE OR INSERTA TEE OR KOR-N-TEE SHALL BE USED.

20. THE CONTRACTOR SHALL SCHEDULE AND COORDINATE THE SHUT-OFF OF EXISTING WATER LINES AND ANY CORRESPONDING SERVICE INTERRUPTIONS WITH THE LCWA/TOL AND ALL AFFECTED CUSTOMERS AT LEAST 48 HOURS PRIOR TO THE SCHEDULED ACTIVITY. THE CONTRACTOR IS TO NOTIFY ALL AFFECTED CUSTOMERS IN WRITING. THE CONTRACTOR SHALL MAKE PROVISIONS TO PROVIDE REASONABLE ACCOMMODATIONS TO AFFECTED CUSTOMERS AND SHALL TAKE ALL NECESSARY STEPS TO MINIMIZE THE LENGTH OF THE SERVICE INTERRUPTION. IN CASES WHERE SPECIAL OPERATIONAL ISSUES ARISE AS A RESULT OF THE PROPOSED WORK, THE LCWA/TOL RESERVES THE RIGHT TO DELAY OR POSTPONE THE WORK SO NOT TO JEOPARDIZE THE INTEGRITY OF ITS UTILITY SYSTEM OR SERVICE TO CUSTOMERS.

21. ALL SANITARY SEWERS CONSTRUCTED IN FILL SHALL BE OF DUCTILE IRON SEWER PIPE (CLASS 52 MINIMUM) WITH MANHOLES FOUNDED ON ORIGINAL GROUND UNLESS A LICENSED GEOTECHNICAL ENGINEER FURNISHES A WRITTEN CERTIFICATION THAT THE FILL HAS BEEN SUFFICIENTLY COMPACTED SO THAT SETTLEMENT OF THE SANITARY SEWER MAIN AND/OR MANHOLE WILL NOT OCCUR.

22. ALL WATER MAINS CONSTRUCTED IN FILL SHALL BE DUCTILE IRON PIPE WITH RESTRAINED JOINTS UNLESS A LICENSED GEOTECHNICAL ENGINEER FURNISHES A WRITTEN CERTIFICATION THAT THE FILL HAS BEEN SUFFICIENTLY COMPACTED SO THAT SETTLEMENT OF THE WATER MAIN WILL NOT OCCUR.

23. ALL SEWER SERVICE CONNECTIONS SHALL BE TERMINATED AT THE PROPERTY LINE WITH AN APPROVED WATER TIGHT PLUG AND MARKED WITH A 2" X 4" BOARD, PAINTED GREEN, INSTALLED PLUMB FROM BOTTOM OF 6" PLUG TO 2 FEET ABOVE GROUND. CLEANOUT ASSEMBLY IS TO BE INSTALLED BY THE BUILDING PLUMBER PER SEW-11.

24. VALVE BOXES NOT LOCATED IN PAVEMENT OR CONCRETE SHALL HAVE A 2 FOOT SQUARE BY 4" THICK CONCRETE PAD POURED AROUND THEM PER DETAIL WAT-5.

25. WATER METERS OR OTHER WATER UTILITY APPURTENANCES SHALL NOT BE LOCATED IN DRIVEWAYS, SIDEWALKS, OR OTHER PAVED AREAS IN SUBDIVISION OR TOWNHOUSE DEVELOPMENTS WITHOUT THE PRIOR APPROVAL OF THE LCWA/TOL.

SEQUENCE OF CONSTRUCTION, TESTING, FLUSHING OF NEW WATERLINE

1. LAY NEW WATERLINES AND APPURTENANCES – CONSTRUCTION SHOULD BEGIN IN THE PROXIMITY OF EXISTING WATERLINES TO FACILITATE FUTURE INSTALLATION OF THE DOUBLE CHECK WITH GATE VALVE AND TESTING CORPORATION STOP ASSEMBLY (I.E. JUMPER) AND TIE–IN. CONNECTION TO ANY EXISTING WATERLINE IS NOT ALLOWED UNTIL CONTRACTOR IS READY TO TEST NEW WATERLINES PRIOR TO PLACING THEM IN SERVICE UNLESS JUMPER IS A CERTIFIED BACKFLOW PREVENTER. COORDINATE ACCEPTABLE "BACKFLOW" ASSEMBLY (PER DETAIL WAT–13) WITH LCWA/TOL INSPECTOR PRIOR TO COMMENCING WORK. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL LABOR AND EQUIPMENT REQUIRED FOR FLUSHING, DECHLORINATION, EROSION PREVENTION, AND REPAIR OF ANY DAMAGE CAUSED BY ANY AND ALL WATERLINE FLUSHING PRIOR TO ISSUANCE OF TENTATIVE ACCEPTANCE BY LCWA/TOL.

2. INITIAL FLUSH – INITIAL FLUSHING OF NEW WATERLINE(S), INCLUDING ALL HYDRANTS AND DEAD–END WATERLINE(S), MAY COMMENCE AFTER JUMPER HAS BEEN INSTALLED AND CONNECTION TO THE EXISTING WATERLINE IS COMPLETE. A SAFE AND STABLE DISCHARGE THAT ALLOWS THE USE OF A PITOT GAUGE FOR FLOW MEASUREMENT MUST BE PROVIDED. LCWA/TOL PERSONNEL WILL VERIFY THAT INITIAL FLUSHING IS PROPERLY PERFORMED AND ALL AIR AND DEBRIS HAVE BEEN REMOVED FROM THE NEW WATERLINE. ALL WATERLINES SHALL BE INITIALLY FLUSHED AT A MINIMUM RATE OF 2.5 FEET PER SECOND (FPS) AND FOR THE DURATION NECESSARY TO PROVIDE A MINIMUM OF 2 COMPLETE WATER TURN–OVERS WITHIN THE NEW WATERLINE(S). THE FOLLOWING TABLE IS PROVIDED AS A GUIDELINE FOR ACHIEVING THE REQUIRED 2.5 FPS VELOCITY AND WATER TURN–OVER RATES. INITIAL FLUSH REQUIREMENTS FOR PIPE DIAMETERS LARGER THAN 16" WILL BE DETERMINED ON A CASE–BY–CASE BASIS AS APPROVED BY LCWA/TOL PERSONNEL.

MAIN SIZE	4"	6"	8"	12"	16"
FLOW (GPM)	98	22	400	900	1,500
GALLON/FT	0.65	1.47	2.61	5.87	10.44

3. PRESSURE TEST – CONDUCT PRESSURE TEST CONSISTENT WITH LCWA/TOL STANDARDS AND AS DIRECTED BY LCWA/TOL INSPECTOR.

4. DISINFECTION – LIQUID SODIUM HYPOCHLORITE SHALL BE USED. USE OF CALCIUM HYPOCHLORITE GRANULES OR TABLETS IS PROHIBITED. THE DISINFECTION SOLUTION SHALL BE FED AT A CONTINUOUS RATE AND MIXED WITH THE WATER ENTERING THE PIPE FROM THE EXISTING SYSTEM SO THAT THE CHLORINE CONCENTRATION OF THE WATER AND DISINFECTION SOLUTION IN THE PIPE IS ELEVATED TO AND MAINTAINED AT A MINIMUM CONCENTRATION OF 50 MG/L AVAILABLE CHLORINE.

5. LOW FLOW FLUSHING – LOW FLOW FLUSHING SHALL NOT BEGIN UNTIL THE DISINFECTION SOLUTION HAS BEEN IN THE NEW WATERLINE FOR AT LEAST 24 HOURS AND A SATISFACTORY CHLORINE RESIDUAL HAS BEEN VERIFIED BY LCWA/TOL PERSONNEL. LOW FLOW FLUSHING IS A LOW VELOCITY FLUSH OF APPROXIMATELY 1 FPS AND SHALL BE MAINTAINED LONG ENOUGH FOR THE DISINFECTION SOLUTION TO BE ENTIRELY REMOVED FROM THE NEW WATERLINE AND THE NORMAL DISTRIBUTION SYSTEM CHLORINE CONCENTRATION IS OBSERVED. LOW FLOW FLUSHING SHALL NOT END UNTIL THE WATER IS VISIBLY CLEAR. LCWA/TOL PERSONNEL WILL VERIFY THAT LOW FLOW FLUSHING IS PROPERLY PERFORMED.

6. BACTERIOLOGICAL TESTING – BACTERIOLOGICAL TESTING SHALL BE COMPLETED NO EARLIER THAN TWO WEEKS PRIOR TO THE SCHEDULED ISSUANCE OF TENTATIVE ACCEPTANCE. BACTERIOLOGICAL TEST SAMPLING SHALL BE CONDUCTED IN THE PRESENCE OF LCWA/TOL PERSONNEL AT LEAST TWO SAMPLES SHALL BE COLLECTED AND TESTED BY A STATE OF VIRGINIA CERTIFIED LABORATORY. THE TWO SAMPLES SHALL BE COLLECTED AT LEAST 24 HOURS APART AT PIPE INTERVALS DETERMINED BY THE INSPECTOR (NOT EXCEEDING 1,200 FEET APART AND AT THE END OF ALL BRANCH LINES AND CUL–DE–SACS). THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE EXPENSE AND COORDINATION OF THE SAMPLE COLLECTION AND TESTING. TWO CONSECUTIVE NEGATIVE TESTS FOR COLIFORM FROM ALL THE SAMPLE LOCATIONS SHALL CONSTITUTE ADEQUATE DISINFECTION OF THE NEW WATERLINE(S). ORIGINALS OF ALL APPLICABLE DOCUMENTATION AND TEST RESULTS MUST BE PROVIDED TO LCWA/TOL INSPECTOR PRIOR TO ISSUANCE OF TENTATIVE ACCEPTANCE AND PROCEEDING TO STEP #7.

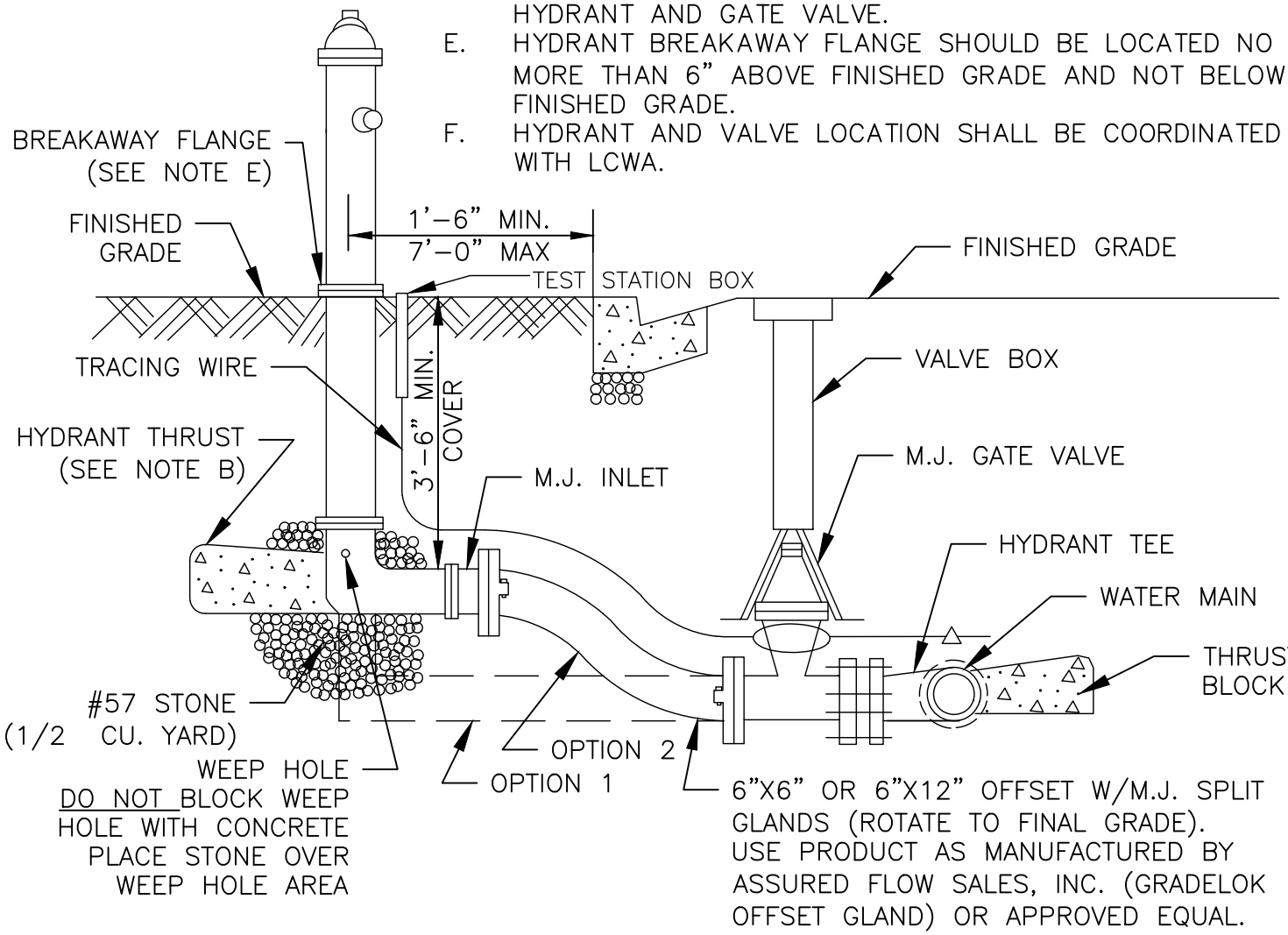
7. REMOVAL OF THE JUMPER AND FINAL FLUSH – ONCE LCWA/TOL APPROVAL HAS BEEN GRANTED, THE CONTRACTOR MAY REMOVE THE JUMPER AND PERFORM NEEDED FLUSHING ON THE NEW WATERLINE TO REMOVE ANY REMAINING AIR AND DEBRIS. LCWA/TOL PERSONNEL WILL FLUSH EXISTING WATERLINES AS NECESSARY AND VERIFY THAT CONTRACTOR'S FLUSHING OF THE NEW WATERLINE(S) IS ADEQUATE.

OPTION 1: IF GRADE ADJUSTMENT IS NOT REQUIRED:

A. THE CONNECTOR PIPE SHALL BE DUCTILE IRON PIPE.
B. IF ALL JOINTS FROM HYDRANT TEE TO HYDRANT ARE RESTRAINED WITH APPROVED JOINT RESTRAINT DEVICE THRUST BLOCKING BEHIND HYDRANT NOT REQUIRED.

OPTION 2: IF GRADE ADJUSTMENT IS REQUIRED:

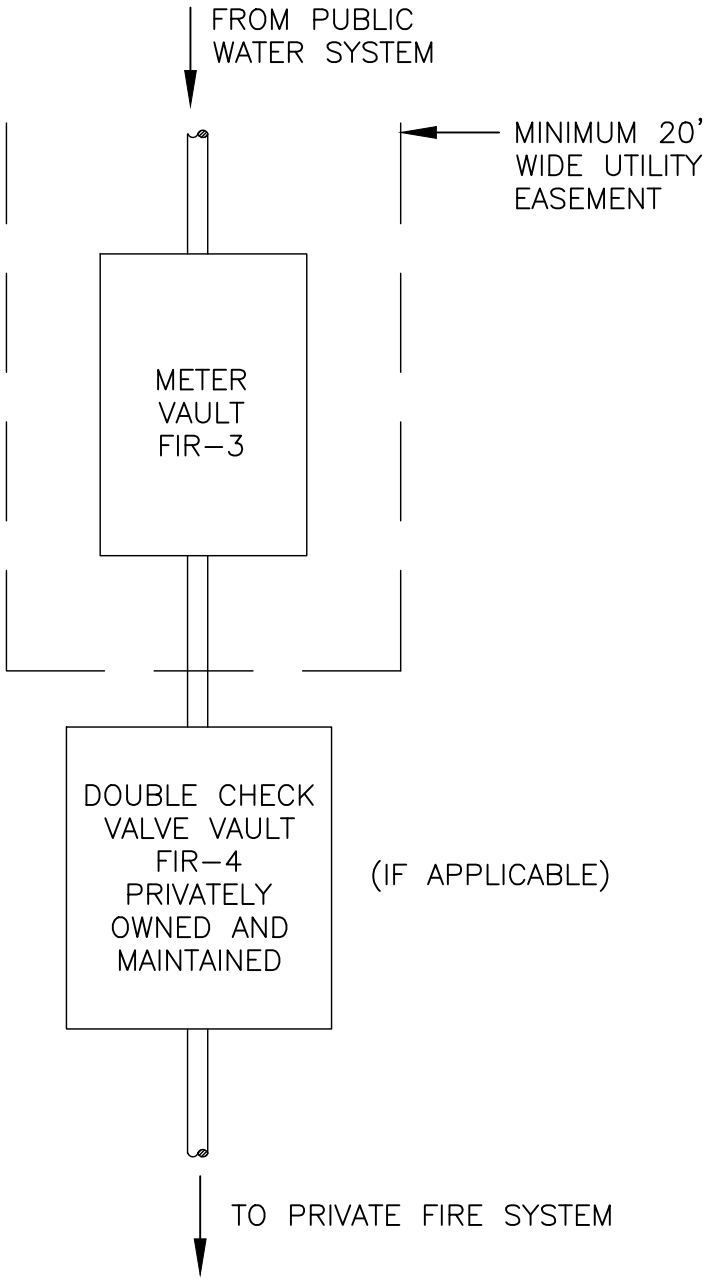
A. THE CONNECTOR PIPE SHALL BE OF THE OFFSET DESIGN SO THAT THE FIRE HYDRANT CAN BE ADJUSTED TO ENSURE PLACEMENT AT THE PROPER GRADE. WHEN THE CONNECTOR PIPE IS THE OFFSET DESIGN IT SHALL HAVE AN ANCHORING FEATURE AT BOTH ENDS SO THAT WHEN USED WITH M.J. SPLIT GLANDS A RESTRAINED JOINT IS PROVIDED.
B. ALL JOINTS FROM HYDRANT TEE TO HYDRANT ARE TO BE RESTRAINED WITH APPROVED JOINT RESTRAINT DEVICE.
C. THE CONNECTOR PIPE SHALL BE CEMENT LINED IN ACCORDANCE WITH AWWA C11 0–ANSI A214.
D. THE CONNECTOR PIPE SHALL BE DUCTILE IRON AWWA C153–ANSO A21.53 AND POSITIONED BETWEEN THE FIRE HYDRANT AND GATE VALVE.
E. HYDRANT BREAKAWAY FLANGE SHOULD BE LOCATED NO MORE THAN 6" ABOVE FINISHED GRADE AND NOT BELOW FINISHED GRADE.
F. HYDRANT AND VALVE LOCATION SHALL BE COORDINATED WITH LCWA.



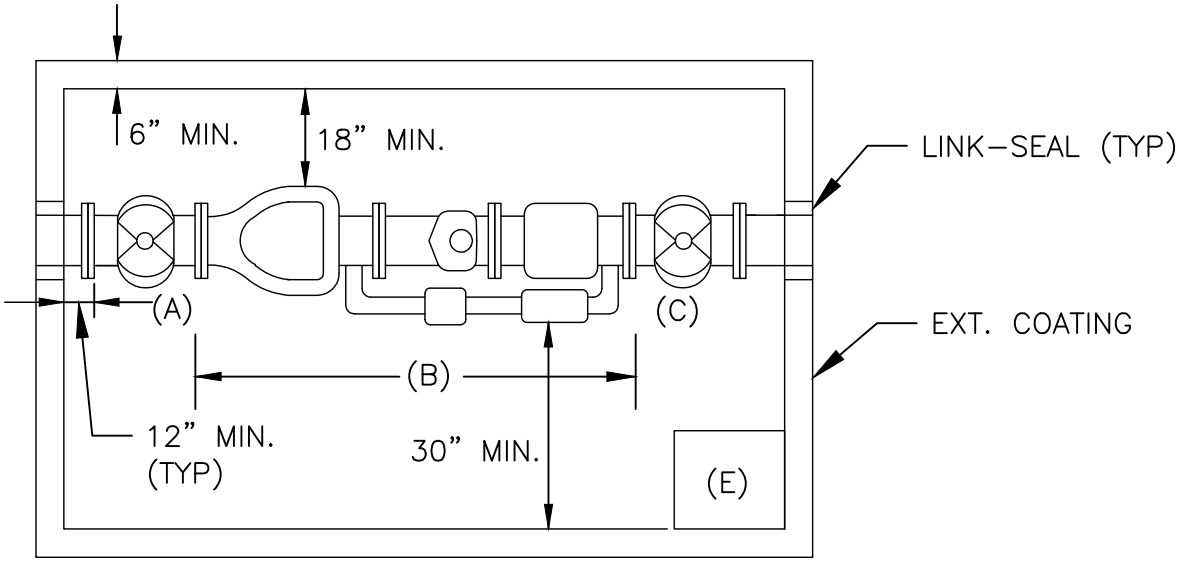
NOTES:

1. ALL SUPPORTING CONCRETE SHALL BE 3000 PSI.
2. FIRE HYDRANT SHALL BE KENNEDY OR MUELLER FOR LCWA AND KENNEDY FOR TOL.
3. ON ROADWAYS WITHOUT CURB AND GUTTER, HYDRANT SHALL BE LOCATED BEHIND THE DITCH AND VALVE SHOULD BE IN SHOULDER OF ROAD OR BETWEEN PAVEMENT AND DITCH. MINIMUM COVER AT DITCH IS 3'–6" OR GREATER.
4. WHEN A SIDEWALK IS ALONG THE SAME SIDE OF THE ROAD AS THE WATERLINE, HYDRANT SHALL BE LOCATED AT LEAST 3 FEET BEHIND THE SIDEWALK.

DATE FEB 2026	TYPICAL FIRE HYDRANT	DRWG. NO. FIR–1
LCWA/TOL		

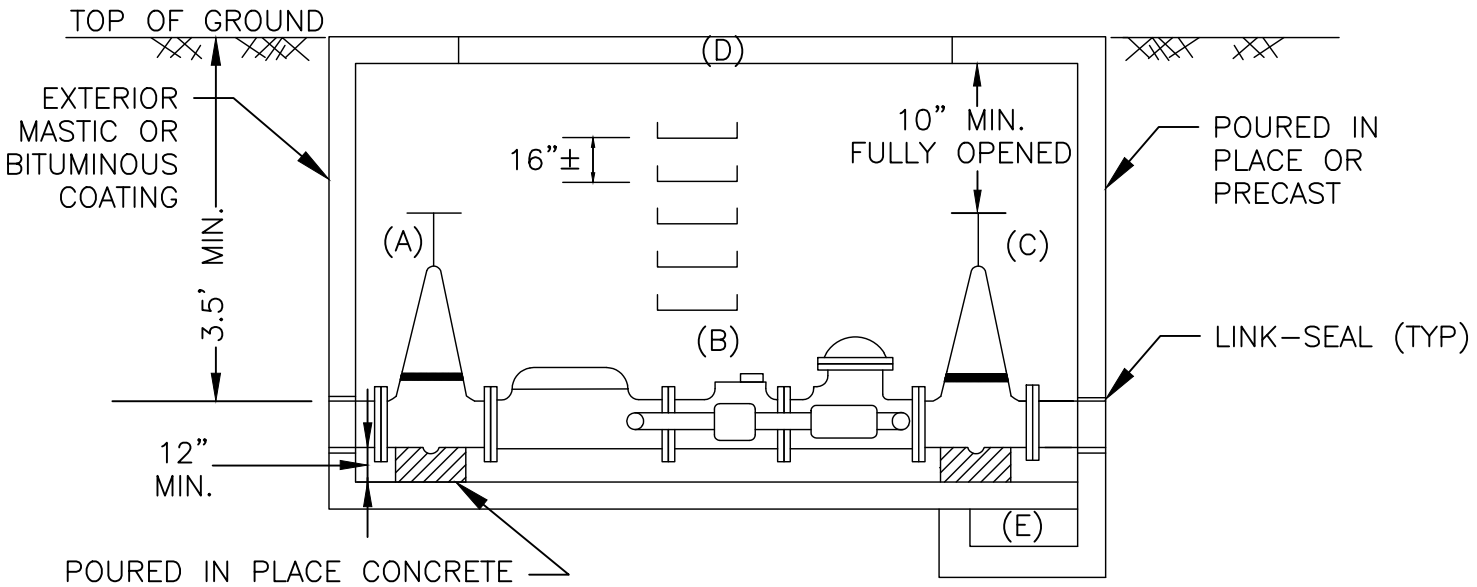


DATE FEB 2026	PRIVATE CENTRAL FIRE SYSTEM PLAN VIEW (1/3)	DRWG. NO. FIR–2
LCWA/TOL		



PLAN

(A) OUTSIDE STEM AND YOKE GATE VALVE
(B) SENSUS FIRELINE METER ASSEMBLY WITH TOUCH READ (FM-720 OR FM-721)
(C) OUTSIDE STEM AND YOKE GATE VALVE
(D) JD-2AL 4'x4' BILCO DOOR, OR AS MANUFACTURED BY VA. SPRINKLER COMPANY, OR APPROVED EQUAL
(E) SUMP PUMP OR GRAVITY DRAIN REQUIRED

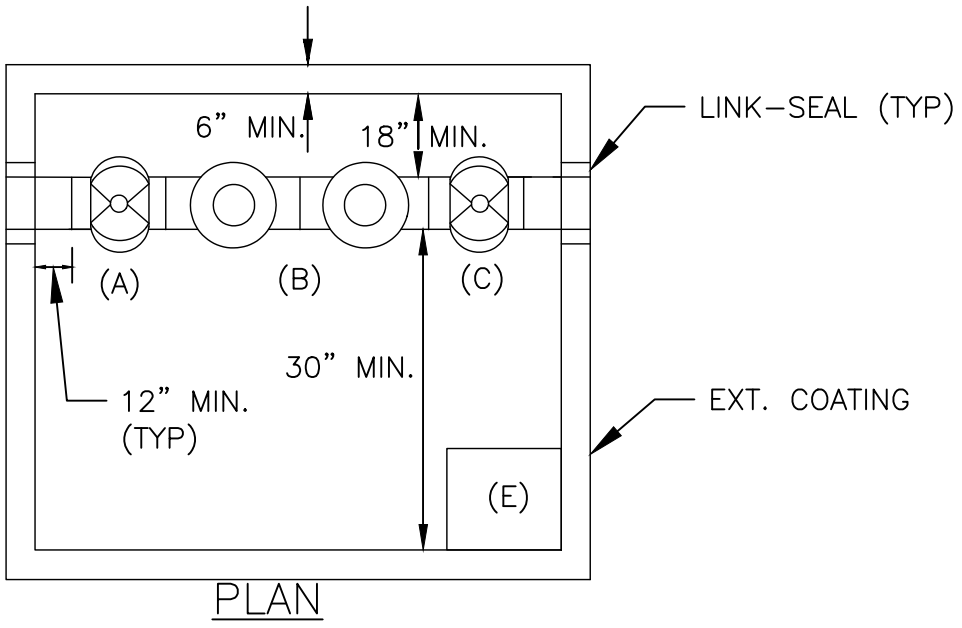


ELEVATION

NOTES:

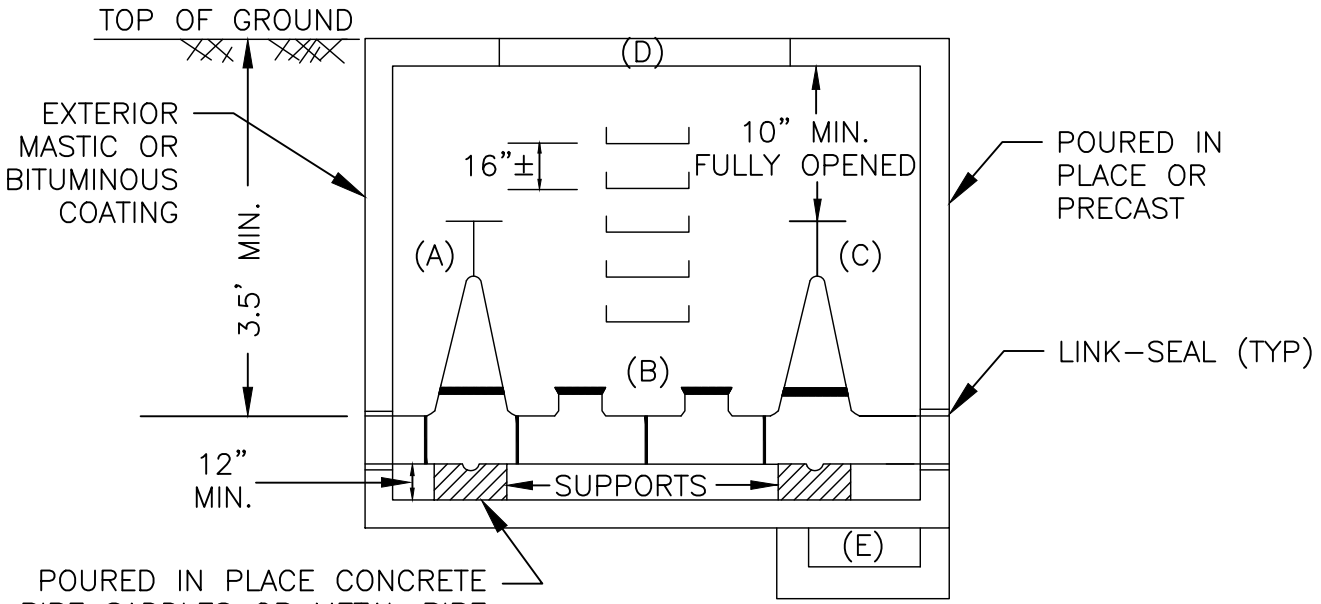
1. FIRE METER SHALL BE INSTALLED IN A VAULT AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING VAULT IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
2. FIRE METER MUST BE U.L. LISTED OR F.M. APPROVED AND APPROVED BY LCWA.

DATE FEB 2026	PRIVATE CENTRAL FIRE SYSTEM	DRWG. NO.
LCWA/TOL	FIRE METER ASSEMBLY & VAULT (2/3)	FIR-3



PLAN

(A) OUTSIDE STEM AND YOKE GATE VALVE
(B) DOUBLE CHECK ASSEMBLY
(C) OUTSIDE STEM AND YOKE GATE VALVE
(D) JD-2AL 4'x4' BILCO DOOR, OR AS MANUFACTURED BY VA. SPRINKLER COMPANY, OR APPROVED EQUAL
(E) SUMP PUMP OR GRAVITY DRAIN REQUIRED

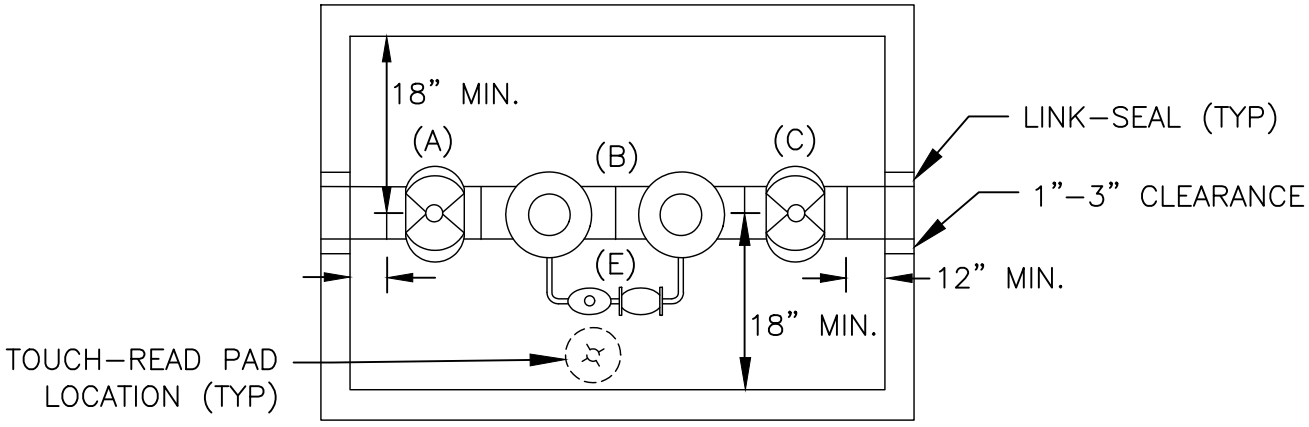


ELEVATION

NOTES:

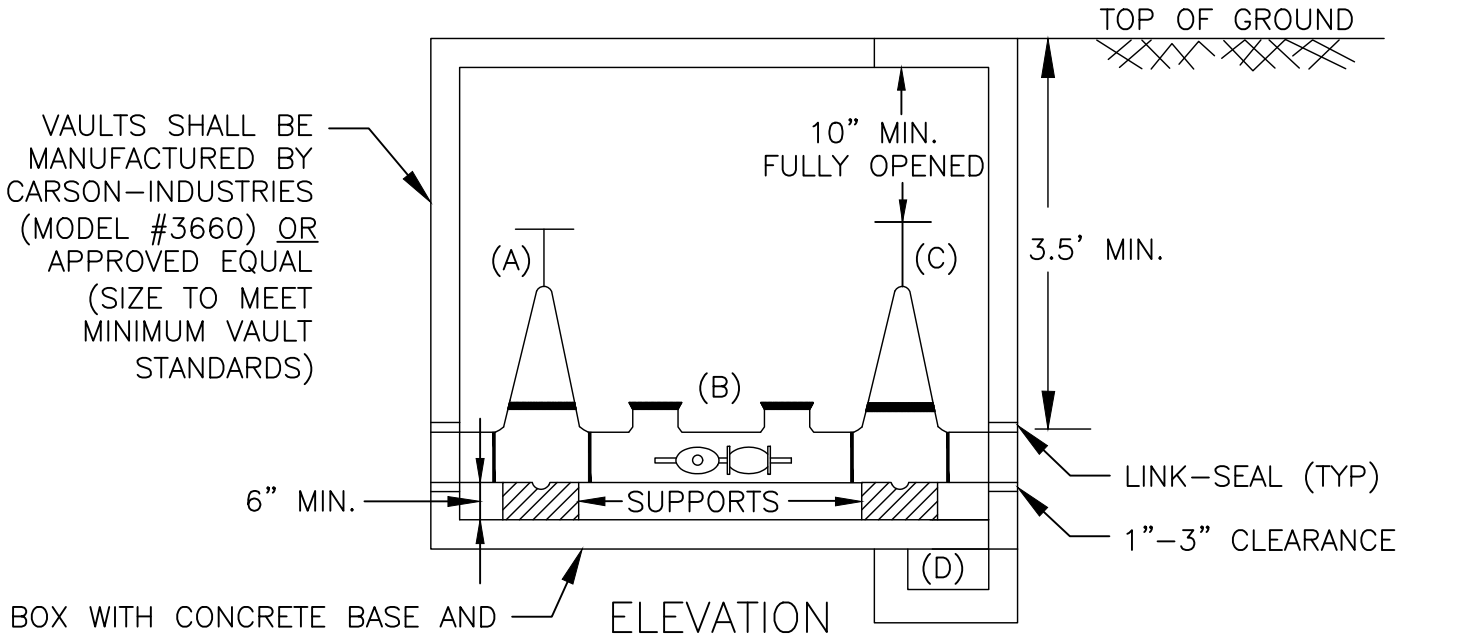
1. DOUBLE CHECK DEVICE SHALL BE INSTALLED IN A BOX AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
2. DOUBLE DETECTOR CHECK ASSEMBLY MUST BE U.L. LISTED OR F.M. APPROVED AND APPROVED BY LCWA.

DATE FEB 2026	SYSTEM INTERCONNECTION 3" OR LARGER DOUBLE CHECK ASSEMBLY & VAULT (3/3)	DRWG. NO. FIR-4
LCWA/TOL		



PLAN

(A) OUTSIDE STEM AND YOKE GATE VALVE
(B) DOUBLE CHECK ASSEMBLY
(C) OUTSIDE STEM AND YOKE GATE VALVE
(D) SUMP PUMP WHERE WATER TABLE IS A PROBLEM OR GRAVITY DRAIN WHERE WATER TABLE IN NOT
(E) BYPASS LOW FLOW METER WITH ISOLATION VALVES AND BACKFLOW PREVENTER (METER TO BE PURCHASED FROM LCWA)



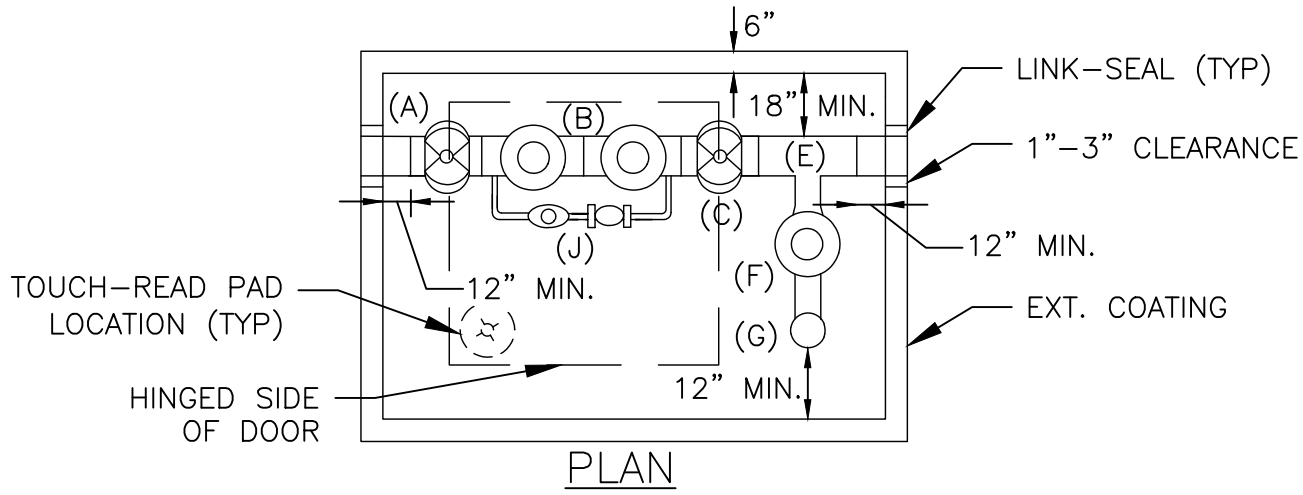
ELEVATION

ISOLATION VALVES ON LOW–FLOW BYPASS SHALL BE 1/4 TURN BALL VALVES WITH SINGLE LEVEL HANDLE. GATE VALVES WITH HANDWHEEL ACTUATORS ARE STRICTLY PROHIBITED.

NOTES:

1. DOUBLE CHECK DEVICE SHALL BE INSTALLED IN A BOX AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
2. DOUBLE DETECTOR CHECK ASSEMBLY MUST BE U.L. LISTED OR F.M. APPROVED AND APPROVED BY LCWA.

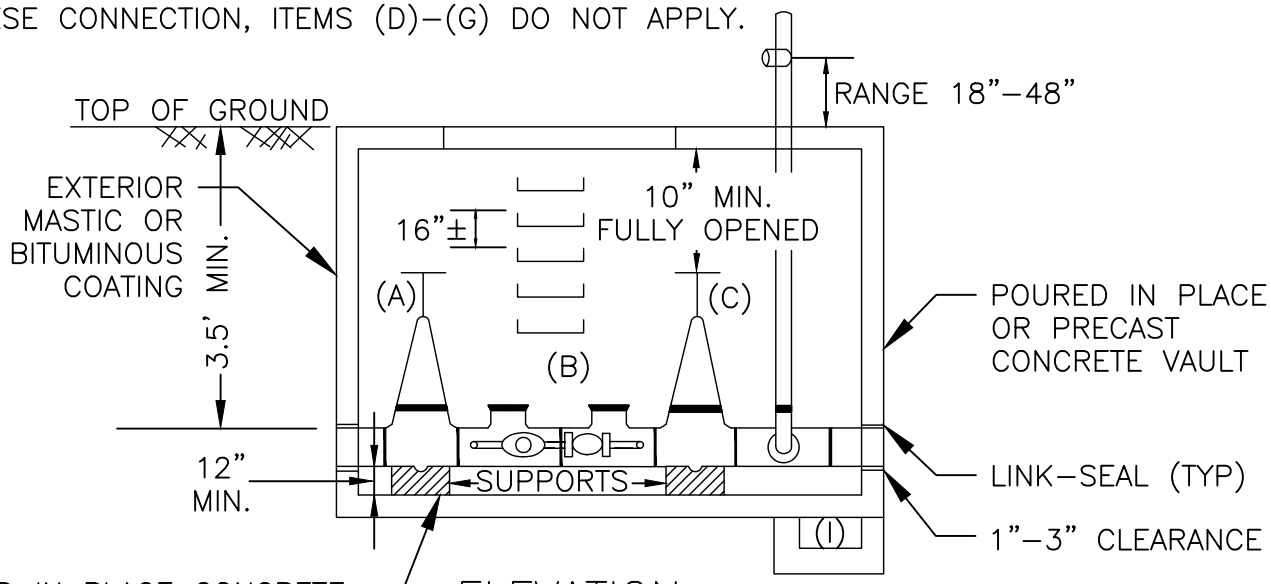
DATE FEB 2026	2" OR SMALLER DOUBLE DETECTOR CHECK ASSEMBLY AND VAULT	DRWG. NO. FIR–5
LCWA/TOL		



PLAN

(A) OUTSIDE STEM AND YOKE GATE VALVE
(B) DOUBLE CHECK ASSEMBLY
(C) OUTSIDE STEM AND YOKE GATE VALVE
*(D) 2 1/2" THREADED N.S.T. SIAMESE CONNECTION FOR FIRE DEPARTMENT W/AUTOMATIC BALL DRIP
*(E) REQUIRED (MAIN LINE SIZE)"X4" TEE
*(F) 4" CHECK VALVE
*(G) 4"–90° BEND
(H) JD–2AL 4'x4' BILCO DOOR, OR AS MANUFACTURED BY VA. SPRINKLER COMPANY, OR APPROVED EQUAL
(I) SUMP WHERE WATER TABLE IS A PROBLEM OR GRAVITY DRAIN WHERE TABLE IS NOT
(J) BYPASS LOW FLOW METER WITH ISOLATION VALVES AND BACKFLOW PREVENTER (METER TO BE PURCHASED FROM LCWA)

*WHERE A 3" OR LARGER FIRE LINE DOES NOT REQUIRE A SIAMESE CONNECTION, ITEMS (D)–(G) DO NOT APPLY.



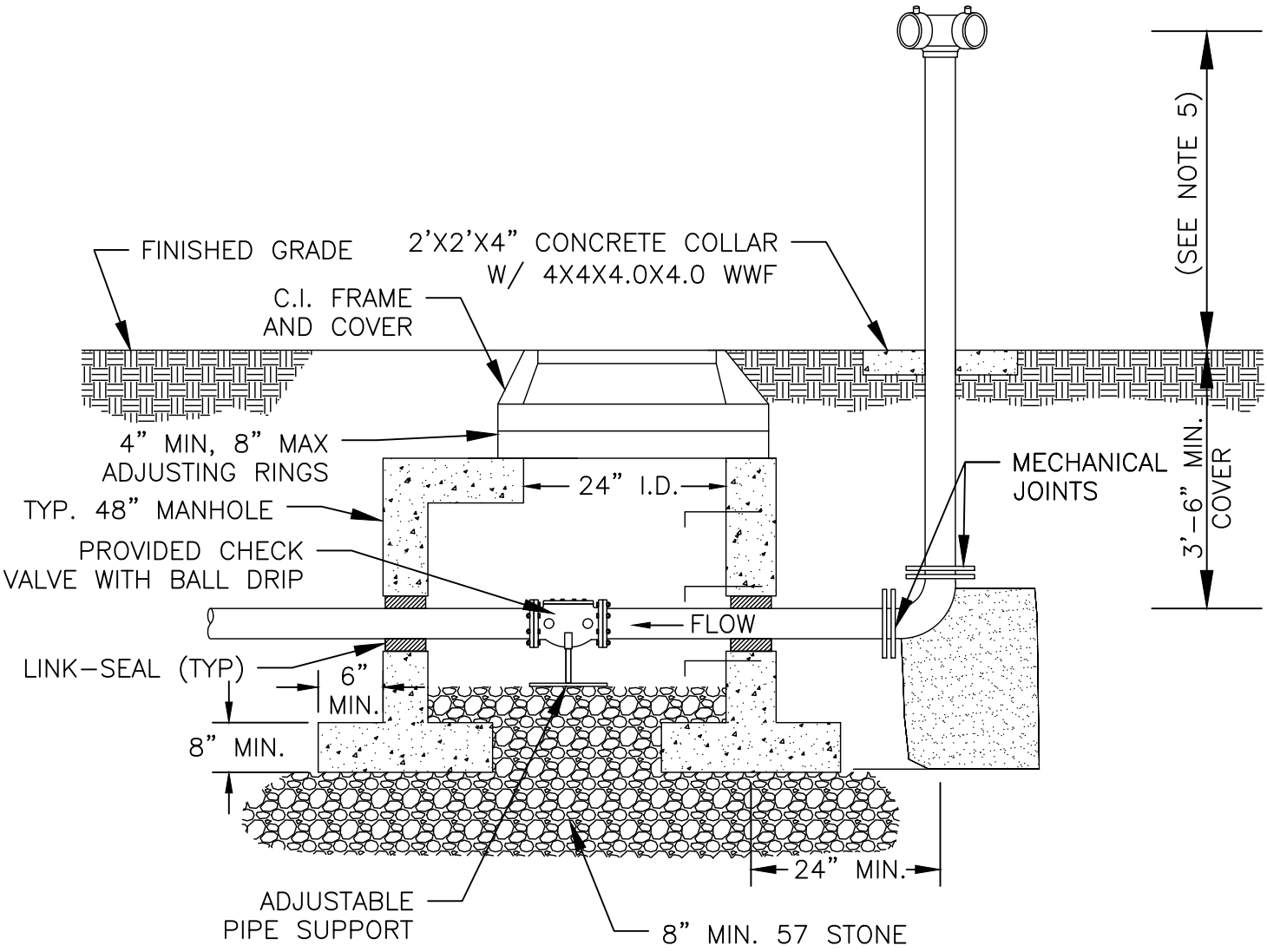
ELEVATION

ISOLATION VALVES ON LOW–FLOW BYPASS SHALL BE 1/4 TURN BALL VALVES WITH SINGLE LEVEL HANDLE. GATE VALVES WITH HANDWHEEL ACTUATORS ARE STRICTLY PROHIBITED.

