



**LOUISA COUNTY WATER AUTHORITY
AND
THE TOWN OF LOUISA**

**WATER AND SEWER UTILITY
STANDARDS**

June 2008

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1. GENERAL CONDITIONS

1.1 General

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 or the Town of Louisa on an individual basis. Such variations must be requested in writing along with sufficient documentation supporting the request.

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, 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.

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, Virginia Department of Health (water), and Virginia Department of Environmental Quality for (sewer). 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 shall be amended and submitted for review and approval as construction plans for future phases are submitted for approval if future development is not in accordance with the approved 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 Department for Louisa County. The Louisa County Water Authority/Town of Louisa will require that the applicant submit two additional copies of the plans directly to the Louisa County Water Authority for its use prior to final plan approval.

It is recommended that for complex projects and projects which may require special considerations that the engineer arranges a meeting with the Louisa County Water Authority/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/Town of Louisa.

It is recommended that the engineer confer with the Virginia Department of Transportation, 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.

It should be noted that where it is determined that water or sewer lines are necessary to serve properties beyond the subdivision or development in question, the developer will be required to design and construct his system, properly sized and at an appropriate location and to 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 the area which naturally drains towards the system. Public water systems must be designed and constructed through the development to facilitate for future extensions. Utilities easements must be provided to allow adjoining properties to connect to the system.

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 preformed 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

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. Notification shall be made in the form of a letter to be sent to the property owner. Copies of these letters shall be provided to the Louisa County Water Authority or the Town of Louisa if requested.

1.3 Easements

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

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

- 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.
- Easements will be traversable for operation and maintenance.

1.4 Construction Drawings

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.

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 with regard to their existing easements, rights-of-way and facilities.

Where the possibility of conflicts with existing utilities exists, the Louisa County Water Authority/ Town of Louisa reserves 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.

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 prepared. After revisions are made, the engineer must resubmit the plans for review. A letter of approval will be sent when all Louisa County Water Authority/Town of Louisa criteria are met. The Virginia Department of Health and Virginia Department of Environmental Quality will issue separate letters.

Vertical datum for surveys shall be noted on the plans.

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.
___	___	___	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 Developers 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/Town of Louisa Department of Public Works has reviewed and approved the plan.
- _____ 3 – The project plan has been approved by all appropriate agencies (i.e. Virginia Department of Transportation; Virginia Department of Health; Virginia Department of Environmental Quality; Louisa County Planning & Zoning; Thomas Jefferson Soil & Water Conservation District, etc.).
- _____ 4 – All review and inspection fees have been paid. All bonds have been posted.
- _____ 5 – Erosion control measures have been installed and approved by the Louisa County E&S Inspector.
- _____ 6 – A pre-construction conference between the Contractor and the Louisa County Water Authority/Town of Louisa Department of Public Works has occurred. This meeting must be requested at least 48 hours 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 the existing sewer line 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 i.e., storm sewers, retaining walls, grading, curb and gutter, concrete paving, obstacles (garbage pads, light posts, and other utility lines) etc., 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, i.e., notifying the Inspection Section 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 of way line or utility easement as appropriate.

- J. Water meter sizing calculations must be submitted to the Louisa County Water Authority/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/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, engineer must show the proposed water line tie-in and the proposed location of any additional associated structures.
- N. Standard Utility notes included on plans or referenced.
- O. 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 lines and how this project will connect to the public sewer systems.
2. _____ Site Utilization Survey Form has been submitted.
3. _____ The plan needs to show the as-built location and information of the existing sewer connection.
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 random sampling.

1.4.5 Engineers 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 sets and ½ size set plans submitted with each plan package).
- _____ I. Scale drawings are accurate to within +/- 2% for vertical and horizontal scales.

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. Miss Utility 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 about the 100-year flood plain elevation 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.
- _____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 random 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 3.0 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.

2. WATER SUPPLY SYSTEM DESIGN

2.1 Hydraulic Design for Water Mains

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/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/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.

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 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.

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

<u>Land Use</u>	<u>Gallons per Day per Acre</u>	<u>Equivalent Persons per Acre</u>
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:

<u>Discharge Facility</u>	<u>Design Units</u>	<u>Flow gpd</u>
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.

To determine maximum daily demands and peak hourly demands, the engineer can base factors on Virginia Department of Health Waterworks Regulations or historic data. The factor must be approved by the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health prior to design.

Minimum pipe size shall be 8", 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/ 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.

The Louisa County Water Authority/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

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.

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.

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.

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.

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.

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.

The engineer shall meet the requirements for separation of water and sanitary sewer facilities and shall use the same requirements stated in Section 5.3, Sanitary Sewer Location, of these standards.

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 and Virginia Department of Environmental Quality, 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'.

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, Part 5 – Pipelines (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/Town of Louisa prior to a Construction Permit being issued for the project.

Water mains entering or crossing streams shall be 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.

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.

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.

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.

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.

2.3 Depths of Water Mains

Standard minimum cover shall be 36" and maximum cover shall be 10 feet. 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 36" of cover from the existing/proposed edge of pavement. Greater depths shall be required where street grades will possibly be lowed 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 10 feet below finished grade and a minimum depth of 36" below finished grade. Where the depth of the water main will exceed 10 feet, the water main shall be raised. Where the depth of cover is less than 36", the water main shall be lowed.

2.4 Water Main Appurtenances

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

Valves shall be located at not over 1000 foot intervals and at all changes in pipe diameter. Valves shall also be provided at all pipe line intersections so as to provide shut off for repairs of limited sections without interruption of service to large areas and to facilitate testing. A minimum of 2 valves shall be provided at tees and three valves at crosses. However an additional valve may be required at the discretion of the Louisa County Water Authority or the Town of Louisa. Valves shall be located as close to the fitting as practical. All valves are to be restrained to fittings by approved methods.

When connecting to an existing water main, installing a main line valve and tee as opposed to a tapping sleeve and valve is desirable when there are long distances between main line valves (greater than 1000 feet) or even in the distance is less than 1000 feet where it would be an advantage to add a main line valves for better system control. Therefore, it is important that each project be carefully evaluated by the engineer with the Louisa County Water Authority's/Town of Louisa's assistance to determine if a main line valve ins 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.

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.

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. Flushing hydrants or fire hydrants, whichever is practical, shall be installed on all dead-end mains.

2.5 Fire Hydrant Locations

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.

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.

2.6 Flushing Hydrants

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.

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.

2.7 Services

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"x3/4" meter, unless there is the potential for an irrigation system to be fed by the service. 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. County standard meter sizing forms shall be submitted with all non-residential site plans.

2.8 Fire Department Connections

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

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.

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.

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 SYSTEM MATERIAL SPECIFICATIONS

All products must comply with the Materials Specifications as referenced in this section and the Louisa County Water Authority/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

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.

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.

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)

Polyvinyl Chloride Pipe 4" in Diameter and Larger - PVC pipe in sizes 4" 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.

3.2 Pipe Fittings

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).

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.

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

3.3 Gate Valves

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.

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")

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

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.

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.

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.

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.

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

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

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.

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.

Valves shall open counter-clockwise.

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 may not be externally adjustable.

All valves shall be coated with AWWA Standard Epoxy Coatings or asphalt varnish equal, in conformance to AWWA Standard C-550 or C-450, 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 Tapping Valves

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.

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

3.6 Tapping Sleeves

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.

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

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.

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.

3.6.1 Tapping Sleeves (Fabricated Steel)

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).

3.6.2 Tapping Sleeves (Stainless Steel)

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.

3.7 Fire Hydrants

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 geysir, 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.

3.8 Check Valves

Valves 4" and larger – Check valves 4 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.

3.9 Service Connections

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).

3.10 Water Meters

3.10.1 General Description

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.

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.

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.

3.10.2 Registration Accuracy

All meters shall meet the following 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	3/4 – 50	25
1 1/2"	1 1/2	5 – 100	50
2"	2	8 – 160	80

3.10.3 Main Cases

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.

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

3.10.4 Register and Remote Module

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.

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.

3.10.5 Measuring Chambers

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.

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.

3.10.6 Pistons and Discs

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

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.

3.10.7 Strainers

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.

3.10.8 Warranties

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.

3.11 Water Meter Boxes (Louisa County Water Authority)

3.11.1 Meter Boxes

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.

3.11.2 Corporation Stops

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.

3.11.3 Connections and Valves

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.

3.11.4 Saddles

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

3.12 Water Meters Boxes (Town of Louisa)

3.12.1 Meter Boxes

Meter Boxes: Standard boxes of appropriate size, (10 1/4" x 15 1/2"), complete with cast iron covers as manufactured by Mid-States Plastics, Inc. (MSBC1015-18) or approved

equal shall be furnished and installed around all coppersettors and meters as indicated on the attached Plans. Flip top lids are not acceptable. Boxes shall be of the type approved by OWNER.

3.12.2 Corporation Stops

Corporation Stops: 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.

3.12.3 Coppersettors

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.

3.12.4 Saddles

Saddles must be Ford FC202 epoxy coated or approved equal

3.13 Valve Boxes

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.

3.14 Air Release Valves

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.

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 designing engineer. The piping used for the installation shall be Schedule 40 galvanized steel, the cut-off valve and hose bib shall be of bronze construction, 150 psi rated.

3.15 Flushing Hydrants

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.

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.

3.16 Valve Manholes

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.

3.17 Joint Restraint Systems

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. 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.

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.

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.

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

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

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

3.18 Cast Couplings

3.18.1 Center Sleeve

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.

3.18.2 End Ring

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.

3.18.3 Gaskets

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

3.18.4 Bolts

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

3.19 Casing Spacers

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.

3.20 Tracing Wire System

3.20.1 Detection Wire

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.