NOTES:

1. DOUBLE CHECK DEVICE SHALL BE INSTALLED IN A BOX AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
2. DOUBLE DETECTOR CHECK ASSEMBLY MUST BE U.L. LISTED OR F.M. APPROVED AND APPROVED BY LCWA.

DATE FEB 2026	3" OR LARGER DOUBLE DETECTOR CHECK ASSEMBLY AND VAULT	DRWG. NO. FIR–6
LCWA/TOL		



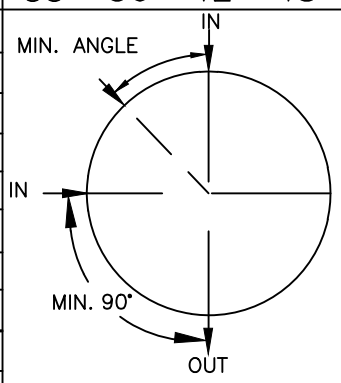
NOTES:

1. SHALL ONLY BE USED WITH SPECIFIC PERMISSION.
2. ALL MATERIALS AND RELEVANT DIMENSIONS MUST BE IN CONFORMANCE WITH THE MOST RECENT NFPA STANDARDS AND SPECIFICATIONS. SHOP DRAWINGS SHALL BE SUBMITTED AND APPROVED BY LCWA/TOL PRIOR TO ALL FDC INSTALLATIONS.
3. STONE BEDDING SHALL EXTEND TO UNDISTURBED EARTH IN ALL DIRECTIONS AROUND MANHOLE.
4. ALL M.J. FITTINGS SHALL BE RESTRAINED ON EACH END.
5. THE HEIGHT OF STANDPIPE SHALL BE IN CONFORMANCE WITH THE MOST CURRENT NFPA STANDARDS.
6. ALL THREADS SHALL BE NATIONAL STANDARD.

DATE FEB 2026	STANDARD YARD FIRE DEPARTMENT CONNECTION (FDC)	DRWG. NO. FIR-7
LCWA/TOL		

PIPE SIZE

		8	10	12	15	18	21	24	27	30	33	36	42	48	54
48" MH	8	38°	40°												
	10	40°	43°												
	12	43°	45°	48°											
	15	47°	49°	51°	55°										
	18	55°	57°	59°	63°	71°									
	21	59°	61°	64°	67°	76°	80°								
	24	63°	65°	68°	71°	80°	84°	88°							
60" MH	12	34°	36°	38°	41°										
	15	37°	39°	41°	44°										
	18	44°	46°	48°	51°	57°									
	21	47°	49°	51°	54°	61°	64°								
	24	51°	53°	54°	57°	64°	67°	71°							
	27	54°	56°	58°	61°	67°	71°	74°	77°						
	30	57°	59°	61°	64°	71°	74°	77°	81°	84°					
	33	61°	63°	64°	67°	74°	77°	81°	84°	87°	90°				
72" MH	15				37°	42°									
	18				42°	48°									
	21				45°	50°	53°								
	24				48°	53°	56°	59°							
	27				50°	56°	59°	62°	64°						
	30				53°	59°	62°	64°	67°	70°					
	33				56°	62°	64°	67°	70°	73°	76°		②		
	36				59°	64°	67°	70°	73°	76°	78°	81°	87°		
84" MH	18					41°	43°								
	21					43°	46°								
	24					46°	48°	50°							
	27					48°	50°	53°	55°						
	30					50°	53°	55°	58°	60°					
	33					53°	55°	58°	60°	62°	65°				
	36					55°	58°	60°	62°	65°	67°	70°			
	42					60°	62°	65°	67°	70°	72°	74°	79°		
	48					65°	67°	70°	72°	74°	77°	79°	84°	89°	
96" MH	54								67°	69°	71°	73°	78°	82°	86°



THICK–WALL OR NON–FLOAT PIPE MUST BE CALCULATED.

* D=PIPE DIAMETER
W=PIPE WALL THICKNESS

PIPE 18" AND OVER IS ASSUMED TO BE CONCRETE.

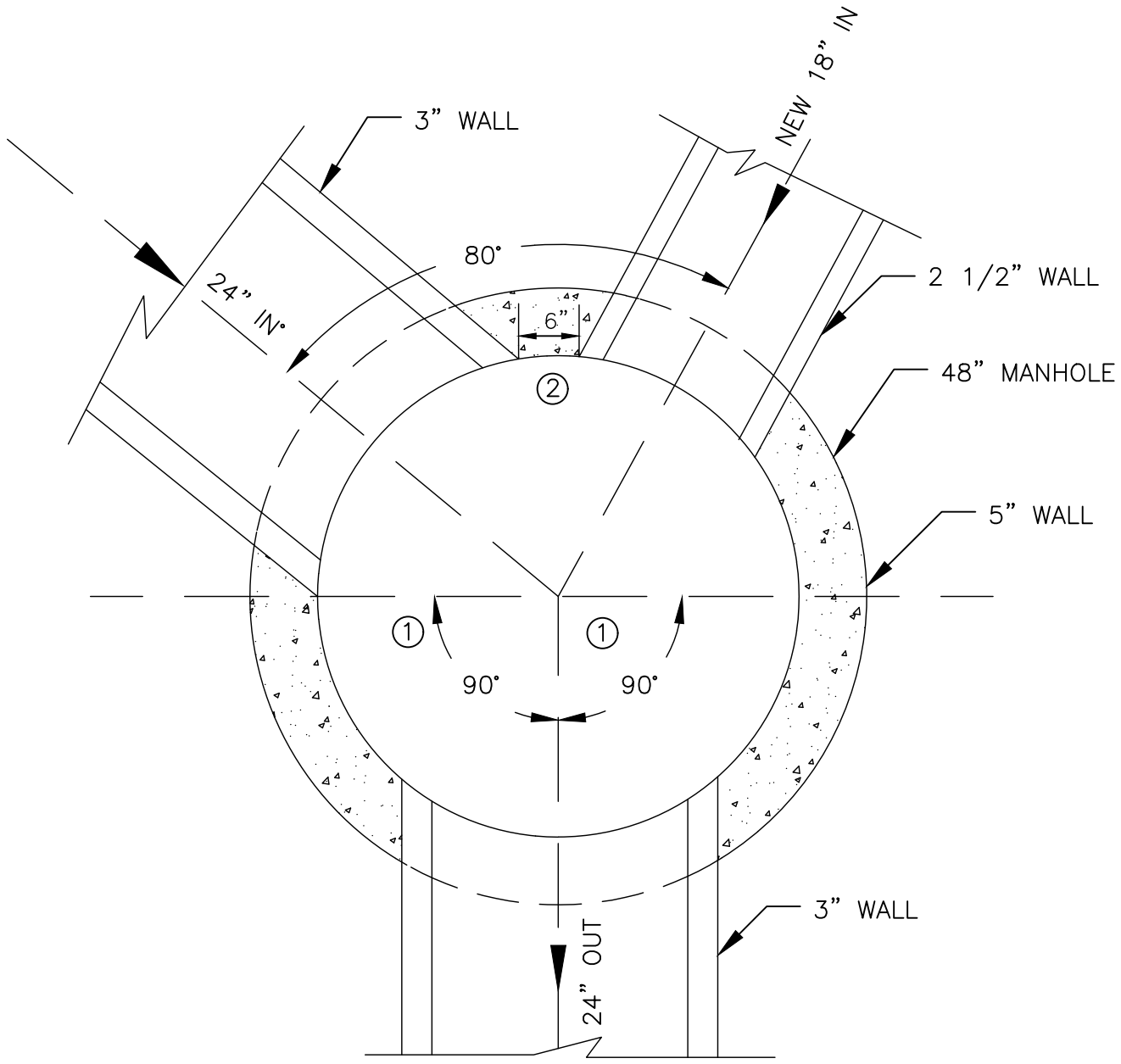
② 42" PIPE WILL BE ALLOWED IN 72" MH WHERE THE CALCULATION ALLOWS IT. FOR EXAMPLE, STRAIGHT THRU OR MIN. ANGLE OVER 92° FOR TWO 42" PIPES.

MINIMUM ANGLE FOR COMBINATIONS NOT GIVEN MAY BE DERIVED BY:

$$\frac{\frac{D1}{2} + \frac{D2}{2} + (7+W1+W2)}{\pi \times \text{MH DIA.}} \times 360$$

D = PIPE DIAMETER
W = PIPE WALL THICKNESS

DATE	MANHOLE SIZING AND MINIMUM ANGLE TABLE	DRWG. NO.
FEB 2026		MAN–1A
LCWA/TOL		

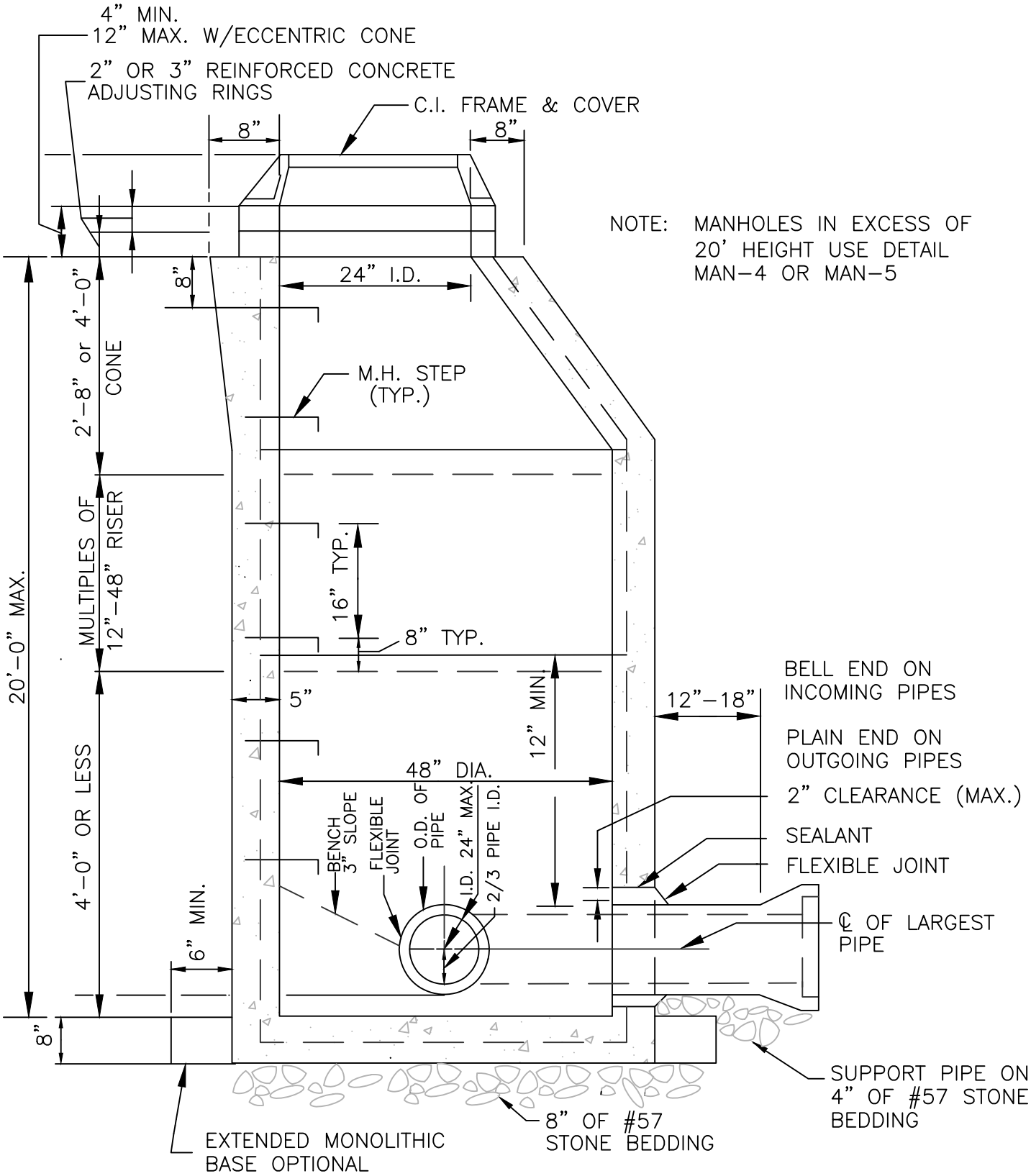


NOTES:

1. MINIMUM ANGLE BETWEEN INFLUENT AND EFFLUENT PIPES IS 90°, EXCEPT BY SPECIAL DESIGN.
2. EXCEPTIONS TO THE MINIMUM SEPARATION BETWEEN PIPES WILL BE CONSIDERED PER EACH, BY SPECIAL DESIGN.

EXAMPLE: 48" MANHOLE, EXISTING 24" IN, EXISTING 24" OUT, NEW 18" IN, ALL CONCRETE. MAN–1A TABLE INDICATES A MINIMUM ANGLE OF 80° BETWEEN THE EXISTING 24" (IN) AND THE NEW 18" (IN), RESULTING IN APPROXIMATE 6" OF INTERIOR MANHOLE WALL REMAINING BETWEEN THE 2 PIPES.

DATE FEB 2026	MANHOLE SIZING AND MINIMUM ANGLE DETAIL	DRWG. NO. MAN–1B
LCWA/TOL		

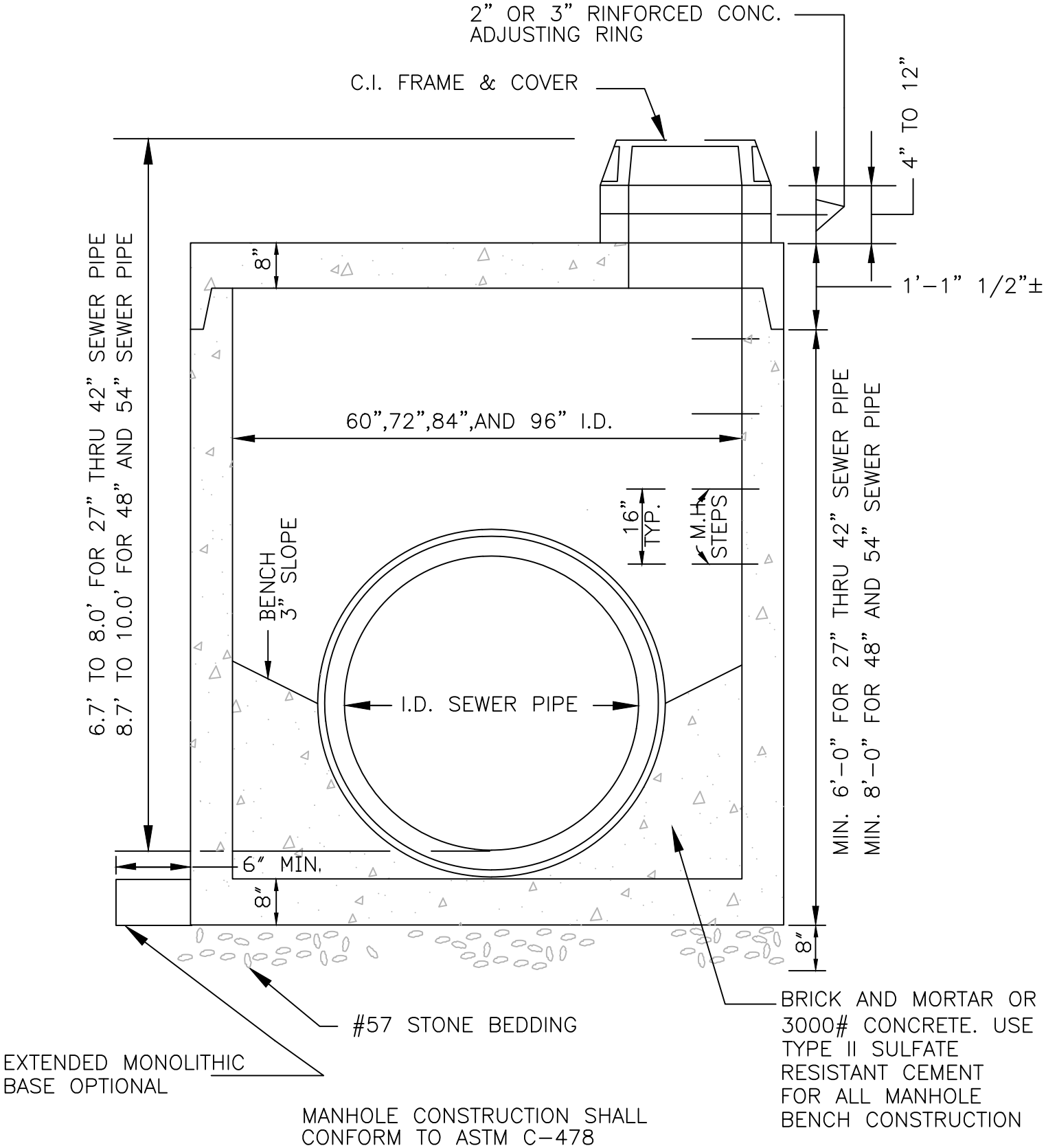


NOTE: MANHOLES IN EXCESS OF 20' HEIGHT USE DETAIL MAN-4 OR MAN-5

NOTE: BENCH MAY BE CONC. OR BRICK AND MORTAR. USE TYPE II SULFATE RESISTANT CEMENT FOR ALL MANHOLE BENCH CONSTRUCTION.

NOTE: STONE BEDDING SHALL EXTEND TO THE OUTER BOUNDARY OF ALL UNDISTURBED AREAS SURROUNDING THE MANHOLE.

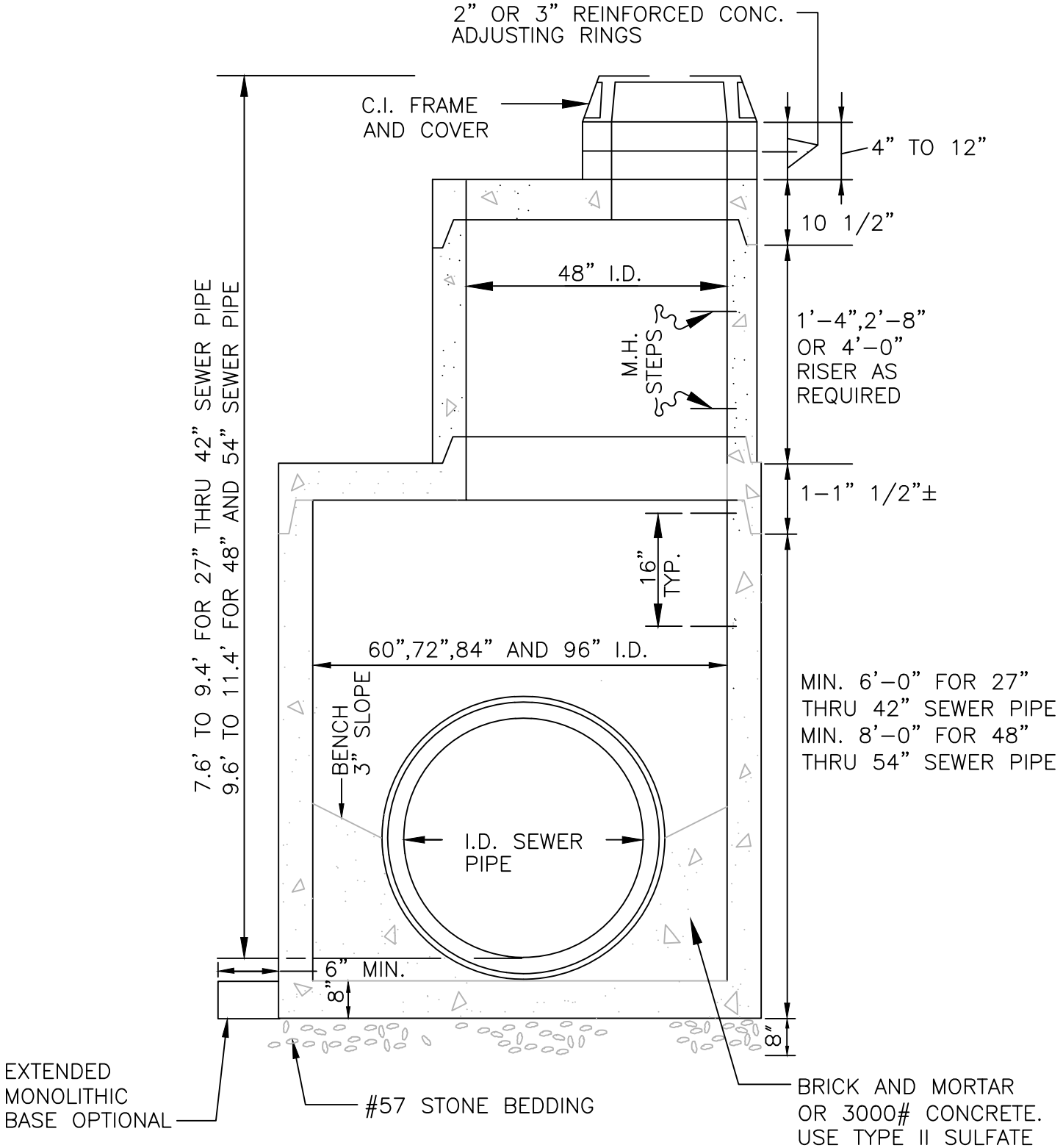
DATE FEB 2026	STANDARD PRECAST CONCRETE MANHOLE SEWERS 8" TO 24"	DRWG. NO. MAN-2
LCWA/TOL		



MANHOLE CONSTRUCTION SHALL CONFORM TO ASTM C-478

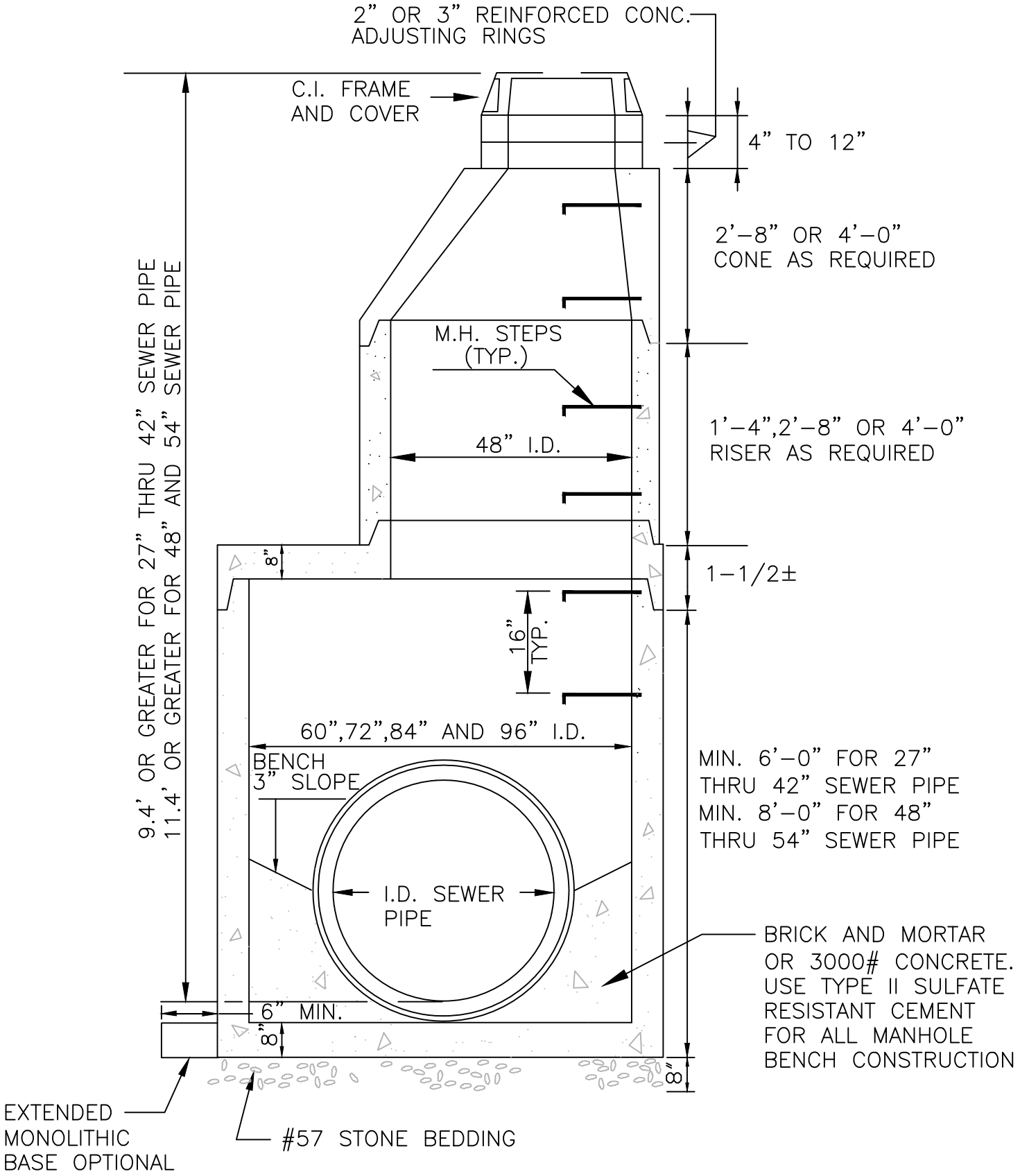
NOTE: WHERE STUBS ARE PROVIDED FOR FUTURE CONNECTIONS BENCH SHALL BE SO FORMED.

DATE FEB 2026	60", 72", 84" & 96" I.D. MANHOLE - I	DRWG. NO. MAN-3
LCWA/TOL		



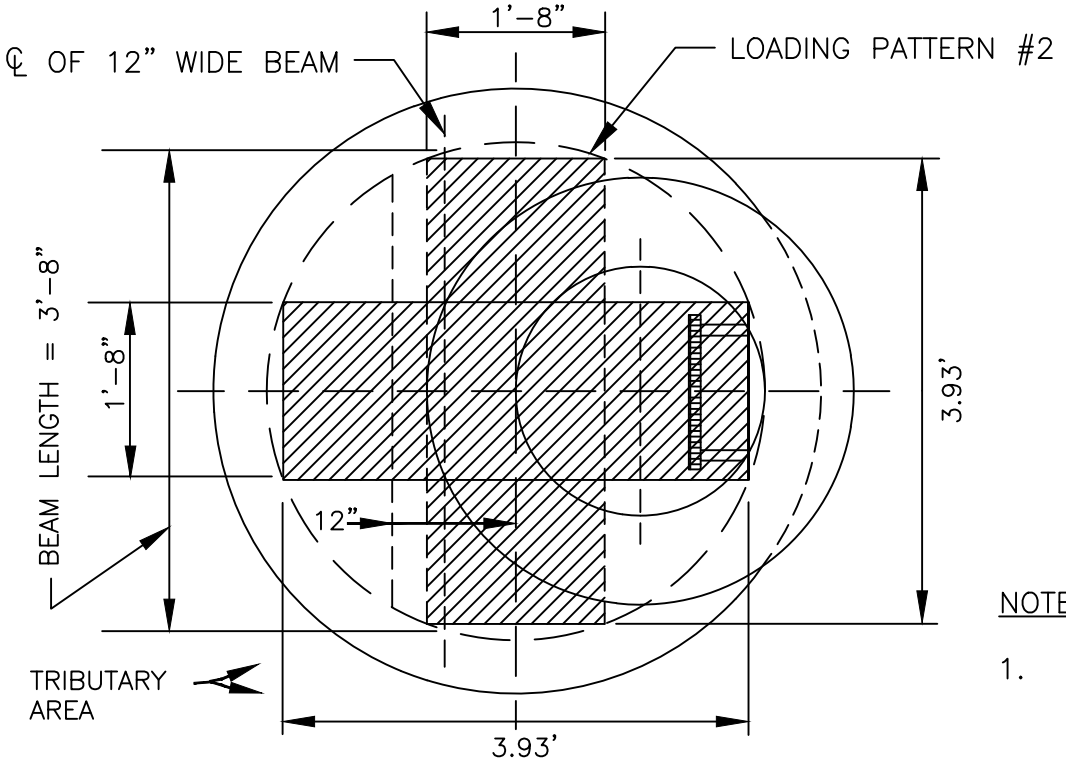
NOTE: WHERE STUBS ARE PROVIDED FOR FUTURE CONNECTIONS BENCH SHALL BE SO FORMED.

DATE FEB 2026	60", 72", 84" & 96" I.D. MANHOLE – II	DRWG. NO. MAN-4
LCWA/TOL		



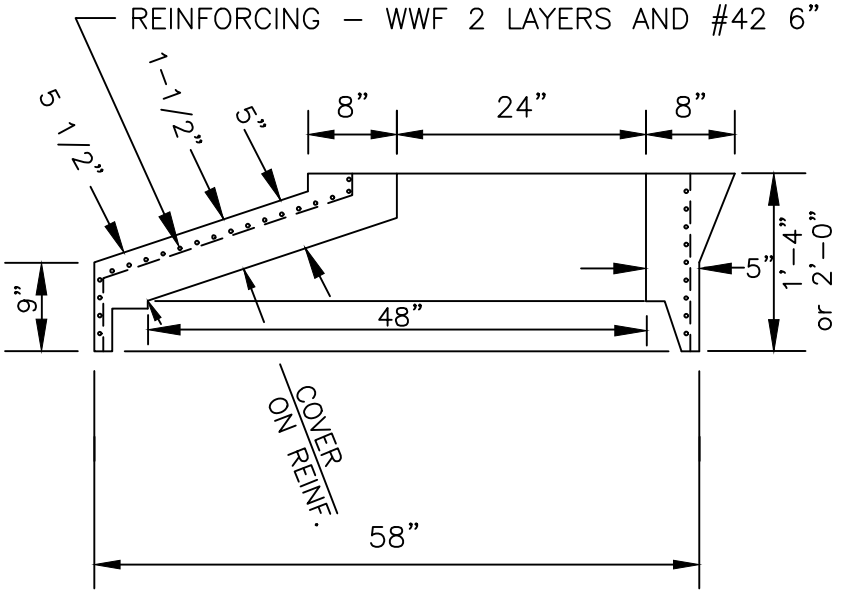
NOTE: WHERE STUBS ARE PROVIDED FOR FUTURE CONNECTIONS BENCH SHALL BE SO FORMED.

DATE FEB 2026	60", 72", 84" & 96" I.D. MANHOLE – III	DRWG. NO. MAN-5
LCWA/TOL		

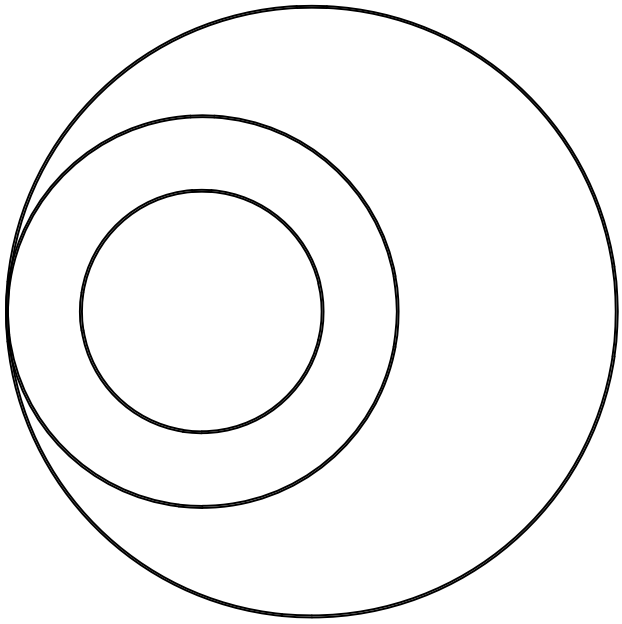


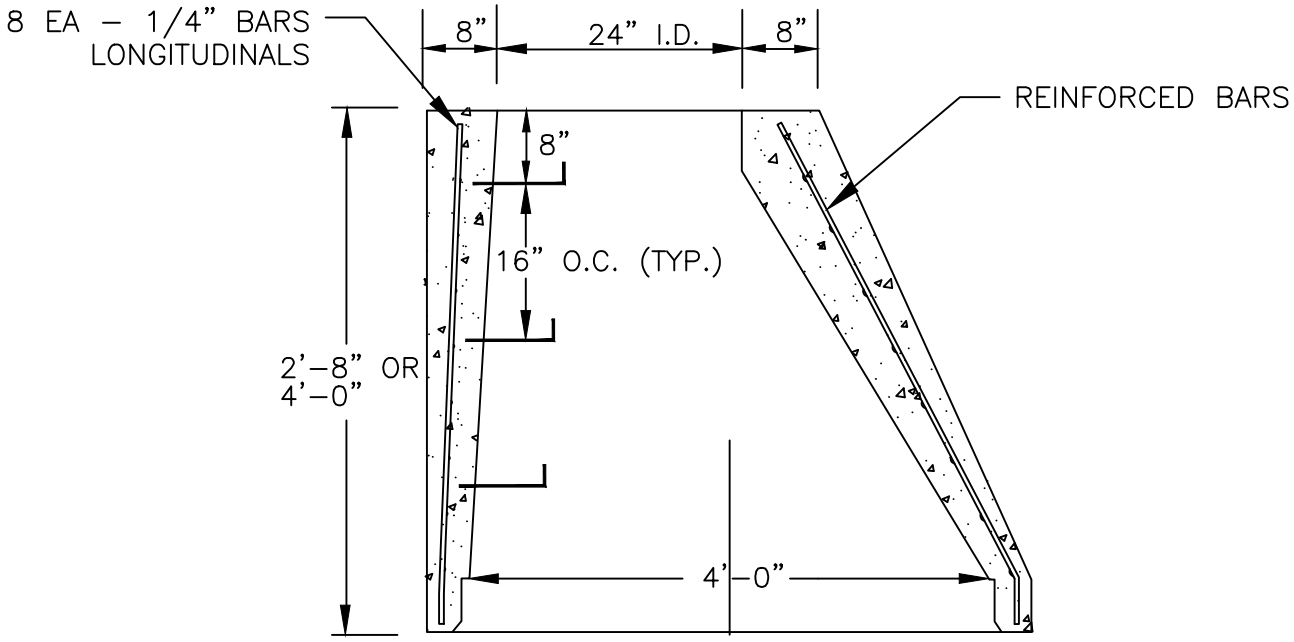
NOTES:

1. REINFORCING TO MEET ASTM A–185 FOR MESH AND ASTM A–615 FOR REBARS.
2. MANHOLE MEETS ALL REQUIREMENTS OF ASTM C–478.
3. CONCRETE IS 4,000 PSI COMPRESSIVE STRENGTH MINIMUM.



DATE FEB 2026	1'–4" or 2'–0" CONE (TYPE 1)	DRWG. NO. MAN–6
LCWA/TOL		

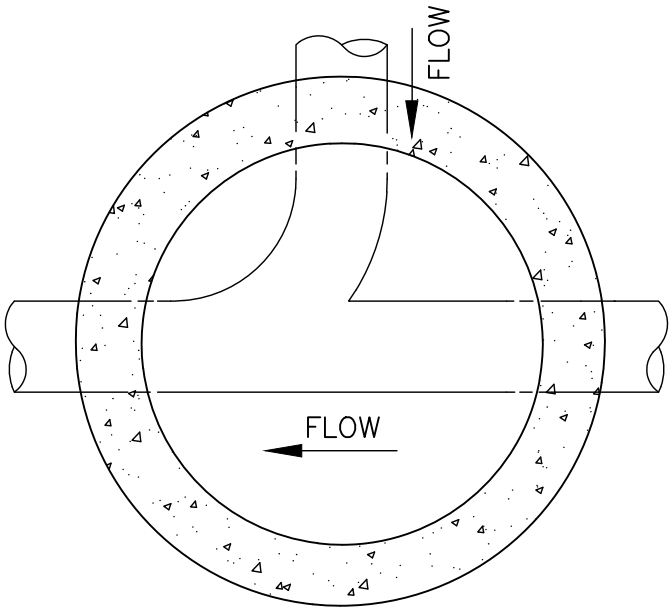




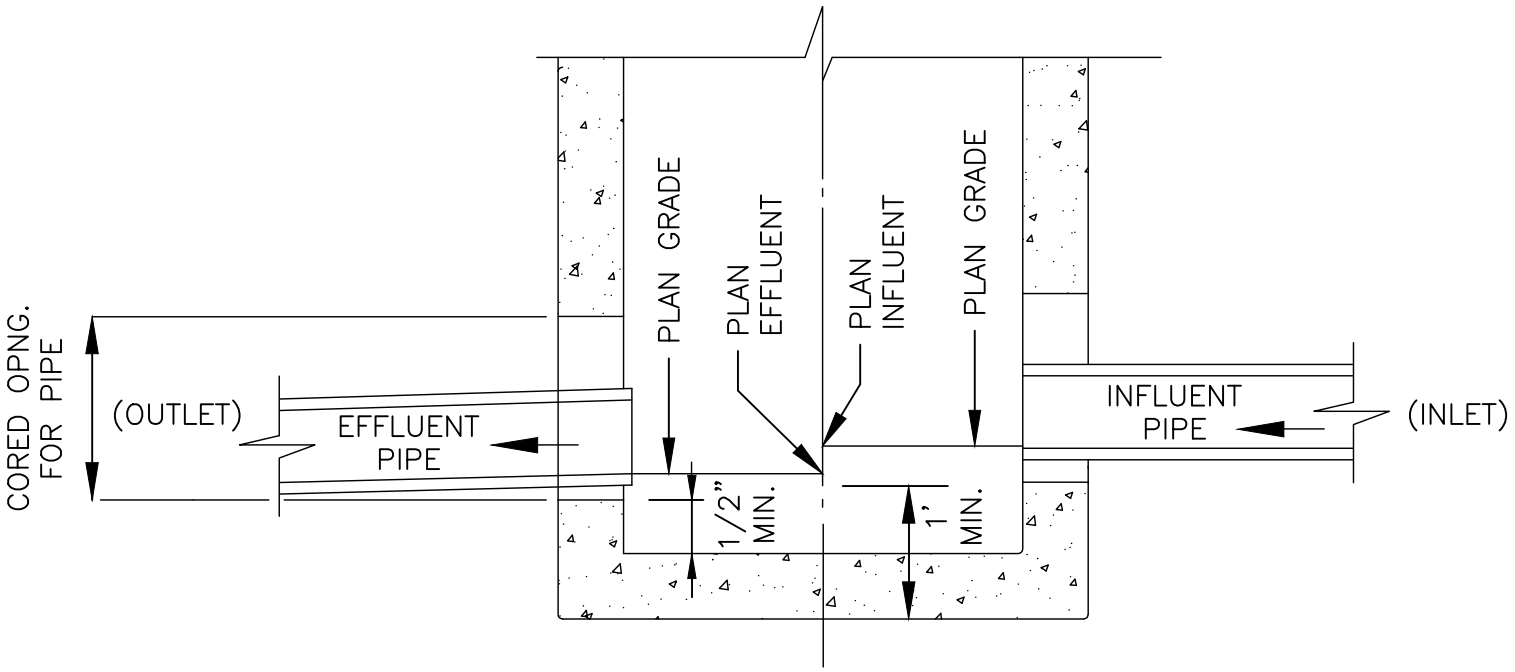
NOTES:

1. CONE SHALL MEET REQUIREMENTS OF ASTM C478. O–RING GASKET JOINTS MEET REQUIREMENTS OF ASTM C443.
2. CONCRETE STRENGTH SHALL MEET OR EXCEED THE TEST 4,000 PSI MINIMUM COMPRESSIVE 28–DAY STRENGTH.
3. APPROVED STEPS SHALL BE EQUAL, SPACED @ 16 INCHES O.C.
4. REINFORCING SHALL BE A MINIMUM 0.12 IN2/FT. (MINIMUM OF 8 EACH – 1/4" BARS ON BACK FACE; & MINIMUM OF 4 EACH – #3 BARS ON FRONT FACE AND W3.4 [5 GAL.] WIRING.)
5. A MAXIMUM OF TWO LIFT HOLES PER SECTION

DATE FEB 2026	STANDARD ECCENTRIC CONE	DRWG. NO. MAN–7
LCWA/TOL		



PLAN INVERT

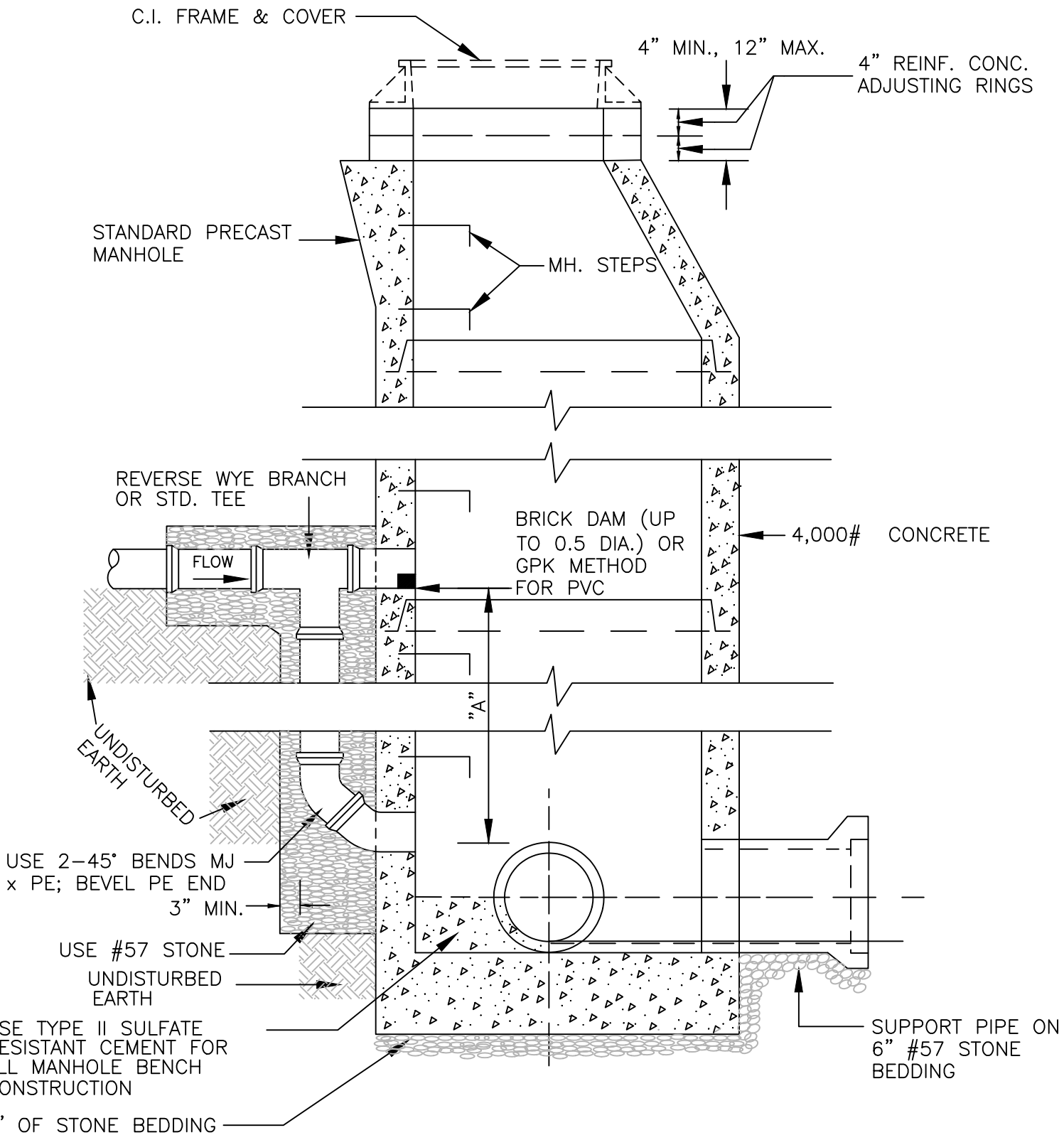


SECTION

NOTES:

1. THE EFFLUENT ELEVATION SHOWN AT A MANHOLE IS ESTABLISHED FROM THE INFLUENT ELEVATION OF THE MANHOLE IMMEDIATELY DOWNSTREAM. ELEVATIONS SHOWN APPLY AT THE ℄ OF MANHOLES AND ARE BASED ON THE HORIZONTAL DISTANCE, ℄ TO ℄ MH USING PERCENT OF GRADE INDICATED.

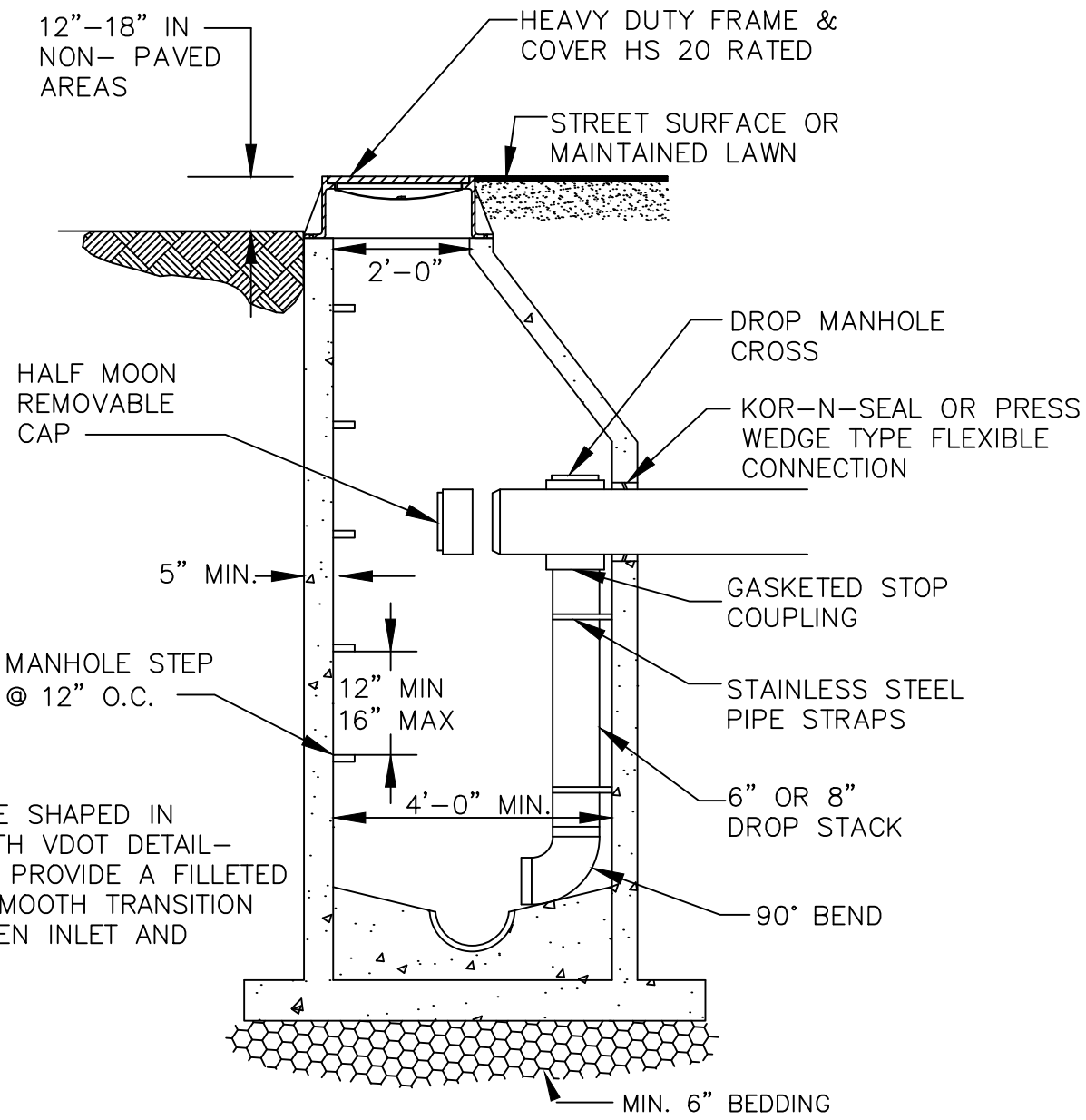
DATE FEB 2026	STANDARD INVERT DETAILS	DRWG. NO. MAN–8
LCWA/TOL		



NOTES:

1. WHERE "'A"' IS GREATER THAN 2'-0", USE STD. DROP CONNECTION. ALL PIPING UTILIZED IN DROP CONNECTION SHALL BE RESTRAINED JOINT DUCTILE IRON (CLASS 52). PIPING MAY TRANSITION TO PVC PIPE AT A POINT ONE JOINT AWAY FROM THE DROP MANHOLE UNLESS OTHERWISE NOTED ON THE PLANS.

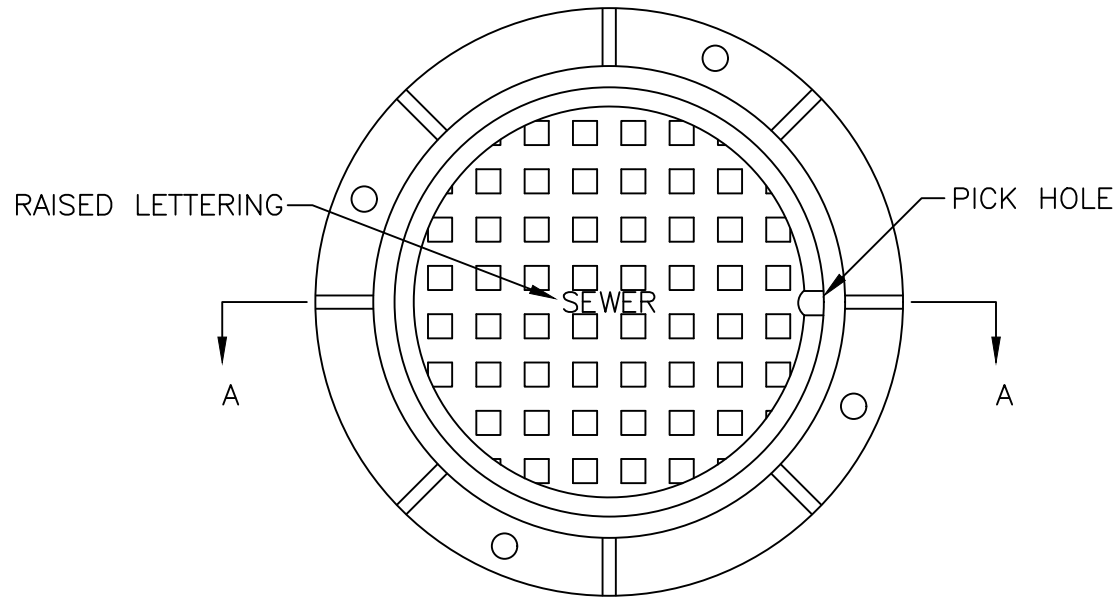
DATE FEB 2026	STANDARD OUTSIDE DROP CONNECTION	DRWG. NO. MAN-9
LCWA/TOL		



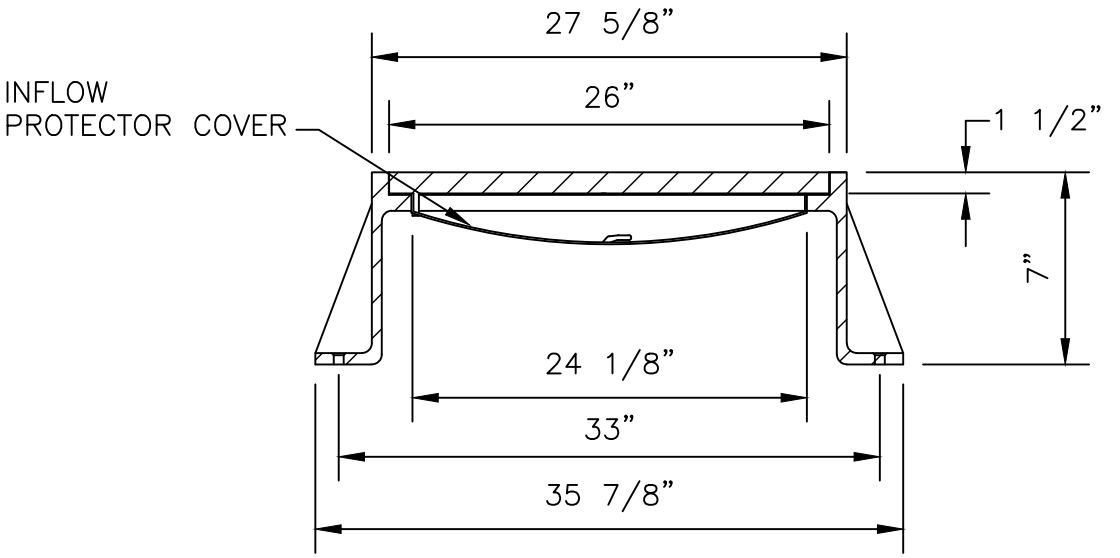
INVERT SHALL BE SHAPED IN ACCORDANCE WITH VDOT DETAIL– CONTRACTOR TO PROVIDE A FILLETED INVERT FOR A SMOOTH TRANSITION OF FLOW BETWEEN INLET AND OUTLET PIPE.

NOTE:
PRECAST INSIDE DROP MANHOLE SHALL ONLY BE USED WHEN APPROVED IN ADVANCE BY OWNER.

DATE FEB 2026	STANDARD INSIDE DROP CONNECTION	DRWG. NO. MAN–10
LCWA/TOL		



PLAN

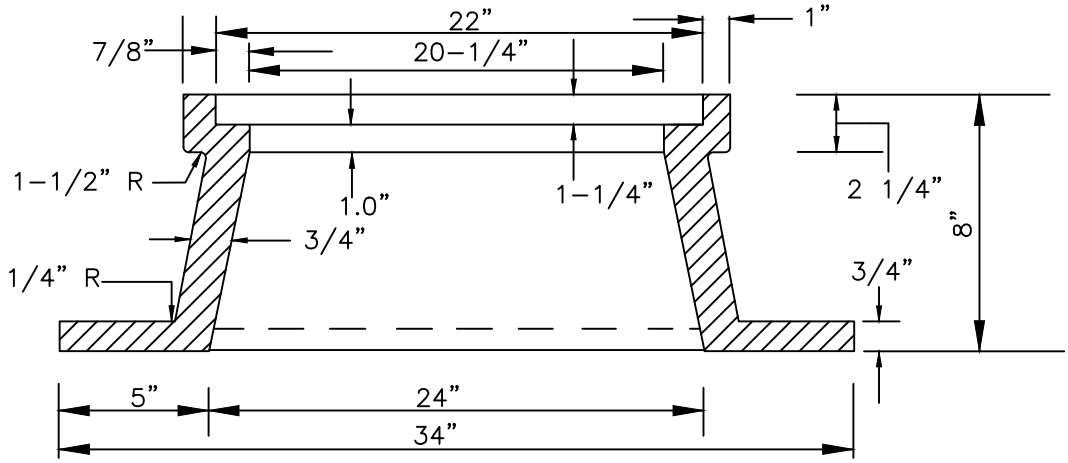


SECTION A–A

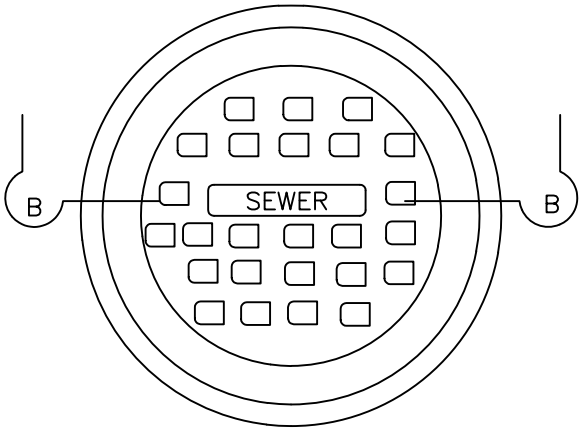
NOTES:

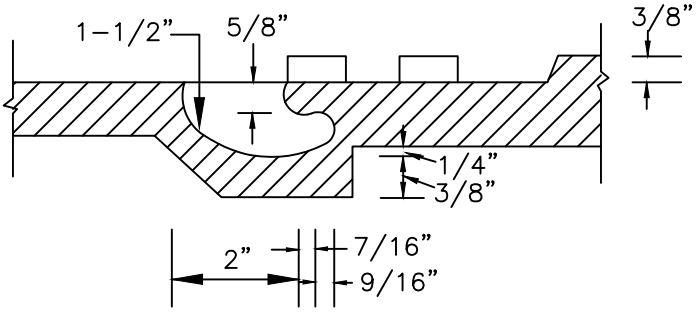
1. ALL GRAY IRON CASTINGS SHALL CONFORM TO ASTM A–48, CLASS 30 AND SHALL BE OF UNIFORM QUALITY. CASTING SHALL BE HEAVY DUTY.
2. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF 1/8"±.
3. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING USING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.
4. ALL MANHOLES SHALL INCLUDE A CORROSION PROOF, SHOCK–RESISTANT INFLOW PROTECTOR COVER.
5. ON COVERS FOR WATER FACILITIES, THE WORD "WATER" IS TO BE CAST IN THE TOP RATHER THAN "SEWER."

DATE FEB 2026	STANDARD MANHOLE FRAME AND COVER	DRWG. NO. MAN–11
LCWA/TOL		

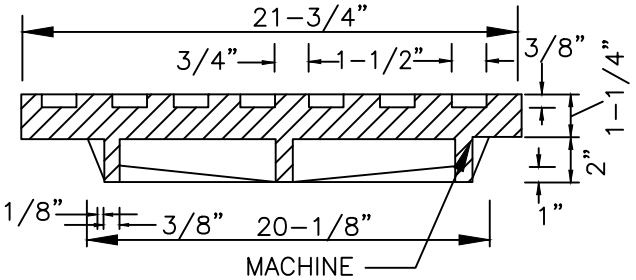


FRAME SECTION

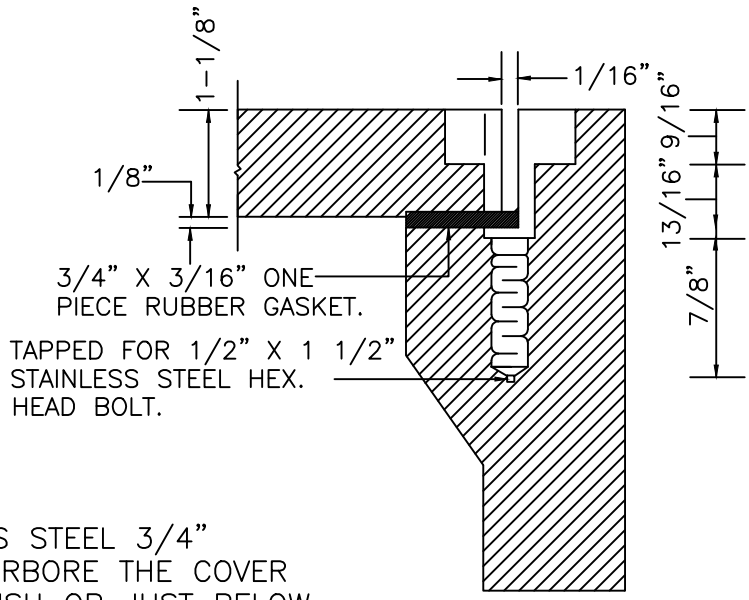




X–SECT. OF PICK HOLE



SECTION B–B

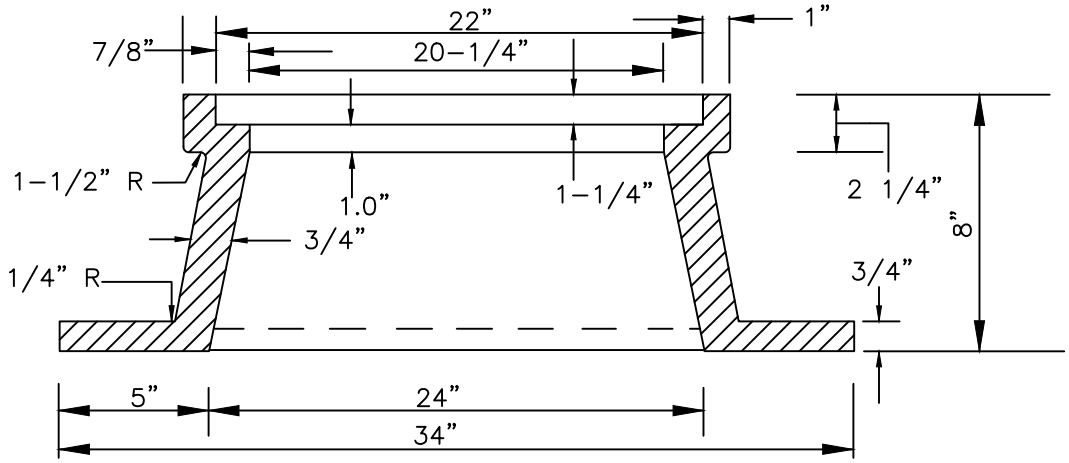


X–SECT. OF BOLT

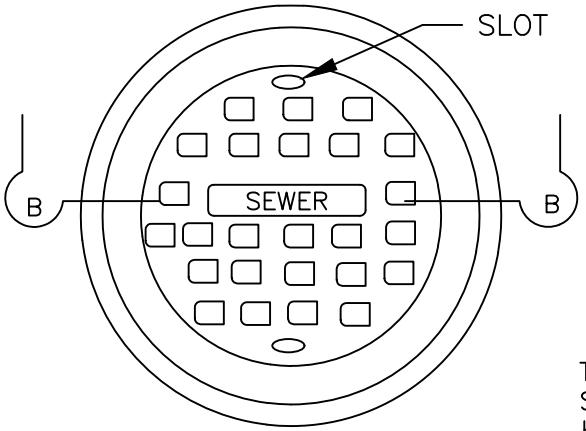
NOTES:

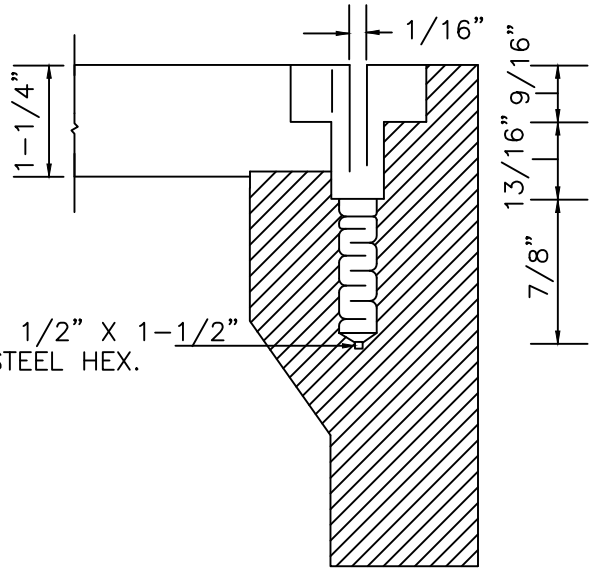
1. INSTALL FOUR 1/2" X 1–1/2" STAINLESS STEEL 3/4" HEXAGONAL HEAD BOLTS AT 90°. COUNTERBORE THE COVER SO THAT THE HEAD OF THE BOLT IS FLUSH OR JUST BELOW THE TOP OF THE COVER. PENTAGON HEAD BOLTS ARE OPTIONAL FOR WATERTIGHT OR VANDAL RESISTANT INSTALLATIONS.
2. MANHOLE FRAMES LOCATED ABOVE GRADE SHALL BE ATTACHED TO MANHOLE BY USE OF FOUR 1/2" STAINLESS STEEL ANCHOR BOLTS, WEDGE ANCHORS, OR STUD ANCHORS WITH STAINLESS STEEL WASHER AND NUT LOCATED ON OPPOSITE SIDES OF MANHOLE FRAME. HOLES IN MANHOLE FRAME SHALL BE NEATLY DRILLED TO ALIGN WITH ANCHORS.
3. SEALANT FOR MANHOLE FRAMES SHALL BE ONE–COMPONENT POLYURETHANE OR BITUMASTIC MATERIAL.
4. INSTALLATION OF A CRETEX OF APPROVED EQUAL MANHOLE CHIMNEY SEAL REQUIRED ON ALL WATERTIGHT FRAME AND COVER INSTALLATIONS.

DATE FEB 2026	WATERTIGHT MANHOLE FRAME AND COVER	DRWG. NO. MAN–12
LCWA/TOL		

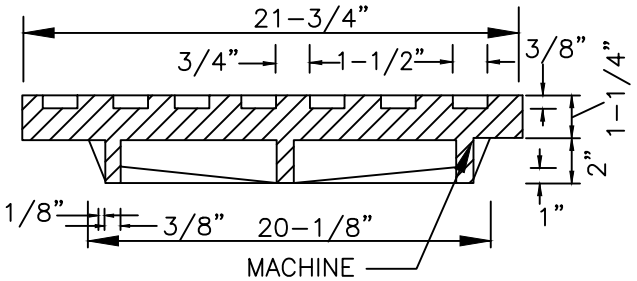


FRAME SECTION





X-SECT. OF BOLT

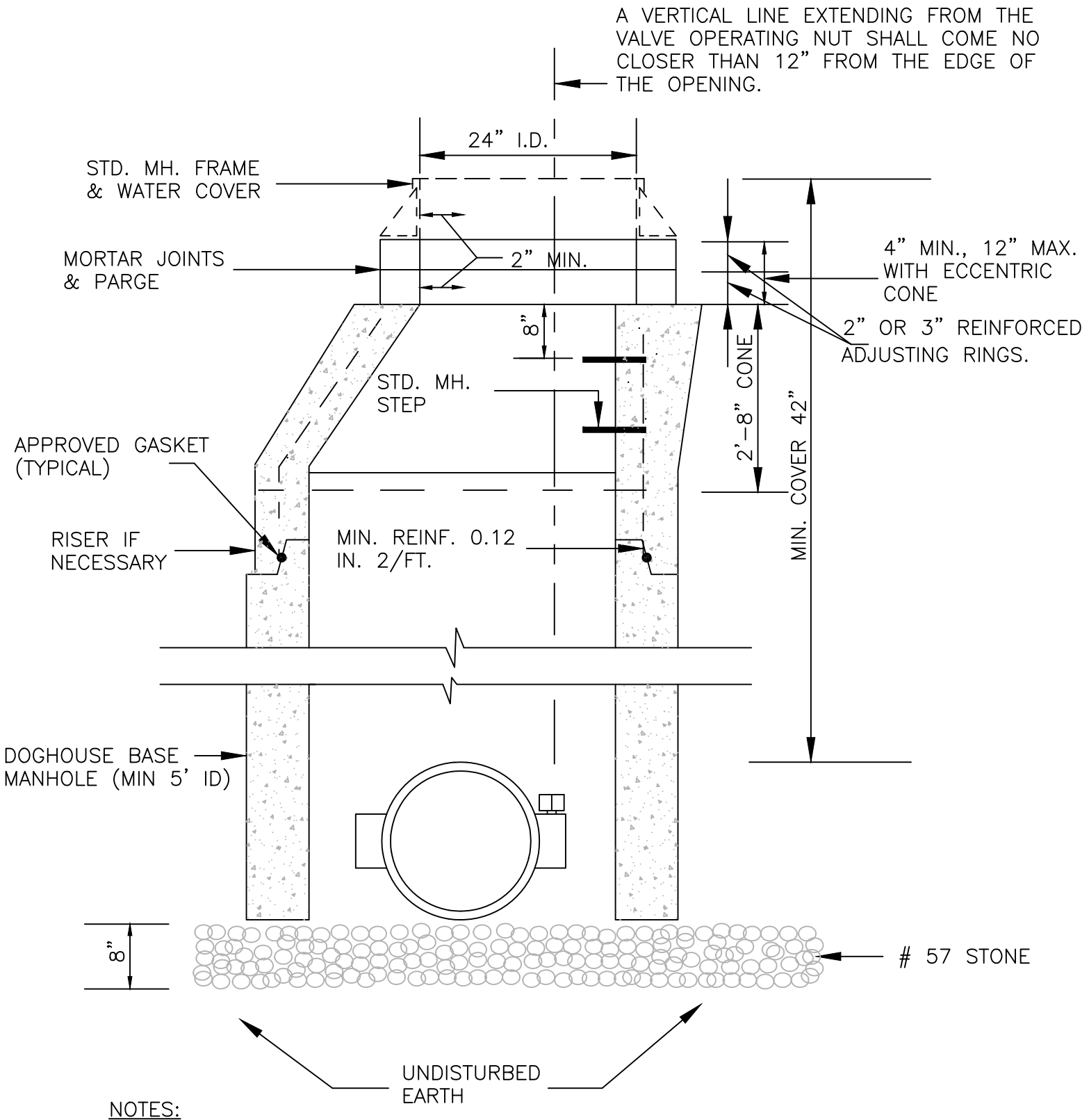


SECTION B-B

NOTES:

1. INSTALL FOUR 1/2" X 1-1/2" STAINLESS STEEL 3/4" HEXAGONAL HEAD BOLTS AT 90°. COUNTERBORE THE COVER SO THAT THE HEAD OF THE BOLT IS FLUSH OR JUST BELOW THE TOP OF THE COVER. PENTAGON HEAD BOLTS ARE OPTIONAL FOR WATERTIGHT OR VANDAL RESISTANT INSTALLATIONS.
2. MANHOLE FRAMES LOCATED ABOVE GRADE SHALL BE ATTACHED TO MANHOLE BY USE OF FOUR 1/2" STAINLESS STEEL ANCHOR BOLTS, WEDGE ANCHORS, OR STUD ANCHORS WITH STAINLESS STEEL WASHER AND NUT LOCATED ON OPPOSITE SIDES OF MANHOLE FRAME. HOLES IN MANHOLE FRAME SHALL BE NEATLY DRILLED TO ALIGN WITH ANCHORS.
3. SEALANT FOR MANHOLE FRAMES SHALL BE ONE-COMPONENT POLYURETHANE OR BITUMASTIC MATERIAL.

DATE FEB 2026	VANDALPROOF MANHOLE FRAME AND COVER	DRWG. NO. MAN-13
LCWA/TOL		

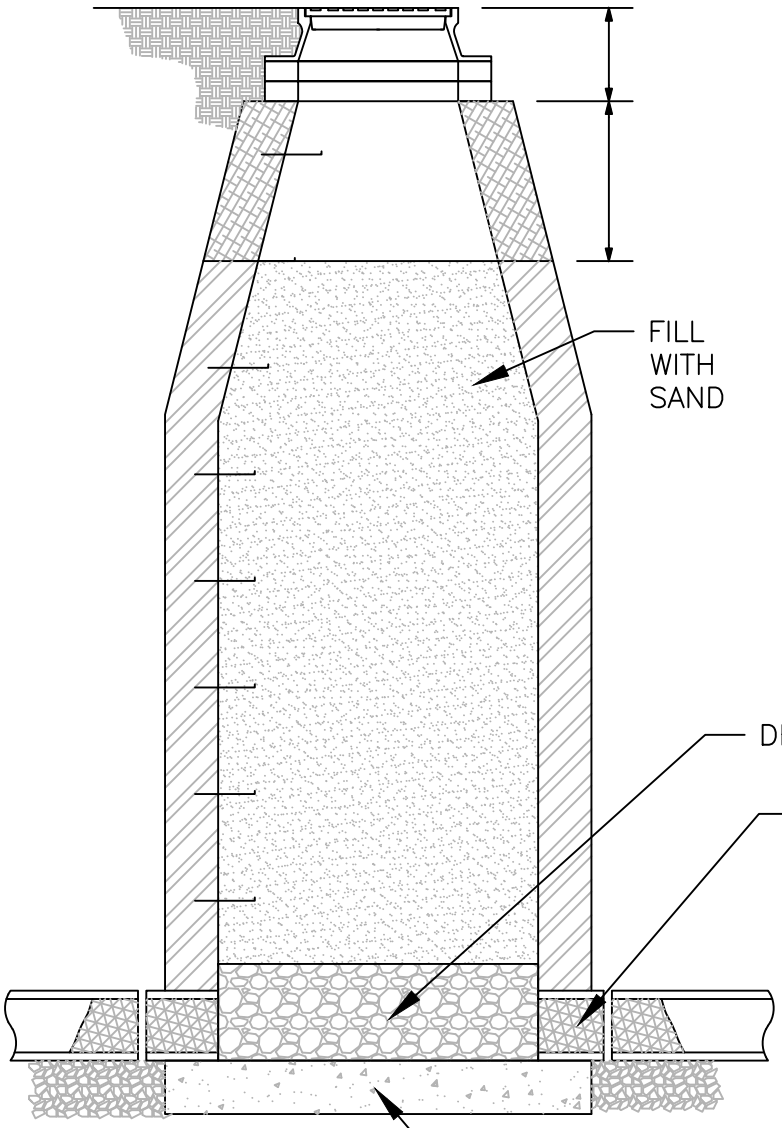


NOTES:

1. MANHOLE IS REQUIRED WHEN VALVE IS LOCATED UNDER PAVEMENT. USE STANDARD VALVE BOX OVER OPERATING NUT FOR OTHER INSTALLATIONS.

DATE FEB 2026	STANDARD BUTTERFLY VALVE MANHOLE (16" AND LARGER)	DRWG. NO. MAN-14
LCWA/TOL		

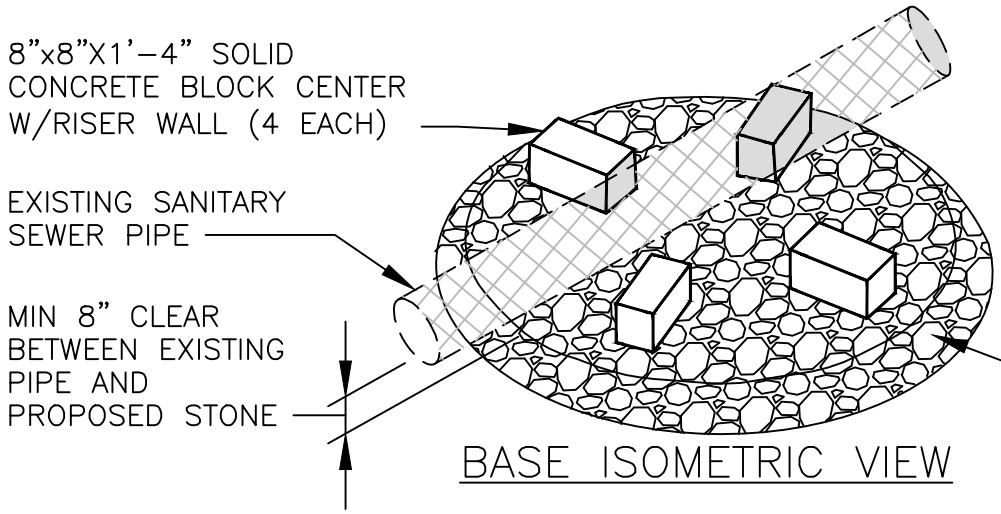
WHERE MANHOLE IS LOCATED IN PAVEMENT, PAVEMENT WILL BE RESTORED IN ACCORDANCE WITH TOA OR VDOT STANDARDS. FOR MANHOLES NOT LOCATED IN PAVEMENT, AREA WILL BE GRADED AND RESTORED SIMILAR TO SURROUNDING CONDITIONS.



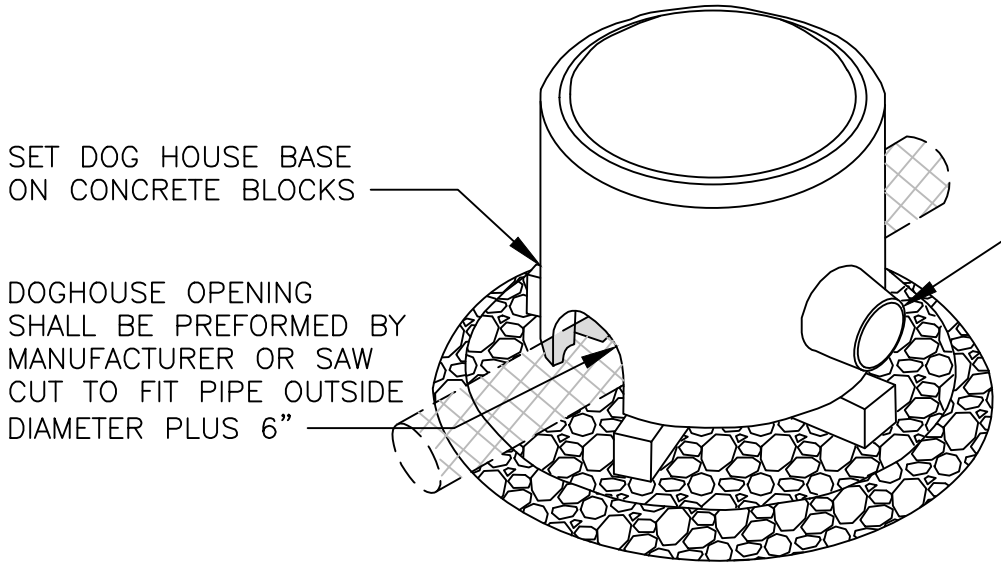
NOTES:

1. REMOVE ALL MATERIAL, INCLUDING MECHANICAL AND ELECTRICAL EQUIPMENT, WIRING, CONDUIT, PIPING, PIPE SUPPORTS, STAIRWAYS, LADDERS, GRATING, HATCHES, COMBUSTIBLE MATERIALS, AND DEBRIS FROM EXISTING BELOW GRADE STRUCTURES TO BE DEMOLISHED.
2. DRILL OR PUNCH HOLES IN THE BASE SLABS. 4 INCH DIAMETER HOLES AT 48 INCHES ON CENTER MAX.
3. COMPLETELY DEMOLISH STRUCTURES TO A MINIMUM OF 3 FEET BELOW FINISHED GRADE.
4. PROVIDE A MINIMUM OF 2 FEET OF DRAINAGE FILL MATERIAL IN THE BOTTOM OF THE STRUCTURES. BACKFILL UPPER 3 FEET WITH COMMON OR SELECT FILL MATERIAL.

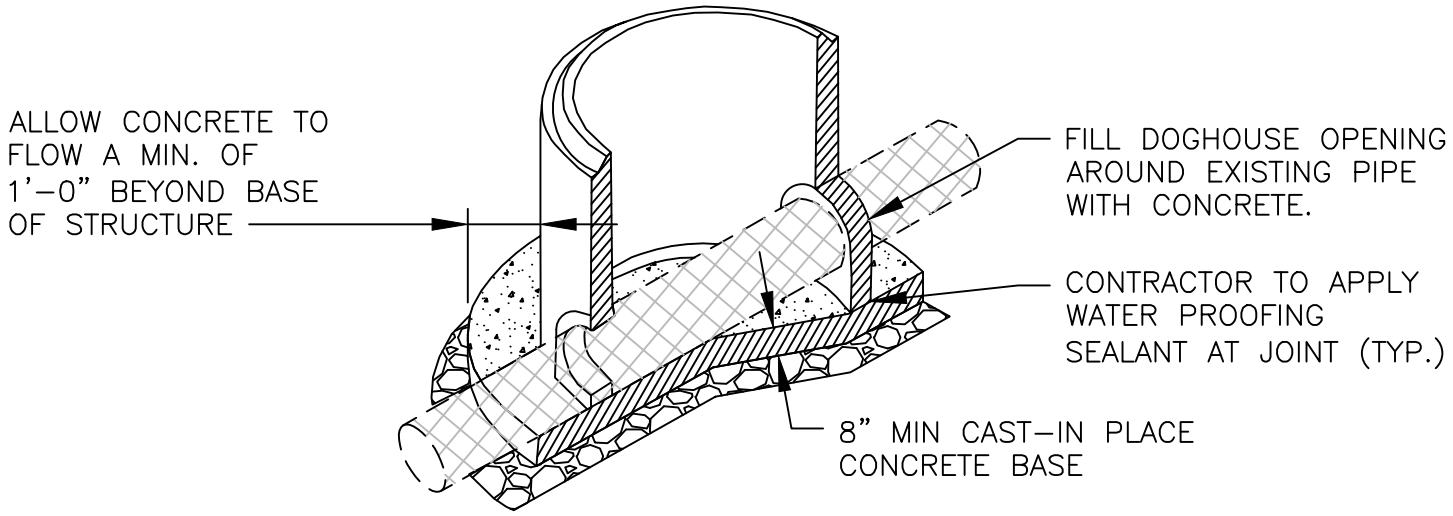
DATE FEB 2026	ABANDONMENT OF MANHOLES	DRWG. NO. MAN–15
LCWA/TOL		



BASE ISOMETRIC VIEW

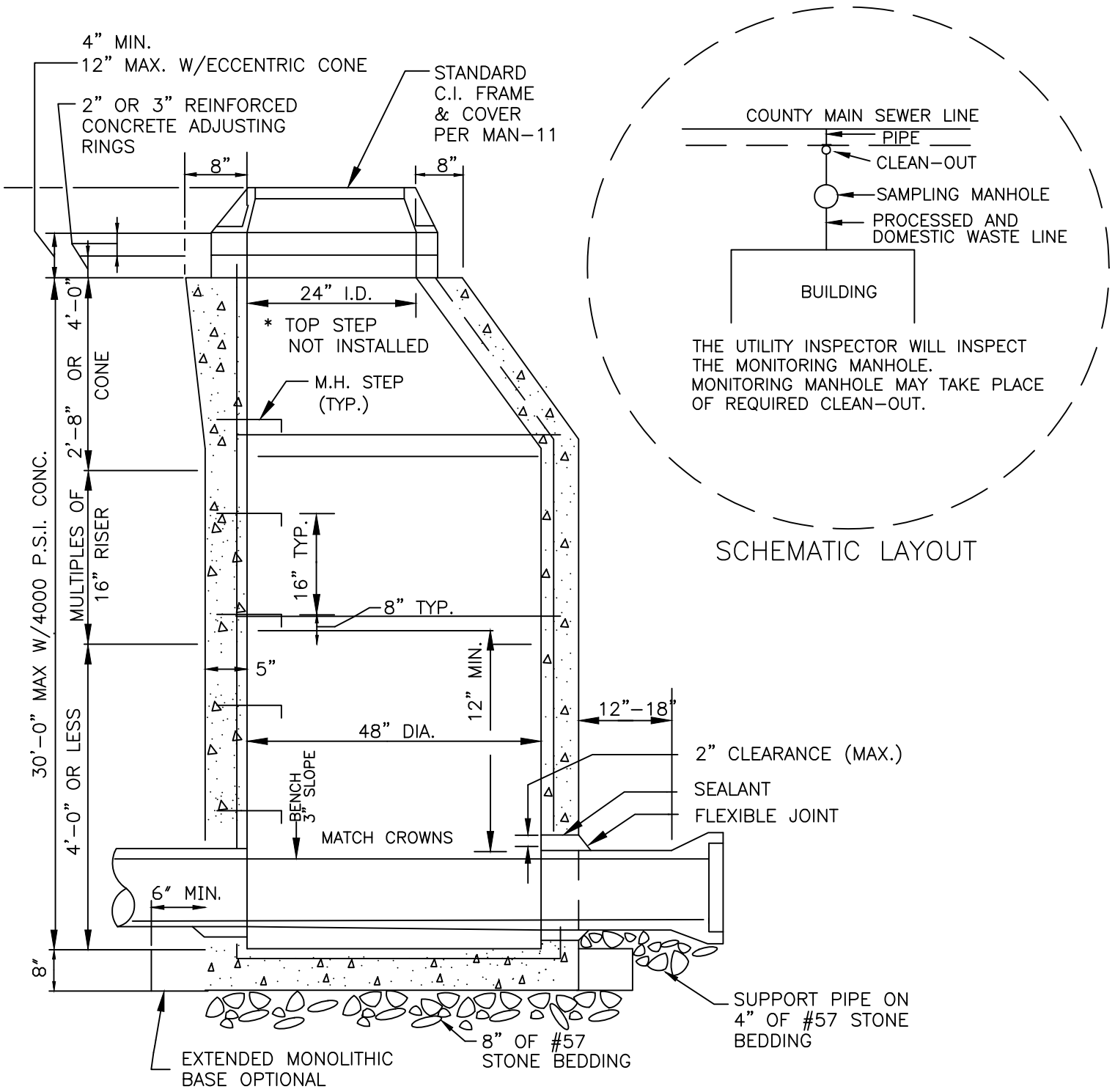


RISER ISOMETRIC VIEW



FOUNDATION SECTION VIEW

DATE FEB 2026	DOGHOUSE MANHOLE	DRWG. NO. MAN-16
LCWA/TOL		

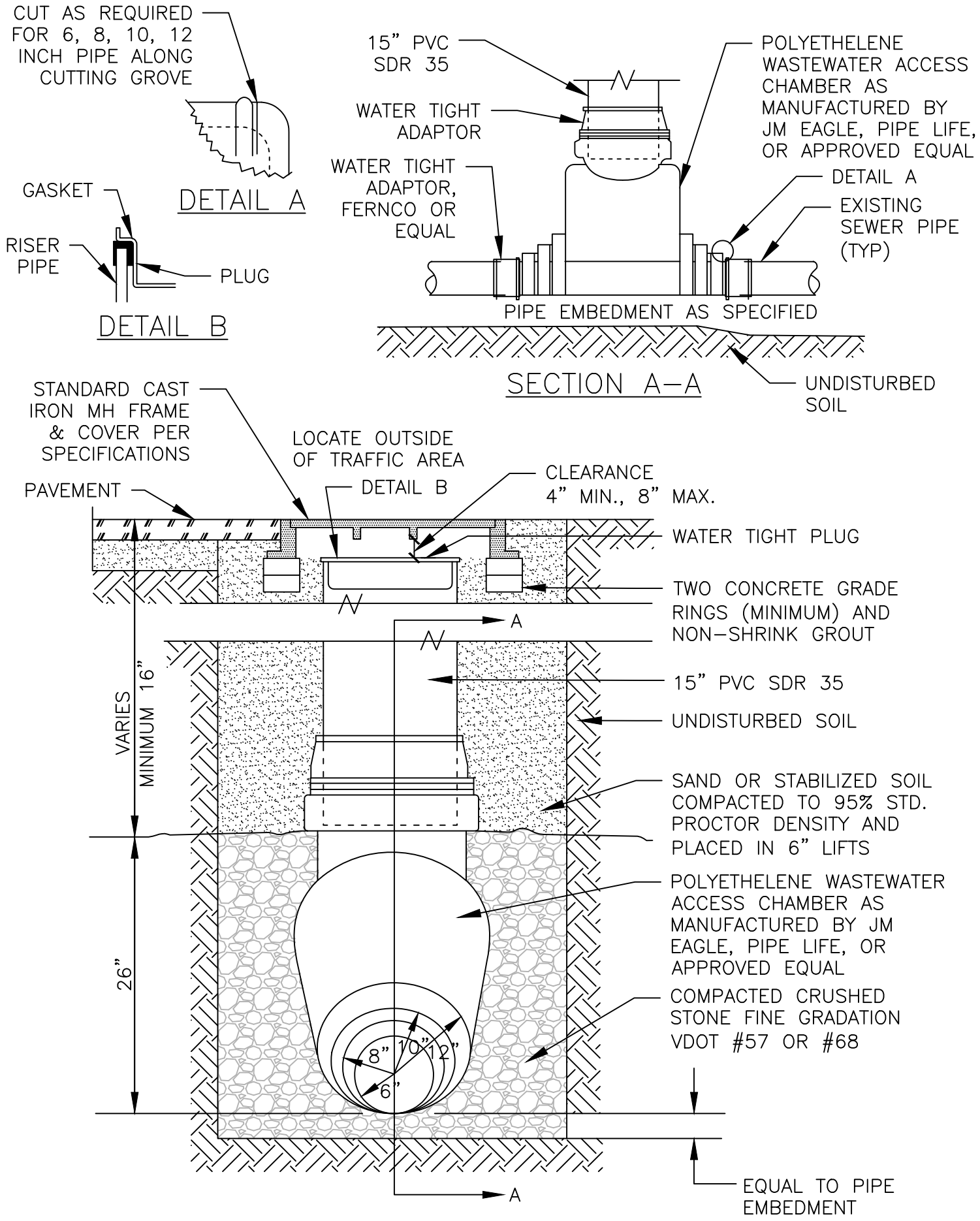


SCHEMATIC LAYOUT

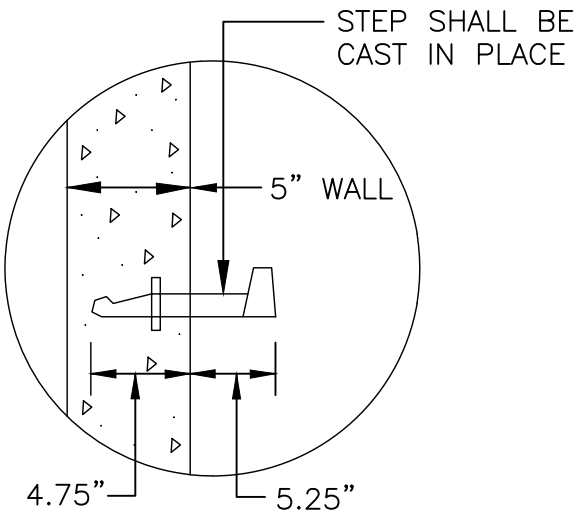
NOTES:

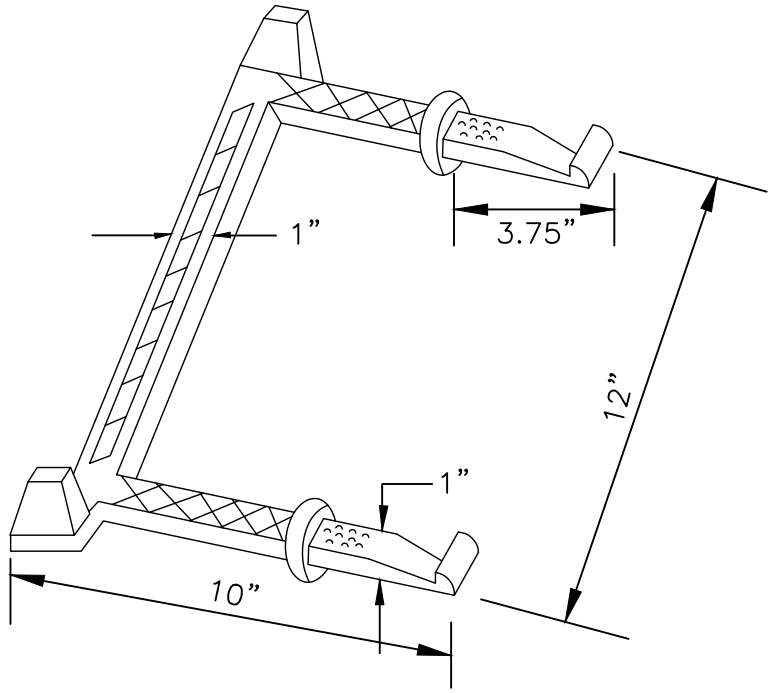
1. BENCH MAY BE CONC. OR BRICK AND MORTAR. USE TYPE II SULFATE RESISTANT MORTAR.
2. MINIMUM DEPTH FROM THE BENCH TO THE TOP OF THE CONE SHALL BE 4' UNLESS OTHERWISE APPROVED.
3. STONE BEDDING SHALL EXTEND TO THE OUTER BOUNDARY OF All UNDISTURBED AREAS SURROUNDING THE MANHOLE.