3.20.2 Test Station Box

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 Marking Tape

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

3.21.1 Warning Tape for Metallic Piping

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.

3.21.2 Detectable Warning Tape for Non-Metallic Piping

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. Water System Construction Specifications

4.1 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 Louisa County Water Authority, the Town of Louisa and the Virginia Department of Health 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.

4.2 General

Installation of pipe, fittings, valves, and associated appurtenances shall be in accordance with the requirements of the following specifications:

Ductile Iron Pipe - ANSI/AWWA C600

PVC Pressure Pipe - Uni-Bell UNI-B-3, AWWA C900, ASTM D2774

Every precaution shall be taken to insure that the entire length of pipe is supported evenly with the joints mated securely together. Pipe bedding shall be as specified by the pipe manufacturer.

4.3 Dewatering

4.3.1 Method

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 assure the continuous dewatering, duplicate units of the selected system incorporated with emergency power should be employed so that a reliable operation may be obtained.

4.3.2 Location

All site work areas shall be dewatered where surface, leachate and/or ground water flows, if any, will adversely impact construction.

4.3.3 Maintenance

All permanent improvements shall be constructed in areas free from water. Construct and maintain all permanent or temporary slopes, dikes, levees, drainage ditches, sumps, and observation wells necessary for the removal of water from work areas. Design, furnish, install, maintain, and operate all necessary pumping and other dewatering equipment required for dewatering the various site work areas and for keeping the foundation and other areas free from water from any and all sources.

4.3.4 Schedule

All dewatering shall be performed in advance of grading, excavation and/or filling. The dewatering shall be accomplished in a manner that will prevent loss of fines from the foundation, will maintain stability of all excavated slopes and bottoms of excavations, and will permit all construction operations to be performed in the dry. Dewatering of excavations shall be performed to the extent required to permit placement of compacted fill materials in the dry and to prevent sloughing of the excavation side slopes.

4.3.5 Requirements

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.

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.

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.

4.3.6 Contingency

Furnish standby equipment of sufficient size and capacity to insure continuous operation of the dewatering system.

4.3.7 Completion

Dewatering shall be maintained in the work areas for as long as is necessary for the completion of work. Upon completion of the dewatering and control of water operation, all temporary dewatering facilities shall be removed in a manner satisfactory to the Louisa County Water Authority or the Town of Louisa.

4.3.8 Disposal of Drainage Water

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.

4.4 Earthwork

All excavation shall be open-cut type except where otherwise shown on the construction drawings. The slope of the sides of the excavation shall be kept as nearly vertical as possible consistent with the types of materials encountered. Where trenches would become unreasonably large due to a deep excavation or extremely wet condition, contractor shall slope or bench the trench walls to maintain safe working conditions per OSHA Trenching Criteria. A clear area shall be maintained a sufficient distance back from the top edge of the excavation to avoid overloading which may cause slides, cave-ins or shifting of the pipe. Any damage to pipes or structures occurring through settlements, heaving, water or earth pressures, slides, cave-ins or other causes shall be repaired by contractor. The contractor has the option of shoring, including sheet piling, which shall be installed during excavation where required for the protection of workmen, banks, roadways and adjacent paving, structures, and utilities or as directed by the Louisa County Water Authority or the Town of Louisa. All excavation shall be performed in accordance with the current OSHA guide lines and any other regulatory authorities having jurisdiction. Provide adequate equipment to comply with OSHA regulations.

All excavation shall be placed on the up gradient side of the trench.

4.4.1 Protection

Protect existing structures, utilities, sidewalks, pavements, and other facilities in areas of work. Barricade open excavations and provide warning lights.

4.4.2 Shoring or Sheeting

Shoring or sheeting shall be removed as the work progresses, unless left in place by written order of the Louisa County Water Authority or the Town of Louisa.

4.4.3 Trench Excavation

The contractor shall comply with all local, state and federal guidelines when excavating trenches. 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 the minimum trench width shall be 33 inches in all cases. The width of the trench above the top of the pipe may be as wide as necessary for sheeting and bracing and the proper performance of the work.

4.4.4 Sidewalls

The sidewalls of pipe trenches shall be as nearly vertical as practicable to a point above the top of the pipe.

4.4.5 Overexcavation

Trenches shall be excavated to the design grade of the pipe to provide uniform bearing and support along the entire length of pipe. Care shall be taken not to over excavate. Over excavation of otherwise suitable material shall be replaced with suitable material as directed by the Louisa County Water Authority or the Town of Louisa. The cost of such

fill shall be borne by the contractor.

4.4.6 Rock

Where the bottom of the pipe trench occurs in rock, the rock shall be excavated to 6 inches for pipes 24-inches in diameter and smaller and 9 inches for pipes 30-inches in diameter and larger, below the trench depth indicated. Overdepths in rock excavation and unauthorized overdepths shall be backfilled with VDOT No. 10 stone/gravel dust.

4.4.7 Unsuitable Material

Whenever wet or otherwise unsuitable material, which is incapable of properly supporting the pipe, is encountered in the trench bottom, such material shall be overexcavated to a depth necessary to allow for construction of a stable pipe bedding. The trench shall be backfilled with suitable materials to proper grade. The contractor shall notify the Louisa County Water Authority or the Town of Louisa immediately when such conditions are encountered and the Louisa County Water Authority or the Town of Louisa will determine the amount of overexcavation required.

4.4.8 Bedding

4.4.8.1 Ductile Iron

Unless otherwise specified on the Drawings, bedding for flexible Ductile Iron conduit will be a minimum of Class III for pipes 24-inches in diameter and smaller. Class III shall be the minimum for pipes 30-inches in diameter and larger.

4.4.8.2 PVC

Unless otherwise specified on the Drawings, bedding for flexible PVC conduit will be a minimum of Class III.

4.4.9 Backfilling

4.4.9.1 Operation

The contractor shall keep trenches backfilled on a daily basis. Prior to the end of the working day, each trench will be completely backfilled. All backfill shall be brought up equally along each side of the pipe in such manner as to avoid displacement of or damage to the pipe.

4.4.9.2 Material

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.

4.4.9.3 Disposal of Unsatisfactory Material

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.

4.4.9.4 Compaction

The material to be used for backfill shall contain a moisture content that will facilitate compaction. The backfill shall be brought up in layers not exceeding 6 inches in compacted depth for the full length of pipe. Each layer shall be thoroughly compacted by rolling, or with mechanical tampers or hammers. This method of filling and compacting shall continue until the fill has reached an elevation 12 inches above the top of the pipe.

The remainder of the trench shall be backfilled and compacted in layers not exceeding 8 inches. Other methods of achieving the compaction may be used, however, only after review by Licensed Geotechnical Engineer and written approval of the Louisa County Water Authority or the Town of Louisa.

4.4.9.5 Open Areas

Backfill in open areas shall be compacted to a density equal to that of the existing ground.

4.4.9.6 Roadways

Backfill under roadways, VDOT Right of Ways, or other similar installations shall be compacted to a minimum density of 95 percent as determined by the modified ASTM D-698.

4.4.9.7 Testing

All costs associated with testing shall be borne by the contractor. The backfill shall be tested to insure that the required density is being achieved. The Louisa County Water Authority or the Town of Louisa shall select the depth at which the test is to be taken. Backfill not compacted to the required density shall be removed, recompacted, and retested at the contractor's expense until the requirements are met.

4.4.9.8 Excess Disposal

Excess material shall be disposed of legally offsite by the contractor. No extra payment will be made for disposal.

4.4.9.9 Settlement

All backfilled areas where settlement occurs shall be filled and maintained during the life of the Project and for a period of 1 year following the date of final acceptance of all work.

4.4.9.10 Hazards

When the contractor is notified by the Louisa County Water Authority or the Town of Louisa that any backfill presents a hazard, contractor shall correct such hazardous condition at once.

4.4.10 Fill

4.4.10.1 Material

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. Fill material shall be free of debris, roots, and organic or frozen materials.

4.4.10.2 Foundation

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.

4.4.10.3 Moisture Content

Each layer shall be uniformly spread and moistened, or dried by aeration as required to attain the proper moisture content for the required degree of compaction.

4.4.10.4 Placing

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.

4.4.11 Borrow

4.4.11.1 Availability

Where satisfactory materials are not available in sufficient quantity from required excavations, suitable materials shall be obtained from approved off-site borrow areas.

4.4.11.2 Placement

Borrow material shall be placed and compacted only when approved by the Louisa County Water Authority or the Town of Louisa and a Licensed Geotechnical Engineer.

4.4.12 Compaction

4.4.12.1 Method

Where sands and/or gravels are used for backfill, the material shall be compacted to maximum possible density with a plate-type vibrating compactor of standard manufacture, consisting of a variable speed power unit attached to a vibratory plate. The vibrator may be single or multiple type and shall provide sufficient unit pressure on the vibratory plate to obtain maximum density. When the proper moisture content is obtained for all other soils to be used for backfill, they shall be compacted to a density of 95 percent of maximum density or increased as required in pavement areas.

4.4.12.2 Moisture

Moisture density relations, specified for materials used for fills and backfill, shall be determined and the degree of compaction controlled (except where otherwise specified) in accordance with the requirements of AASHTO T 99.

4.5 Pipe Installation

4.5.1 Handling

All materials shall be shipped, unloaded, and stored in accordance with the manufacturer's recommendations. All materials shall be handled in such a manner as to avoid damage to the material. When such damage cannot be repaired to the Louisa County Water Authority's or the Town of Louisa's satisfaction, the item shall be replaced at the contractor's expense. The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

4.5.2 Placement

Installation of all piping, fittings, valves, and appurtenances shall be to the lines, grades and locations shown on the construction drawings. All pipe, fittings, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. The pipe or accessories shall be inspected for defects prior to lowering into the trench. Any foreign matter or dirt shall be removed from the interior of pipe before lowering into position in the trench. 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.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. 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. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. When pipe laying is not in progress, the open

ends of pipe shall be closed by a watertight plug or other means approved by the Louisa County Water Authority or the Town of Louisa. This provision shall apply during any suspense of work such as the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner, without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. Care shall be taken to avoid damaging the lining of the pipe. Flame cutting of iron pipe with oxyacetylene torch shall not be permitted.