DATE FEB 2026	MONITORING MANHOLE	DRWG. NO. MAN-17
LCWA/TOL		



DATE	WASTEWATER ACCESS AND MONITORING CHAMBER FOR RETROFIT APPLICATIONS ONLY	DRWG. NO.
FEB 2026		MAN–18
LCWA/TOL		

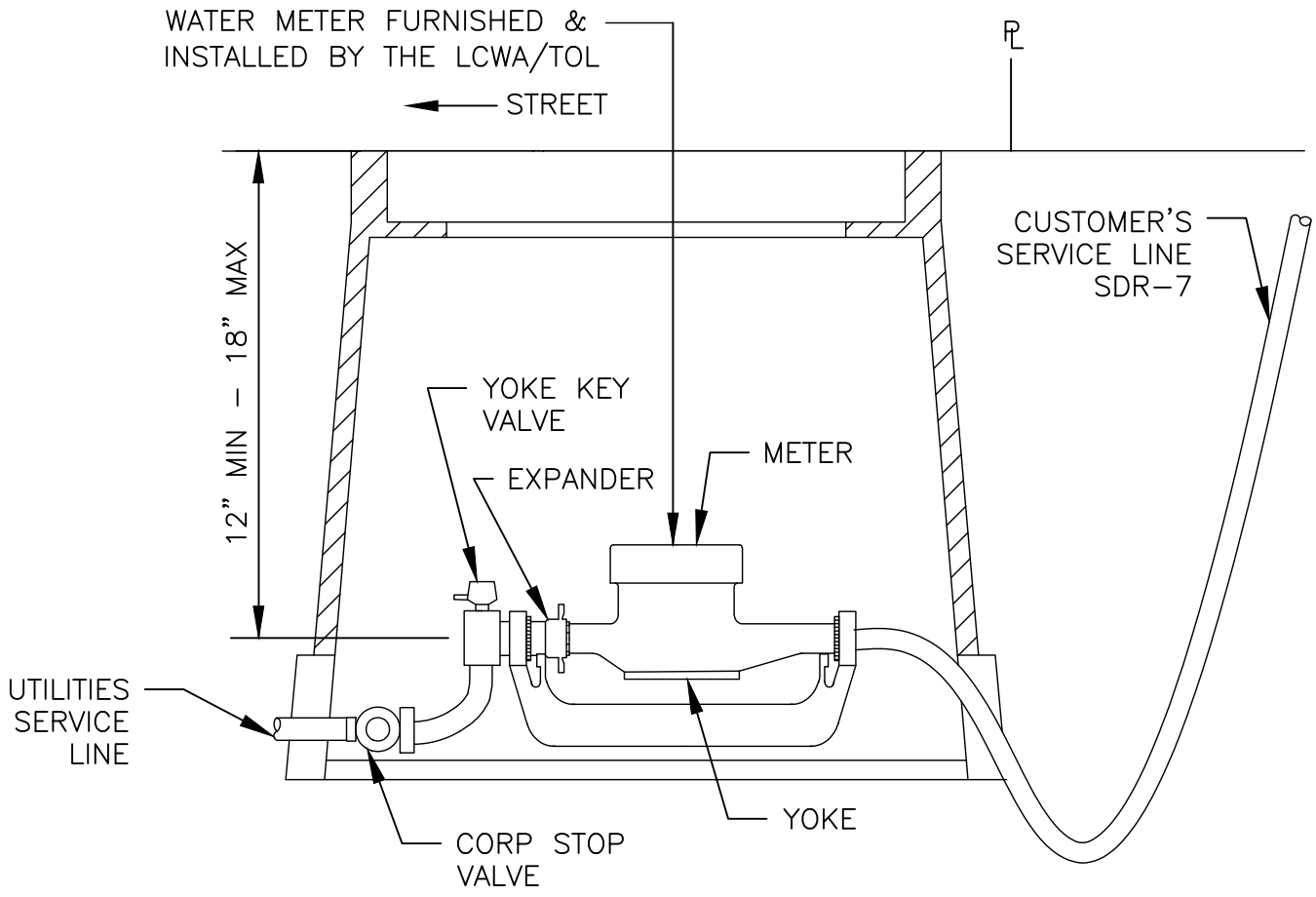


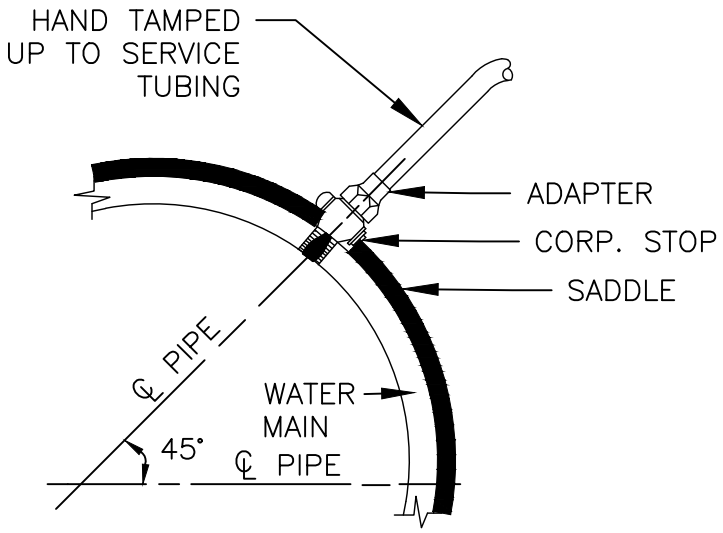


NOTES:

1. STEP SHALL BE CORROSION RESISTANT MADE WITH 1/2" STEEL GRADE 60 STEEL REINFORCING ROD ENCAPSULATED IN COPOLYMER POLYPROPYLENE.
2. STEP SHALL CONFORM TO ASTM C478 AND BE M.A. INDUSTRIES, INC. OR APPROVED EQUAL.

DATE FEB 2026	TYPICAL MANHOLE STEP	DRWG. NO. MAN–19
LCWA/TOL		





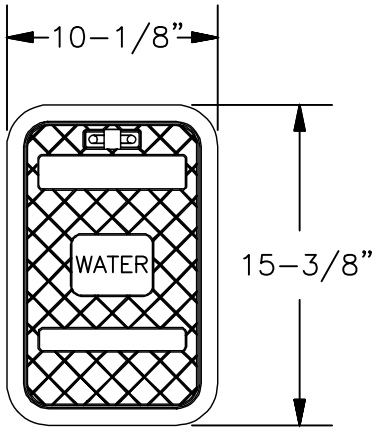
SADDLE MUST BE USED FOR ALL TAPS

ENLARGED VIEW

NOTES:

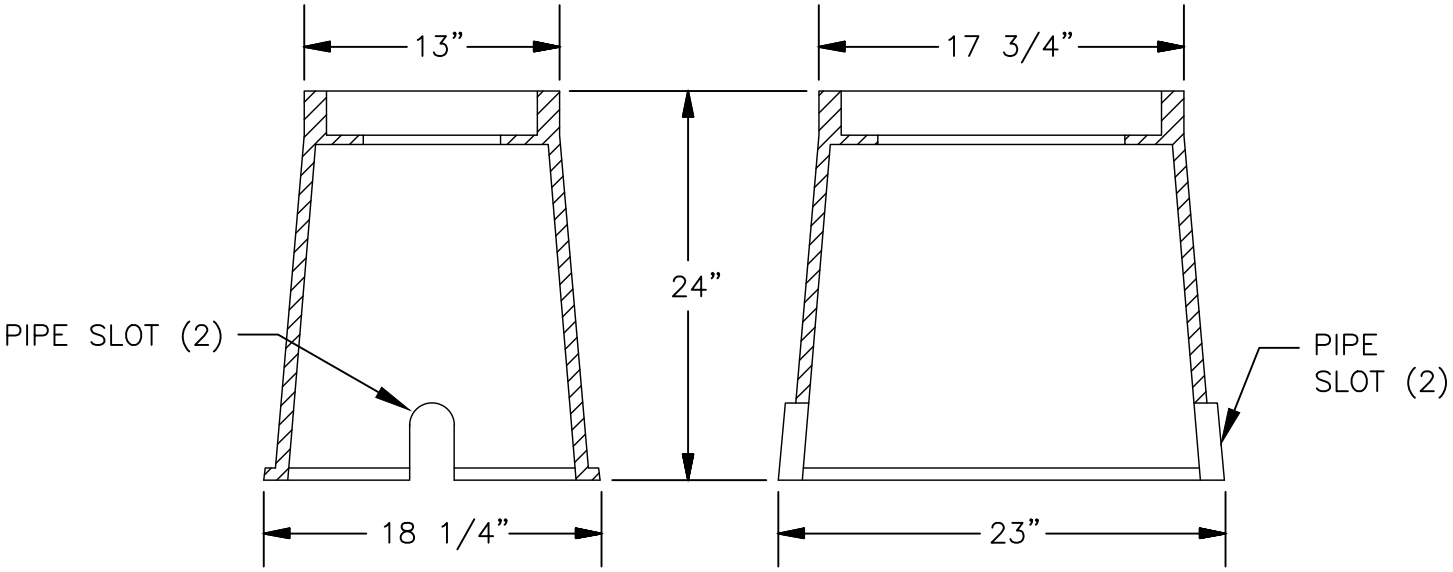
1. YOKE SHALL BE CENTERED IN METER BOX.
2. METER BOX SHOULD BE LOCATED 1' INSIDE OF ROW OR EASEMENT LINE. METER BOX MAY BE MOVED A REASONABLE DISTANCE INSIDE ROW OR EASEMENT LINE IN ORDER TO INSTALL ON REASONABLY LEVEL GROUND.
3. SERVICES SHALL BE INSTALLED PRIOR TO TESTING.
4. YOKES SHALL BE FORD 500 SERIES OR APPROVED EQUAL.
5. EXPANDERS SHALL BE FORD EC23 (5/8"), EC4 (1") OR APPROVED EQUAL.
6. TOP OF METER BOX SHALL BE 1/2" TO 1" ABOVE YARD GRADE OR FLUSH WITH PAVEMENT.

DATE FEB 2026	TYPICAL WATER METER CONNECTION FOR $\frac{3}{4}$" AND 1" SERVICE	DRWG. NO. MET–1
LCWA/TOL		



NOTES:

1. LOUISA COUNTY WATER AUTHORITY AND TOWN OF LOUISA STANDARD METER BOX (10–1/4”X15–1/2”) WITH CAST IRON COVER BY MID–STATES PLASTICS, INC. (MSBC1015–18) OR APPROVED EQUAL.



DATE FEB 2026	PLASTIC METER BOX (5/8” AND 1” METERS)	DRWG. NO.
LCWA/TOL		MET–2

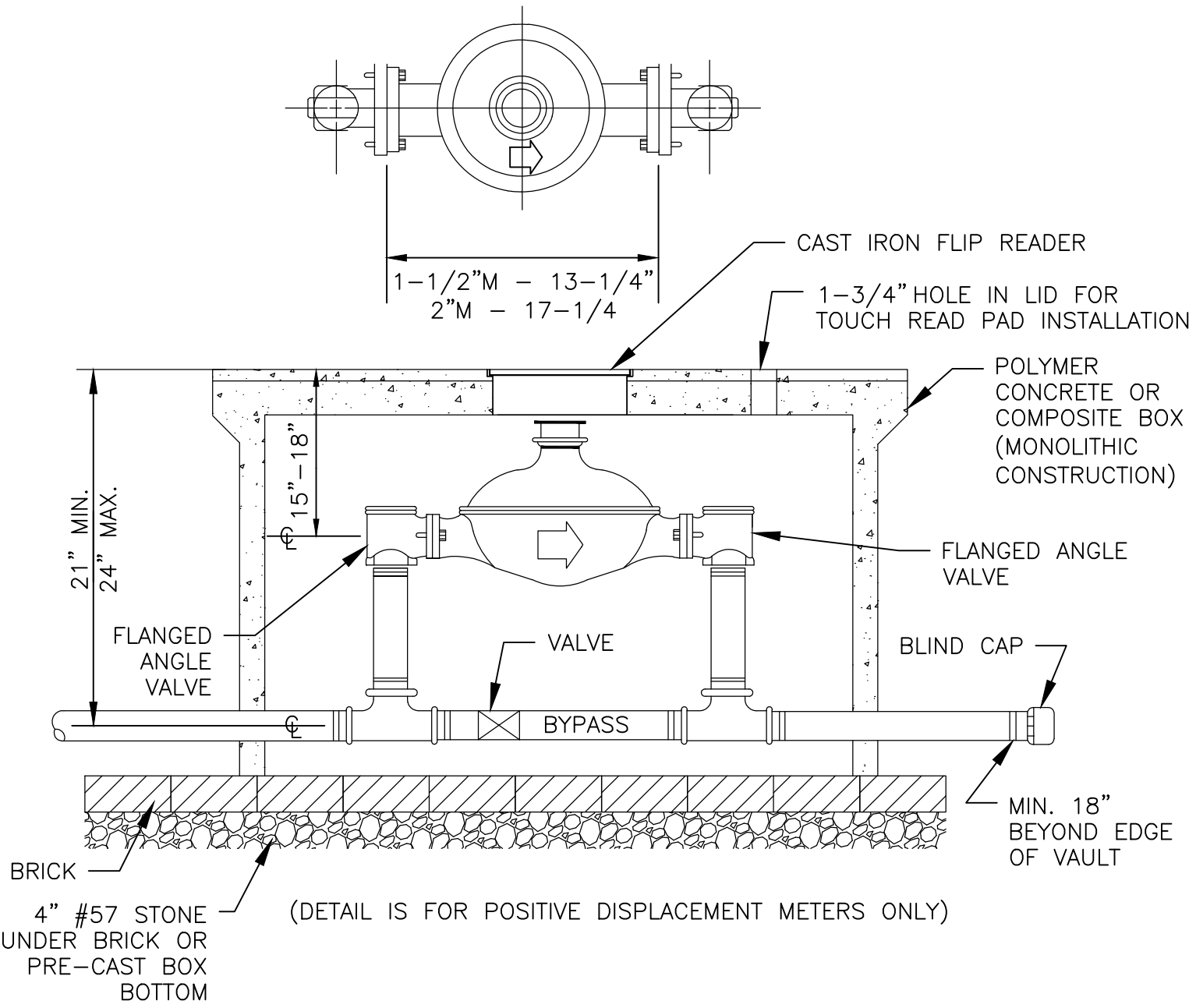
LCWA CONNECTION

TOWN OF LOUISA CONNECTION

NOTES:

1. ALL WATER SERVICES IN VDOT ROADWAY SHALL BE PLACED IN CASINGS.

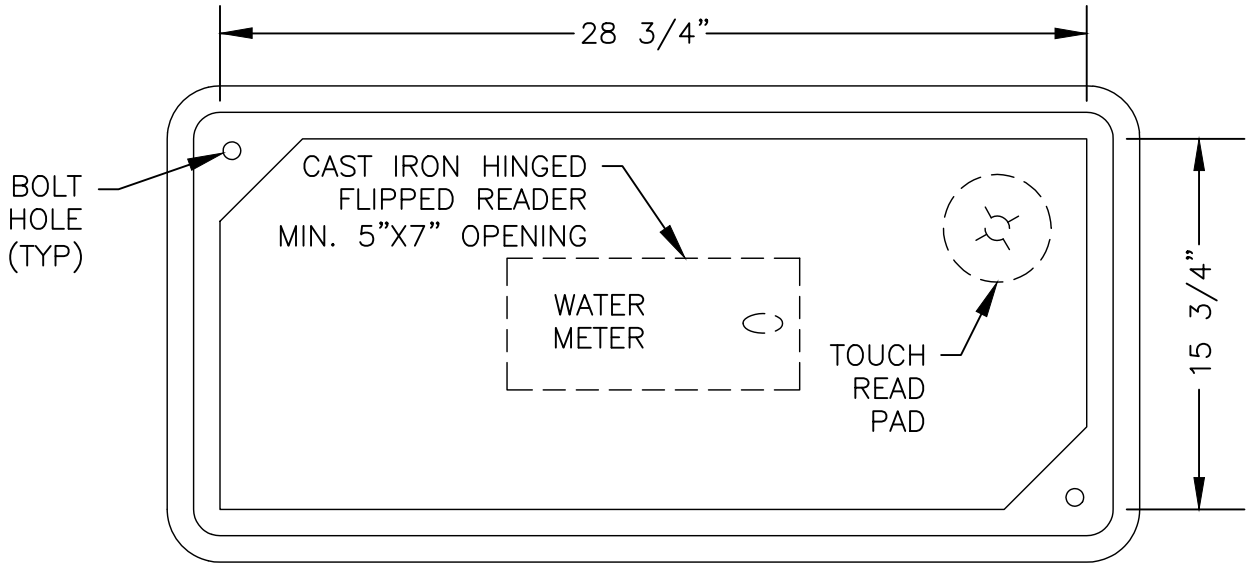
DATE FEB 2026	TYPICAL 3/4" WATER METER SERVICE CONNECTION	DRWG. NO. MET-3
LCWA/TOL		



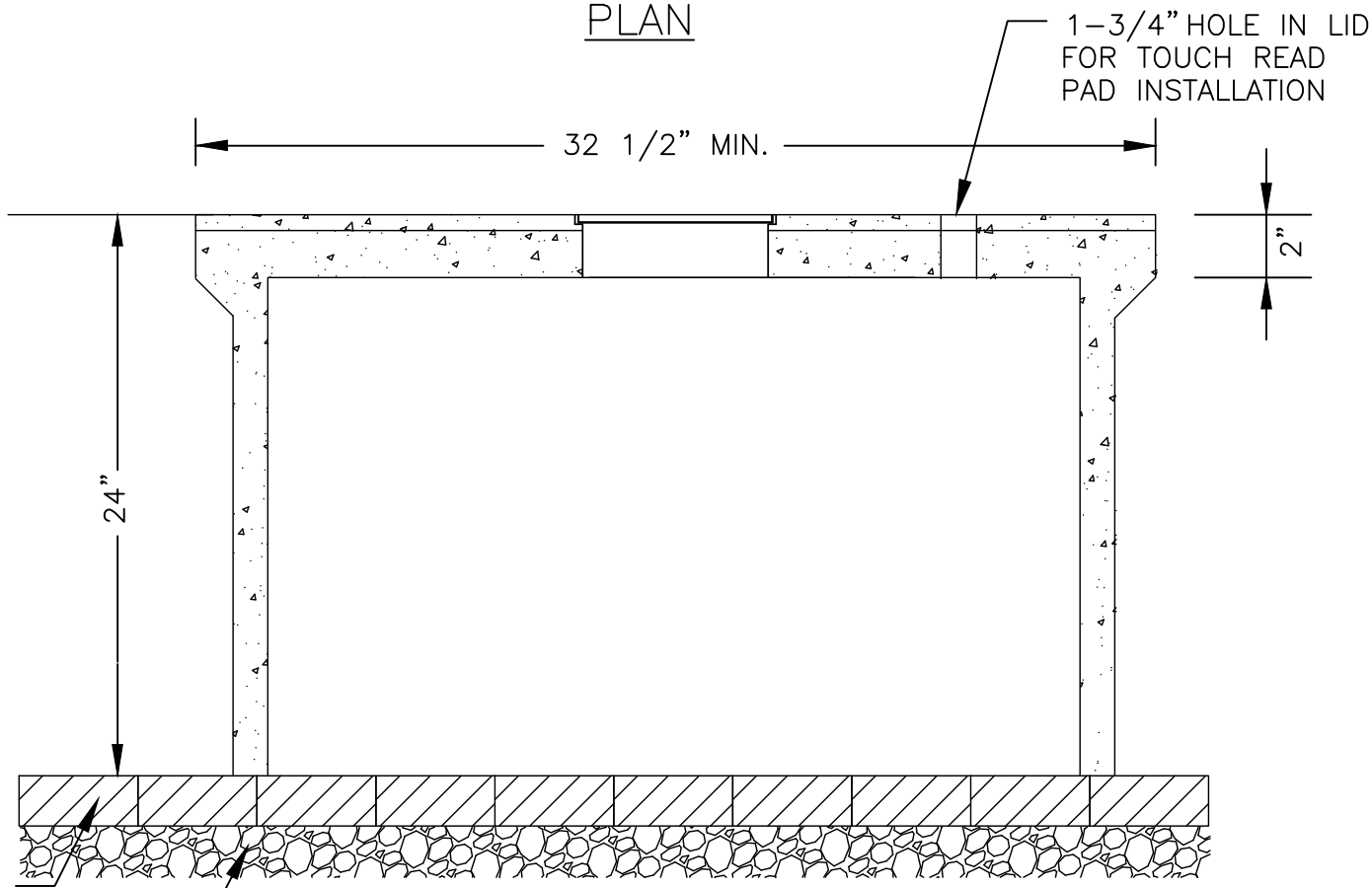
NOTES:

1. ALL 1-1/2" AND 2" METERS SHALL BE TIED TO THE MAIN PER DRAWINGS.
2. WATER SERVICE LATERALS FOR 1-1/2" AND 2" SERVICES WILL BE SDR-7. CONNECTIONS FOR 1-1/2" AND 2" SERVICES WILL BE APPROVED COMPRESSION FITTINGS.
3. METER BOX TO BE AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
4. BYPASS SHALL BE LOCATED ABOVE OR AT FLOOR LEVEL OF METER VAULT.
5. METER BOXES TO BE PER SPECIFICATIONS.
   A. TOUCH READ TO BE INSTALLED IN BOX TOP NOT FLIP READER.
   B. BOX TO HAVE MOUSE HOLES FOR SERVICE LINE ENTRY AND EXIT. SEAL RESIDUAL OPENING AS DIRECTED BY LCWA INSPECTOR.
   C. IF BOTTOM PROVIDED IN PRECAST BOX, DRAINAGE HOLES TO BE INSTALLED AS DIRECTED BY INSPECTOR.

DATE FEB 2026	1-1/2" OR 2" METER SETTING	DRWG. NO. MET-4
LCWA/TOL		



PLAN

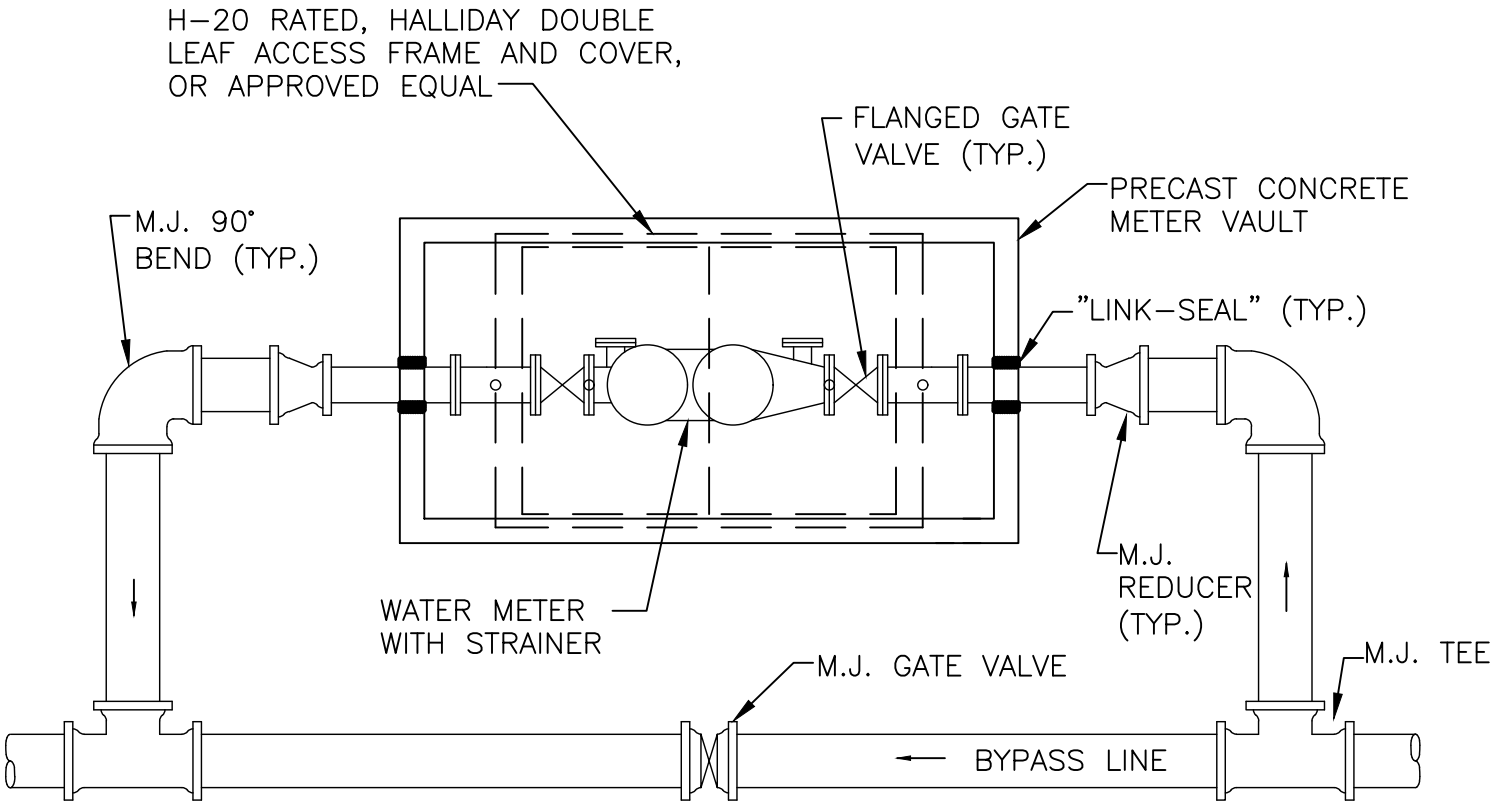


ELEVATION

NOTES:

1. MONOLITHIC CONSTRUCTION POLYMER CONCRETE OR COMPOSITE BOX WITH SEPARATE LID. BOX MAY HAVE BOTTOM AS PART OF CAST STRUCTURE. BOX WITHOUT BOTTOM AND BRICK BASE SHOWN ABOVE. BOX TO BE PER SPECIFICATIONS.

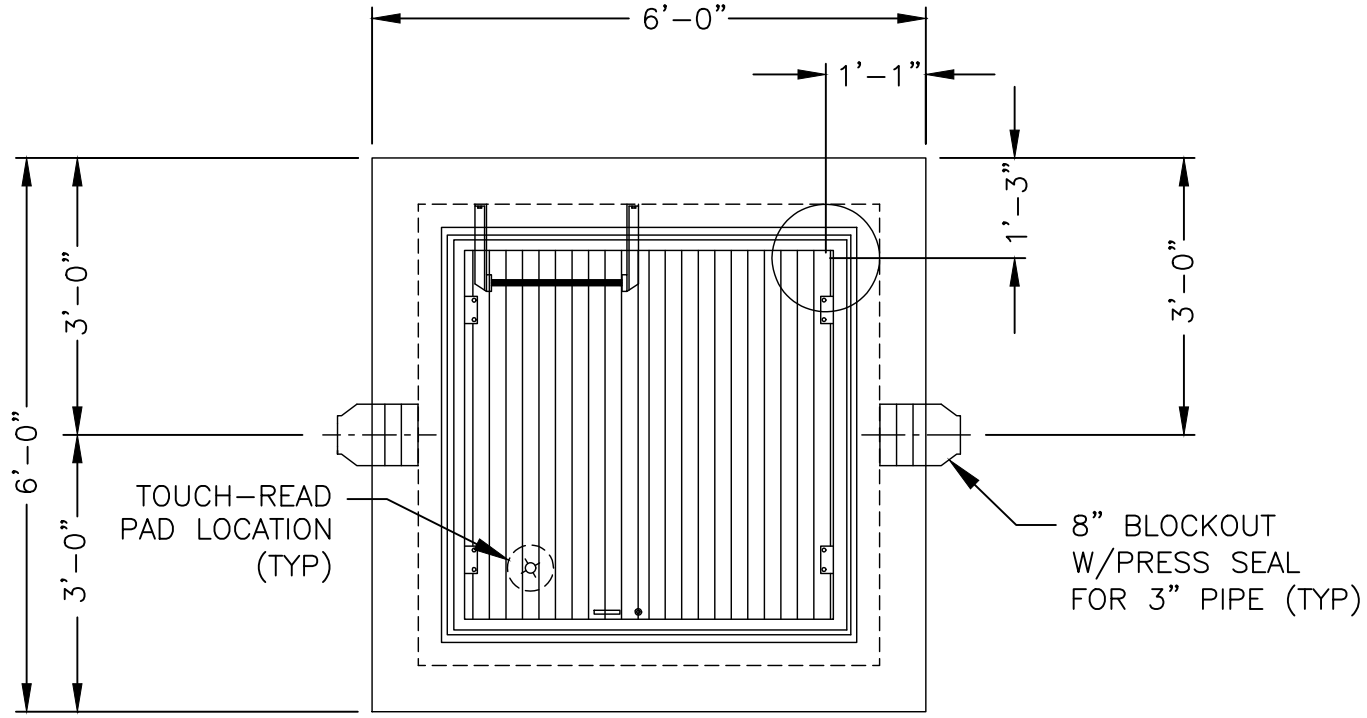
DATE FEB 2026	1-1/2" & 2" METER BOX	DRWG. NO. MET-5
LCWA/TOL		



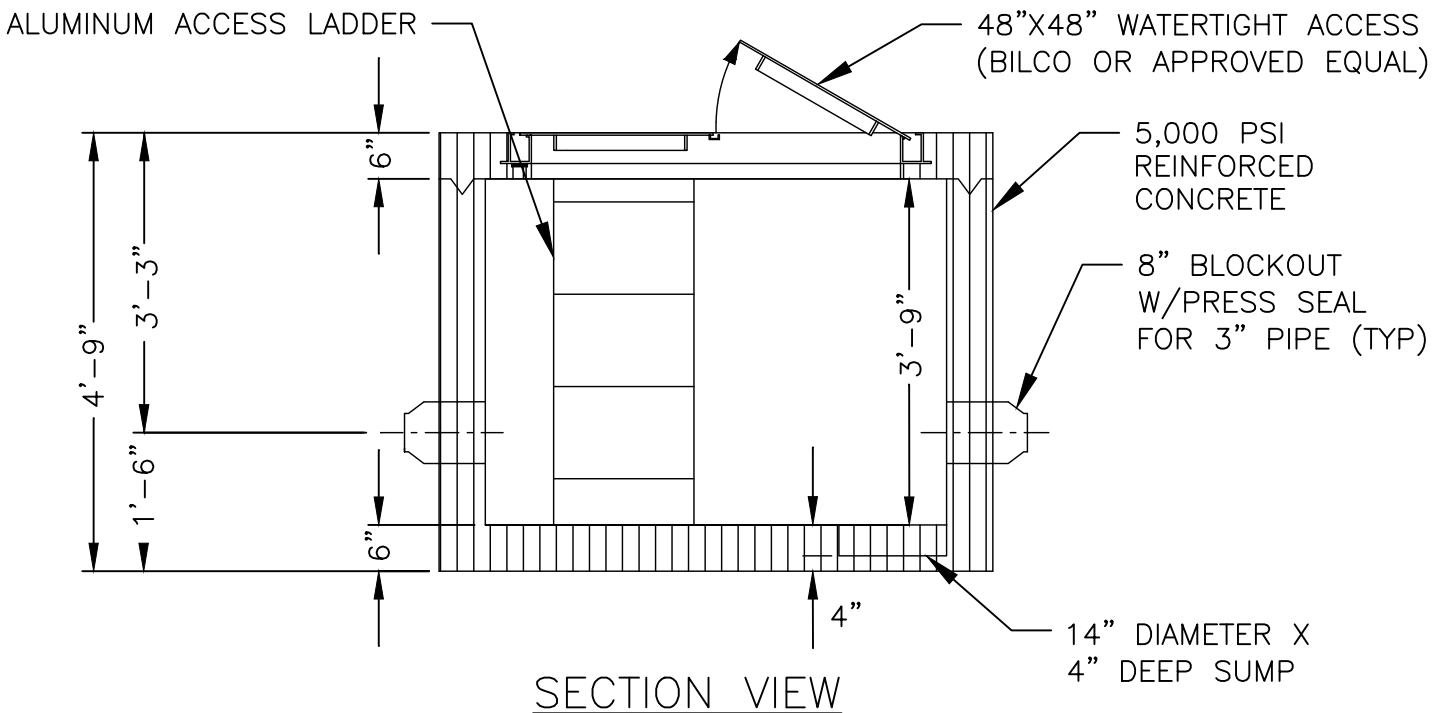
NOTES:

1. PER VDH WATERWORKS REGULATIONS 12 VAC 5–590–1160, METER VAULTS SHALL BE DRAINED TO THE GROUND SURFACE WHERE THEY ARE NOT SUBJECT TO FLOODING BY SURFACE WATER, OR DRAINED TO ABSORPTION PITS LOCATED ABOVE THE SEASONAL GROUNDWATER TABLE ELEVATION, OR SUMP PUMPS MAY BE USED WHERE OTHER MEANS ARE NOT PRACTICABLE. METER VAULTS SHALL NOT BE CONNECTED DIRECTLY TO ANY STORM OR SANITARY SEWER DRAIN.

DATE FEB 2026	TYPICAL MASTER METER VAULT	DRWG. NO. MET–6
LCWA/TOL		



PLAN VIEW

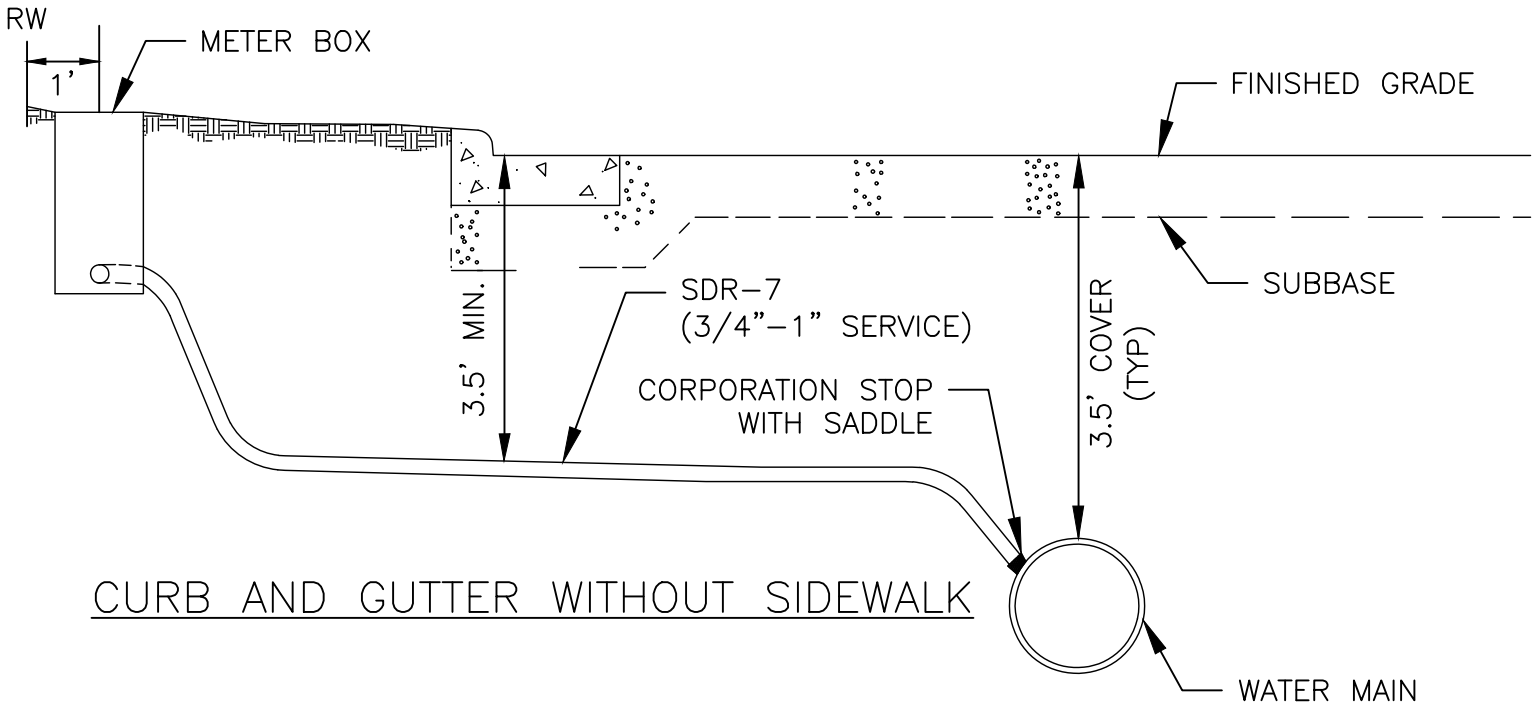


SECTION VIEW

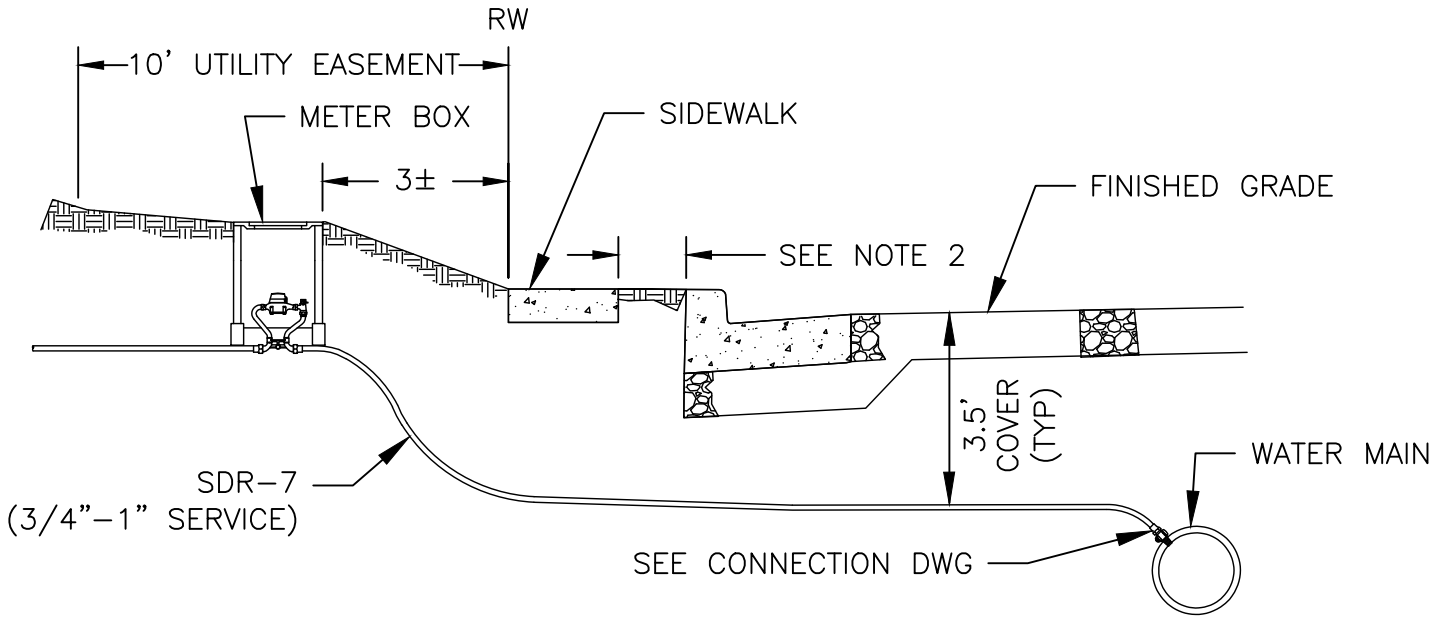
NOTES:

1. CLEAR FLOW VAULT SHIPPED ASSEMBLED WEIGHING APPROX. 12,000 LBS.
2. METER VAULT TO BE AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING VAULT IN AREAS SUBJECT TO VEHICULAR TRAFFIC.

DATE FEB 2026	VAULT DETAIL FOR 3" AND 4" WATER METERS	DRWG. NO.
LCWA/TOL		MET-7



CURB AND GUTTER WITHOUT SIDEWALK

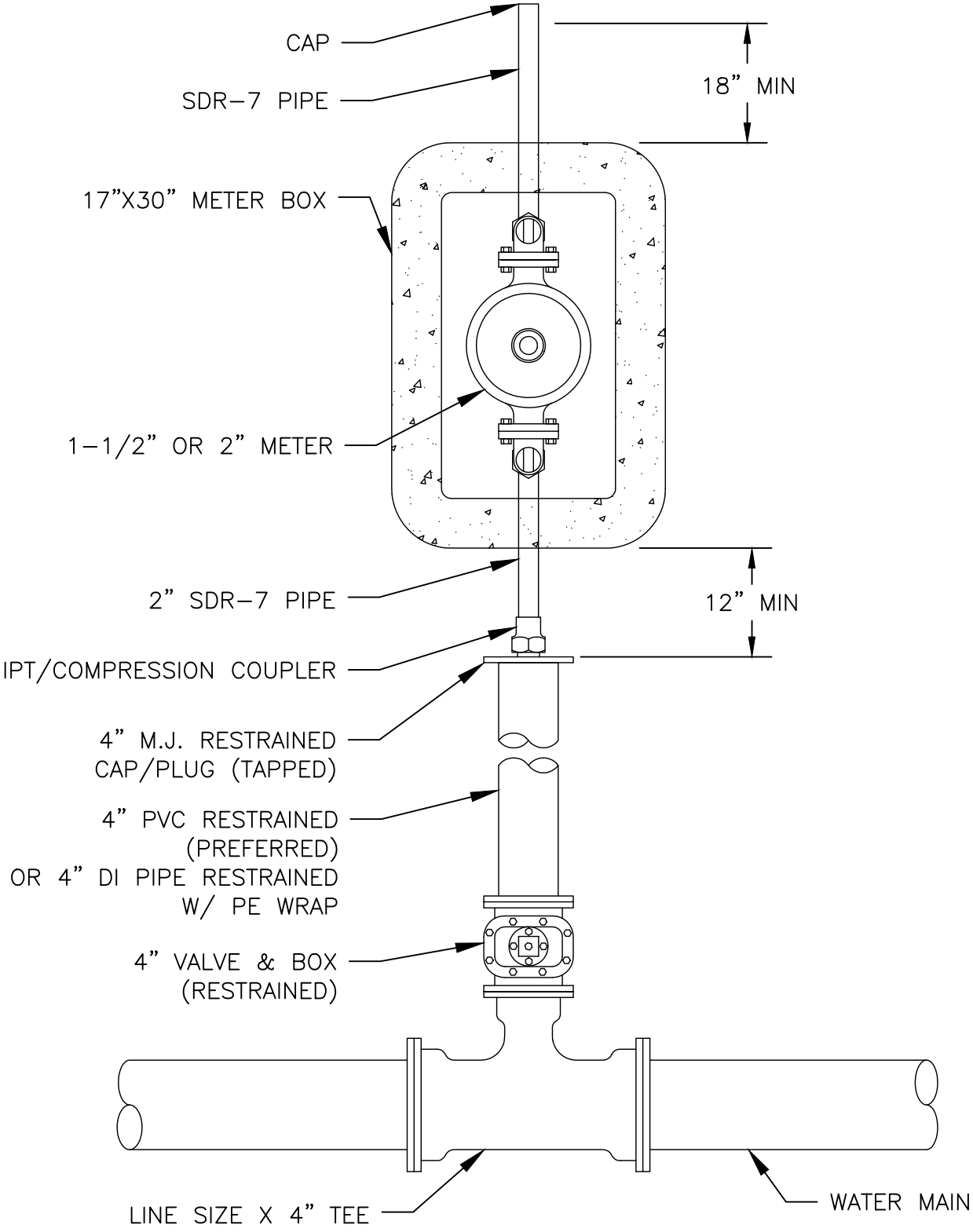


CURB AND GUTTER WITH SIDEWALK

NOTES:

1. SADDLE MUST BE USED.
2. WATER METER MAY BE INSTALLED BETWEEN CURB AND SIDEWALK IF THE DISTANCE IS 3' OR MORE.
3. IF RIGHT OF WAY HAS A DITCH VERSUS CURB AND GUTTER, METER BOX IS TO BE LOCATED ON THE PROPERTY SIDE OF THE DITCH IN A LEVEL AREA. SERVICE LINE TO BE 3.5' BELOW THE INVERT OF THE DITCH.

DATE FEB 2026	WATER SERVICE INSTALLATION DETAIL FOR 5/8" OR 1" METERS	DRWG. NO.
LCWA/TOL		MET-8A

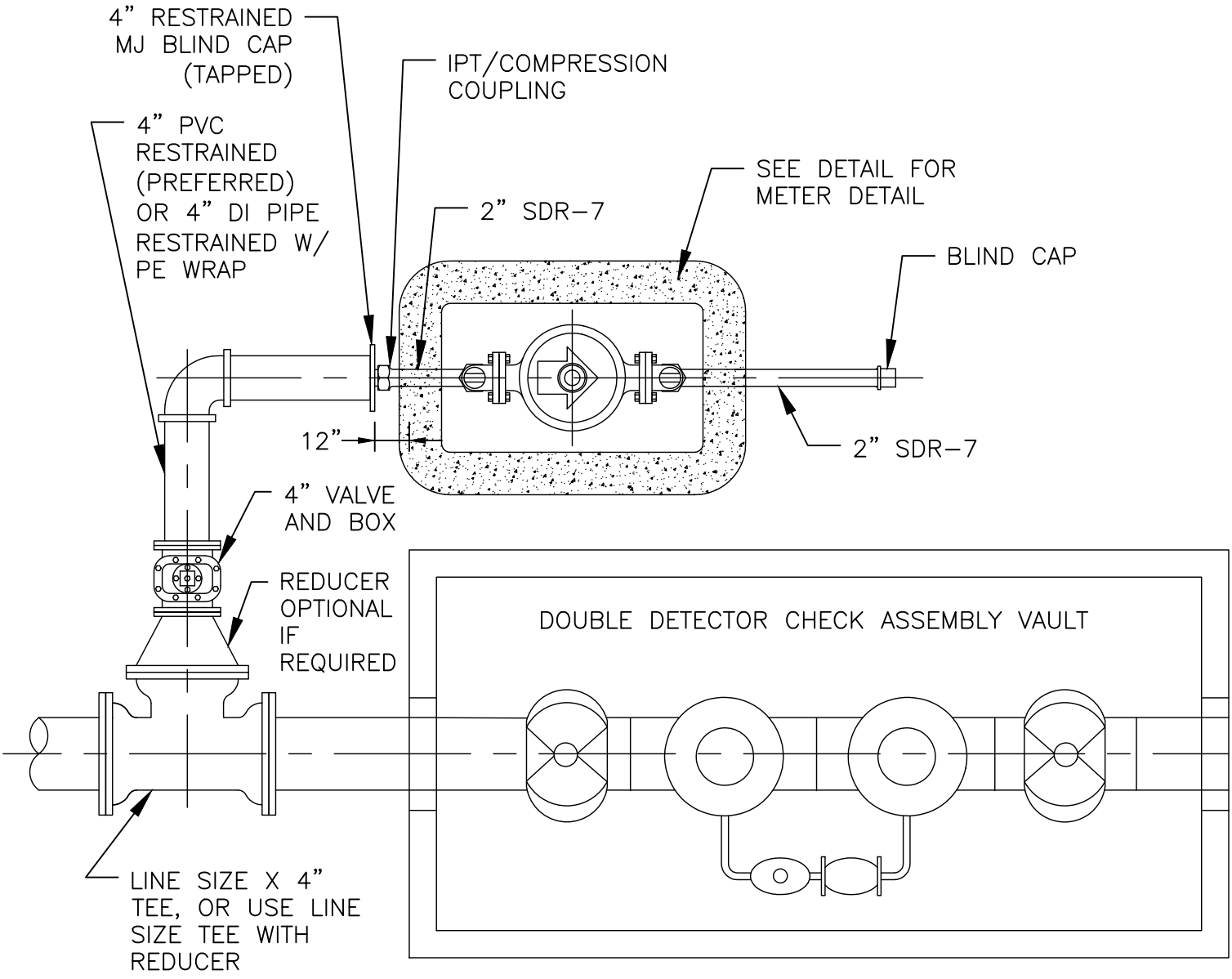


PLAN VIEW

NOTES:

1. CAP/PLUG TO BE LOCATED AT LEAST 12" PAST THE EDGE/BACK OF THE IMPROVED HARD SURFACE; I.E. PAVEMENT, CURBING, SIDEWALK, ETC.

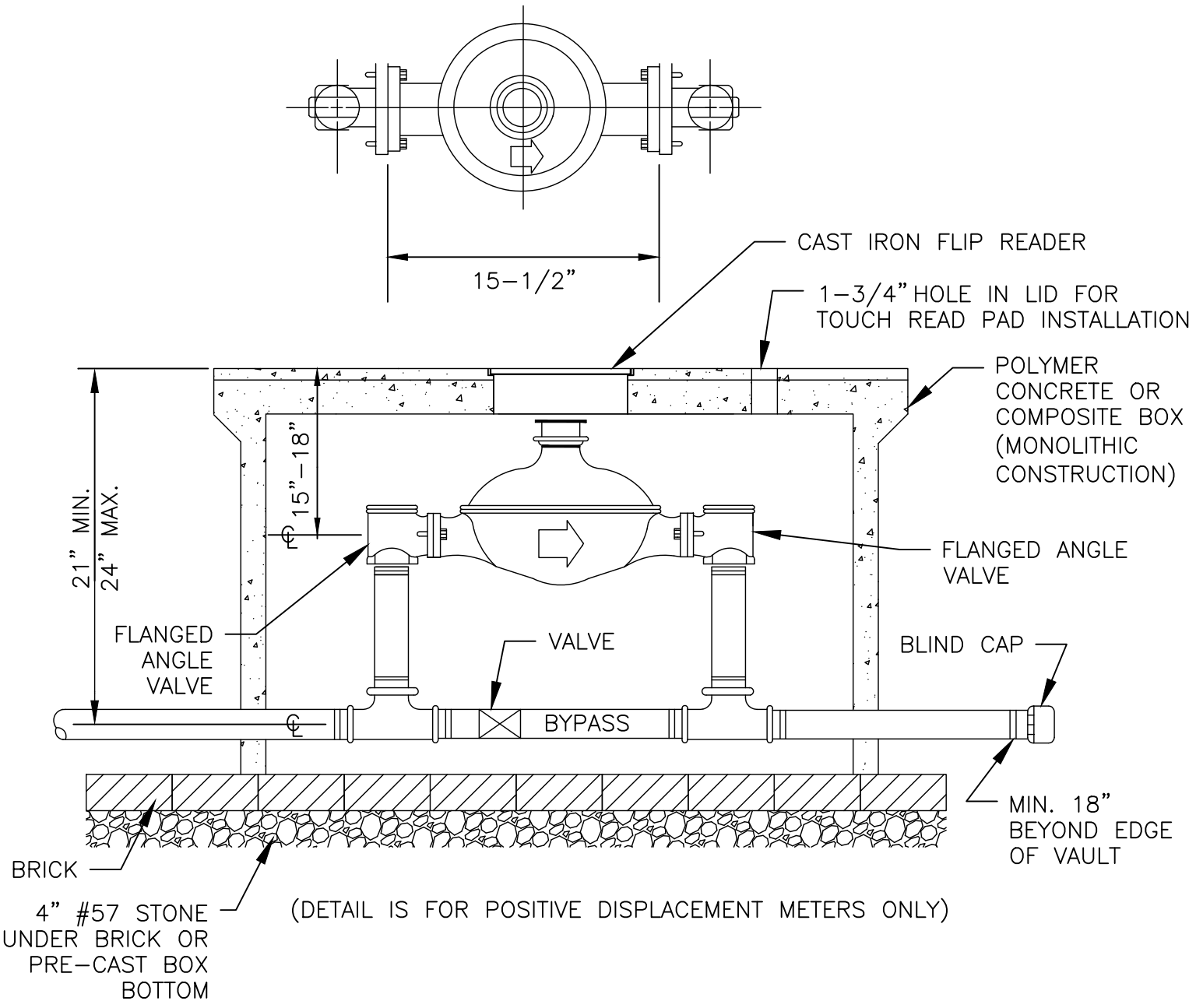
DATE FEB 2026	WATER SERVICE INSTALLATION DETAIL FOR 1–1/2" AND 2" METERS	DRWG. NO. MET–8B
LCWA/TOL		



NOTES:

1. PIGGY BACK WATER AND DOUBLE DETECTOR CHECK MAIN SERVICE LINE SHALL HAVE A VALVE LOCATED AT THE MAIN ADJACENT TO ITS TEE.

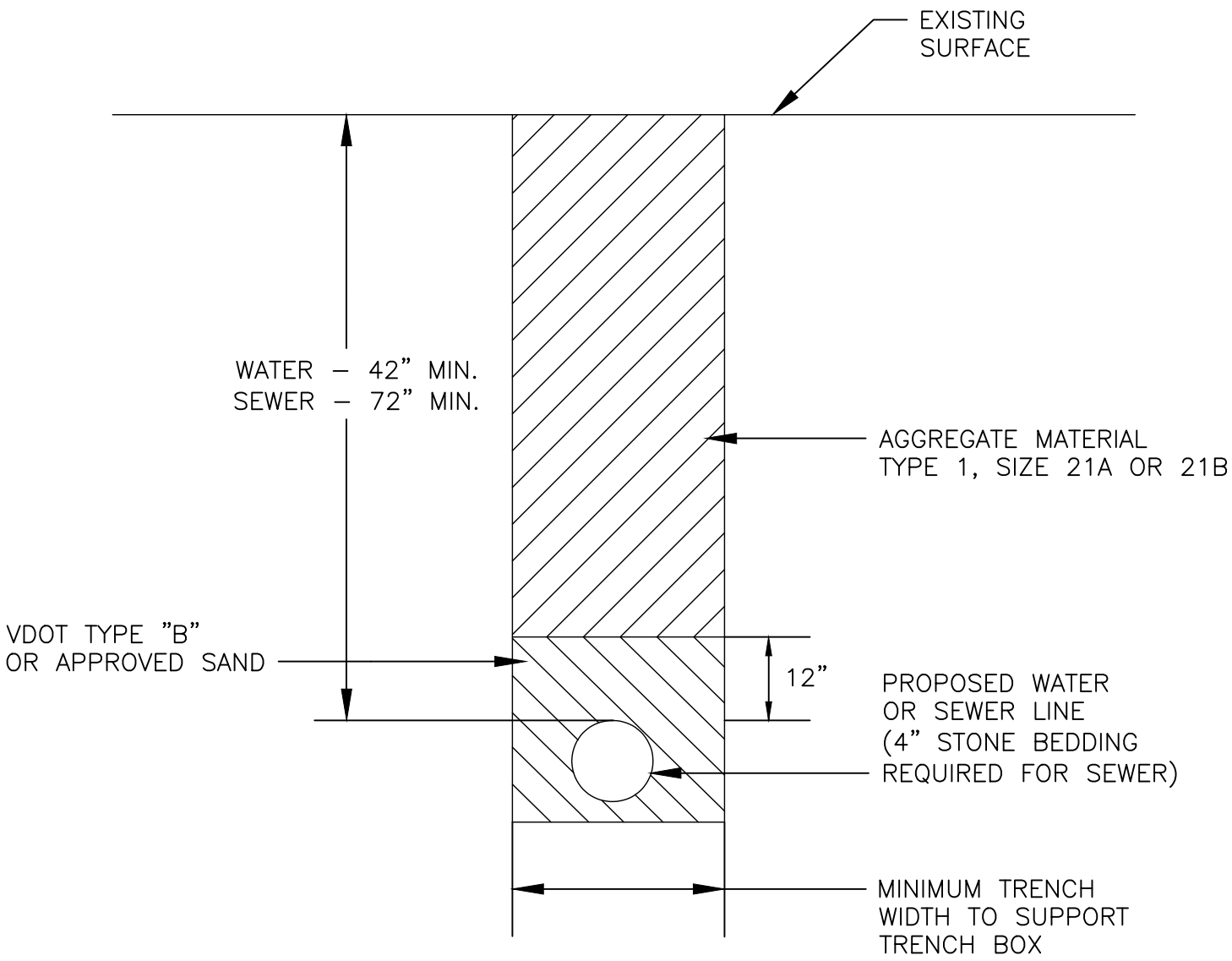
DATE FEB 2026	1/2" AND 2" METER 4", 6" OR 8" DETECTOR SETTING	DRWG. NO. MET-8C
LCWA/TOL		



NOTES:

1. ALL 2" METERS SHALL BE TIED TO THE MAIN PER DRAWINGS.
2. WATER SERVICE LATERALS FOR 2" SERVICES WILL BE SDR–7. CONNECTIONS FOR 2" SERVICES WILL BE APPROVED COMPRESSION FITTINGS.
3. METER BOX TO BE AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
4. BYPASS SHALL BE LOCATED ABOVE OR AT FLOOR LEVEL OF METER VAULT.
5. METER BOXES TO BE PER SPECIFICATIONS.
   A. TOUCH READ TO BE INSTALLED IN BOX TOP NOT FLIP READER.
   B. BOX TO HAVE MOUSE HOLES FOR SERVICE LINE ENTRY AND EXIT. SEAL RESIDUAL OPENING AS DIRECTED BY LCWA INSPECTOR.
   C. IF BOTTOM PROVIDED IN PRECAST BOX, DRAINAGE HOLES TO BE INSTALLED AS DIRECTED BY INSPECTOR.

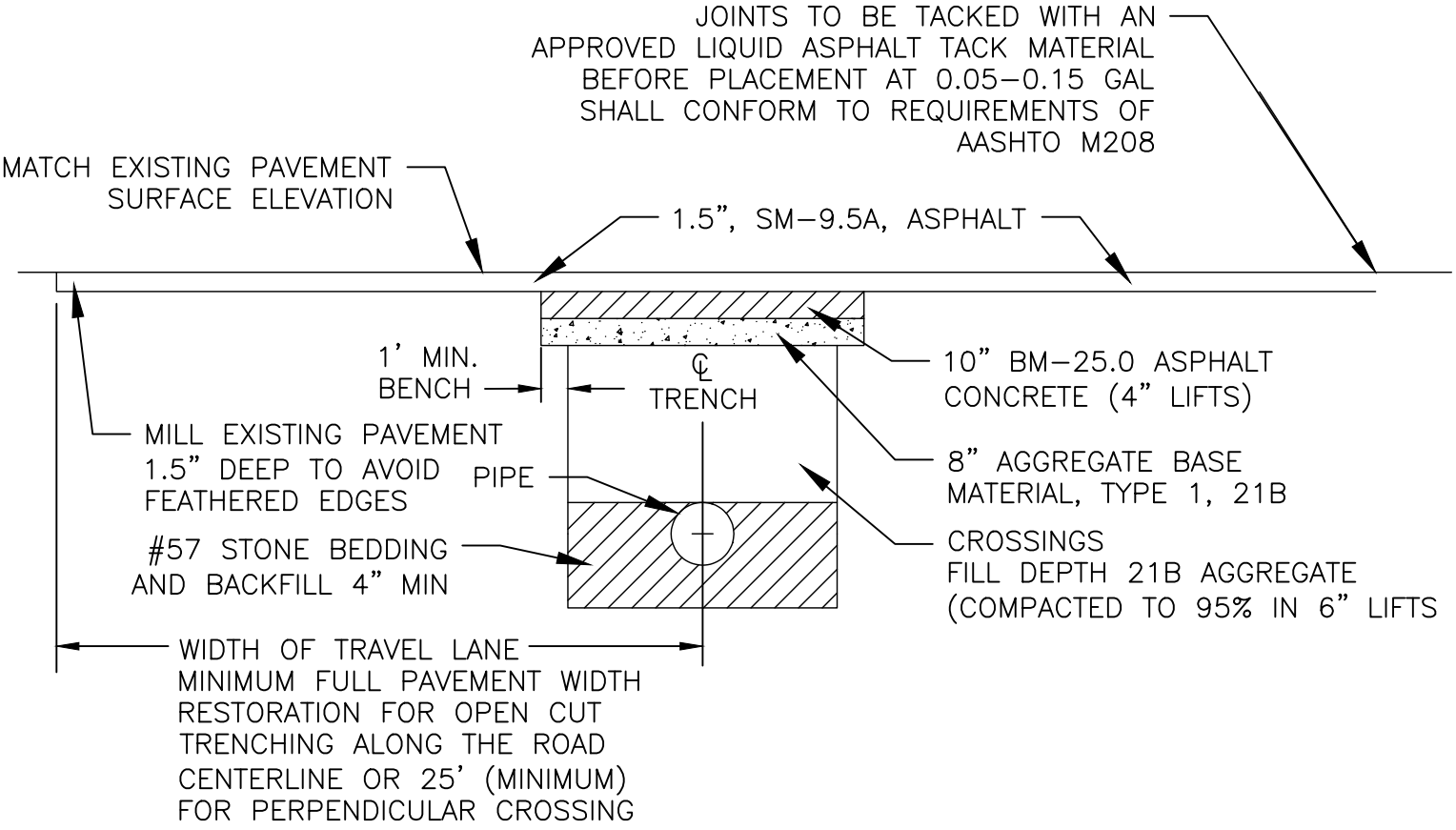
DATE FEB 2026	2" COMPOUND METER SETTING	DRWG. NO. MET–9
LCWA/TOL		



NOTES:

1. EXISTING SURFACE CAPPING DONE ON SHOULDERS, GRAVEL, AND DIRT ROADS.

DATE FEB 2026	TYPICAL SECTION FOR REPAIR OF "PRIMARY" ROADWAY SHOULDERS OR OTHER UNPAVED TRAVELED AREAS FOR WATER & SEWER CROSSINGS	DRWG. NO.
LCWA/TOL		PAV–1



NOTES:

1. ALL BACKFILL AND COMPACTING SHALL BE IN ACCORDANCE WITH CURRENT VDOT STANDARDS AND SPECIFICATIONS.

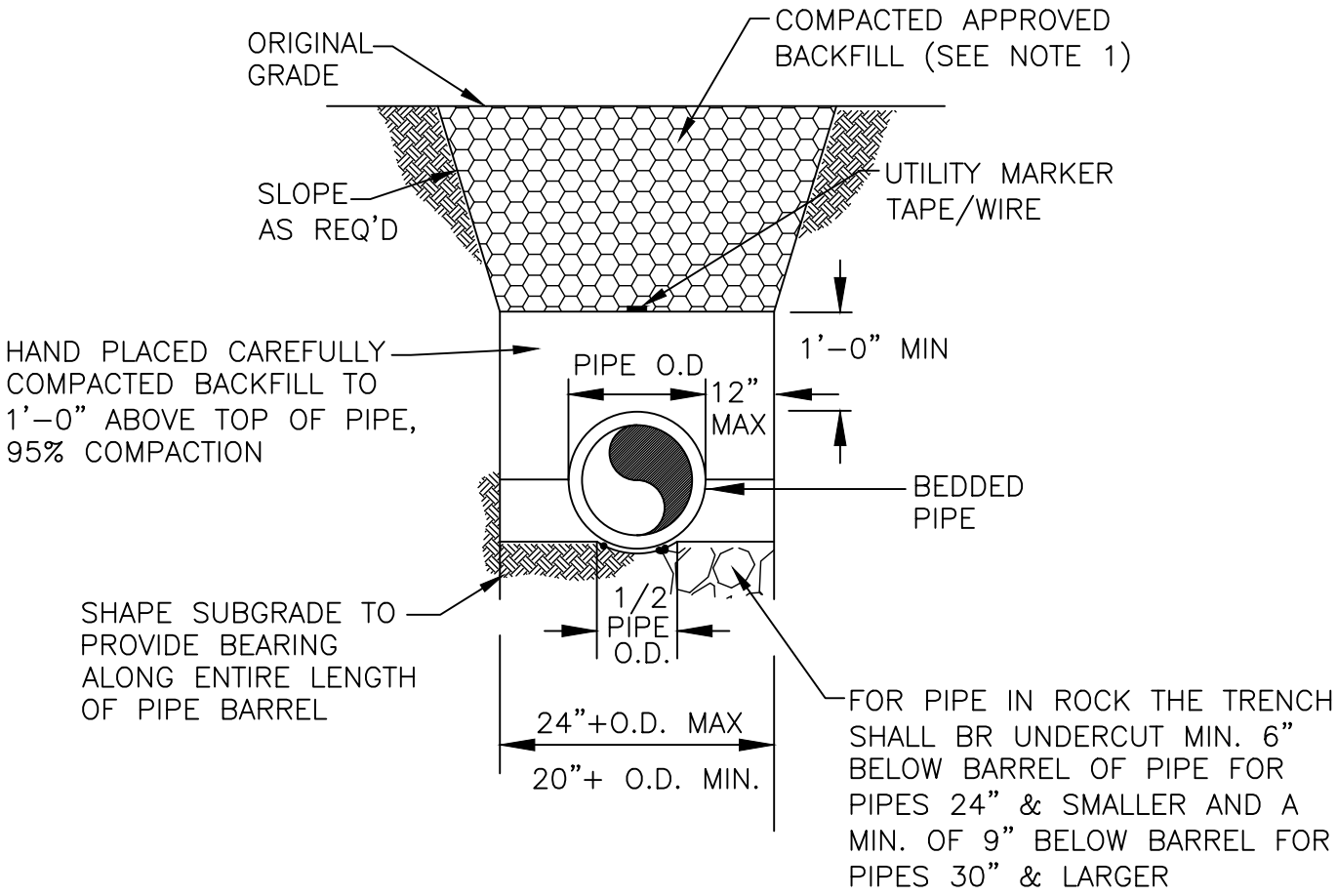
2. WHENEVER THE PAVEMENT IS PERMITTED TO BE CUT, NOT OVER ONE–HALF OF THE ROADWAY SHALL BE DISTURBED AT ONE TIME. THE FIRST OPENING SHALL BE COMPLETELY RESTORED TO SATISFACTORY, TRAVELABLE CONDITION BEFORE THE SECOND HALF CAN BE OPENED.

3. IF THE OPEN CUT AREA IS GREATER THAN 16 SQ. FT. THEN THE PERMITTE SHALL MILL AND RESURFACE ALL (ASPHALT) CONCRETE ROADWAY AND RESURFACE ALL OTHER ROADWAY WITH LIKE MATERIAL THAT IS EXISTING FOR A DISTANCE OF 25 FEET ON EACH SIDE OF THE DISTURBED AREA FROM EDGE–OF–PAVEMENT TO EDGE–OF–PAVEMENT OR AS INDICATED ON THE APPROVED PLANS.

4. A GEOTECHNICAL ENGINEER SHALL ASCERTAIN THE CAUSE AND CERTIFY THE METHOD FOR ALL PAVEMENT STRUCTURE FAILURES AND BE PRESENT DURING BACKFILL OPERATIONS TO CERTIFY THE AGGREGATE HAS BEEN INSTALLED AT 95% COMPACTION RATE. WHERE THE PAVEMENT IS DISTURBED OR DEEMED WEAKENED IN ITS ENTIRETY OR SUCH PORTIONS OF IT AS DEEMED DESIRABLE BY VDOT SHALL BE RESTORED OR REPLACED IN A MANNER WHICH IS SATISFACTORY TO VDOT'S RESIDENT ENGINEER OR HIS/HER REPRESENTATIVE.

5. ALL PAVEMENT MARKINGS DAMAGED OR DESTROYED BY TRENCH EXCAVATION ACTIVITY SHALL BE REPLACED BY THE PERMITTEE IN ACCORDANCE WITH CURRENT VDOT STANDARDS & SPECIFICATIONS.

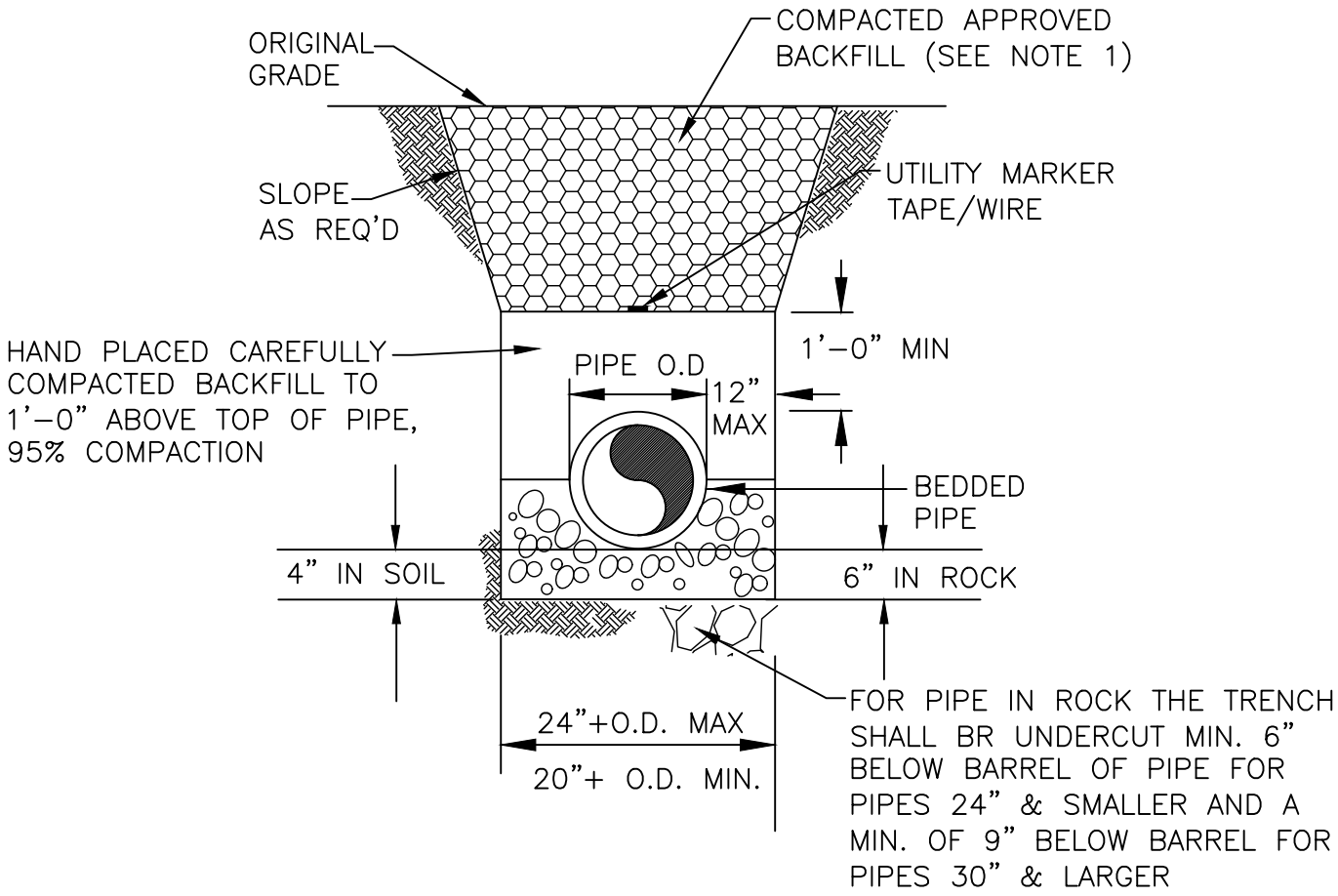
DATE FEB 2026	TYPICAL SECTION FOR REPAIR OF OPEN CUT AFTER PLACEMENT OF SEWER IN SURFACE TREATED ROAD WHERE A BASE (EXCEPT CONCRETE OR PLANT MIX) IS PRESENT	DRWG. NO.
LCWA/TOL		PAV–2



NOTES:

1. ALL BACKFILL IN TRENCHES WHICH ARE LOCATED WITHIN PAVED VDOT STREETS & ROADS SHALL BE VDOT NO. 21–A STONE FOR THE FULL DEPTH OF TRENCH.
2. WALLS SHALL BE SLOPED AND OR SHEETING PROVIDED PER OSHA REQUIREMENTS.
3. INSTALL UTILITY MARKER PER LOUISA COUNTY WATER AUTHORITY AND THE TOWN OF LOUISA WATER AND SEWER UTILITY STANDARDS.

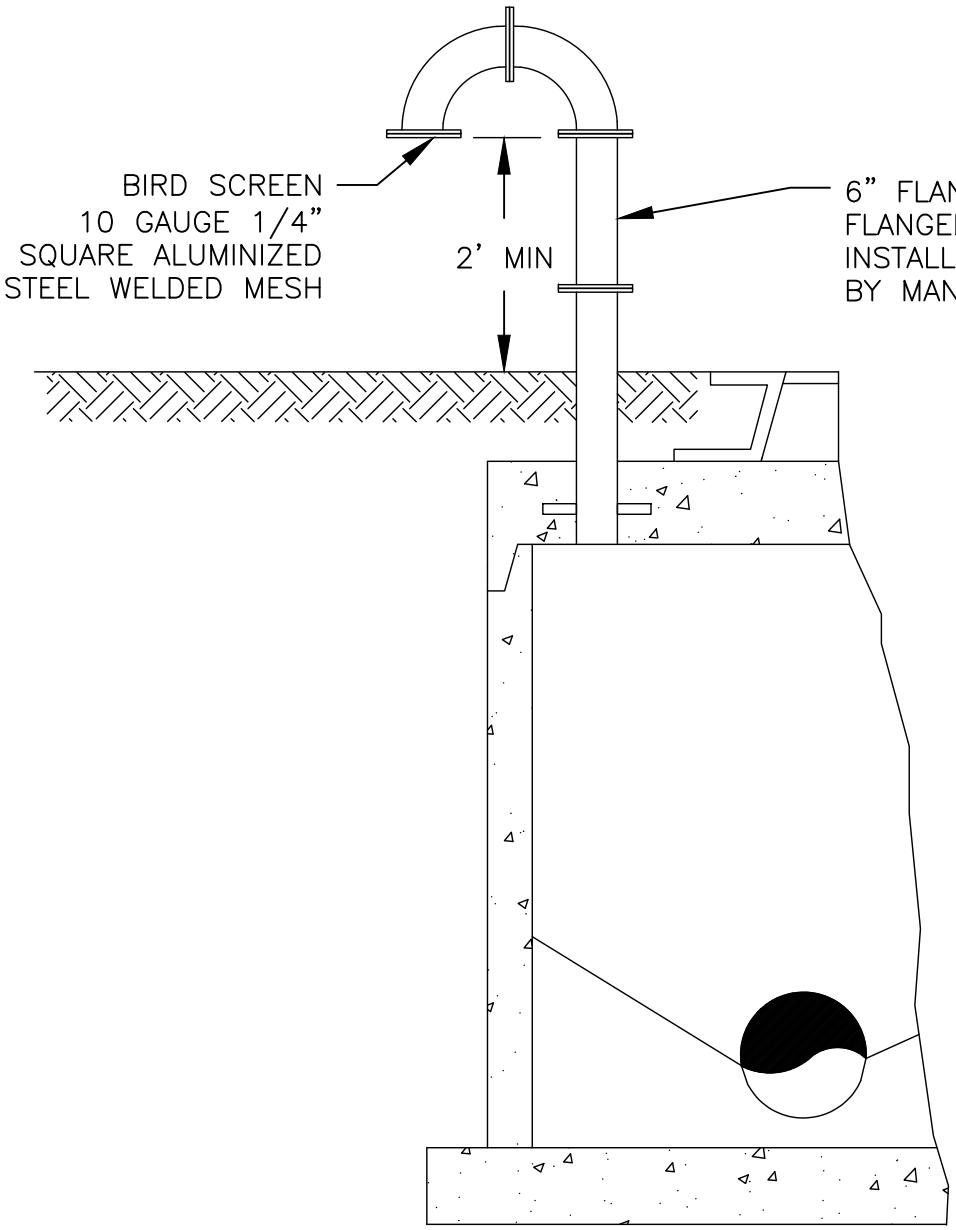
DATE FEB 2026	PIPE LAYING CONDITION DUCTILE IRON PIPE	DRWG. NO. SEW–1
LCWA/TOL		



NOTES:

1. ALL BACKFILL IN TRENCHES WHICH ARE LOCATED WITHIN PAVED VDOT STREETS & ROADS SHALL BE VDOT NO. 21–A STONE FOR THE FULL DEPTH OF TRENCH.
2. WALLS SHALL BE SLOPED AND OR SHEETING PROVIDED PER OSHA REQUIREMENTS.
3. INSTALL UTILITY MARKER PER LOUISA COUNTY WATER AUTHORITY AND THE TOWN OF LOUISA WATER AND SEWER UTILITY STANDARDS.

DATE FEB 2026	PIPE LAYING CONDITION PLASTIC PIPE	DRWG. NO. SEW–2
LCWA/TOL		



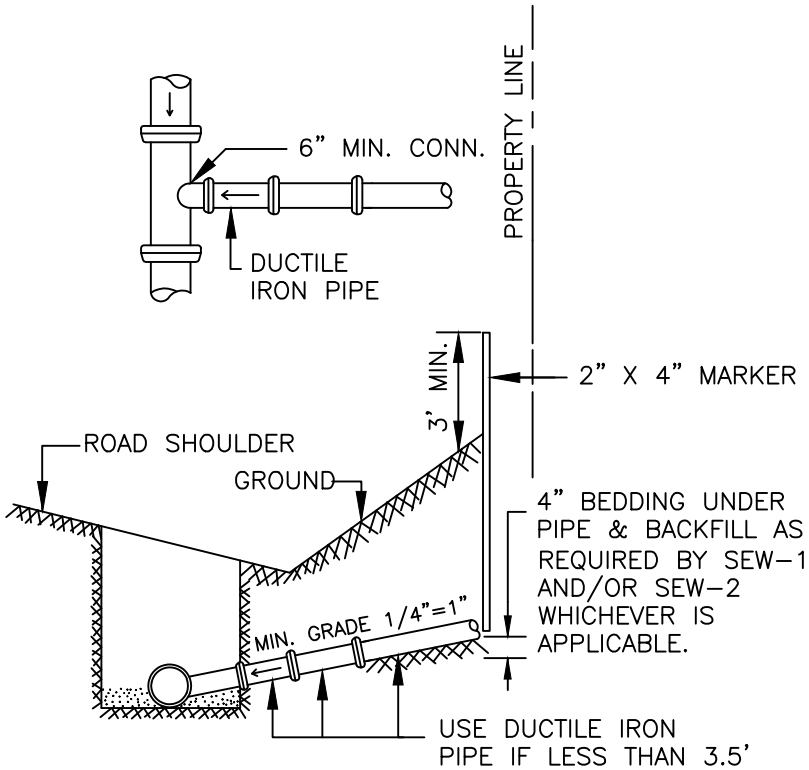
NOTES:

1. PAINT EXPOSED PORTION OF PIPE WITH GREEN RUST INHIBITIVE PAINT.

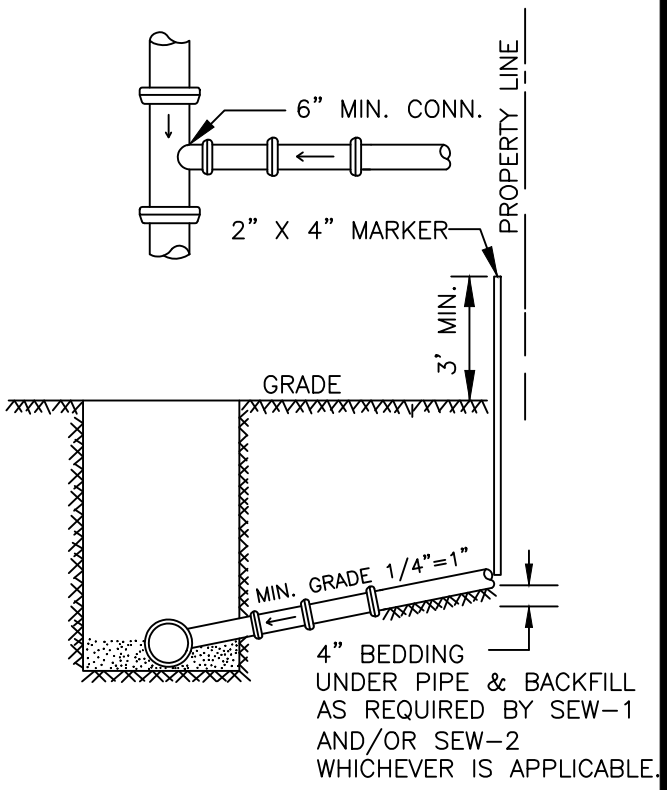
2. WHERE MANHOLE IS LOCATED IN FLOOD PLAIN, AIR VENT SHALL BE SET AT LEAST 12" ABOVE 100-YR FLOOD ELEVATION OR BE EQUIPPED WITH BACKWATER VALVE.

SECTION

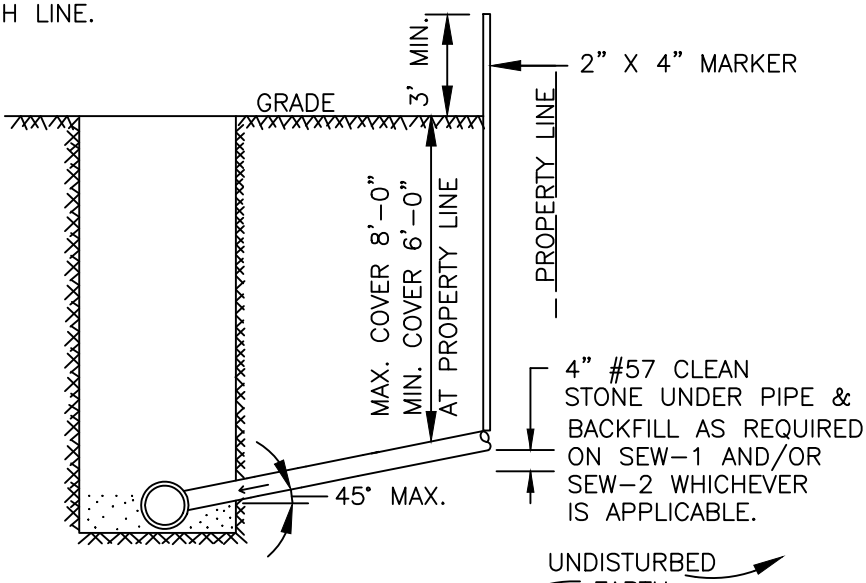
DATE FEB 2026	AIR VENT	DRWG. NO. SEW-3
LCWA/TOL		



DITCH CROSSING



STD. HOUSE CONNECTION

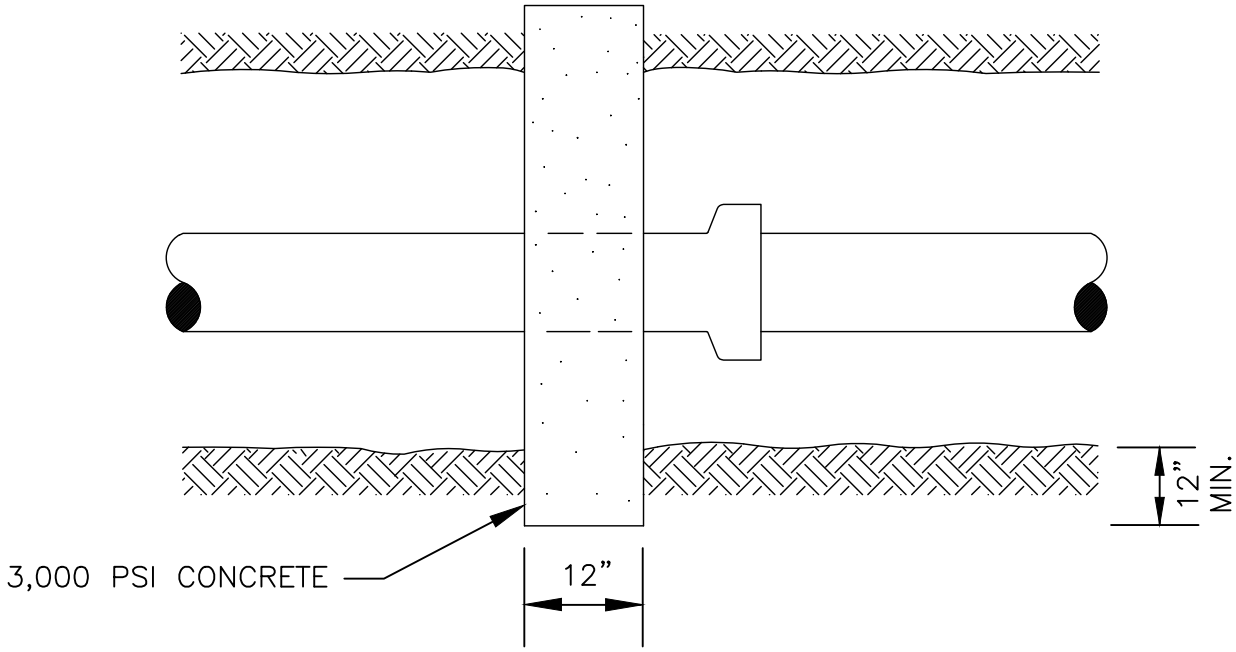


DEEP HOUSE CONNECTION

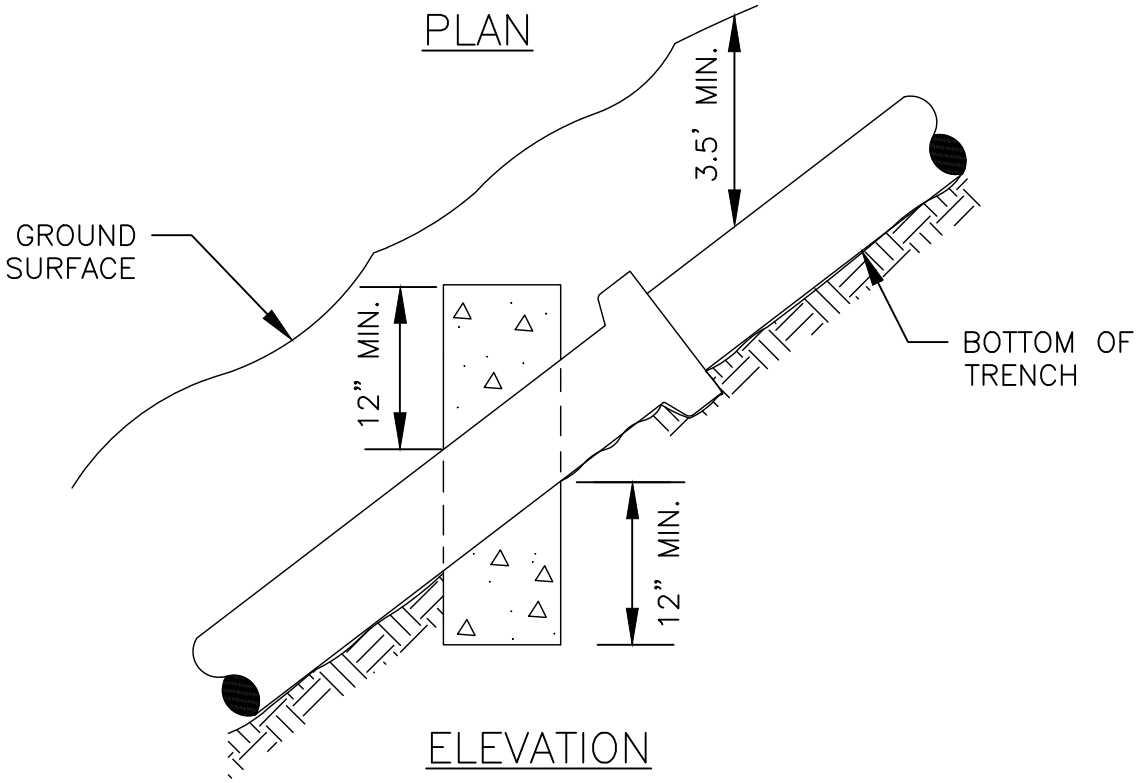
NOTES:

1. HOUSE CONNECTION SHALL BE LAID AT AN ANGLE NOT GREATER THAN 45" FROM HORIZONTAL
2. WHERE MAIN LINE DEPTH IS GREATER THAN 12', CONTRACTOR SHALL LAY CONNECTION AS SHOWN PROVIDED THE ELEVATION OF CONNECTION AT THE PROPERTY LINE IS SUCH THAT THE LOT IS SERVED PROPERLY.
3. CLEANOUT IS TO BE PROVIDED BY PLUMBER AT PROPERTY OR EASEMENT LINE.