4.5.3 Deflection of Pipe

Where it becomes necessary to deflect the line of pipe, in either a vertical or horizontal plane, to avoid obstructions or in locations where long-radius curves are permitted, the amount of deflection shall not exceed 50% of that recommended in the applicable specification for the particular pipe material.

4.5.4 Valve, Fittings, and Fire Hydrants

Installation of valves, fittings and hydrants shall be done as per the details on the Contract Drawings.

4.6 Testing Of Water Distribution System

All pipe, valves, fittings, and appurtenances shall be tested and inspected for water-tightness and soundness before being accepted in accordance with the requirements specified herein and as directed by the Louisa County Water Authority or the Town of Louisa.

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.

4.6.1 Pressure Testing

Waterlines shall be subjected to a hydrostatic pressure test of 150 psi for not less than 2 hours during which time the leakage loss shall not exceed the number of gallons per hour for each section tested, as determined by the following formulas:

For Ductile Iron Pipe:

$$L = \frac{SD * P^{(0.5)}}{133,200}$$

L = Allowable leakage, in gallons per hour

S = Length of line under test, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure, in psi

For PVC Pipe:

$$L = \frac{ND * P^{(0.5)}}{7,400}$$

L = Allowable leakage, in gallons per hour

N = Number of joints in the length of line under test, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure, in psi

The test shall be made only under the supervision of the Louisa County Water Authority or the Town of Louisa. The contractor shall provide all equipment and perform all work required for the purposes. In case any section under test shows leakage in excess of the allowable amount, the contractor shall make such repairs to the line as are required to bring the loss within the stipulated limits. Each valved section of the pressure pipe is to be tested individually. The contractor shall meet ANSI/AWWA C600 for ductile iron pipe and ANSI/AWWA C605 and UNI-BELL UNI-B-3 for PVC pipe.

When approved in advance, water from the Louisa County Water Authority or the Town of Louisa's water system shall be used for flushing, sterilization and testing. Filling of water main may be performed provided permission has been obtained from the Louisa County Water Authority or the Town of Louisa. The contractor is not permitted to operate valves on existing lines unless approved by the Louisa County Water Authority or the Town of Louisa.

4.6.2 Disinfection

All waterlines shall be disinfected prior to being placed in operation. Prior to disinfection all waterlines shall be flushed unless the tablet method of disinfection is used. All valves and hydrants shall be operated during this operation. Flushing velocities shall not be less than 2.5 ft/sec. If ductile iron pipe is being used, the water used to disinfect the waterline should not remain in contact with the waterline for more than 24 hours.

4.6.2.1 Flushing

Water for filling the line and flushing will be taken from the Louisa County Water Authority's or the Town of Louisa's water system. The use of water for making the new water main available for service will be as follows:

Initial Flush

See table entitled "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 Louisa County Water Authority or the Town of Louisa. 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.

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. For site specific locations the Louisa County Water Authority or the Town of Louisa may require the use of a neutralizing chemical and piping arrangement. The expense of a neutralizing station is the responsibility of the developer/contractor.

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.

Main size (Nominal)	Double Check Valve Single Gate Size (Note 1)	INITIAL FLUSH (Note 2)	FINAL FLUSH (Note 2)
		Min. Flow (gpm)	Max. Flow (gpm)
6"	4"	220	88
8"	4"	400	160
12"	6"	900	350
16"	6"	1500	624
20"	8"	2450	978
24"	10"	3525	1410
30"	Designed by Consultant	5505	2202
36"	Designed by Consultant	7935	3174

Notes:

1. 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.
2. On a case-by-case basis, dependent upon such variables as length of new water main <200'); space limitations; or other unforeseeable obstacles, the Louisa County Water Authority or the Town of Louisa 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.

4.6.2.2 Methods of Chlorine Application

Continuous Feed Method

Potable water shall be introduced into the pipe line at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the so that the chlorine concentration in the water in the pipe is at least 50 mg/l. The chlorinated water shall remain in the pipe line at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/l. All valves and appurtenances shall be operated while the chlorinated water remains in the pipe line.

Slug Method

Potable water shall be introduced into the pipe line at a constant flow rate. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/l in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the pipe are exposed to the 100 mg/l chlorine solution for at least 3 hours. The chlorine residual shall be checked at regular intervals not to exceed 2,000 feet to insure that adequate disinfection is occurring. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances.

Tablet Method

This method shall not be used if non-potable water or foreign material have entered the lines or if the water temperature is below 5°C (41°F). The tablets shall be placed in each pipe section and in all appurtenances. Enough tablets shall be used to insure that a chlorine concentration of 25 mg/l is provided in the water. They shall be attached by an adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The adhesive shall be approved by the Engineer. The velocity of the potable water in the pipe line shall be less than 1 ft./sec. The water shall remain in contact with the pipe for 24 hours. All valves and appurtenances shall be operated while the chlorinated water is in the pipe.

4.6.2.3 Testing

After the lines have been flushed, the waterlines shall be tested in the following methods:

All chlorine residual determinations shall be made using only those methods approved by the Virginia Department of Health. One approved method is the DPD Kit method.

Two water samples for bacteriological analysis must be collected at least 24 hours apart and analyzed by a certified laboratory. The results of these samples must indicate no contamination before the pipe, tanks or equipment can be utilized as part of the waterworks. If contamination is indicated, then the disinfection procedure must be repeated. Samples shall be collected at regular intervals, not exceeding 2,000 feet throughout the length of pipe line.

4.6.3 Testing Of Double Check Assembly

The Developer is responsible for having the double check assembly tested by an approved tester prior to service being authorized to the building. Tests on the double check assembly will be conducted on an ongoing basis annually by a certified tester approved by the Louisa County Water Authority or the Town of Louisa. The results of the test will be sent to the Louisa County Water Authority or the Town of Louisa. Costs of tests shall be paid by the developer/owner.

4.7 Abandonment of Existing Facilities

4.7.1 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

4.7.2 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.

4.8 Clean-Up

Upon the completion of the installation of the water system and prior to the Louisa County Water Authority's or the Town of Louisa's acceptance all restoration shall be complete. The work area shall be restored to its original condition and pavement replaced to the satisfaction of the Louisa County Water Authority or the Town of Louisa and VDOT. All trash and debris shall be removed and properly disposed of. Areas not otherwise stabilized shall be seeded and mulched and a good stand of grass established.

5. SEWER COLLECTION SYSTEM DESIGN

5.1 Hydraulic Design for Sanitary Sewers

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.

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

<u>Land Use</u>	<u>Gallons per Day per Acre</u>	<u>Equivalent Persons per Acre</u>
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

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

<u>Discharge Facility</u>	<u>Design Units</u>	<u>Flow gpd</u>
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
Theatres	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 flow information approved by the Louisa County Water Authority or the Town of Louisa.

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

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. ($Q_P = 4.0 \times Q_A$)

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.

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

5.2 Design Criteria

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

- Sewers shall have a continuous slope, straight alignment and uniform pipe material between manholes.
- 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.
- 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.
- 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.

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.

- Minimum pipe sizes for all sewers between manholes shall be 8”.
- 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.

- 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.

- 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.

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.

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.

5.3 Sanitary Sewer Locations

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.

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.

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:

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

In a crossing installation, sanitary sewers crossing water mains shall be laid to provide a separation of at least 18" between the bottom of the water main and the top of the sewer whenever possible.

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:

- 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.
- In addition, water mains passing under sanitary sewers shall be protected by providing:

A vertical separation of at least 18" between the bottom of the sewer and the top of the water mains.

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

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.

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”.

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.

Carrier pipes within bores for sanitary sewer installation shall generally be ductile iron (Class 52 minimum) sewer pipes with restrained joints.

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.

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.

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.

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 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.

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.

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

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.

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.

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.

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.

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.

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:

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

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

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

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.

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.

5.4 Depth of Sanitary Sewer Lines

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 in 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.

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.

5.5 Sewer Structural Design

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:

- 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.

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

5.6 Sanitary Sewer Manholes

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

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

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" above final ground elevation.

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" and 18" above final ground elevation.

Drop manholes shall 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. Exterior drop connections shall be utilized whenever possible.

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

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.

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

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.

5.7 Service Connections

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.

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.

5.8 Sewage Pump Stations and Force Mains

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:

- 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
- 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
- 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

- 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.

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.

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.

- Structural design and calculations, including reinforcing drawing where applicable, for the facility.
- Hydraulic design for the equipment selected, including scaled drawings.
- Electrical and mechanical drawings and specifications for the equipment selected.
- Project specifications.
- Pump and system head curves
- Site Plan

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

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.

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.

6. SEWER SYSTEM MATERIAL SPECIFICATIONS

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

6.1 Sanitary Sewer Pipe

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

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. 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.

6.1.1.1 Fittings

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.

6.1.1.2 Joints

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.

6.1.2 PVC Flexible Sewer Pipe

6.1.2.1 Pipe 4 Inches Through 18 Inches

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 modulus 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.

6.1.2.2 Pipe 21 Inches Through 48 Inches

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.

6.1.2.3 Joints

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.

6.2 Joint Deformation

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.

6.3 Gaskets

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.

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

6.4 Manholes

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.

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

All manholes shall be watertight.

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

Gasket shall comply with requirements of ASTM C361.

6.4.1 Joints

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.

6.4.2 Connections

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.

6.4.3 Manhole Steps

Manhole steps shall be corrosion-resistant and shall be one-half inch grade 60 steel reinforcing rod encapsulated in a copolymer polypropylene designed so that the foot will not slide off. The steps shall conform with ASTM C478 paragraph 11 and to the dimensions shown on the Standard Details. Steps shall be M.A. Industries, Inc. or approved equal.

6.4.4 Cone Section

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.

6.4.5 Inverts

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.

6.4.6 Grout

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

6.5 Manhole Frame and Cover

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.

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.

6.5.1 Frame Sealant

The manhole frame shall be sealed to the concrete manhole section using a bed of mortar on either side of butyl 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.

6.5.2 Inflow Protector

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.

6.6 Corrosion Resistant Manholes

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

- 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.
- 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.
- 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.

- PermaCast or PermaForm lining with ConShield admixture applied in accordance with manufacturer's recommendations.
- Other coating systems as specifically approved by the Louisa County Water Authority or the Town of Louisa.

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

6.7 Sewage Air/Vacuum Valves

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.

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

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.

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.

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

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

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.

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.

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

All flushing attachments shall be provided with each valve.

6.8 Sewage Combination Air Release Valves

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.

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

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

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

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

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.

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.

Valve shall be suitable for 300 psi working pressure.

All flushing attachments shall be provided with each valve.

6.9 Sewage Air Release Valves

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.

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

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.

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

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.

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

6.10 Sewage Plug Valves

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.

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.

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.

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.

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.

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

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.

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.

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).

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.

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.

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.

Valve shaft journal bearings shall be sleeve type, sintered, oil impregnated, permanently lubricated, type 316 ASTM A 7 43 grade CF -8M or AISI 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.

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.

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.

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.

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

6.11 Tracing Wire System

6.11.1 Detection Wire

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.

6.11.2 Test Station Box

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.

6.12 Marking Tape

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

6.12.1 Warning Tape for Metallic Piping

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.

6.12.2 Detectable Warning Tape for Non-Metallic Piping

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.

7. Sewer System Construction Specifications

7.1 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 Louisa County Water Authority, the Town of Louisa and the Virginia Department of Environmental Health 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.

7.2 General

Installation of pipe, fittings, valves, and associated appurtenances shall be in accordance with the requirements of the following specifications:

Ductile Iron Pipe - ANSI/AWWA C600

PVC Pressure Pipe - Uni-Bell UNI-B-3, AWWA C900, ASTM D2774

Every precaution shall be taken to insure that the entire length of pipe is supported evenly with the joints mated securely together. Pipe bedding shall be as specified by the pipe manufacturer.

7.3 Dewatering

7.3.1 Method

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 assure the continuous dewatering, duplicate units of the selected system incorporated with emergency power should be employed so that a reliable operation may be obtained.

7.3.2 Location

All site work areas shall be dewatered where surface, leachate and/or ground water flows, if any, will adversely impact construction.

7.3.3 Maintenance

All permanent improvements shall be constructed in areas free from water. Construct and maintain all permanent or temporary slopes, dikes, levees, drainage ditches, sumps, and observation wells necessary for the removal of water from work areas. Design, furnish, install, maintain, and operate all necessary pumping and other dewatering equipment required for dewatering the various site work areas and for keeping the foundation and other areas free from water from any and all sources.

7.3.4 Schedule

All dewatering shall be performed in advance of grading, excavation and/or filling. The dewatering shall be accomplished in a manner that will prevent loss of fines from the foundation, will maintain stability of all excavated slopes and bottoms of excavations, and will permit all construction operations to be performed in the dry. Dewatering of excavations shall be performed to the extent required to permit placement of compacted fill materials in the dry and to prevent sloughing of the excavation side slopes.

7.3.5 Requirements

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.

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.

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.

7.3.6 Contingency

Furnish standby equipment of sufficient size and capacity to insure continuous operation of the dewatering system.

7.3.7 Completion

Dewatering shall be maintained in the work areas for as long as is necessary for the completion of work. Upon completion of the dewatering and control of water operation, all temporary dewatering facilities shall be removed in a manner satisfactory to the Louisa County Water Authority or the Town of Louisa.

7.3.8 Disposal of Drainage Water

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.

7.4 Earthwork

All excavation shall be open-cut type except where otherwise shown on the construction drawings. The slope of the sides of the excavation shall be kept as nearly vertical as possible consistent with the types of materials encountered. Where trenches would become unreasonably large due to a deep excavation or extremely wet condition, contractor shall slope or bench the trench walls to maintain safe working conditions per OSHA Trenching Criteria. A clear area shall be maintained a sufficient distance back from the top edge of the excavation to avoid overloading which may cause slides, cave-ins or shifting of the pipe. Any damage to pipes or structures occurring through settlements, heaving, water or earth pressures, slides, cave-ins or other causes shall be repaired by contractor. The contractor has the option of shoring, including sheet piling, which shall be installed during excavation where required for the protection of workmen, banks, roadways and adjacent paving, structures, and utilities or as directed by the Louisa County Water Authority or the Town of Louisa. All excavation shall be performed in accordance with the current OSHA guide lines and any other regulatory authorities having jurisdiction. Provide adequate equipment to comply with OSHA regulations.

All excavation shall be placed on the up gradient side of the trench.

7.4.1 Protection

Protect existing structures, utilities, sidewalks, pavements, and other facilities in areas of work. Barricade open excavations and provide warning lights.

7.4.2 Shoring or Sheeting

Shoring or sheeting shall be removed as the work progresses, unless left in place by written order of the Louisa County Water Authority or the Town of Louisa.

7.4.3 Trench Excavation

The contractor shall comply with all local, state and federal guidelines when excavating trenches. 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 the minimum trench width shall be 33 inches in all cases. The width of the trench above the top of the pipe may be as wide as necessary for sheeting and bracing and the proper performance of the work.

7.4.4 Sidewalls

The sidewalls of pipe trenches shall be as nearly vertical as practicable to a point above the top of the pipe.

7.4.5 Overexcavation

Trenches shall be excavated to the design grade of the pipe to provide uniform bearing and support along the entire length of pipe. Care shall be taken not to over excavate. Over excavation of otherwise suitable material shall be replaced with suitable material as directed by the Louisa County Water Authority or the Town of Louisa. The cost of such

fill shall be borne by the contractor.

7.4.6 Rock

Where the bottom of the pipe trench occurs in rock, the rock shall be excavated to 6 inches for pipes 24-inches in diameter and smaller and 9 inches for pipes 30-inches in diameter and larger, below the trench depth indicated. Overdepths in rock excavation and unauthorized overdepths shall be backfilled with VDOT No. 10 stone/gravel dust.

7.4.7 Unsuitable Material

Whenever wet or otherwise unsuitable material, which is incapable of properly supporting the pipe, is encountered in the trench bottom, such material shall be overexcavated to a depth necessary to allow for construction of a stable pipe bedding. The trench shall be backfilled with suitable materials to proper grade. The contractor shall notify the Louisa County Water Authority or the Town of Louisa immediately when such conditions are encountered and the Louisa County Water Authority or the Town of Louisa will determine the amount of overexcavation required.

7.4.8 Bedding

7.4.8.1 Ductile Iron

Unless otherwise specified on the Drawings, bedding for flexible Ductile Iron conduit will be a minimum of Class III for pipes 24-inches in diameter and smaller. Class III shall be the minimum for pipes 30-inches in diameter and larger.

7.4.8.2 PVC

Unless otherwise specified on the Drawings, bedding for flexible PVC conduit will be a minimum of Class III.

7.4.9 Backfilling

7.4.9.1 Operation

The contractor shall keep trenches backfilled on a daily basis. Prior to the end of the working day, each trench will be completely backfilled. All backfill shall be brought up equally along each side of the pipe in such manner as to avoid displacement of or damage to the pipe.

7.4.9.2 Material

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.

7.4.9.3 Disposal of Unsatisfactory Material

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.

7.4.9.4 Compaction

The material to be used for backfill shall contain a moisture content that will facilitate compaction. The backfill shall be brought up in layers not exceeding 6 inches in compacted depth for the full length of pipe. Each layer shall be thoroughly compacted by rolling, or with mechanical tampers or hammers. This method of filling and compacting shall continue until the fill has reached an elevation 12 inches above the top of the pipe.

The remainder of the trench shall be backfilled and compacted in layers not exceeding 8 inches. Other methods of achieving the compaction may be used, however, only after review by Licensed Geotechnical Engineer and written approval of the Louisa County Water Authority or the Town of Louisa.

7.4.9.5 Open Areas

Backfill in open areas shall be compacted to a density equal to that of the existing ground.

7.4.9.6 Roadways

Backfill under roadways, VDOT Right of Ways, or other similar installations shall be compacted to a minimum density of 95 percent as determined by the modified ASTM D-698.

7.4.9.7 Testing

All costs associated with testing shall be borne by the contractor. The backfill shall be tested to insure that the required density is being achieved. The Louisa County Water Authority or the Town of Louisa shall select the depth at which the test is to be taken. Backfill not compacted to the required density shall be removed, recompact, and retested at the contractor's expense until the requirements are met.

7.4.9.8 Excess Disposal

Excess material shall be disposed of legally offsite by the contractor. No extra payment will be made for disposal.

7.4.9.9 Settlement

All backfilled areas where settlement occurs shall be filled and maintained during the life of the Project and for a period of 1 year following the date of final acceptance of all work.

7.4.9.10 Hazards

When the contractor is notified by the Louisa County Water Authority or the Town of Louisa that any backfill presents a hazard, contractor shall correct such hazardous condition at once.