DATE FEB 2026	HOUSE CONNECTION DETAILS	DRWG. NO. SEW-4
LCWA/TOL		



PLAN



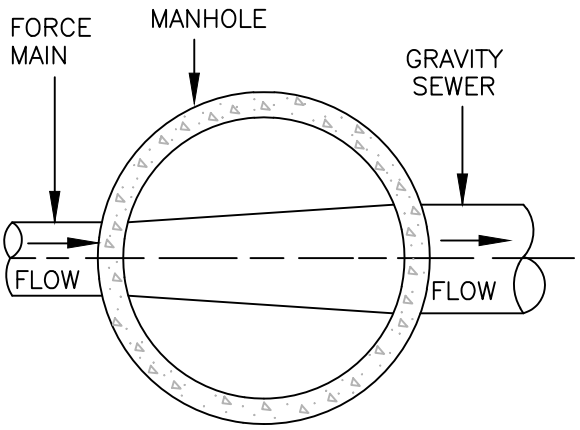
ELEVATION

NOTES:

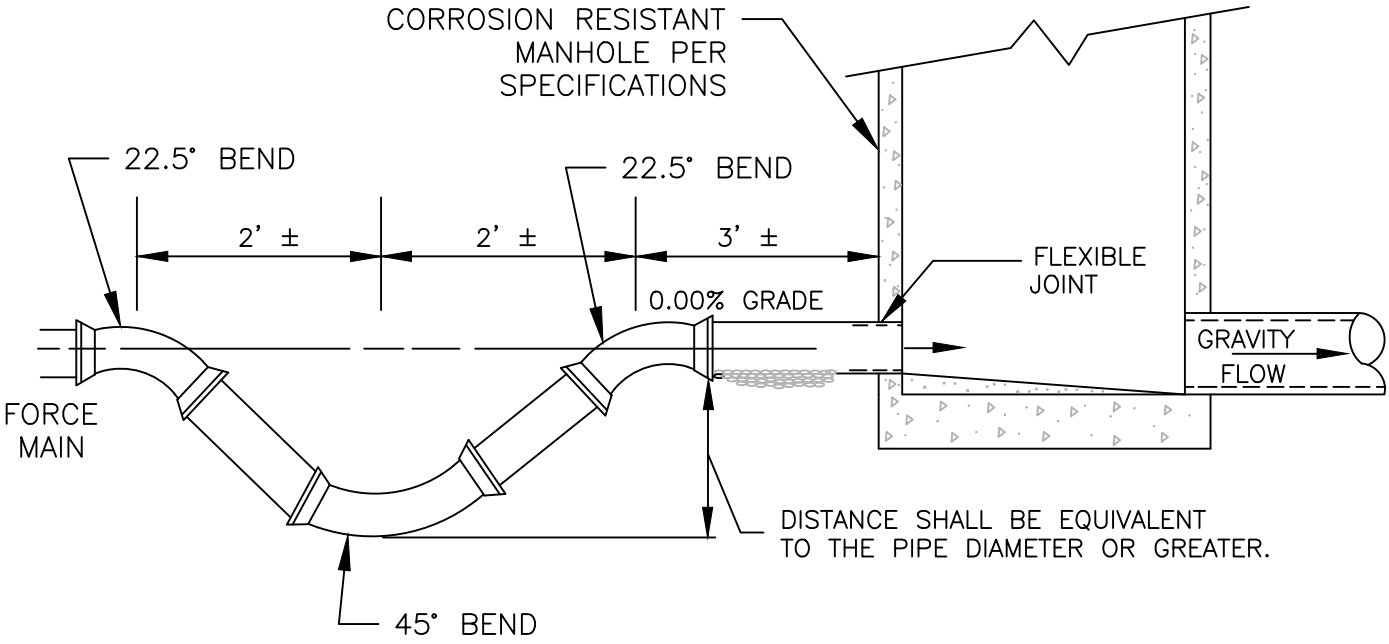
1. CONCRETE TO BE POURED AGAINST UNDISTURBED EARTH.

2. SPACING OF ANCHORS:
SLOPES: 20%–30% – EVERY 2 LENGTHS OF PIPE
31%–50% – EVERY 1 1/2 LENGTHS OF PIPE
OVER 50% – EVERY LENGTH OF PIPE

DATE FEB 2026	SEWER ANCHORAGE IN SLOPES GREATER THAN 20%	DRWG. NO. SEW–5
LCWA/TOL		



PLAN

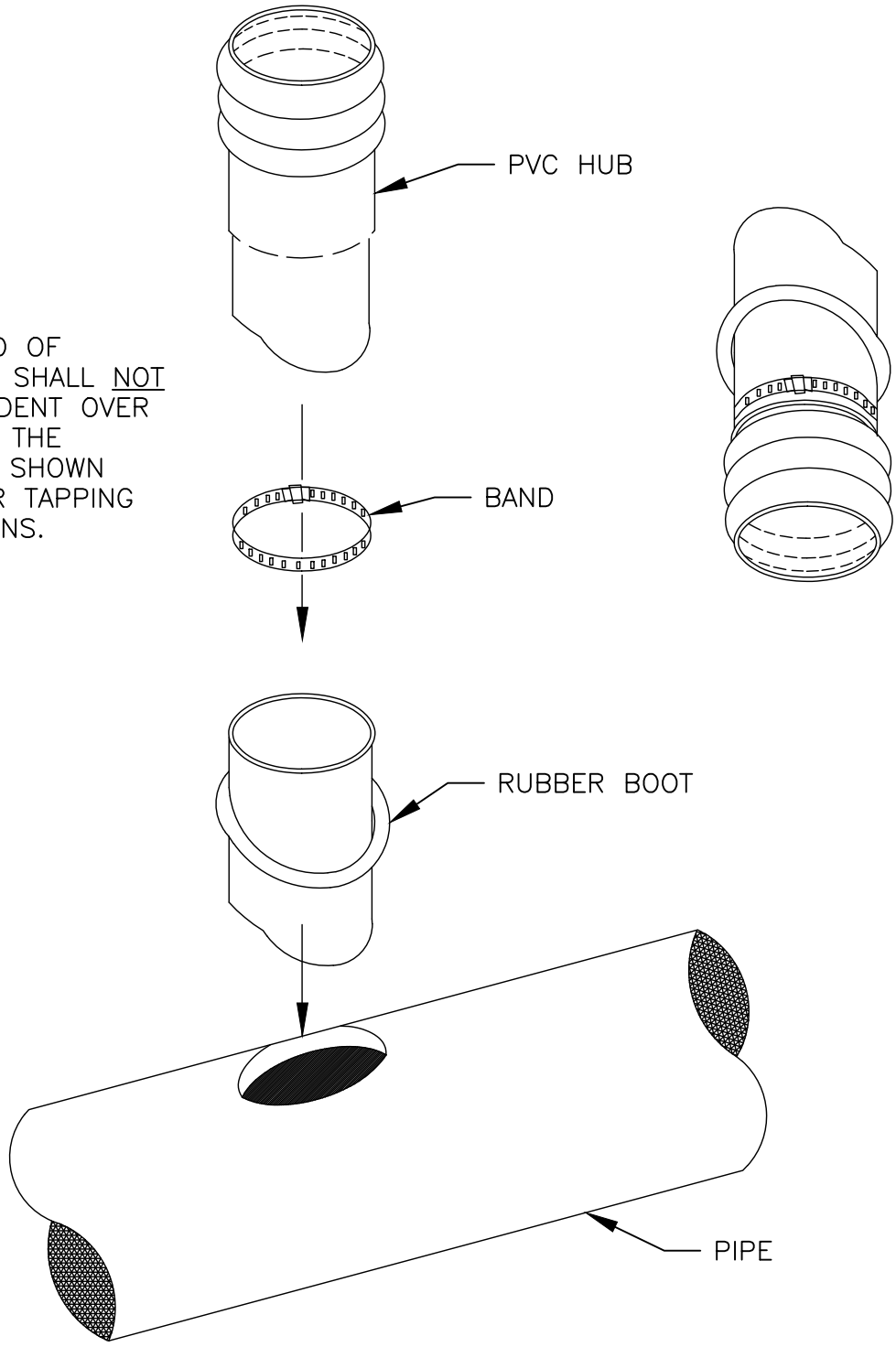


SECTION

NOTES:

1. THIS DETAIL SHALL NOT BE UTILIZED IF THE TERMINAL MANHOLE IS THE FIRST HIGH POINT ON THE FORCE MAIN AND ACTS AS AN AIR RELEASE FOR THE FORCE MAIN. IN THIS CASE, POSITIVE GRADE SHALL BE MAINTAINED TO THE MANHOLE. IF POSSIBLE, THE FIRST 22.5° BEND (FURTHEST FROM MANHOLE) SHOULD BE ELIMINATED AND THE REMAINDER OF THE DETAIL UTILIZED.

DATE FEB 2026	FORCE MAIN DISCHARGE	DRWG. NO. SEW–6
LCWA/TOL		

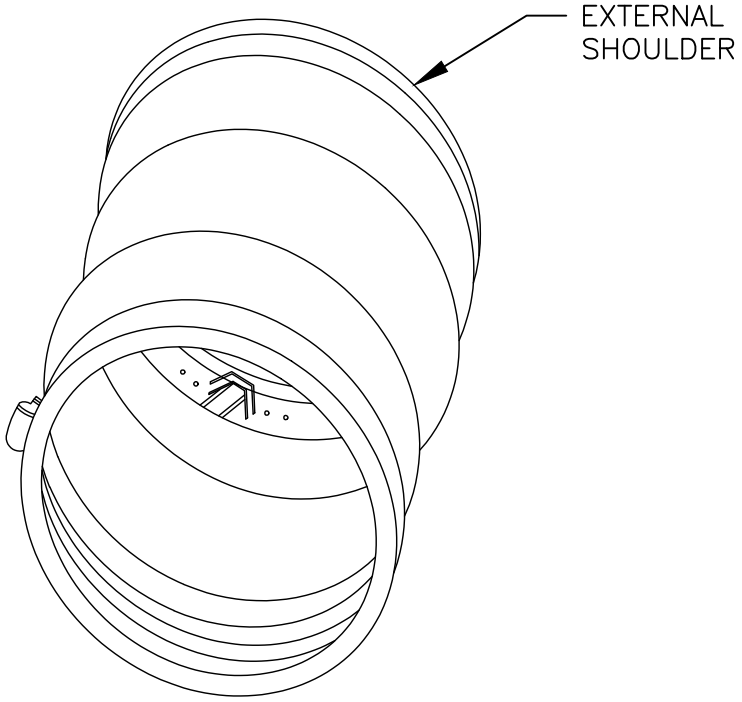


NOTE: THIS METHOD OF CONNECTION SHALL NOT TAKE PRECEDENT OVER USING TEES. THE APPLICATION SHOWN HERE IS FOR TAPPING EXISTING MAINS.

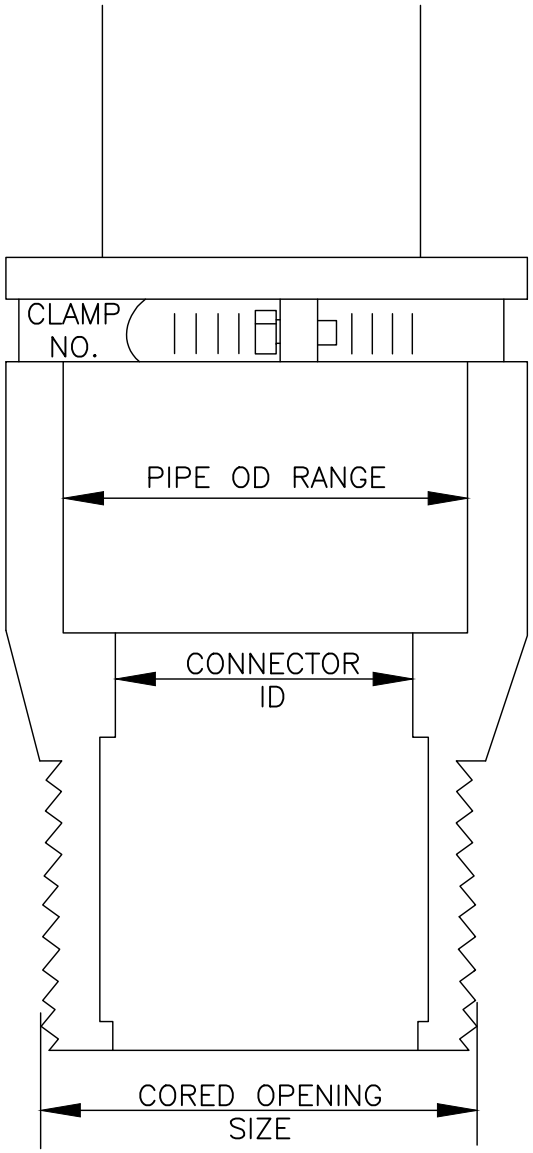
NOTES:

1. INSERTA TEE CAN BE CONNECTED TO PVC, PERMA–LOC, SPIROLITE, SLIP LINER, DUCTILE IRON, THIN WALL MAIN LINES, CONCRETE (MAINLINES AND MANHOLES), CLAY, ALL THICK–WALLED MAIN LINES. IT IS A THREE PIECE CONNECTION THAT IS COMPRESSION–FIT INTO THE CORED WALL OF THE MAIN LINE. IT CONSISTS OF SIDE SERVICES OF 4" THROUGH 12" AND FITS ALL MAIN LINE DIAMETER.

DATE FEB 2026	INSERTA TEE	DRWG. NO. SEW–7
LCWA/TOL		



KOR–N–TEE CONNECTOR

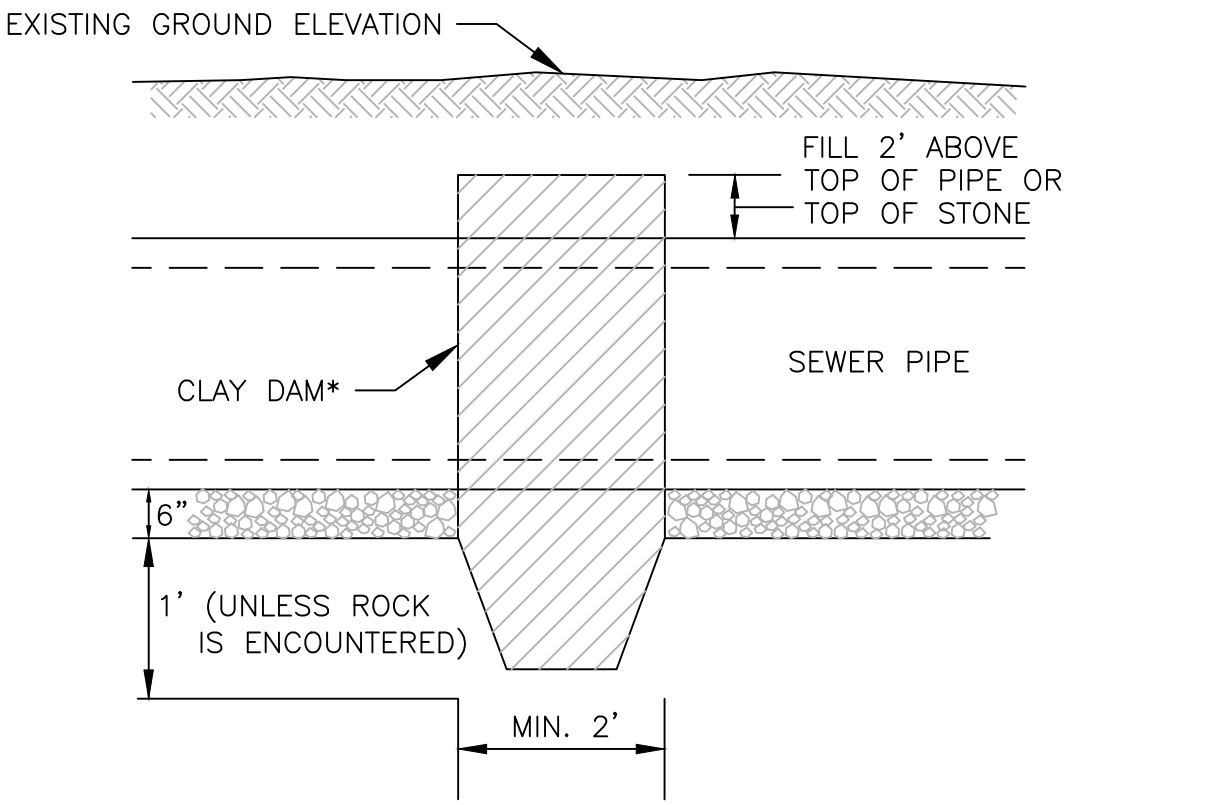


CROSS SECTION

NOTES:

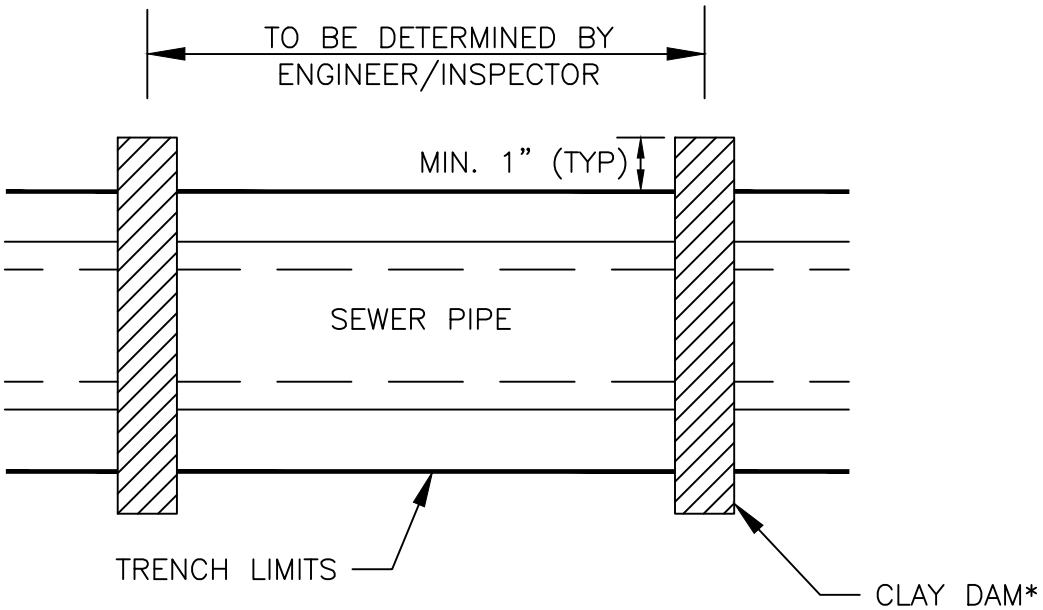
1. IT CAN BE USED FOR INCOMING PIPE SIZES 3.5" O.D. TO 9.875" O.D. THE EXTERNAL SHOULDER PREVENTS THE CONNECTOR FROM PROTRUDING INTO THE TRUNK OR MAIN LINE. THE INTERNAL SHOULDER IN THE CONNECTOR PREVENTS THE INCOMING PIPE OR LATERAL FROM BEING PUSHED THROUGH THE KOR–N–TEE CONNECTOR AND PROTRUDING INTO THE TRUNK OR MAIN LINE. IT MAKES A PERMANENT CONNECTION FOR ALL MATERIALS INCLUDING PVC, FIBERGLASS, ETC.

DATE FEB 2026	KOR–N–TEE	DRWG. NO. SEW–8
LCWA/TOL		



DETAIL

* CLAY DAM SHALL BE BENTONITE CLAY



PLAN VIEW

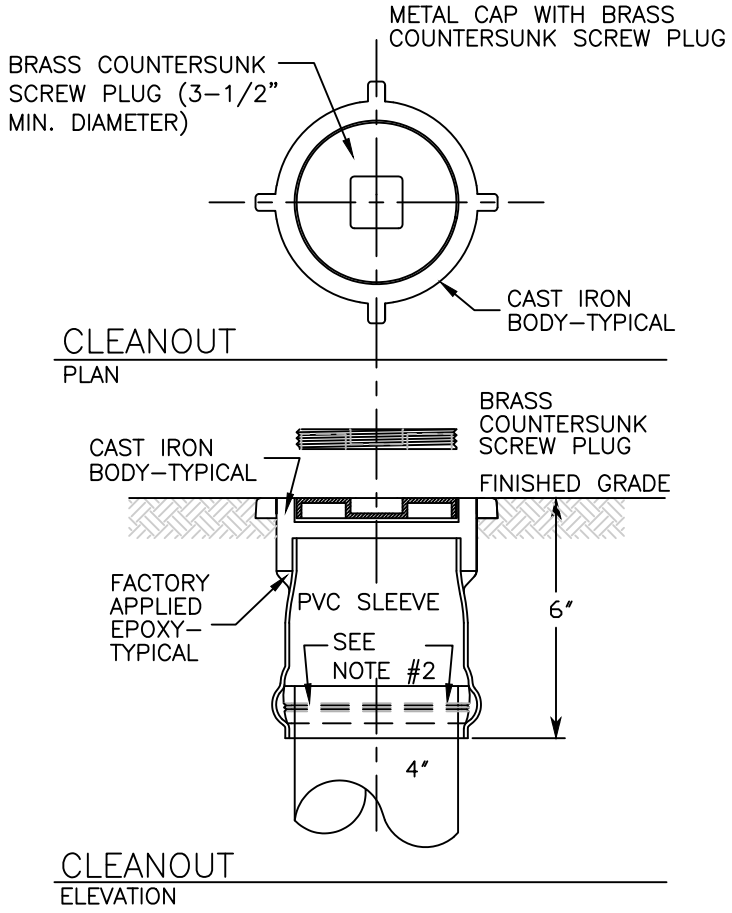
DATE		DRWG. NO.
FEB 2026	CLAY DAM	SEW–9
LCWA/TOL		

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMTERS									
DEPTH (FT)	DIAMETER (IN)								
	30	33	36	42	48	54	60	66	72
	TIME (SEC)								
8"	11	12	14	17	20	23	26	29	33
10"	14	15	18	21	25	29	33	36	41
12"	17	18	21	25	30	35	39	43	49
14"	20	21	25	30	35	41	46	51	57
16"	22	24	29	34	40	46	52	58	67
18"	25	27	32	38	45	52	59	65	73
20"	28	30	35	42	50	53	65	72	81
22"	31	33	39	46	55	64	72	79	89
24"	33	36	42	51	59	64	78	87	97
26"	36	39	46	55	64	75	85	94	105
28"	39	42	49	59	69	81	91	101	113
30"	42	45	53	63	74	87	98	108	121

NOTES:

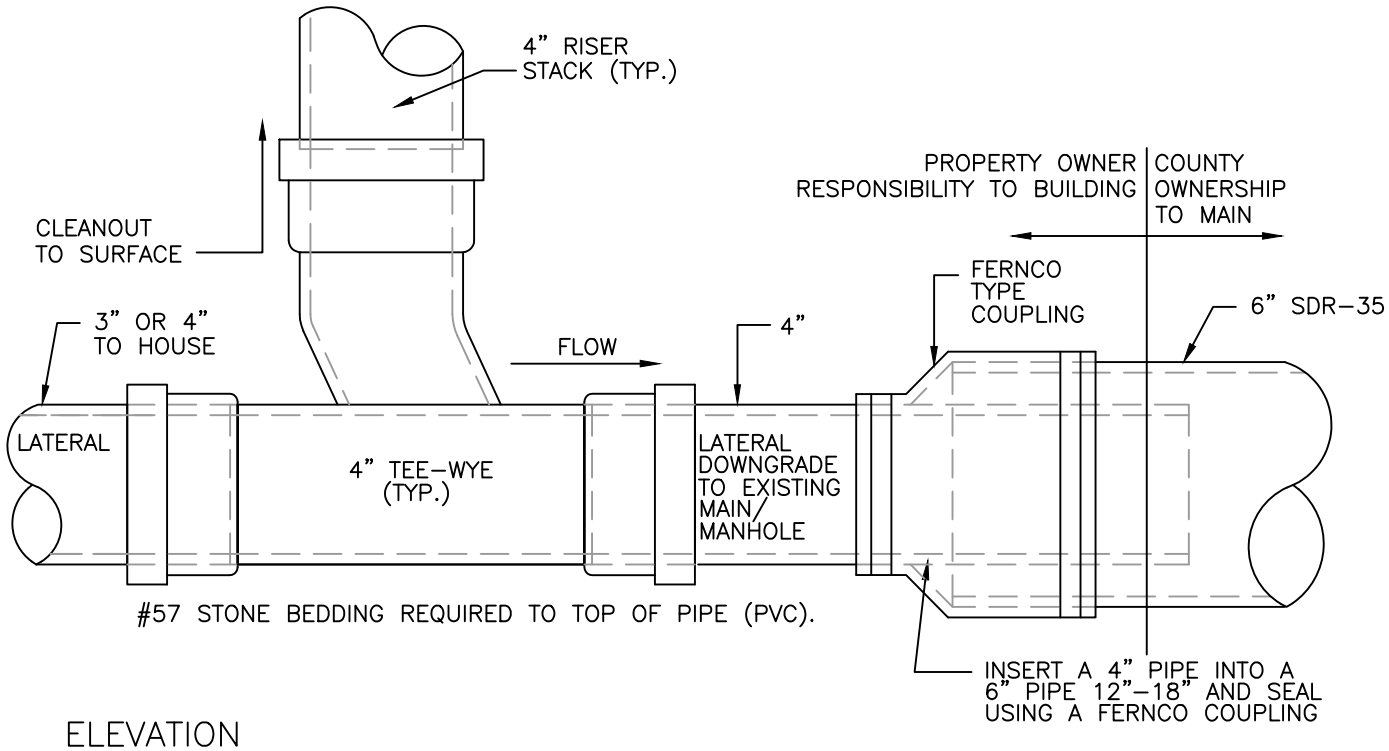
1. THE TEST HEAD SHALL BE PLACED AT THE TOP OF THE MANHOLE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
2. A VACUUM OF 10 IN. OF MERCURY SHALL BE DRAWN ON THE MANHOLE, THE VALVE ON THE VACUUM LINE OF THE TEST HEAD CLOSED, AND THE THE VACUUM PUMP SHUT OFF. THE TIME SHALL BE MEASURED FOR THE VACUUM TO DROP TO 9 IN. OF MERCURY.
3. THE MANHOLE SHALL PASS IF THE TIME FOR THE VACUUM READING TO DROP FROM 10 IN. OF MERCURY TO 9 IN. OF MERCURY MEETS OR EXCEEDS THE VALUES INDICATED IN TABLE.
4. IF THE MANHOLE FAILS THE INITIAL TEST, NECESSARY REPAIRS SHALL BE MADE BY AN APPROVED METHOD. THE MANHOLE SHALL THEN BE RETESTED UNTIL A SATISFACTORY TEST IS OBTAINED.

DATE FEB 2026	MANHOLE VACUUM TEST	DRWG. NO. SEW–10
LCWA/TOL		



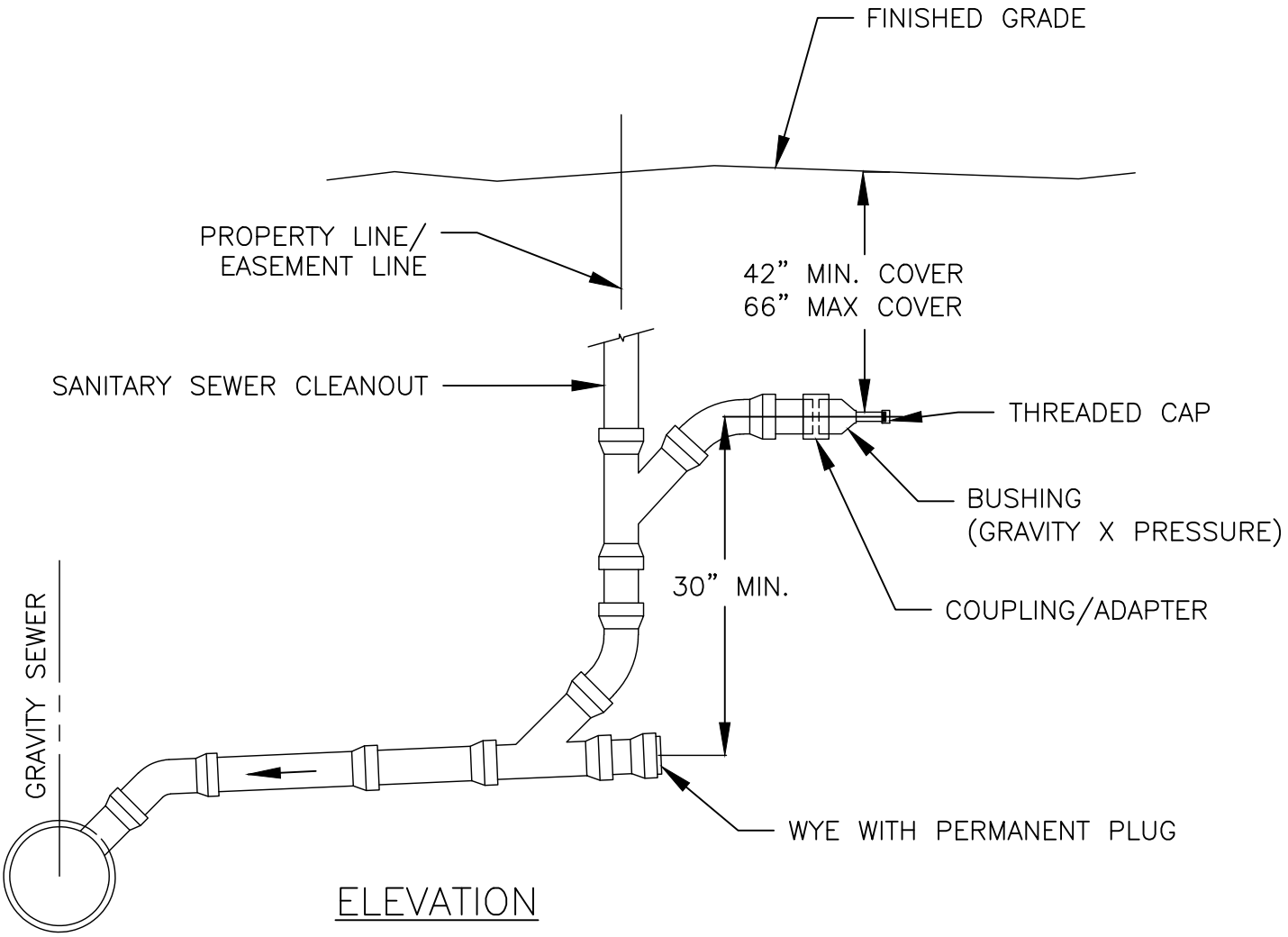
NOTES:

1. CLEANOUTS TO BE INSTALLED EVERY 100' AND AT EVERY 90° BEND OR AS SPECIFIED BY LATEST PLUMBING CODES.
2. CLEANOUT TOP MAY BE GASKETED OR GLUED CONNECTION TO THE STACK. EITHER METHOD MUST BE WATER TIGHT.
3. PIPING BEYOND CLEANOUT TO BE INSTALLED PER LATEST PLUMBING CODES.
4. CLEANOUT OWNED BY PROPERTY OWNER AND SHALL BE GENECO OR EQUAL WITH MIN. 3–1/2" OPENING.



ELEVATION

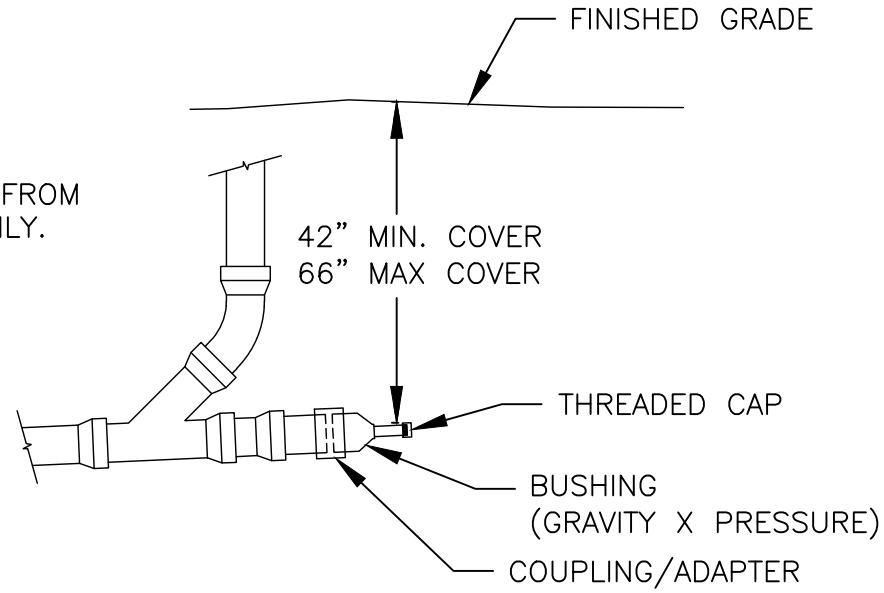
DATE FEB 2026	PROPERTY/EASEMENT LINE CLEANOUT DETAIL	DRWG. NO. SEW–11
LCWA/TOL		



ELEVATION

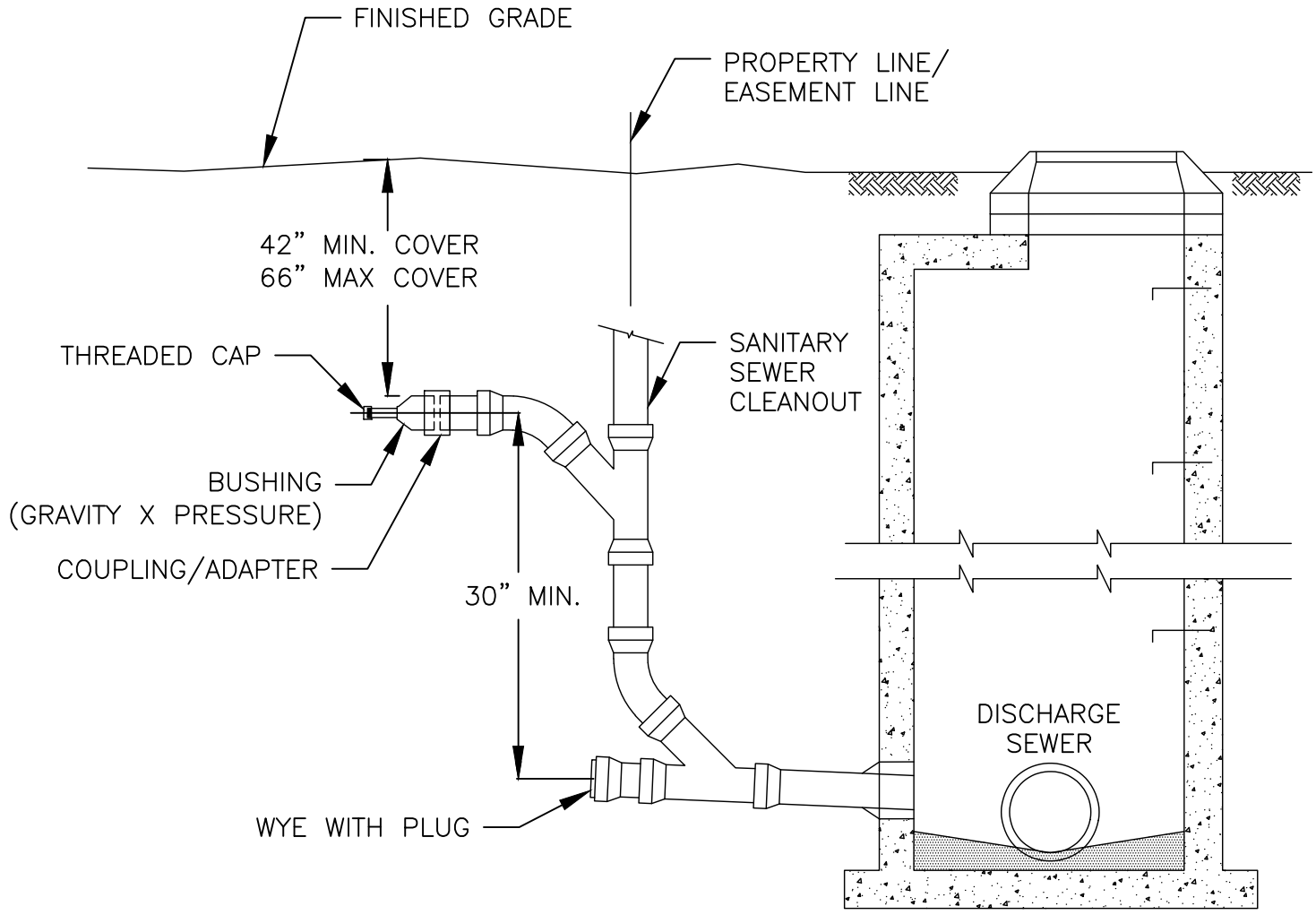
NOTES:

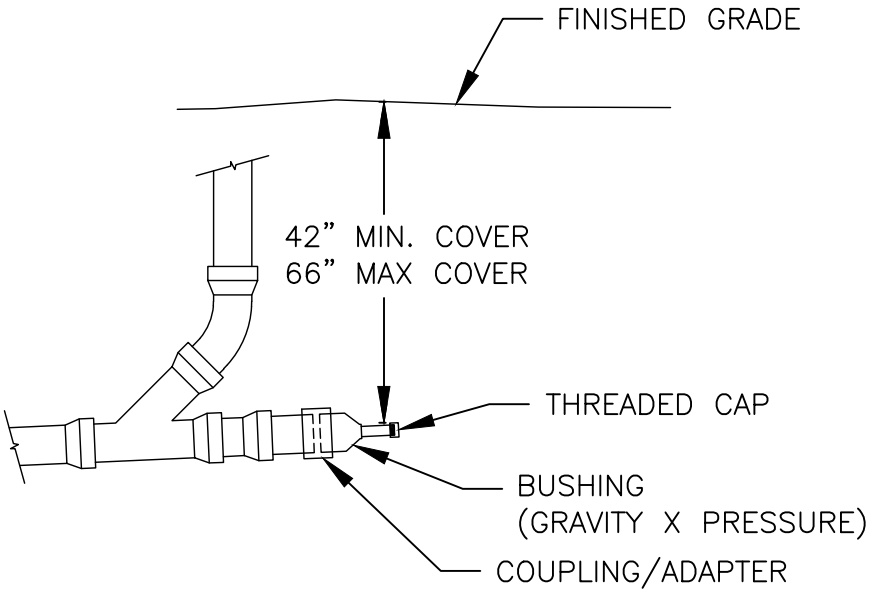
1. FOR SERVICE CONNECTIONS FROM PRIVATE GRINDER PUMPS ONLY.
2. SEE SEW–4 FOR HOUSE CONNECTION AND CLEANOUT REQUIREMENTS.



ALTERNATE FOR SHALLOW GRAVITY LATERAL

DATE FEB 2026	PRESSURE SEWER HOUSE CONNECTION TO GRAVITY SEWER LINE	DRWG. NO. SEW–12
LCWA/TOL		





ALTERNATE FOR SHALLOW GRAVITY LATERAL

NOTES:

1. DETAIL TO BE USED WHEN CONNECTING FORCE MAIN FROM PRIVATE GRINDER PUMPS TO GRAVITY SEWER MANHOLE.
2. APPLY ACID RESISTANT LINING TO MANHOLE AS REQUIRED IN SPECIFICATIONS.
3. SEE SEW–4 FOR HOUSE CONNECTION AND CLEANOUT REQUIREMENTS.
4. CLEANOUT SHALL BE LOCATED AT LEAST 10' FROM MANHOLE.

DATE FEB 2026	PRESSURE SEWER HOUSE CONNECTION TO GRAVITY SEWER MANHOLE	DRWG. NO. SEW–13
LCWA/TOL		

MINIMUM TEST TIME TWO HOURS

WATER LINE TEST BASED ON 150 PSI	
SIZE	MAX. ALLOWABLE LEAKAGE
3/4"	.0124 (GAL/2 HRS)/100 L.F.
1"	.0166 (GAL/2 HRS)/100 L.F.
1–1/2"	.0248 (GAL/2 HRS)/100 L.F.
2"	.0331 (GAL/2 HRS)/100 L.F.
3"	.0497 (GAL/2 HRS)/100 L.F.
4"	.0662 (GAL/2 HRS)/100 L.F.
6"	.0993 (GAL/2 HRS)/100 L.F.
8"	.1324 (GAL/2 HRS)/100 L.F.
12"	.1986 (GAL/2 HRS)/100 L.F.

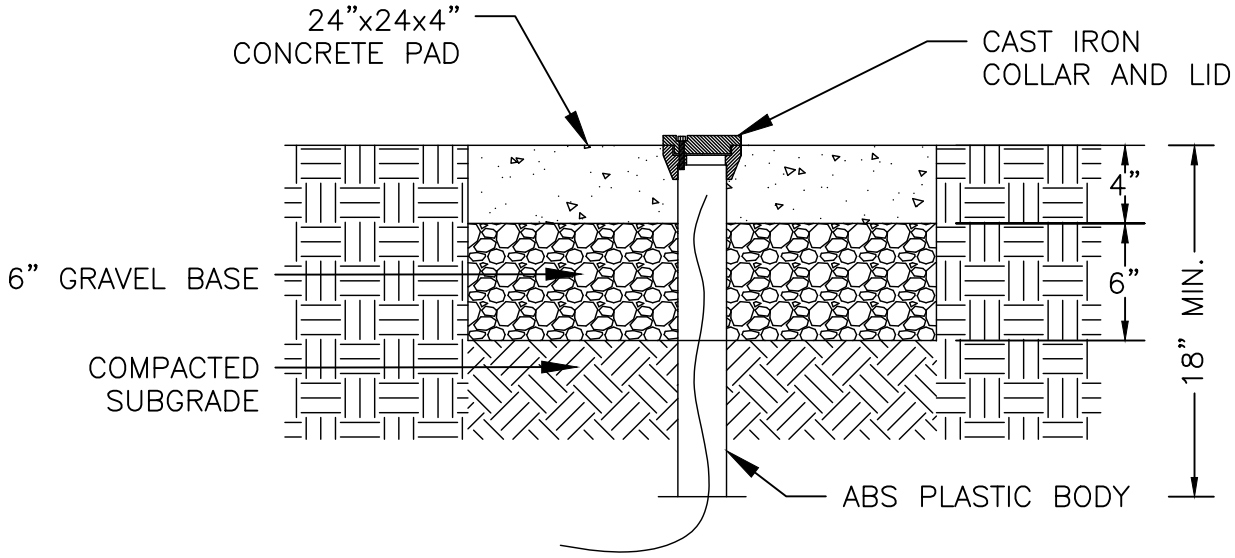
WATER LINE TEST BASED ON 150 PSI	
SIZE	MAX. ALLOWABLE LEAKAGE
16"	.2648 (GAL/2 HRS)/100 L.F.
20"	.3310 (GAL/2 HRS)/100 L.F.
24"	.3972 (GAL/2 HRS)/100 L.F.
30"	.4965 (GAL/2 HRS)/100 L.F.
36"	.5958 (GAL/2 HRS)/100 L.F.
42"	.6951 (GAL/2 HRS)/100 L.F.
48"	.7944 (GAL/2 HRS)/100 L.F.
54"	.8937 (GAL/2 HRS)/100 L.F.