7.4.10 Fill

7.4.10.1 Material

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. Fill material shall be free of debris, roots, and organic or frozen materials.

7.4.10.2 Foundation

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.

7.4.10.3 Moisture Content

Each layer shall be uniformly spread and moistened, or dried by aeration as required to attain the proper moisture content for the required degree of compaction.

7.4.10.4 Placing

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.

7.4.11 Borrow

7.4.11.1 Availability

Where satisfactory materials are not available in sufficient quantity from required excavations, suitable materials shall be obtained from approved off-site borrow areas.

7.4.11.2 Placement

Borrow material shall be placed and compacted only when approved by the Louisa County Water Authority or the Town of Louisa and a Licensed Geotechnical Engineer.

7.4.12 Compaction

7.4.12.1 Method

Where sands and/or gravels are used for backfill, the material shall be compacted to maximum possible density with a plate-type vibrating compactor of standard manufacture, consisting of a variable speed power unit attached to a vibratory plate. The vibrator may be single or multiple type and shall provide sufficient unit pressure on the vibratory plate to obtain maximum density. When the proper moisture content is obtained for all other soils to be used for backfill, they shall be compacted to a density of 95 percent of maximum density or increased as required in pavement areas.

7.4.12.2 Moisture

Moisture density relations, specified for materials used for fills and backfill, shall be determined and the degree of compaction controlled (except where otherwise specified) in accordance with the requirements of AASHTO T 99.

7.5 Pipe Installation

7.5.1 Handling

All materials shall be shipped, unloaded, and stored in accordance with the manufacturer's recommendations. All materials shall be handled in such a manner as to avoid damage to the material. When such damage cannot be repaired to the Louisa County Water Authority's or the Town of Louisa's satisfaction, the item shall be replaced at the contractor's expense. The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

7.5.2 Placement

Installation of all piping, fittings, valves, and appurtenances shall be to the lines, grades and locations shown on the construction drawings. All pipe, fittings, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. The pipe or accessories shall be inspected for defects prior to lowering into the trench. Any foreign matter or dirt shall be removed from the interior of pipe before lowering into position in the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. 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. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. When pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Louisa County Water Authority or the Town of Louisa. This provision shall apply during any

suspense of work such as the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner, without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. Care shall be taken to avoid damaging the lining of the pipe. Flame cutting of iron pipe with oxyacetylene torch shall not be permitted.

7.5.3 Survey Line and Grade

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

7.5.4 Sewer Pipe Laying

Laying of sewer pipe shall be accomplished to line and grade as indicated on the Louisa County Water Authority or the Town of Louisa 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.

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.

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 laying is not in progress the forward end of the pipe shall be kept tightly closed with a water tight 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 Louisa County Water Authority or the Town of Louisa.

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

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 water tight plug or cap.

7.5.5 Joining Pipe

Ductile iron pipe is to be joined in accordance with the requirements of AWWA Standard C600 and the manufacturer's recommendations.

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

Other type pipe shall be joined in accordance with the manufacturer's recommendations and the requirements of the Louisa County Water Authority or the Town of Louisa approved plans and specifications.

All visible leaks shall be corrected prior to testing.

7.6 Manhole Installation

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.

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

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

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.

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

Plug lift holes from the outside with nonshrink grout and repair any defects in manhole.

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" thickness). Parge 1/8" to 1/4" 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 four 1/2" diameter stainless steel epoxied anchor bolts, two 1/2" diameter stainless steel wedge anchors, or two 1/2" diameter stainless steel stud anchors which extend no more than 2" 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"± 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.

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

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

7.6.1 Constructing concrete bench

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

Bench shall be three inches lower at channel than at manhole wall.

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

Use sulfide resistant cement for concrete or mortar on all acid-resistant manholes.

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

All inverts shall be smooth.

7.7 Service Connections

Place a tee fitting with 4" or 6" outlet, depending on the lateral pipe size, in the sewer where service connection is to be constructed. Lay 4" or 6" PVC or ductile iron pipe from the connection to the property line or easement limits on a grade of not less than 1% for 6" laterals or 2% for 4" laterals. 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 2" x 4" board installed plumb from bottom of plug to 2 feet above ground. Service connection shall be of same type of pipe as sewer unless otherwise approved by the Louisa County Water Authority or the Town of Louisa. 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.

7.8 Existing Manhole Tie-In

Core drilling and a flexible pipe-to-manhole connector shall be used in the connection of the sewer pipe to precast manholes, where stubs or bricked up opening do not exist. 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.

7.9 Testing

All structures are required to be watertight and all piping and appurtenances shall be tested for leakage by the contractor under the direction of the Louisa County Water Authority or the Town of Louisa.

All force mains shall pass pressure testing requirements as set forth for water pipe in these standards.

Gravity sewer testing shall be done by air pressure test as specified herein.

7.9.1 Air Test

The contractor shall plug the pipe and shall conduct a low pressure air test to determine the acceptability of the completed work. The contractor shall furnish all men, materials, and supplies necessary to assist in the conducting of this test. This air test shall conform to UNI-B-6-90 or latest revision.

The air testing equipment shall be Air-Lock, as manufactured by Cherne Industrial, Inc., or approved equal. All air used shall pass through a single control panel. Individual air hoses shall be used from control panel to pneumatic plugs; from control panel to sealed line for introducing low pressure air; and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe tested. The plugs shall resist internal test pressures without requiring external bracing or blocking. Plugs shall be tested prior to installation in the pipe run. A joint of pipe shall be sealed at both ends with the plugs to be used in the sewer test. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall then be pressurized to 9 psi. The plugs shall withstand this pressure without bracing or movement. The tested line segment shall be plugged and pressurized to 4.0 psi greater than the ground water back pressure but not to exceed 9 psi. The line shall be allowed to stabilize for 2 minutes after pressurization. After the pressure has stabilized, the air pressure shall be decreased slowly to 3.5 psi (greater than ground water back pressure) and the timing shall commence. The time for the pressure to drop 1 psi from 3.5 psi shall be recorded. The minimum acceptable time durations are shown on Table I. If the elapsed time to drop 1 psi is less than that shown on Table I, then the air loss shall be considered excessive and the section of pipe has failed the test.

TABLE 1
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

PART 1A							
Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)			
				100'	150'	200'	250'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12

PART 1B							
Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)			
				300'	350'	400'	450'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	86:32	100:57	115:22	129:48
030	28:20	80	21.366 L	106:57	124:38	142:26	160:15
33	31:10	72	25.852 L	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	153:50	179:29	205:07	230:46

The test shall be made only under the supervision of the Louisa County Water Authority or the Town of Louisa. The contractor shall provide all equipment and perform all work required for the purposes. In case any section under test shows leakage in excess of the allowable amount, the contractor shall make such repairs to the line as are required to bring the loss within the stipulated limits.

7.9.2 Testing of Manholes

All manholes shall be tested by vacuum testing.

7.9.2.1 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

<u>MH Dia.</u>	<u>MH Height</u>	<u>Hg</u>	<u>Time (Minimum)</u>
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.

7.9.3 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 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

7.10 Clean-Up

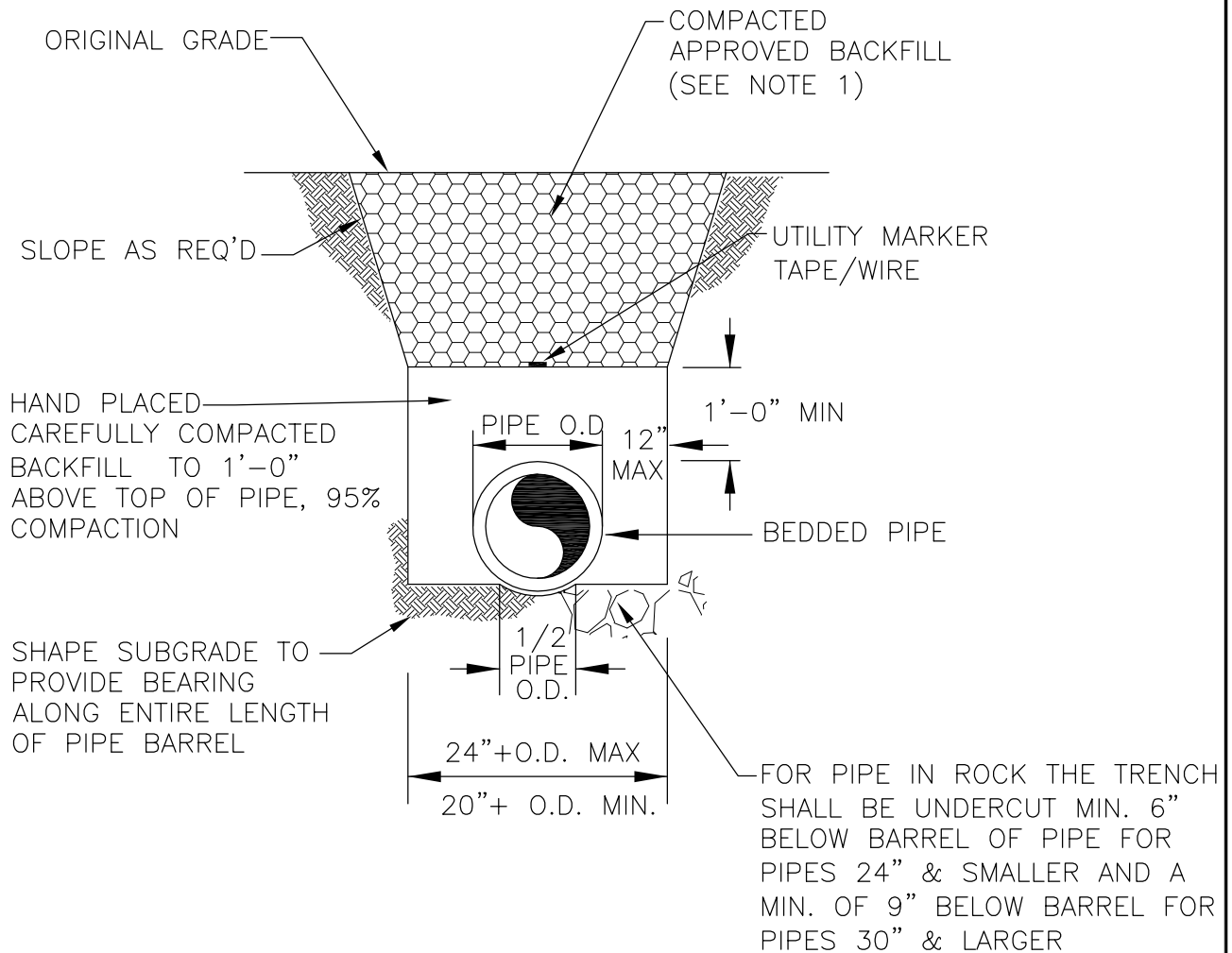
Upon the completion of the installation of the sanitary sewer system and prior to tentative acceptance by the Louisa County Water Authority or the Town of Louisa, sediment and debris shall be removed from the system. Unless waived by the by the Louisa County Water Authority or the Town of Louisa, the 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 Louisa County Water Authority's or the Town of Louisa's existing sewer system prior to the Louisa County Water Authority or the Town of Louisa 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 Louisa County Water Authority or the Town of Louisa. All trash and debris shall be removed and properly disposed of. Areas not otherwise stabilized shall be seeded and mulched and a good stand of grass established.

8. Utility Line and Structure Rehabilitation

8.1 Acceptable Rehabilitation Methods

Rehabilitation of existing utility lines and structures is acceptable in lieu of replacement. The design requirements for rehabilitation shall be determined through discussions with the Louisa County Water Authority or the Town of Louisa and the Virginia Department of Health and/or the Virginia Department of Environmental Quality **PRIOR TO INITIATING THE DESIGN.**

Standard Details



NOTES:

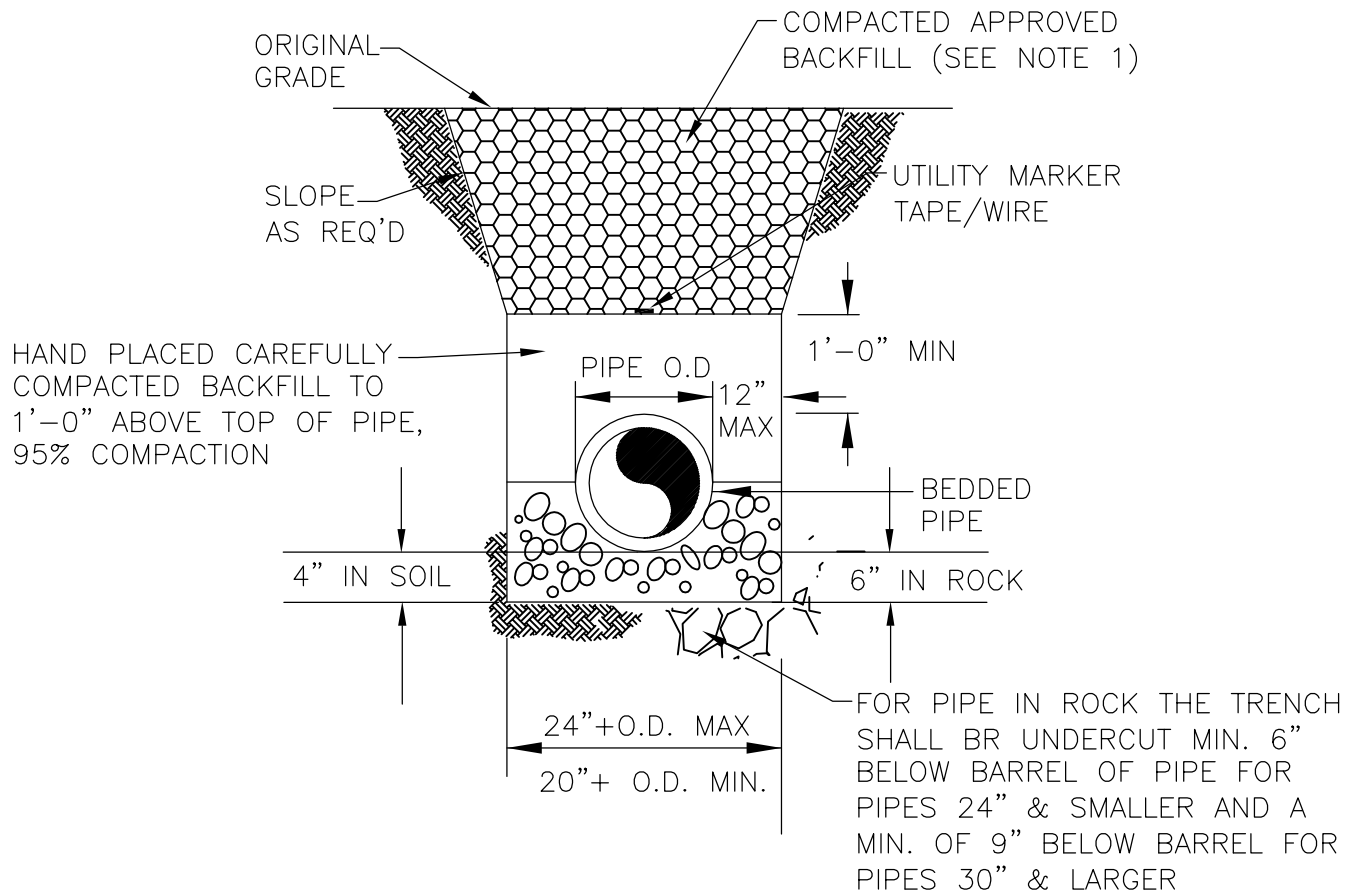
1. ALL BACKFILL IN TRENCHES WHICH ARE LOCATED WITHIN PAVED VDOT STREETS & ROADS SHALL BE VDOT NO. 21-A STONE FOR THE FULL DEPTH OF TRENCH, 95% COMPACTION.
2. WALLS SHALL BE SLOPED AND OR SHEETING PROVIDED PER OSHA REQUIREMENTS.
3. ENGINEER TO VERIFY PIPE LAYING CONDITIONS.
4. INSTALL UTILITY MARKER PER LOUISA COUNTY WATER AUTHORITY AND THE TOWN OF LOUISA WATER AND SEWER UTILITY STANDARDS.

DATE
JUNE 2008

PIPE LAYING CONDITION
DUCTILE IRON PIPE

DRWG. NO.
PIP-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.

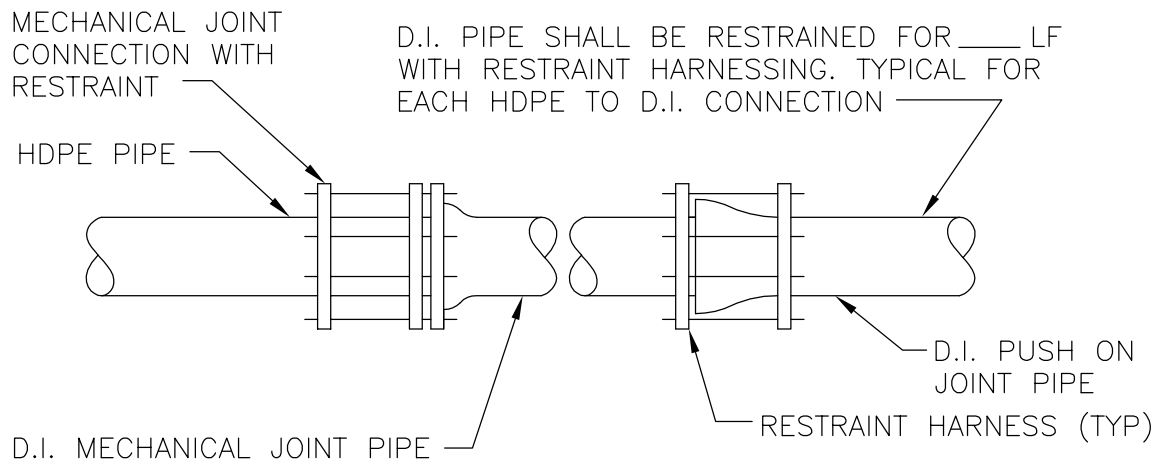
DATE
JUNE 2008

LCWA/TOL

PIPE LAYING CONDITION
PVC

DRWG. NO.

PIP-2



NOTES:

1. MEGA-LUG CONNECTIONS SHALL NOT BE USED ON HDPE PIPE. CONTRACTOR SHALL FOLLOW HDPE PIPE MANUFACTURER'S RECOMMENDATIONS FOR CONNECTION.
2. ENGINEER TO PROVIDE RESTRAINT DISTANCE BASED ON SITE CONDITIONS.
3. CONTRACTOR MAY UTILIZE HDPE FLANGE ADAPTER.