MAXIMUM ALLOWABLE LEAKAGE FOR THE WATER MAIN WILL BE CALCULATED USING THE FOLLOWING FORMULA:

$$L = \frac{DS\sqrt{P}}{148{,}000}$$

WHERE:
L = MAXIMUM ALLOWABLE LEAKAGE, GALLONS/HOUR
S = LENGTH OF PIPE IN TEST SECTION, IN FEET
D = NOMINAL DIAMETER OF TESTED PIPE, IN INCHES
P = TEST PRESSURE, POUNDS PER SQUARE INCH 150 PSI OR 1–1/2 THE WORKING PRESSURE WHICHEVER IS GREATER MEASURED AT THE HIGH POINT OF THE TEST SYSTEM

DATE FEB 2026	ALLOWABLE LEAKAGE TABLE	DRWG. NO. TEST–1
LCWA/TOL		



TYPICAL INSTALLATION
FOR FORCE MAINS AND
WATERLINES

NOTES:

1. TEST BOX TO BE BINGHAM TAYLOR FIG. NO. 375 TEST WITH FLARED BOTTOM; 2–1/2" SIZE OR EQUAL.
2. CONCRETE FOR PAD TO BE 3000 PSI CONCRETE.
3. ALL TEST STATIONS LOCATED OUTSIDE PUBLIC RIGHT OF WAY AND NOT ADJACENT TO OTHER ABOVE GROUND FACILITIES SHOULD HAVE A MARKER/WITNESS POST PROVIDED ADJACENT TO IT UNLESS OTHERWISE APPROVED BY LCWA.
4. PRECAST REINFORCED CONCRETE RING 24" IN DIAMETER MAY BE USED IN LIEU OF 2' SQUARE PAD POURED IN PLACE.
5. TEST STATIONS ADJACENT TO FIRE HYDRANT DO NOT REQUIRE THE CONCRETE PAD/RING.

DATE FEB 2026	TEST STATION BOX	DRWG. NO. TEST–2
LCWA/TOL		

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED
PRESSURE DROP FROM 3.5 PSIF TO 2.5 PSIG*

PIPE DIAMETER (IN.)	MINIMUM TIME (MIN: SEC)	TIME FOR LENGTH (L) (SEC)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
			100 FT.	150 FT.	200 FT.	250 FT.	300 FT.	350 FT.	400 FT.	450 FT.
4	3:46	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	45:21	41.883 L	69:48	104:47	139:37	174:31	209:25	244:19	279:13	314:07

* THE 3.5 PSIG TEST PRESSURE SHALL BE INCREASED BY ADDING THE AVERAGE VERTICAL HEIGHT IN FEET OF GROUND WATER ABOVE THE SEWER PIPE INVERT, DIVIDED BY 2.31 BUT THE MAXIMUM STARTING TEST PRESSURE SHALL NOT EXCEED 9 PSIG.

DATE FEB 2026	PVC PIPE AIR TEST TABLE	DRWG. NO. TEST–3
LCWA/TOL		

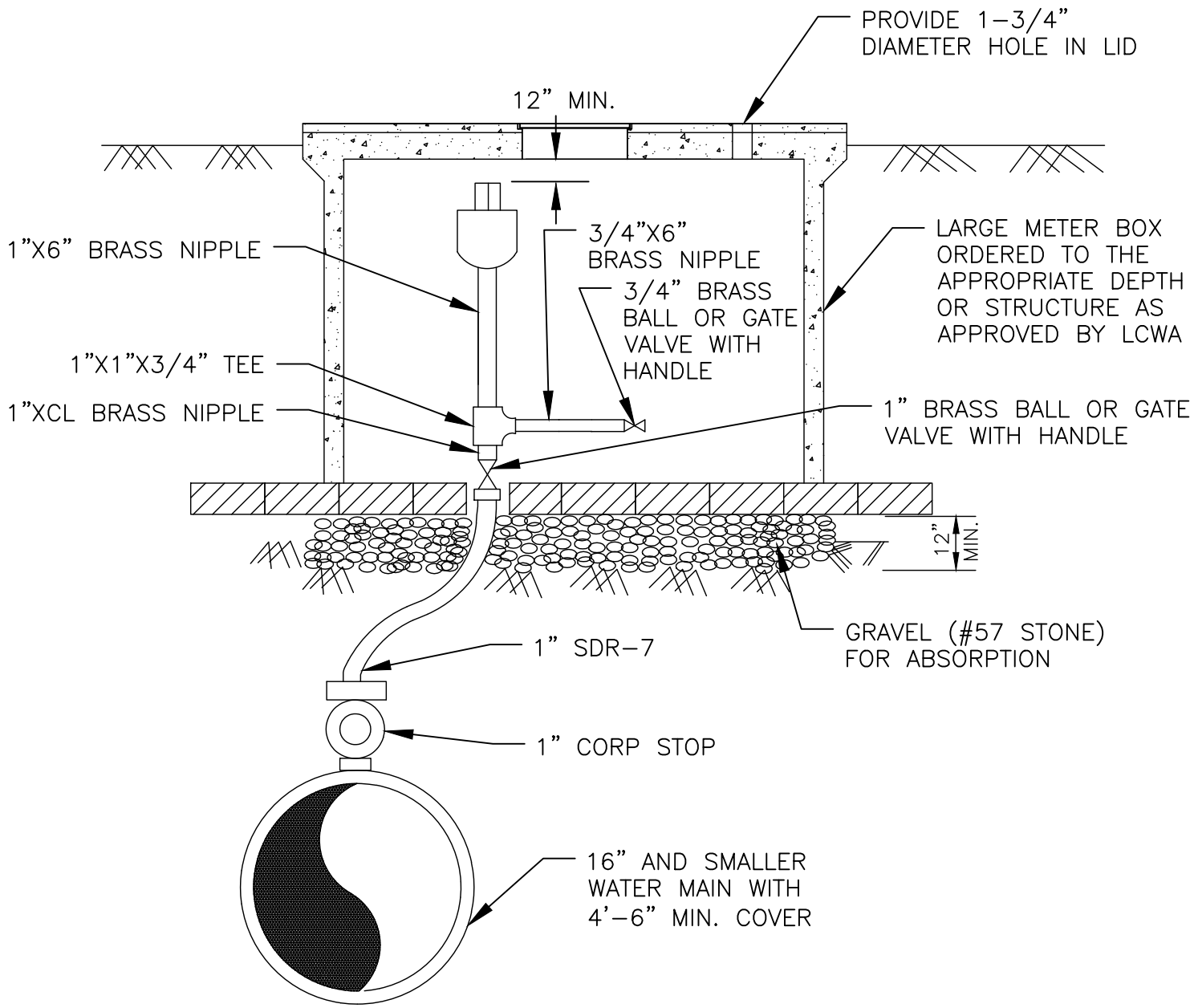
ALL PVC PIPE WITH A STIFFNESS OF 200 PSI OR GREATER MAY BE EXCLUDED FROM THE DEFLECTION TEST (MANUFACTURER SHALL CERTIFY THE STIFFNESS IN EXCESS OF 200 PSI). DEFLECTION TESTS SHALL BE A TEST ON INSTALLATION AND BE PERFORMED NO SOONER THAN 30 DAYS AFTER FINAL FULL BACKFILL HAS BEEN PLACED. THE CONTRACTOR SHALL TEST THE PIPE FOR DEFLECTION BY MEANS OF A GO–NO–GO MANDREL TO ASSURE THAT A DEFLECTION OF 5% HAS NOT BEEN EXCEEDED. THE MANDREL, ONE FOR EACH PIPE SIZE, SHALL BE A NINE ARM MANDREL, WITH PROVING RING, SIZED AT 5% LESS THAN THE ASTM DIMENSION FOR THE PIPE IN ACCORDANCE WITH THE TABLE.

THE MANDREL SHALL BE PULLED THROUGH THE SEWER LINE MANUALLY. TEN PERCENT OF ALL SEWER LINE SHALL BE TESTED AT LOCATIONS SPECIFIED BY THE ENGINEER. SHOULD ANY OF THE 10% FAIL THE TEST, IT SHALL BE CORRECTED UNTIL IT DOES PASS THE TEST, AT THE CONTRACTOR'S EXPENSE. ADDITIONAL SEWER SHALL BE TESTED AT THE DISCRETION OF THE ENGINEER, AND ANY SEWER NOT PASSING THE TEST SHALL BE CORRECTED UNTIL IT DOES PASS THE TEST.

NOMINAL DIAMTER (IN)	L (IN)	PVC–SDR 35 ASTM D3034 D (IN)
8	8	7.50
10	10	9.33
12	12	11.16
15	15	13.60
18	18	16.60

THE TEST SHALL BE MADE ONLY UNDER THE SUPERVISION OF THE ENGINEER. THE CONTRACTOR SHALL PROVIDE ALL EQUIPMENT AND PERFORM ALL WORK REQUIRED FOR THE PURPOSES.

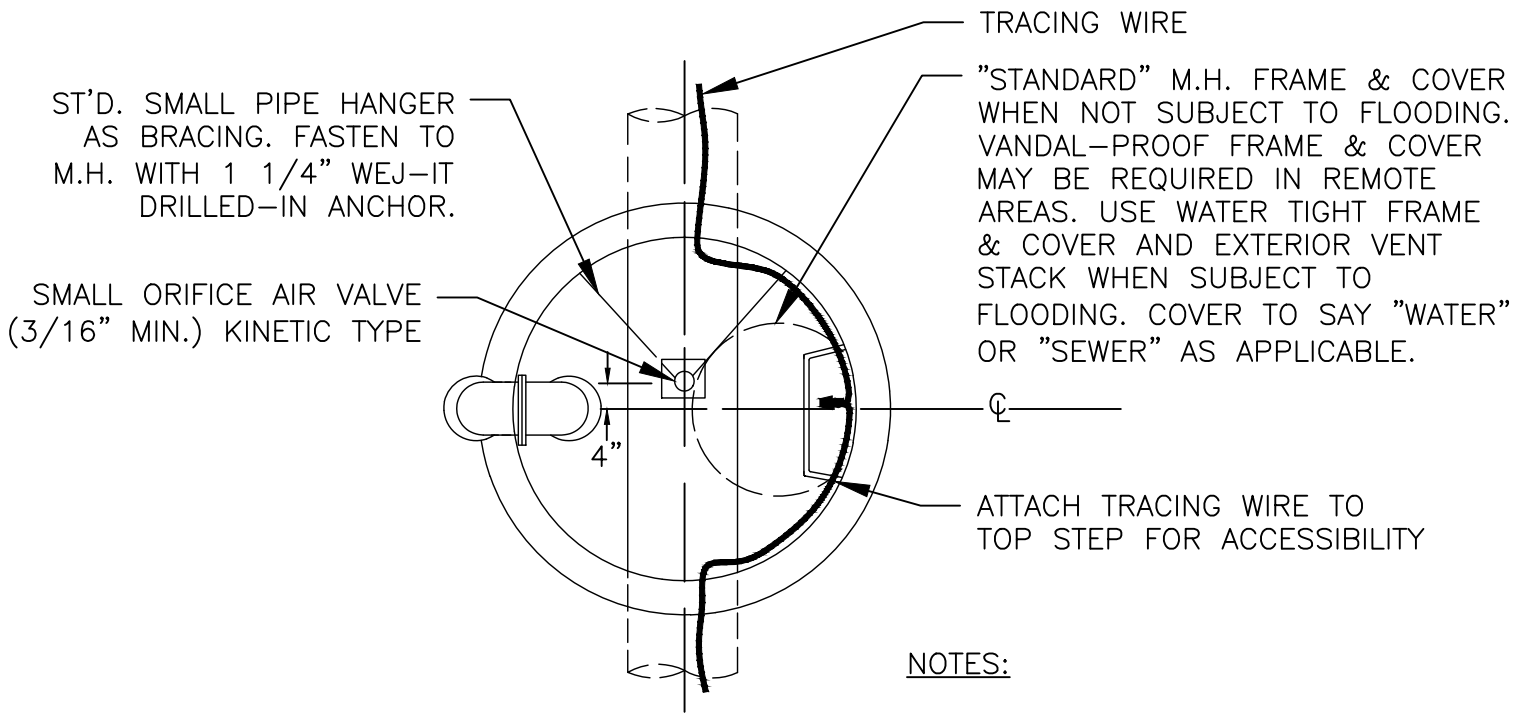
DATE FEB 2026	DEFLECTION TEST FOR PVC GRAVITY PIPE	DRWG. NO. TEST–4
LCWA/TOL		



NOTES:

1. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DESIGN THE PUBLIC WATER SYSTEM TO MINIMIZE THE NUMBER OF AIR RELEASE VALVES BY ELIMINATING HIGH POINTS WHERE REASONABLY FEASIBLE AND TO PROPERLY SIZE THE AIR RELEASE VALVE TAKING INTO CONSIDERATION ALL THE DESIGN FACTORS, AND KEEPING IN MIND THAT A 1" AIR RELEASE VALVE FOR 16" LINES IS DESIRABLE. ORIFICE SIZE SHALL BE NOTED ON PLANS.
2. ALL FITTINGS WILL BE COMPRESSION TYPE.
3. SADDLE MUST BE USED FOR TAP.
4. WHERE THE AIR RELEASE VALVE IS REMOTE FROM THE WATER LINE THERE MUST BE CONTINUOUS RISE IN THE SDR–7 SUPPLY LINE TO THE AIR RELEASE VALVE AND NO TRAP SHALL BE PERMITTED.
5. AIR RELEASE VALVE TO BE PLACED WHERE NOT SUBJECT TO FLOODING OR VEHICULAR TRAFFIC.
6. CONTRACTOR TO VERIFY DEPTH AND APPURTENANCES ARE APPROPRIATE PRIOR TO BEGINNING CONSTRUCTION.

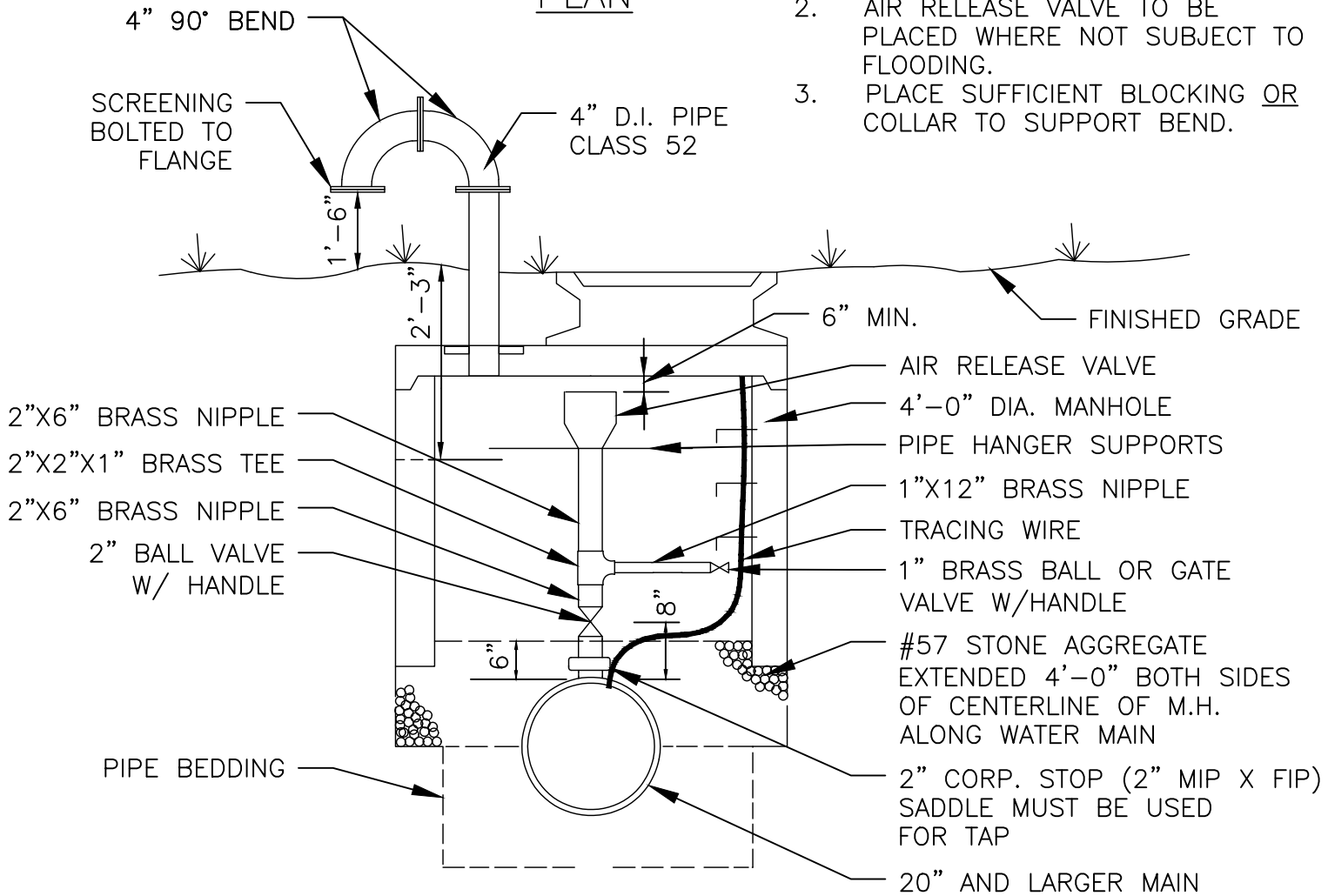
DATE FEB 2026	1" AIR RELEASE VALVE	DRWG. NO. WAT–1
LCWA/TOL		



PLAN

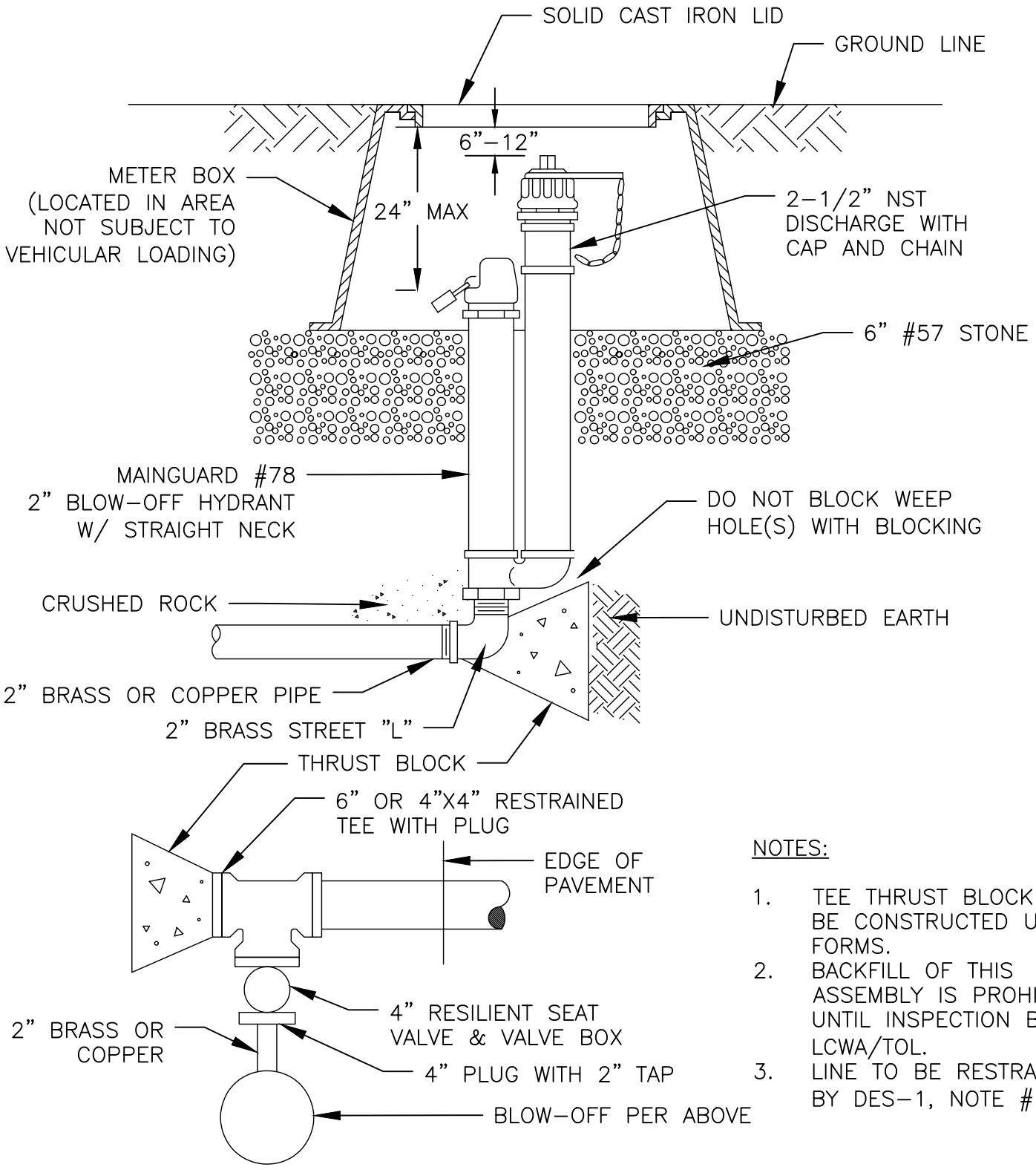
NOTES:

1. ALL PIPING SHOULD BE BRASS.
2. AIR RELEASE VALVE TO BE PLACED WHERE NOT SUBJECT TO FLOODING.
3. PLACE SUFFICIENT BLOCKING OR COLLAR TO SUPPORT BEND.



ELEVATION

DATE FEB 2026	2" AIR RELEASE VALVE ASSEMBLY	DRWG. NO. WAT–2
LCWA/TOL		

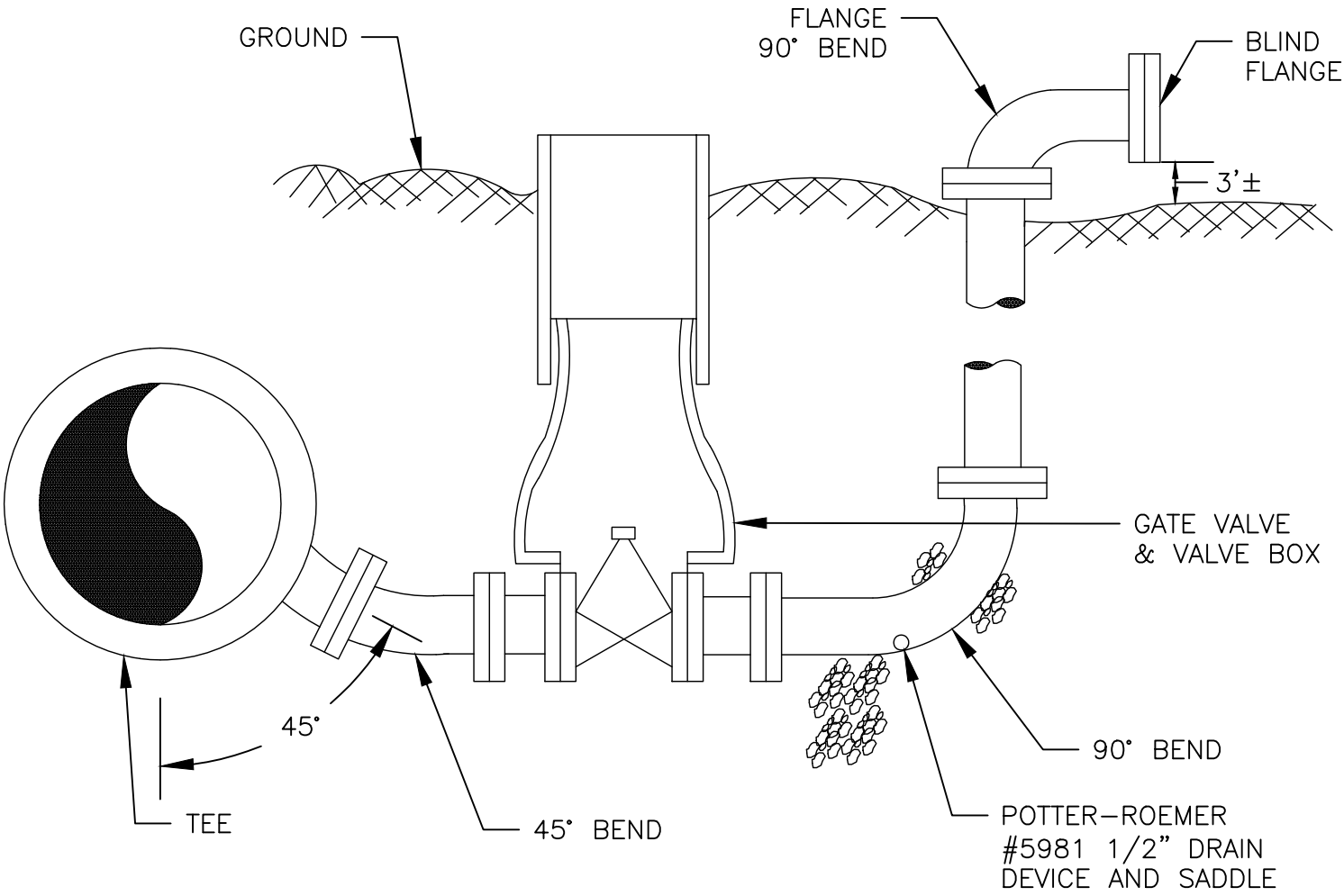


NOTES:

1. TEE THRUST BLOCK TO BE CONSTRUCTED USING FORMS.
2. BACKFILL OF THIS ASSEMBLY IS PROHIBITED UNTIL INSPECTION BY LCWA/TOL.
3. LINE TO BE RESTRAINED BY DES–1, NOTE #16

TYPICAL PLAN VIEW OF INSTALLATION

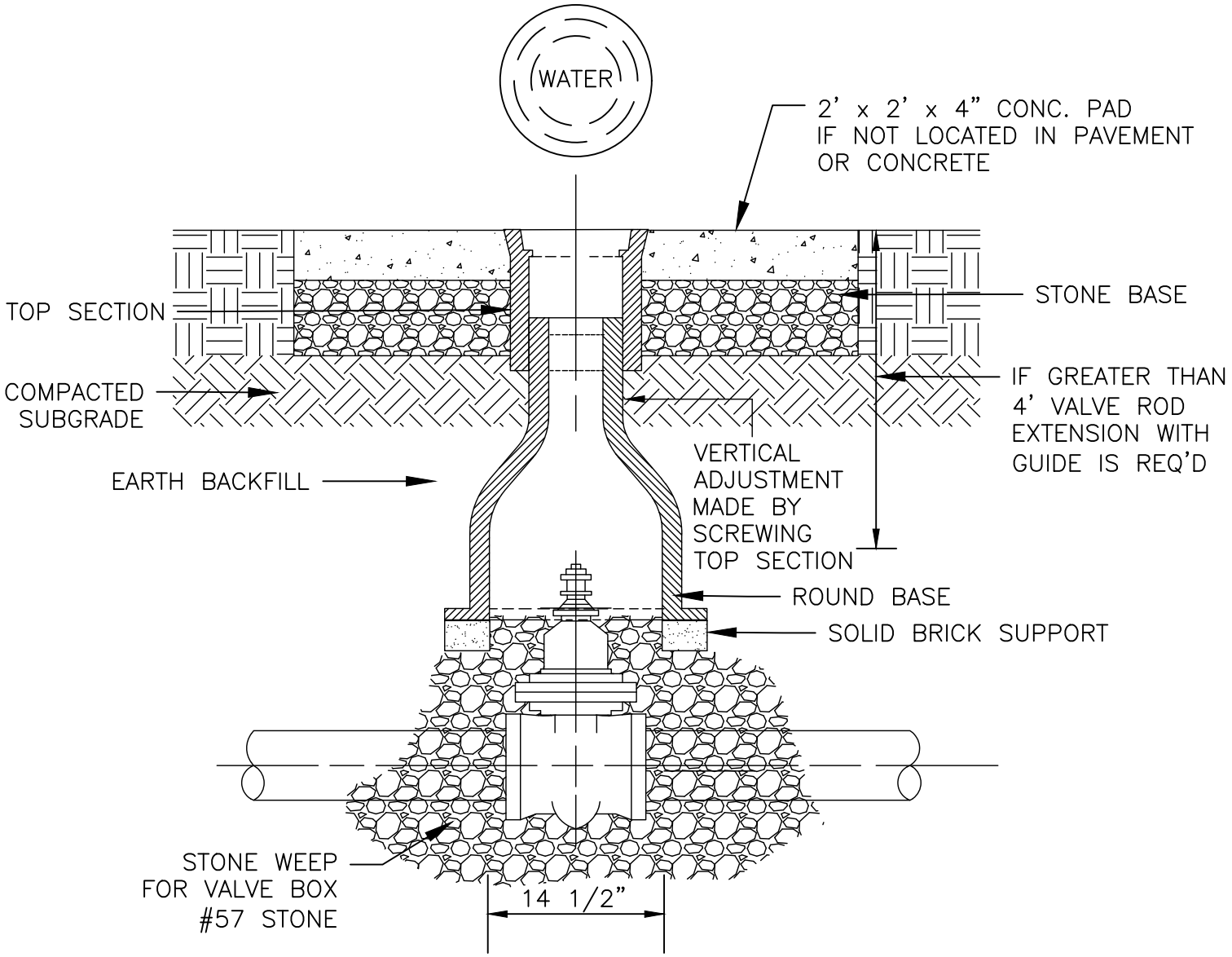
DATE FEB 2026	FLUSHING HYDRANT (FOR 4" AND 6" WATERLINES)	DRWG. NO. WAT–3
LCWA/TOL		



NOTES:

1. ALL PIPES AND FITTINGS SHALL BE FLANGED OR M.J. RESTRAINED JOINTS.
2. PROVIDE POTTER–ROEMER #5981 1/2" DRAIN DEVICE AND SADDLE TO DRAIN PIPE AND PREVENT FREEZING. DEVICE TO BE LOCATED AT LEAST 2 FEET BELOW GRADE. PROVIDE AT LEAST 1/2 CUBIC YARD OF #57 STONE BELOW DRAIN DEVICE.
3. THIS DETAIL SHALL BE UTILIZED ON 8" OR LARGER WATERLINES. MINIMUM SIZE BLOW–OFF SHALL BE 4" FOR UP TO 12" MAINS, 6" FOR 16" MAINS, AND 8" FOR 24" MAINS.
4. APPROPRIATE DISCHARGE FACILITY SHALL BE PROVIDED NEAR THE BLOW–OFF LOCATION, I.E. A RIP–RAP LINED POOL OR STORM STRUCTURE.

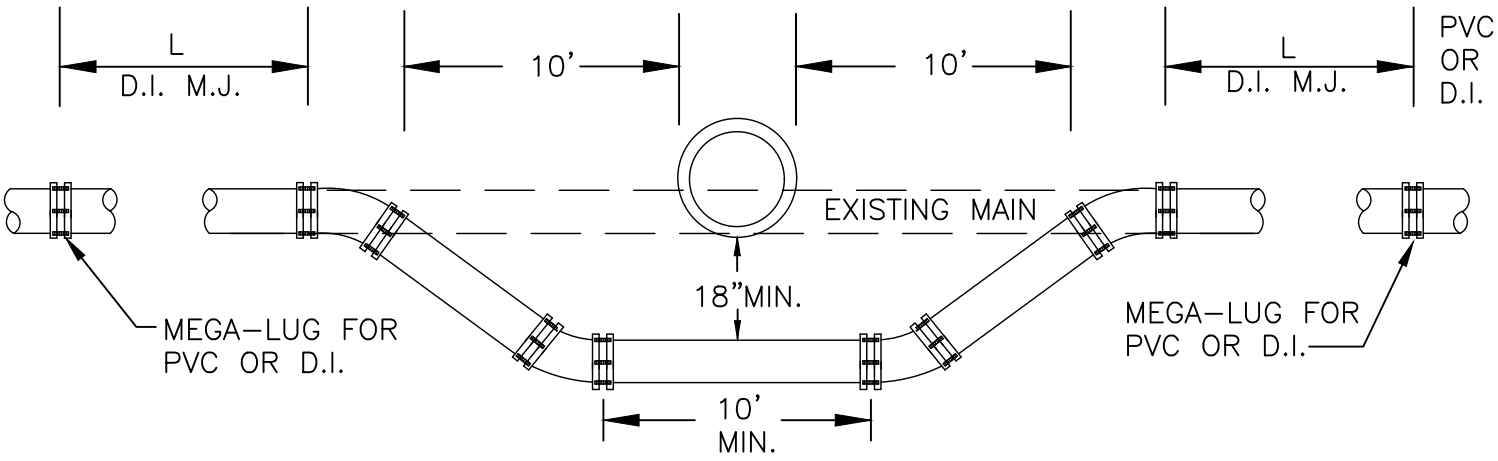
DATE FEB 2026	TYPICAL 4" AND LARGER BLOW–OFF (FOR WATERLINES 8" AND LARGER)	DRWG. NO. WAT–4
LCWA/TOL		



NOTES:

1. PRECAST REINFORCED CONCRETE RING 2' DIAMETER MAY BE USED IN LIEU OF THE 2' SQUARE POURED IN PLACE PAD.
2. USE STANDARD DESIGNED VALVE BOX OF THE APPROPRIATE LENGTH (HEIGHT) UTILIZING APPROVED MANUFACTURERS OF VALVE BOX APPURTENANCES.
3. IF EXCESSIVE DEPTH, A SECTION OF DUCTILE IRON PIPE WITH BELL END MAY BE USED NEAR THE VALVE AND THEN JOINED TO THE STANDARD ADJUSTABLE VALVE BOX. IF DEPTH TO VALVE OPERATING NUT EXCEEDS 4', THEN AN EXTENSION IS REQUIRED.

DATE FEB 2026	SMALL VALVE BOX	DRWG. NO. WAT–5
LCWA/TOL		



NOTES:

1. LOWERED SECTION TO BE OF DUCTILE IRON MECHANICAL JOINT PIPE WITH RESTRAINED JOINTS AT ANY INCLUDED JOINTS. THE ENGINEER SHALL CALCULATE LENGTH OF RESTRAINED SECTION.
2. THRUST BLOCKS FOR VERTICAL BENDS MAY BE DELETED WITH RESTRAINED JOINTS.
3. SUPPORT THE COUPLING WITH 4" X 4" SALT TREATED TIMBER DURING INSTALLATION. TIMBER SUPPORT TO BE LEFT IN PLACE AND MAY BE REQUIRED UNDER THE A/C PIPE AS DIRECTED BY THE INSPECTOR.
4. DEFLECTION IS NO MORE THAN 1/2 MANUFACTURER'S RECOMMENDATION.

DATE FEB 2026	LOWERING WATER MAIN OR NEW INSTALLATION	DRWG. NO. WAT-6
LCWA/TOL		

DISCHARGE TABLE FOR HYDRANTS.*+

OUTLET PRESSURE MEASURED BY PITOT GAGE.

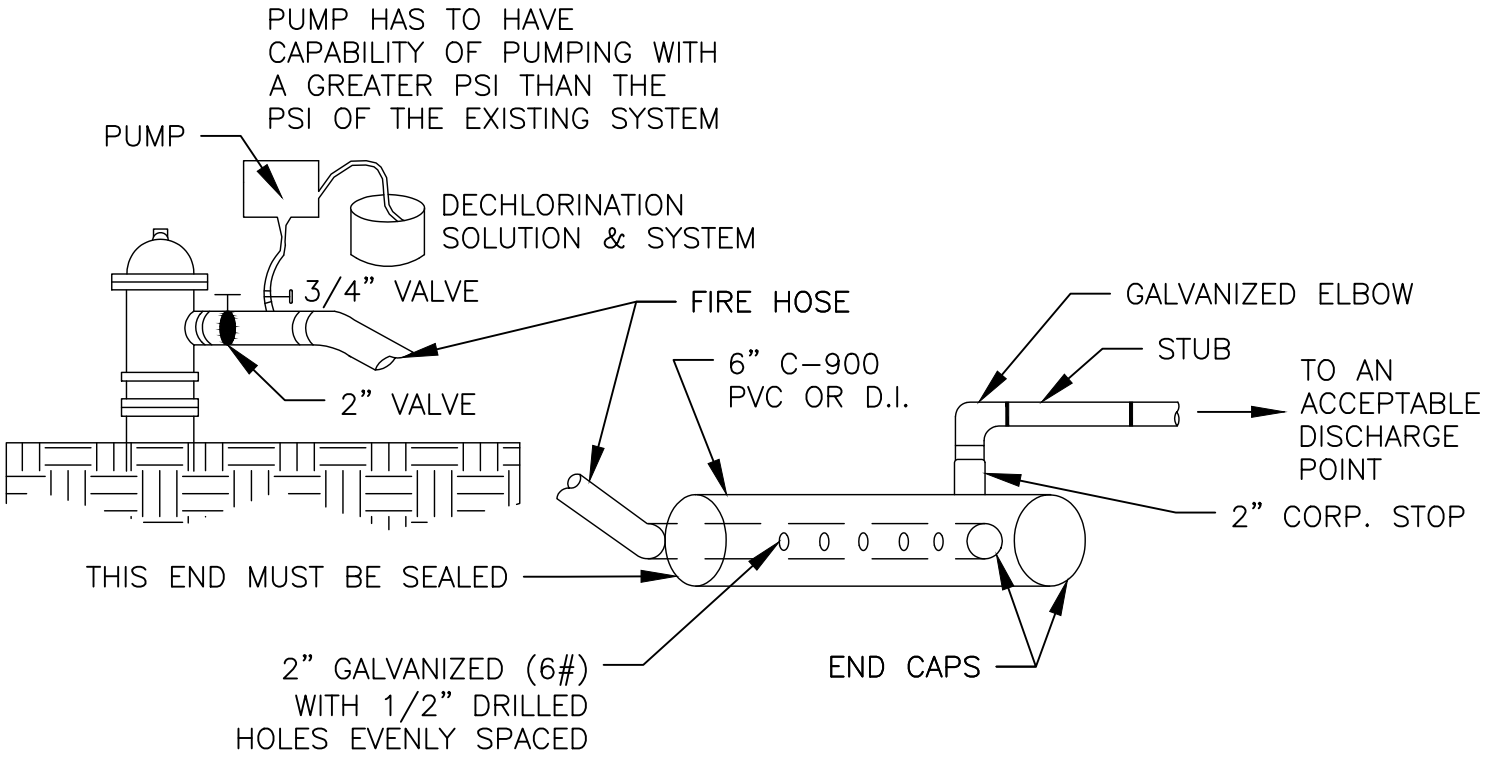
FLOWING PRESSURE IN lb/in²	OUTLET DIAMETER IN INCHES											
	2–3/8	2–1/2	2–5/8	2–3/4	2–7/8	3	3–1/8	3–7/8	4	4–3/8	4–1/2	4–5/8
	U.S. GALLONS PER MINUTE											
1	150	170	180	200	220	240	260	400	430	510	540	580
2	210	240	260	290	310	340	370	570	610	720	770	810
3	260	290	320	350	380	420	450	700	740	890	940	990
4	300	340	370	410	440	480	530	810	860	1030	1090	1150
5	340	380	410	450	500	540	590	900	960	1150	1220	1290
6	370	410	450	500	540	590	640	990	1050	1260	1340	1410
7	400	440	490	540	590	640	690	1070	1140	1360	1440	1520
8	430	480	520	570	630	680	740	1140	1220	1450	1540	1620
9	450	500	550	610	670	730	790	1210	1290	1540	1640	1720
10	480	530	580	640	700	760	830	1280	1360	1630	1730	1820
11	500	560	610	670	730	800	870	1340	1430	1710	1810	1910
12	520	580	640	700	770	840	910	1400	1490	1780	1890	1990
13	550	610	670	730	800	870	950	1450	1550	1850	1960	2070
14	570	630	690	760	830	900	980	1510	1610	1920	2040	2150
15	590	650	720	790	860	940	1020	1560	1660	1990	2110	2220
16	610	670	740	810	890	970	1050	1620	1720	2060	2180	2300
17	620	690	760	840	910	1000	1080	1660	1770	2120	2240	2370
18	640	710	780	860	940	1030	1110	1710	1820	2180	2310	2440
19	660	730	810	890	960	1050	1140	1760	1870	2240	2370	2510
20	680	750	830	910	990	1080	1170	1800	1920	2290	2430	2570
22	710	790	870	950	1040	1130	1230	1890	2020	2400	2550	2700
24	740	820	910	1000	1090	1180	1290	1970	2110	2510	2660	2810
26	770	860	940	1040	1130	1230	1340	2050	2190	2620	2770	2930
28	800	890	980	1070	1170	1280	1390	2130	2280	2720	2880	3040
30	830	920	1010	1110	1210	1320	1430	2210	2350	2820	2980	3150
32	860	950	1050	1150	1260	1370	1480	2280	2430	2910	3080	3250
34	880	980	1080	1180	1290	1410	1530	2350	2510	3000	3170	3350
36	910	1010	1110	1220	1330	1450	1580	2420	2580	3080	3260	3440
38	930	1040	1140	1250	1370	1490	1620	2480	2650	3170	3350	3540
40	960	1060	1170	1290	1400	1530	1660	2550	2720	3250	3440	3630

*COMPUTED WITH COEFFICIENT, C = 0.90, TO NEAREST 10 GALS. PER MIN.
+FROM NATL BD. OF FIRE UNDERWRITERS.

EQUIPMENT FOR APPROXIMATING HYDRANT FLOWS (per R.C. Dennett, Engr. Natl. Bd of Fire Underwriters

THE EQUIPMENT NECESSARY CONSISTS OF EITHER A STANDARD PITOT TUBE OR A HYDRANT CAP TAPPED TO TAKE A PRESSURE GAGE. IF THE HYDRANTS USED AS A DISCHARGE POINT FOR FLUSHING HAS TWO OR MORE OUTLETS, A PRESSURE GAGE ON ONE OUTLET WHILE ANOTHER OUTLET IS FLOWING WILL GIVE APPROXIMATELY THE SAME RESULTS AS THE USE OF A PITOT TUBE.

DATE FEB 2026	DISCHARGE FLOW RATES FOR FLUSHING	DRWG. NO. WAT–7
LCWA/TOL		



NOTES:

1. ALL FITTINGS USED MUST BE RESISTANT TO DECHLORINATION CHEMICALS.
2. THE FIRE HOSE NEEDS TO BE DISCHARGED INTO AN AREA THAT WILL CAUSE NO ENVIRONMENTAL/EROSION PROBLEMS. THIS POINT WILL BE MONITORED TO MAKE SURE THAT THE DISCHARGING WATER IS DECHLORINATED.
3. THIS DETAIL IS A RECOMMENDED DESIGN CONCEPT. ALTERNATE METHOD(S) MAY BE SUBMITTED TO THE LCWA FOR APPROVAL PRIOR TO SCHEDULED FLUSHING.