DATE JUNE 2008
LCWA/TOL

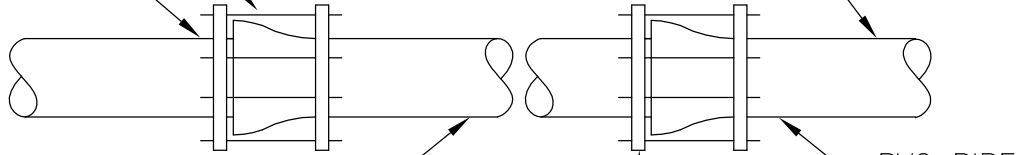
HDPE TO DUCTILE IRON
PIPE TRANSITION

DRWG. NO. PIP-3

PVC CONNECTION
WITH RESTRAINT

HDPE PIPE

PVC PIPE SHALL BE RESTRAINED FOR _____ LF
WITH RESTRAINT HARNESSING. TYPICAL FOR EACH
HDPE TO PVC CONNECTION



PVC PUSH ON JOINT PIPE

RESTRAINT HARNESS (TYP)

NOTES:

1. MEGA-LUG CONNECTIONS SHALL NOT BE USED ON HDPE PIPE. CONTRACTOR SHALL FOLLOW HDPE PIPE MANUFACTURER'S RECOMMENDATIONS FOR CONNECTION.
2. ENGINEER TO PROVIDE RESTRAINT DISTANCE BASED ON SITE CONDITIONS.
3. CONTRACTOR MAY UTILIZE HDPE FLANGE ADAPTER.

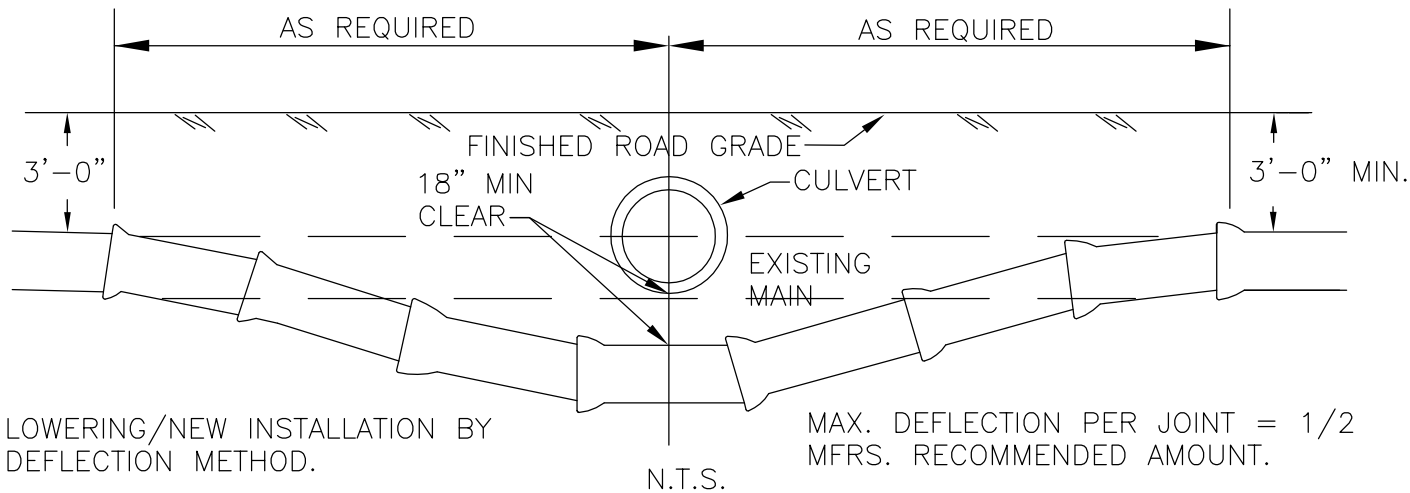
DATE
JUNE 2008

HDPE TO PVC
PIPE TRANSITION

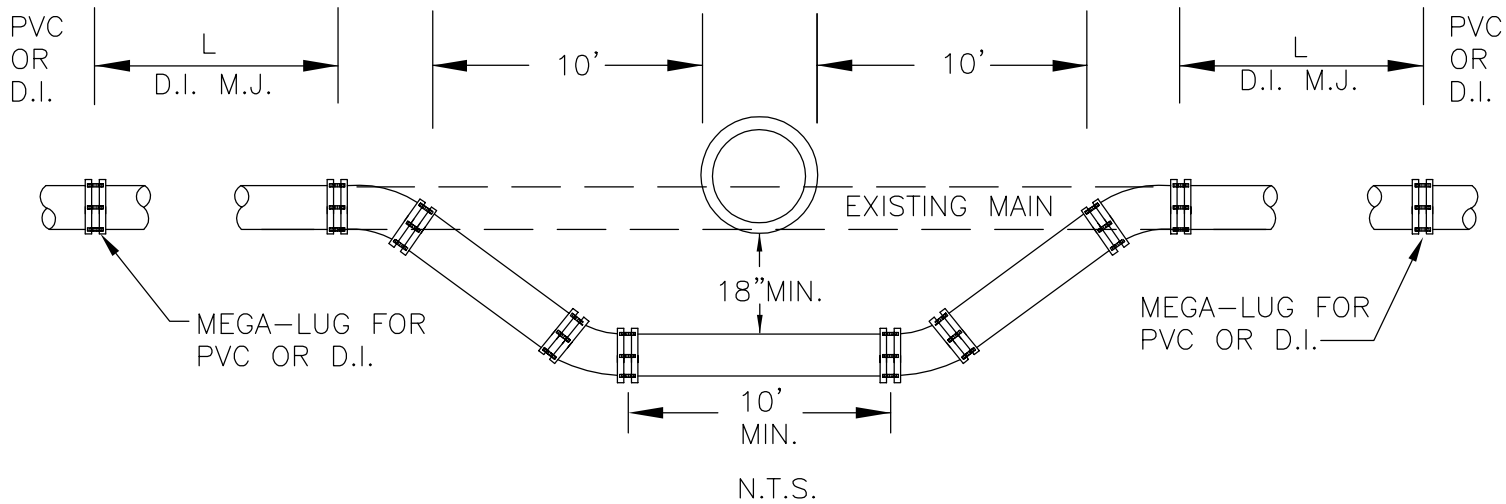
DRWG. NO.

PIP-4

LCWA/TOL



OR



NOTE:
 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.

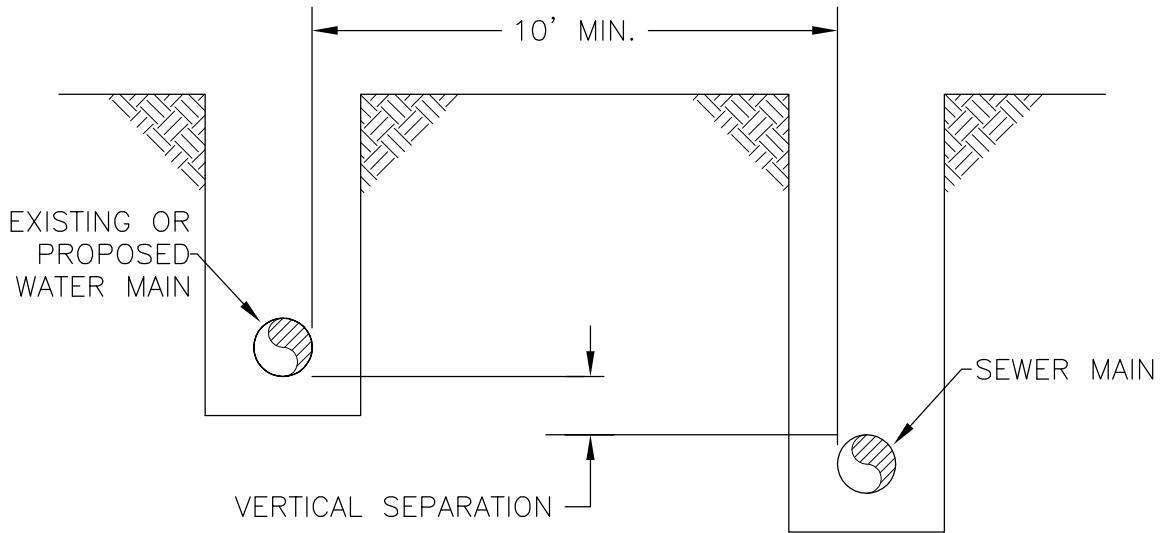
DATE
 JUNE 2008

LCWA/TOL

LOWERING WATER MAIN OR NEW INSTALLATION

DRWG. NO.
 PIP-5

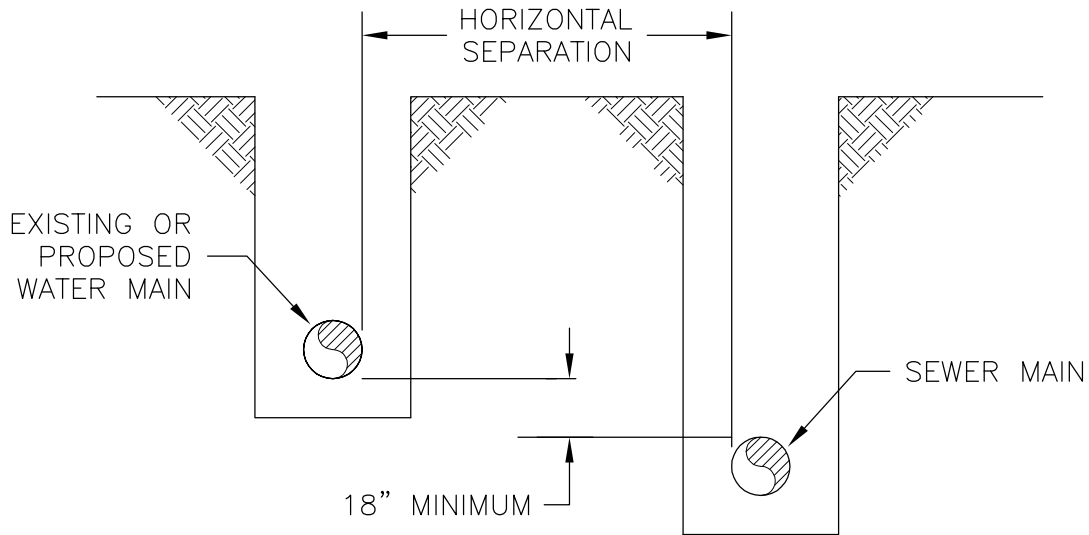
TYPICAL INSTALLATION
(MINIMUM 10' HORIZONTAL SEPARATION)
N.T.S.