DATE FEB 2026	NEUTRALIZATION STATION (DECHLORINATION)	DRWG. NO. WAT-8
LCWA/TOL		

PIPE MATERIAL TYPE AND SIZE	MAXIMUM DEFLECTION AT EACH JOINT (Θ)	DEFLECTIONS (INCHES EACH JOINT) 18' LAYING LENGTHS (S)	RADIUS (MINIMUM) (R)
DUCTILE IRON (PUSH–ON JOINT)			
6"–12"	2° 30'	9.5"	413'
14"–16"	2° 00'	7.5"	516'
18"+	1° 30'	5.5"	688'
DUCTILE IRON (MECHANICAL JOINT)			
6"	3° 30'	13.5"	291'
8"–12"	3° 00'	11.5"	344'
16"	2° 00'	7.5"	516'
24"	1° 30'	5.5"	688'

NOTES:

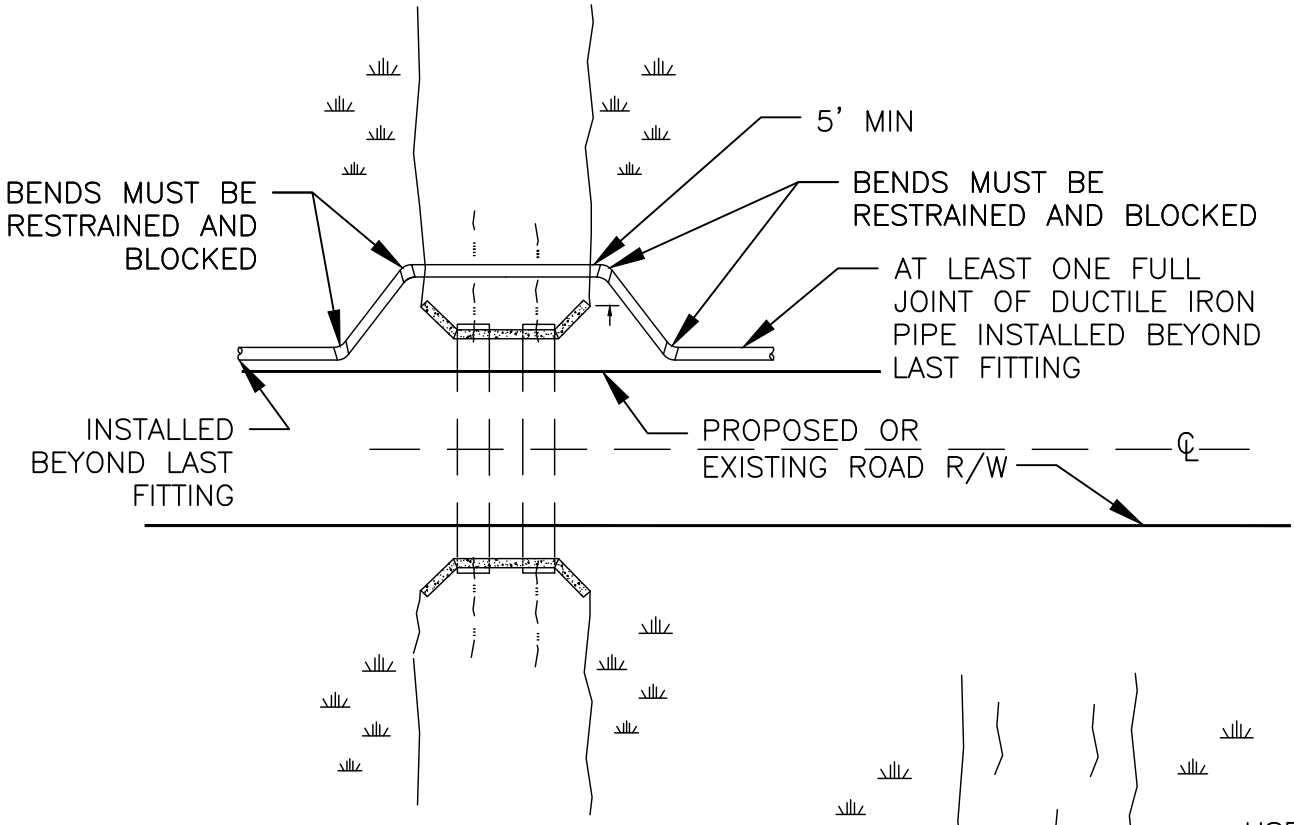
1. ANY DEFLECTION NOT LISTED FOR IRON PIPE MAY BE DERIVED BY:

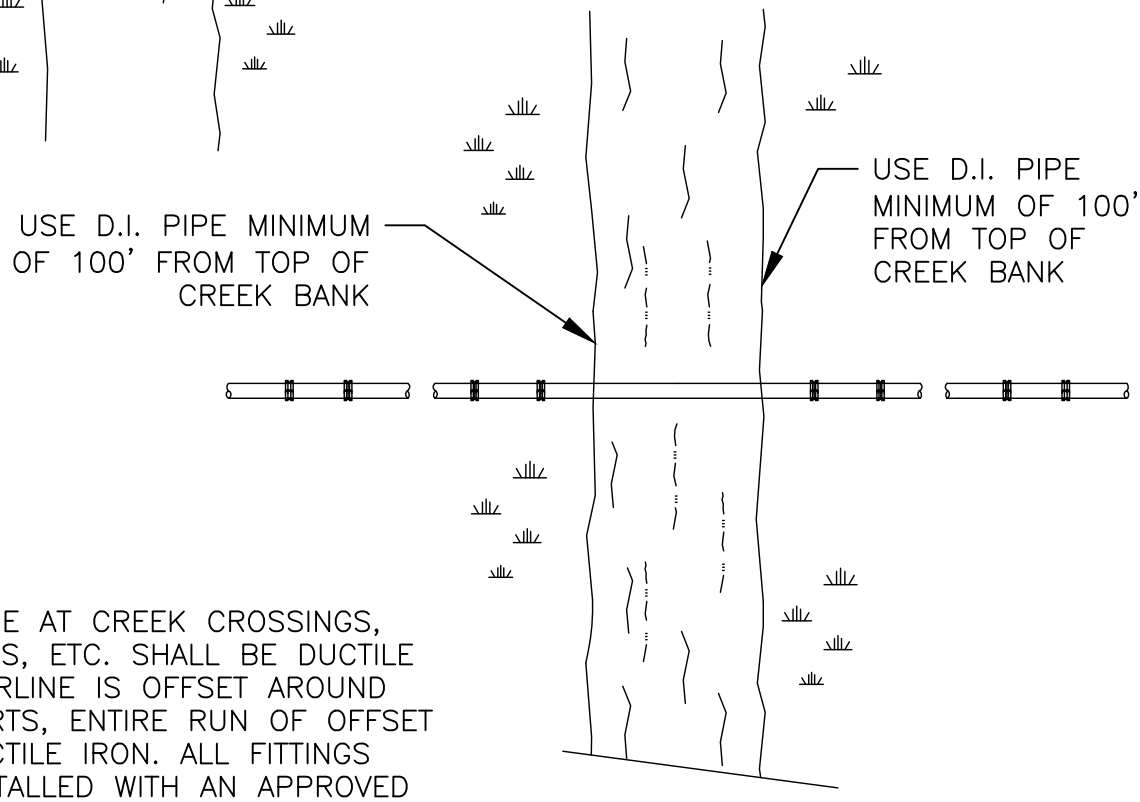
$$R = \frac{L}{2 \text{ TAN } (\Theta/2)}$$

$$S = \text{TAN}(\Theta) \text{ X } L \text{ X } 12$$

R = RADIUS OF CURVE
L = LAY LENGTH OF PIPE
X = DEFLECTION ANGLE
S = JOINT DEFLECTION OFFSET

DATE FEB 2026	ALLOWABLE DEFLECTIONS FOR WATER PIPE	DRWG. NO. WAT–9
LCWA/TOL		

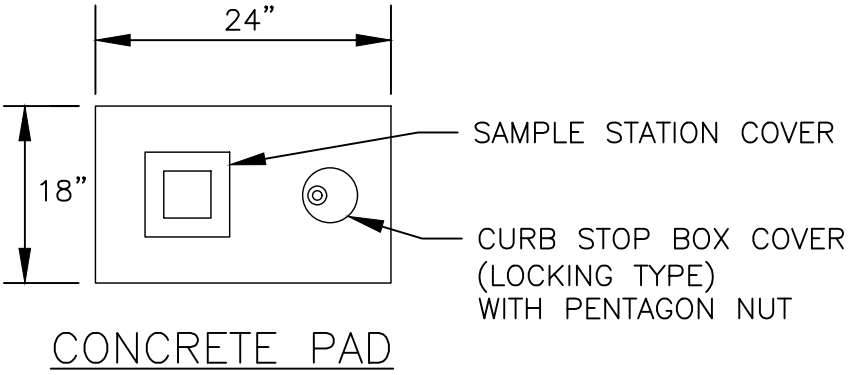




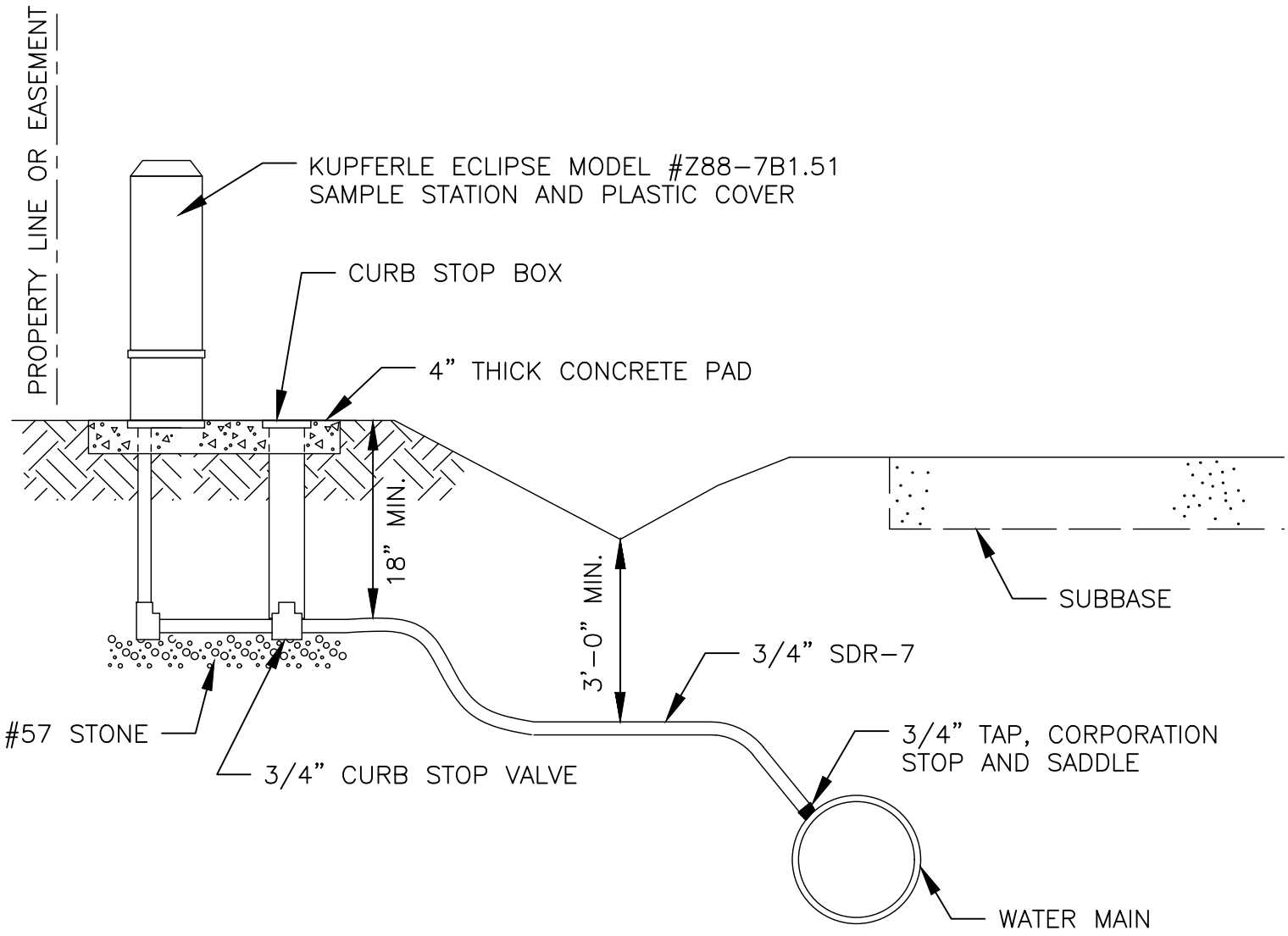
NOTES:

1. WATERLINE PIPE AT CREEK CROSSINGS, RIVERS, SWALES, ETC. SHALL BE DUCTILE IRON. IF WATERLINE IS OFFSET AROUND CREEK CULVERTS, ENTIRE RUN OF OFFSET SHALL BE DUCTILE IRON. ALL FITTINGS SHALL BE INSTALLED WITH AN APPROVED JOINT RESTRAINT SYSTEM.
2. NO JOINTS ARE TO BE INSTALLED UNDER THE CREEK, WHERE POSSIBLE.
3. ISOLATION VALVES SHALL BE PLACED ON EITHER SIDE OF THE CREEK CROSSING IN A LOCATION NOT NORMALLY SUBJECT TO FLOODING.

DATE FEB 2026	TYPICAL WATERLINE CREEK CROSSINGS	DRWG. NO. WAT–10
LCWA/TOL		



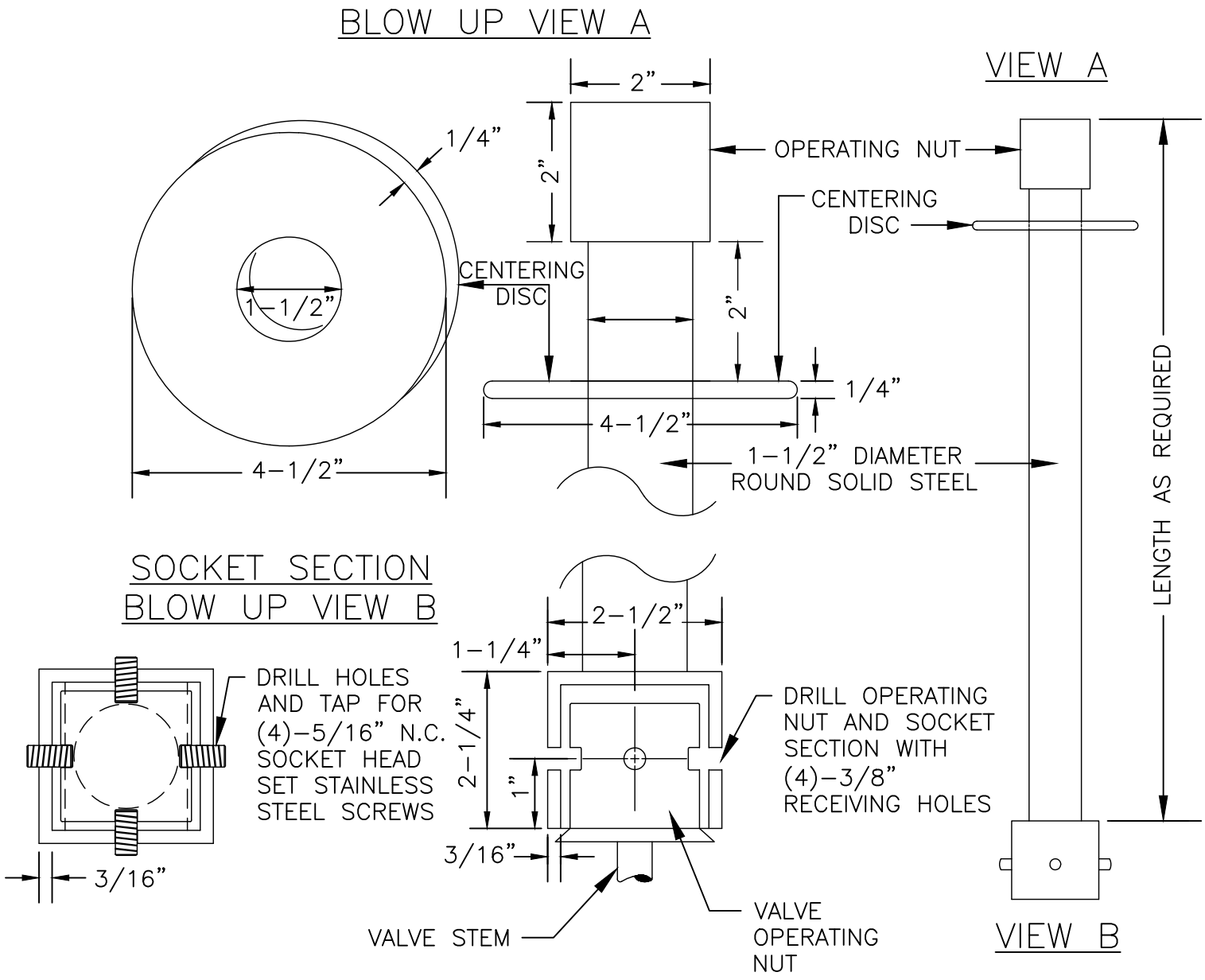
CONCRETE PAD



NOTES:

1. ALL FITTINGS SHALL BE AWWA APPROVED BRASS.

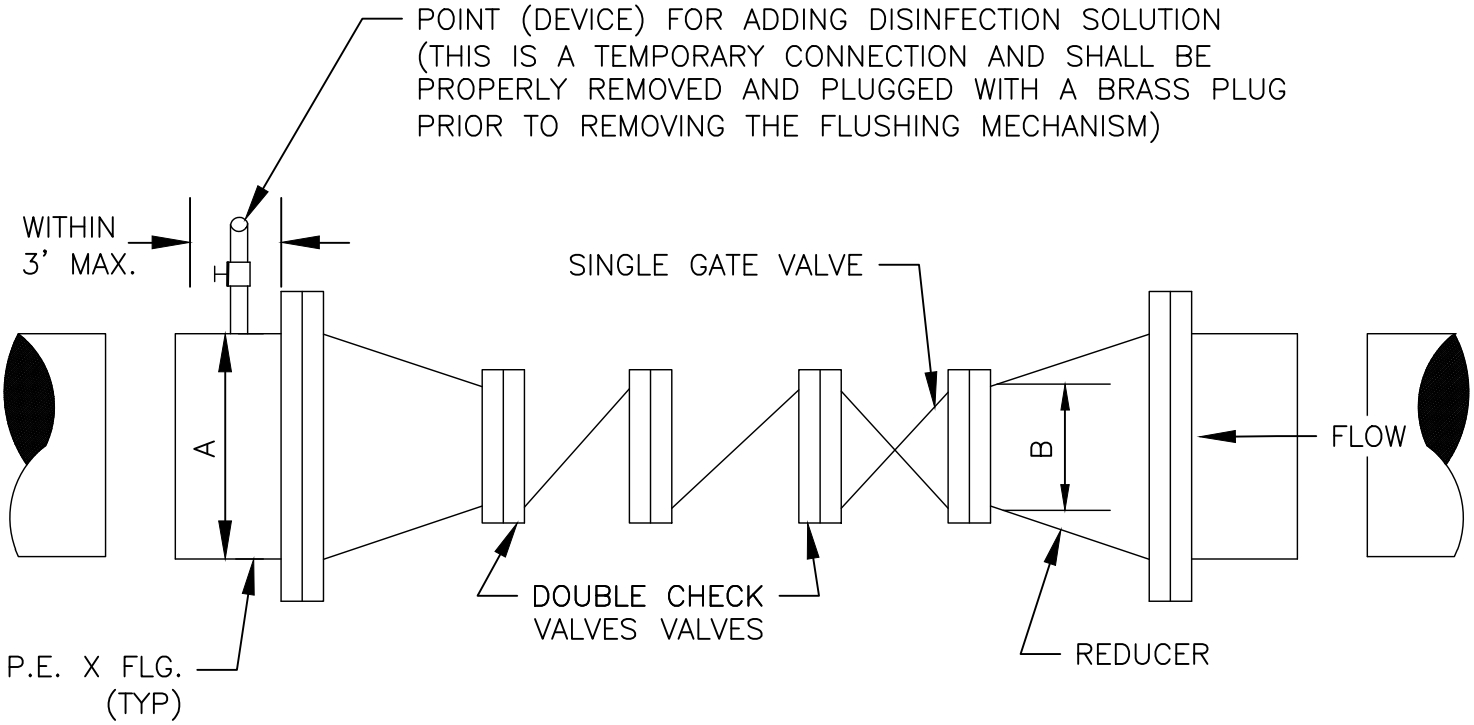
DATE FEB 2026	WATER QUALITY MONITORING STATION	DRWG. NO. WAT–11
LCWA/TOL		



NOTES:

1. USE THIS DETAIL WHEN DISTANCE FROM TOP OF OPERATING NUT OF VALVE TO FINISH GRADE EXCEEDS 4'-0".
2. ALL STEEL, WELDED VALVE EXTENSIONS SHALL BE COATED WITH OIL-BASED ENAMEL OR OTHER RUST -PREVENTIVE COATING.
3. SPECIFIED LENGTH WILL BE TOTAL LENGTH OF ADJUSTMENT, MEASURED AS SHOWN.
4. THE 2" SQUARE OPERATING NUT ON TOP SHALL BE WELDED TO FORM A COMPLETE BOX WITH NO OPENINGS.
5. 2-1/2" SQUARE SOCKET ON BOTTOM SHALL BE TAPPED ON 4 SIDES FOR MINIMUM 5/16" N.C. SOCKET HEAD SET SCREWS AND SCREWS SHALL BE PROVIDED.
6. CENTER EXTENSION BAR SHALL BE 1-1 /2" DIAMETER ROUND SOLID STEEL
7. A 4-1/2" DIAMETER X 1/4" STEEL CENTERING DISC SHALL BE WELDED TO THE 1-1/2" STEEL ROD, POSITIONED 2" BELOW THE 2" SQUARE OPERATING NUT AS SHOWN.

DATE FEB 2026	VALVE KEY EXTENSION	DRWG. NO. WAT-12
LCWA/TOL		



A	B
6"	4"
8"	4"
12"	6"
16"	6"
20"	8"
24"	12"
30"	12"
36"	*

A = MAIN SIZE

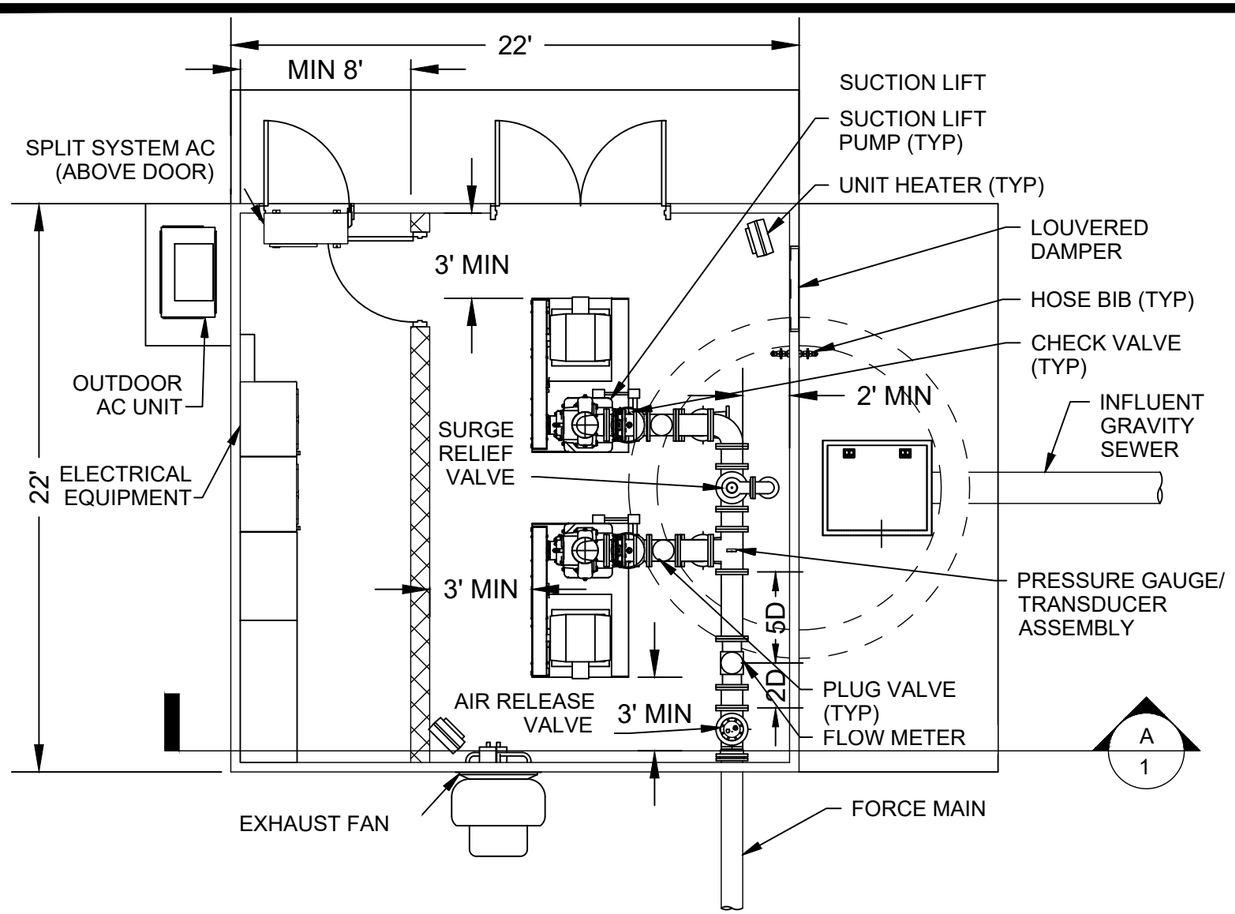
B = CHECK VALVE AND GATE VALVE SIZE

* = TO BE DESIGNED BY CONSULTANT

NOTES:

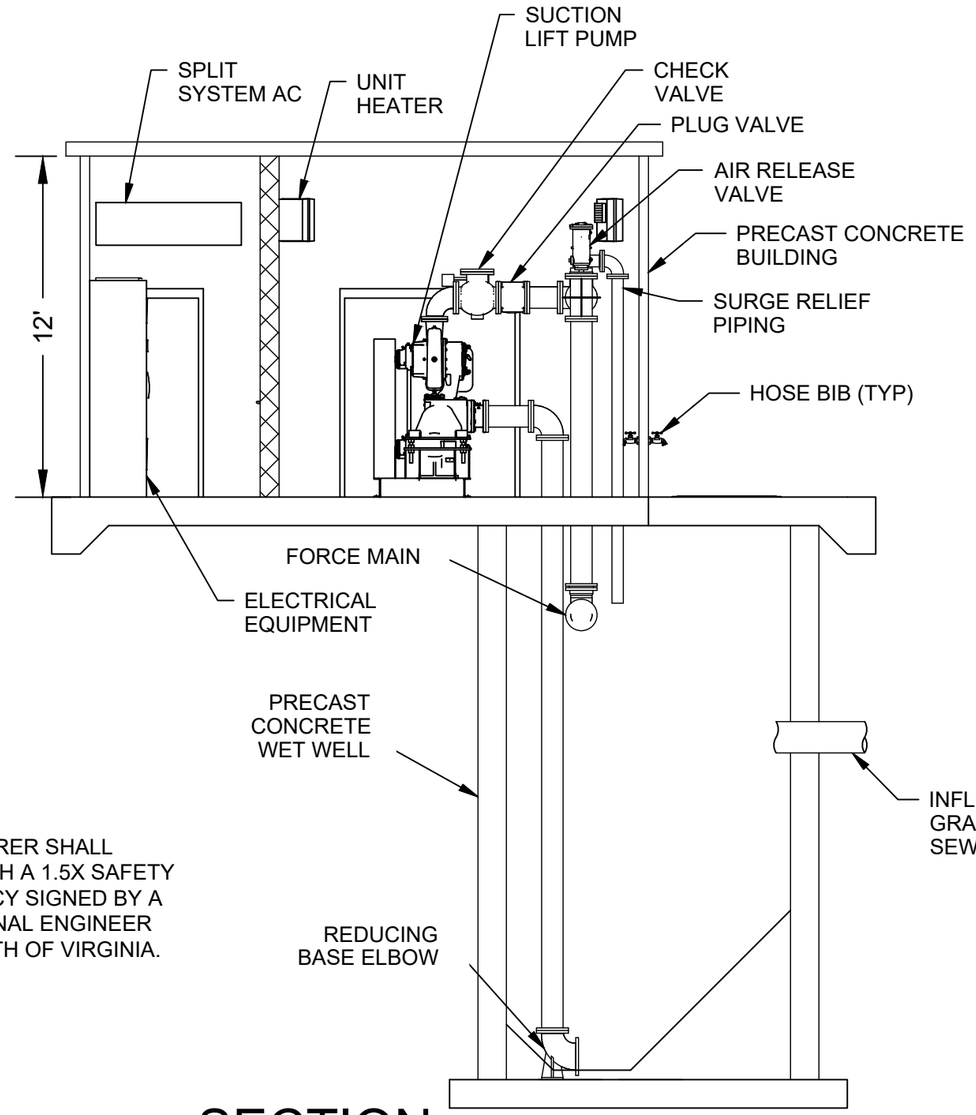
1. CONTRACTOR SHALL USE IN ACCORDANCE WITH FLUSHING SCHEDULE, SPECIFICATIONS AND STANDARD NOTES.

DATE FEB 2026	DOUBLE CHECK VALVE ASSEMBLY FOR ISOLATING NEW MAINS DURING TESTING	DRWG. NO. WAT-13
LCWA/TOL		



1 PLAN

Scale: N.T.S.



A SECTION

Scale: N.T.S.

NOTE:

1. PRECAST MANUFACTURER SHALL DESIGN WET WELL WITH A 1.5X SAFETY FACTOR FOR BUOYANCY SIGNED BY A LICENSED PROFESSIONAL ENGINEER IN THE COMMONWEALTH OF VIRGINIA.

DATE
FEB 2026

LCWA/TOL

TYPICAL PUMP STATION

DRWG. NO.
PS–1

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Appendix C –

Standard Forms

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Appendix C–1

Utility Services Agreement

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GPIN # _____

UTILITY SERVICE AGREEMENT

THIS AGREEMENT, dated , 20 , is entered into by the LOUSIA COUNTY WATER AUTHORITY (the "LCWA") or THE TOWN OF LOUSIA (the "Town") and (the "Owner").

WHEREAS the Owner is the sole owner of the property shown on the attached plat (Exhibit "A"), having acquired this property by a deed recorded among the land records of Lousia County, Virginia, in Deed Book , at page , (the "Property"); and

WHEREAS the Owner desires that a public water and/or sewer system owned and operated by the LCWA or Town serve the Property; and

WHEREAS the Owner proposes to construct and dedicate to the LCWA or Town an extension of the public water and/or sewer system(s) to serve the Property as shown on the approved Plans described below (the "Extensions"); and

WHEREAS the LCWA or Town has determined that it is in the public interest for the LCWA or Town to own, operate, and maintain such Extensions to serve the Property.

THEREFORE, the LCWA or Town and the Owner agree as follows:

I. Owner's Covenants

A. The Owner agrees to have designed and constructed at the Owner's sole expense complete workable public water and sewer extensions, including all necessary on-site and off-site equipment and facilities, to serve the Property as shown on the LCWA or Town approved engineering design plans entitled , dated , and prepared by (the "Plans").

B. Prior to engaging in any construction activity, the Owner agrees that it will (i) notify the General Manager of LCWA (the "GM") of the proposed date of commencement of construction; and (ii) apply for and receive a construction permit to be issued by the GM. The Owner further agrees to (i) submit to the GM executed deeds conveying to the LCWA or Town, with General Warranty and English Covenants of Title, in a form approved by the LCWA or Town Attorney, all on-site and off-site rights-of-way and easements as necessary for the construction, operation, maintenance and repair of the Extensions; and (ii) convey to the LCWA or Town all on-site easements the GM determines are necessary for future utility lines or facilities to serve adjacent properties by a duly executed deed with General Warranty and English Covenants of Title, in a form approved by the LCWA or Town Attorney.

C. Any LCWA or Town approved subdivision plat or on-site deed duly accepted by the LCWA or Town shall be recorded prior to tentative acceptance of the Extensions by the LCWA or Town.

D. Prior to tentative acceptance, the Owner shall dedicate or convey, or cause to be dedicated or conveyed to the LCWA or Town with General Warranty and English Covenants of Title, all easements for any part of the on-site and off-site Extensions, including all lines, facilities and appurtenances thereto, which the GM determines are not wholly within any previously dedicated or conveyed public right-of-way or public easement for such purposes based upon the "As-Built" Plans and/or visual inspection or other reasonable basis.

II. LCWA and Town's Covenants

A. In consideration of the above covenants, the LCWA or Town agrees to provide water and sewer service to the Property, provided service capacity is available within the LCWA or Town's public water and sewer system and the Owner has complied with this Agreement.

B. Upon (1) completion of the Extensions in accordance with this Agreement, (2) acceptance of the Extensions by the LCWA or Town, and (3) receipt of the capacity fees prescribed by the LCWA Water and Sewer Utility Standards, as amended at the time service is actually requested, the LCWA or Town agrees, subject to the provisions of paragraph A hereof, to provide water and sewer service to property for which capacity fees have been paid.

III. Terms and Conditions

This agreement is subject to the following terms and conditions:

A. Plans and Specifications

1. The plans and specifications for the Extensions were approved by (i) the LCWA or Town on and (ii) if necessary, have been or will be submitted to and approved by the appropriate authorities of the Commonwealth of Virginia, prior to the start of construction of any phase of the Extensions.

2. As-Built Plans. Prior to tentative acceptance of the Extensions or any independently functional portion thereof, the Owner shall provide the LCWA or Town with one (1) set of prints and one digital or electronic copy of final "As-Built" plans of the entire Extensions. The Owner's Engineers shall certify by signed statement on each page of the final As-Built plans (i) that the Extensions have at a minimum been installed in compliance with the Plans and the provisions of the "Water and Sewer Utility Standards, Lousia County Water Authority and the Town of Lousia" in effect on the date of this Agreement, and (ii) that all on-site and off-site water and sewer lines and appurtenances, improvements and any other facilities are located within public right-of-ways or easements conveyed or dedicated to the LCWA or Town, and, in fact, have been constructed at the locations as represented by the As-Built plans. These final As-Built plans must

be acceptable to the LCWA or Town as record drawings and signed by a professional engineer or surveyor.

B. Construction and Inspections

1. Prior to beginning construction, the Owner will notify the GM of the date construction will commence. The LCWA or Town will make inspections during construction and installation of the Extensions and before service is furnished. If any portion of the construction is covered before the LCWA or Town inspection is made, the LCWA or Town may require such construction to be uncovered at the Owner's sole expense so that an inspection can be made.

2. The LCWA or Town, through its inspector, shall have the right to require an immediate halt to construction should it determine that any portion of the Extensions is not being installed or constructed in accordance with the approved Plans, and the terms of this Agreement.

3. If at any time the inspection or testing of the Extensions or any portion thereof reveals that construction is not in accordance with the approved Plans and this Agreement, the Owner, at no expense to the LCWA or Town, shall make such corrections as the GM may deem necessary for complete compliance.

4. The Owner agrees to pay to the LCWA or Town, prior to or at the time of its application for a construction permit, a plan review and inspection fee of four percent (4%) of the estimated construction costs. The construction cost will be estimated by the LCWA or Town using unit costs determined by the GM based upon information including bids, annual contract costs, and documentation received from contractors.

5. Once the Extensions are completed, the Owner will request in writing that the LCWA or Town make an inspection for purposes of tentative acceptance. Tentative acceptance will be given by letter from the GM, or designee, and at that time the Extensions may be placed in

service, provided that the Owner has complied with its obligations under this Agreement.

6. A list of deficiencies discovered during the period of tentative acceptance will be compiled by the LCWA or Town and forwarded to the Owner prior to final acceptance. The Owner agrees to correct all deficiencies and make all required repairs at its expense. If such deficiencies and repairs are not corrected or made within ninety (90) days from the date of the list of deficiencies, the LCWA or Town will have the right to make the necessary corrections and require payment from the Owner for any work done.

7. Owner agrees that he will request in writing final inspection and acceptance of the Extensions after all streets have been paved, after all curbs and gutters have been installed, and after all corrections and omissions to the Extensions and administrative requirements have been addressed to the satisfaction of the GM.

IV. Miscellaneous

A. The Owner will be responsible for furnishing all material, performing all work, entering into all necessary agreements and insuring that those agreements are with licensed contractors and subcontractors, hiring all the labor, and paying all costs associated with the construction of the Extensions. Such costs shall include but not be limited to labor, materials, engineering fees, inspection fees, legal fees, surveying fees, award fees, recordation fees, appraisal fees, and both on-site and off-site land acquisitions, including rights-of-way and easements. A summary of all costs must be submitted to the GM on a form provided by the GM prior to tentative acceptance by the LCWA or Town.

B. The Owner expressly agrees to indemnify, defend and hold the LCWA or Town harmless from and against all claims, loss, damage, injury and liability however caused, including any negligence by Owner's agents or employees resulting from, arising out of, or in any way

connected with the construction, dedication or conveyance of the water and sewer system or any portion thereof, or the dedication or conveyance of any right-of-way or easement.

C. All conveyances of interest in land made pursuant to this Agreement will be prepared and after written acceptance by the LCWA or Town, recorded in the Clerk's Office of the Circuit Court of Lousia County. The Owner shall provide title insurance or the Owner's attorney shall certify to the LCWA or Town that the necessary interest in land is free and clear of all liens and title exceptions inconsistent with use of the easements for utility purposes. The status of title to such interest in property shall be acceptable to the LCWA or Town.

D. The undertakings by the Owner under this Agreement shall be guaranteed by surety acceptable to the LCWA or Town and approved by the LCWA or Town Attorney in the amount of the construction cost, as estimated by the LCWA or Town.

E. The Owner agrees to guarantee all workmanship and material to be in workable and good condition for a period of one (1) year from the date of final acceptance. Owner agrees to furnish a defect bond in the amount of ten percent (10%) of the construction cost, as estimated by the LCWA or Town. The bond will indemnify the LCWA or Town against any defects in material or workmanship discovered within one (1) year from the date of final acceptance.

F. In the event of breach by the Owner of any provisions of this Agreement, the LCWA or Town may give written notice to the Owner specifying the manner in which the Agreement has been breached. If notice of breach is given and the Owner has not substantially corrected the breach within ten (10) days receipt of the written notice, the LCWA or Town shall have the right to terminate this Agreement.

G. This Agreement shall be binding upon the Owner, its Heirs, Successors, and Assigns and shall be recorded in the Clerk's Office of the Circuit Court of Lousia County. This Agreement

shall expire upon the expiration of the warranty period or the completion of repairs to all defects identified during the warranty period, whichever occurs later.

H. Any notice required pursuant to this Agreement shall be given by first class mail, postage prepaid:

To the LCWA: Lousia County Water Authority
General Manager
23 Loudin Lane
Louisa, Virginia 23093

To the Owner:

The signatures of the parties are set out below in acknowledgment of this Agreement.

APPROVED AS TO FORM:

_____

Deputy County Attorney

LOUSIA COUNTY WATER AUTHORITY
TOWN OF LOUSIA

By: _____ (SEAL)
County Administrator/
Deputy County Administrator

COMMONWEALTH OF VIRGINIA,
LOUSIA COUNTY WATER AUTHORITY or TOWN OF LOUSIA, to-wit:

The foregoing instrument was acknowledged before me _____, 20___, by _____, County Administrator/Deputy County Administrator, on behalf of the Lousia County Water Authority.

My commission expires: _____
Registration Number: _____

_____
Notary Public

APPROVED AS TO SUBSTANCE:
By:_____
Title: _____
Louisa County Water Authority

[Name of owner if corp, partnership or LLC]

By: _____(SEAL)
Name (printed): _____
Title: _____

COMMONWEALTH OF VIRGINIA,
COUNTY OF _____, to-wit:

The foregoing instrument was acknowledged before me _____, 20___, by _____, _____[title] on behalf of _____[name of corporation, partnership, or LLC,].

My commission expires: _____
Registration Number: _____

_____
Notary Public

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Appendix C–2

Site Utilization Survey Form

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SITE UTILIZATION SURVEY FORM

Lousia County Water Authority

Industrial Waste Pretreatment Program

Business Name | Site Plan # | Utilities Account #

Contact Person (owner/operator) | Phone # | SIC Code (Standard Industrial Classification)

e-Mail Address | NAICS Code (North America Industry Classification System)

Service Address

City, State | Zip Code

CERTIFICATION STATEMENT

I am the owner or operator of the above referenced facility or the most qualified person to assess the operations of this business. I certify that the information provided is true and correct to the best of my knowledge.

Signature / Date | Name and phone (if different from the contact person above)

QUESTIONS	YES	NO
Does the facility utilize Louisa County Water Authority's Sewer System? If YES, please answer the following: Estimated average wastewater discharge in gallons per day (GPD): _____ Total number of employees: _____	☐	☐
Is this facility located in a strip mall or other multi-unit building?	☐	☐
Does your business discharge or have the potential to discharge a waste product to the sewer system OTHER THAN normal sanitary wastewater?	☐	☐
Are hauled waste services utilized at any time of the year? If YES, please check all that apply: ☐ Septic Tank ☐ Oil / Water Separator ☐ Grease Trap ☐ Amalgam Separator ☐ Grit Trap ☐ Other (describe):	☐	☐
Is this a Dental Facility? If YES, the facility has to comply with 40CFR 441 which requires the installation of amalgam separators compliant with the ISO 11143 standard (or its equivalent) and a one time reporting requirement through DEQ's website	☐	☐
Does the facility store chemicals in quantities of 50 gal or more? If YES, list all chemicals and raw materials that are used/stored at the site (attach a list if necessary)	☐	☐

Chemical Name	Quantity Stored Onsite	Chemical Use

Please check all that apply to the site:

NATURE OF THE BUSINESS

- ☐ Offices only
- ☐ Retail
- ☐ Medical/Dental
- ☐ Packaging / Repackaging
- ☐ Warehouse / Distribution
- ☐ Manufacturing / Processing
- ☐ Service Related

INDUSTRIAL CATEGORY

- ☐ Airport Deicing
- ☐ Aluminum Forming
- ☐ Asbestos Manufacturing
- ☐ Battery Manufacturing
- ☐ Canned and Preserved Fruits and Vegetable Processing
- ☐ Canned and Preserved Seafood
- ☐ Carbon Black Manufacturing
- ☐ Cement Manufacturing
- ☐ Centralized Waste Treatment
- ☐ Coal Mining
- ☐ Coil Coating
- ☐ Concentrated Animal Feeding Operations
- ☐ Concentrated Aquatic Animal Production
- ☐ Construction and Development
- ☐ Copper Forming
- ☐ Dairy Products Processing
- ☐ Dental Office
- ☐ Electrical and Electronic Components
- ☐ Electroplating
- ☐ Explosives Manufacturing
- ☐ Ferroalloy Manufacturing
- ☐ Fertilizer Manufacturing
- ☐ Glass Manufacturing
- ☐ Grain Mills
- ☐ Gum and Wood Chemicals Manufacturing
- ☐ Hospital
- ☐ Ink Formulating
- ☐ Inorganic Chemicals Manufacturing
- ☐ Iron and Steel Manufacturing
- ☐ Landfills
- ☐ Leather Tanning and Finishing
- ☐ Meat and Poultry Products
- ☐ Metal Finishing
- ☐ Metal Molding and Casting
- ☐ Metal Products and Machinery
- ☐ Mineral Mining and Processing
- ☐ Nonferrous Metals Forming and Metal Powders
- ☐ Nonferrous Metals Manufacturing
- ☐ Oil and Gas Extraction
- ☐ Ore Mining and Dressing
- ☐ Organic Chemicals Plastics and Synthetic Fibers
- ☐ Paint Formulating
- ☐ Paving and Roofing Materials (Tars and Asphalt)
- ☐ Pesticide Chemicals
- ☐ Petroleum Refining
- ☐ Pharmaceutical Manufacturing
- ☐ Phosphate Manufacturing
- ☐ Photographic
- ☐ Plastics Molding and Forming
- ☐ Porcelain Enameling
- ☐ Pulp, Paper and Paperboard
- ☐ Rubber Manufacturing
- ☐ Soap and Detergent Manufacturing
- ☐ Steam Electric Power Generating
- ☐ Sugar Processing
- ☐ Textile Mills
- ☐ Timber Products Processing
- ☐ Transportation Equipment Cleaning
- ☐ Waste Combustors

Provide a brief description of the business(es) at this address and list any operations or processes which may be associated with this address.

_____

_____

_____

_____

_____

_____

For questions regarding this form, please contact the Louisa County Water Authority.

Appendix C–3

Industrial and Strong Waste Survey Form

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Lousia County Water Authority
Industrial and Strong Waste Survey Form

Facility Name: _____

Facility Contact Name: _____

Mailing Address: _____

Facility Address: _____

Contact Phone Number: _____ E-mail (optional): _____

DPU Account #: _____ Hours/Days of Operation: _____

1. What is the nature of the business at this service address?

   Account Sub-classification Code (see code sheet): _____

2. Do you have a Back Flow Prevention Device(s)? Yes _____ No _____ Unsure _____

   If Yes, What type(s)? _____

   Location? _____

3. Do you have an irrigation or fire sprinkler system? Yes _____ No _____ Unsure _____

4. Does your operation provide Food Service to customers or employees? Yes _____ No _____
   (If No, skip question 5)

5. Do you have a grease trap or interceptor? Yes _____ No _____ Unsure _____

   If Yes, How many?_____

   Where are they located in relation to your building?_____

6. Do you have an Oil/Water Separator? Yes _____ No _____ Unsure _____

7. Does your business discharge or have the potential to discharge a waste liquid to the sewer system other than from restroom toilets, sinks, showers, and other potable water fixtures?
   Yes _____ No _____ Unsure _____

   If Yes, describe:

8. What is your Standard Industrial Classification (SIC) Code (if known)? _____

9. Do you currently treat any of your wastewater onsite? Yes _____ No _____ Unsure _____

   If Yes, describe:

10. Additional Comments:

I certify that the information provided is true and represents, to the best of my knowledge, full disclosure of the information requested.

Signature_____ Title_____ Date _____
(Authorized Representative)