NOTES:

1. THERE ARE NO VERTICAL SEPARATION REQUIREMENTS WHEN HORIZONTAL SEPARATION IS 10' OR GREATER.

INSTALLATION WHERE HORIZONTAL SEPARATION IS LESS THAN 10'
(USED ONLY WHEN LOCAL CONDITIONS PREVENT TYPICAL INSTALLATION)
N.T.S.



NOTES:

1. THE SEWER MUST BE LAID IN A SEPARATE TRENCH FROM THE WATER.
2. THE TOP OF THE SEWER MAIN MUST BE A MINIMUM OF 18" BELOW THE BOTTOM OF THE WATER MAIN.
3. WHERE THE MINIMUM 18" SEPARATION CANNOT BE OBTAINED, THE SEWER SHALL BE CONSTRUCTED OF PRESSURE TYPE PIPE AND SHALL BE PRESSURE TESTED IN PLACE TO 50 PSI PRIOR TO BACKFILLING.
4. SANITARY MANHOLES SHALL HAVE 10 FEET HORIZONTAL SEPARATION FROM THE WATER.

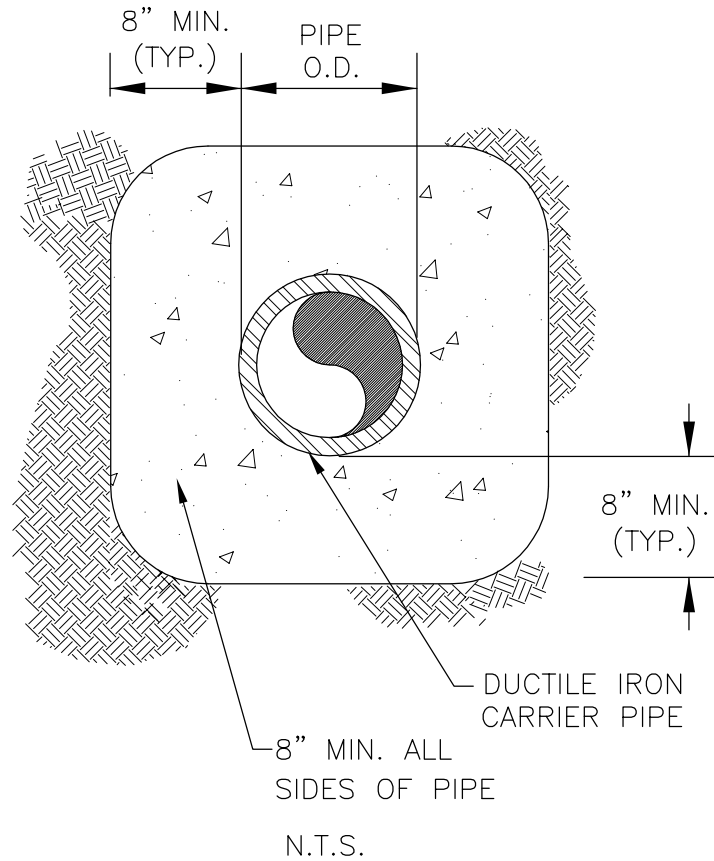
DATE
JUNE 2008

WATER AND SEWER
SEPARATION

LCWA/TOL

DRWG. NO.

PIP-6



NOTES:

1. CONTRACTOR SHALL PROTECT PIPE JOINTS AS NECESSARY FOR PORTIONS ENCASED.
2. CONTRACTOR SHALL USE VIBRATORY METHOD TO ENSURE COMPLETE ENCASEMENT.
3. FLOTATION OF THE PIPE DURING CONCRETE PLACEMENT SHALL BE PREVENTED.
4. ALL PIPE LINES INSTALLED UNDER STREAMS SHALL TEST ZERO INFILTRATION.

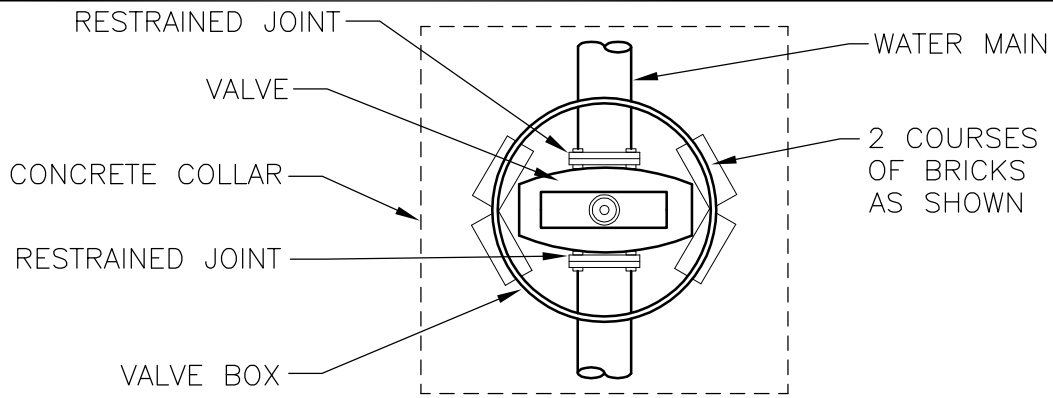
DATE
JUNE 2008

LCWA/TOL

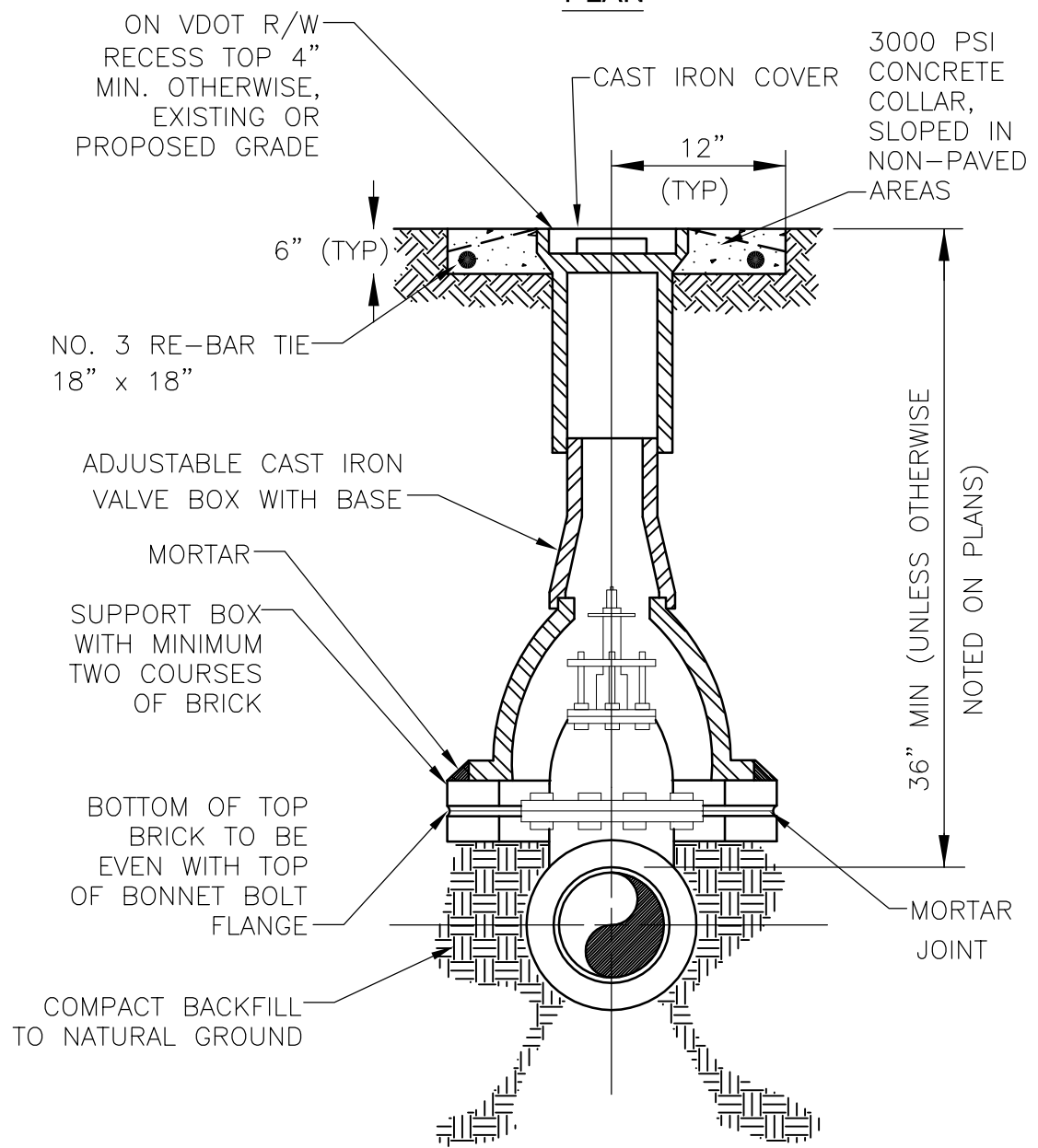
CONCRETE ENCASEMENT OF PIPE

DRWG. NO.

PIP-7



PLAN



SECTION

NOTE:
ALL VALVES AND FITTINGS SHALL HAVE STAINLESS STEEL TIE RODS.

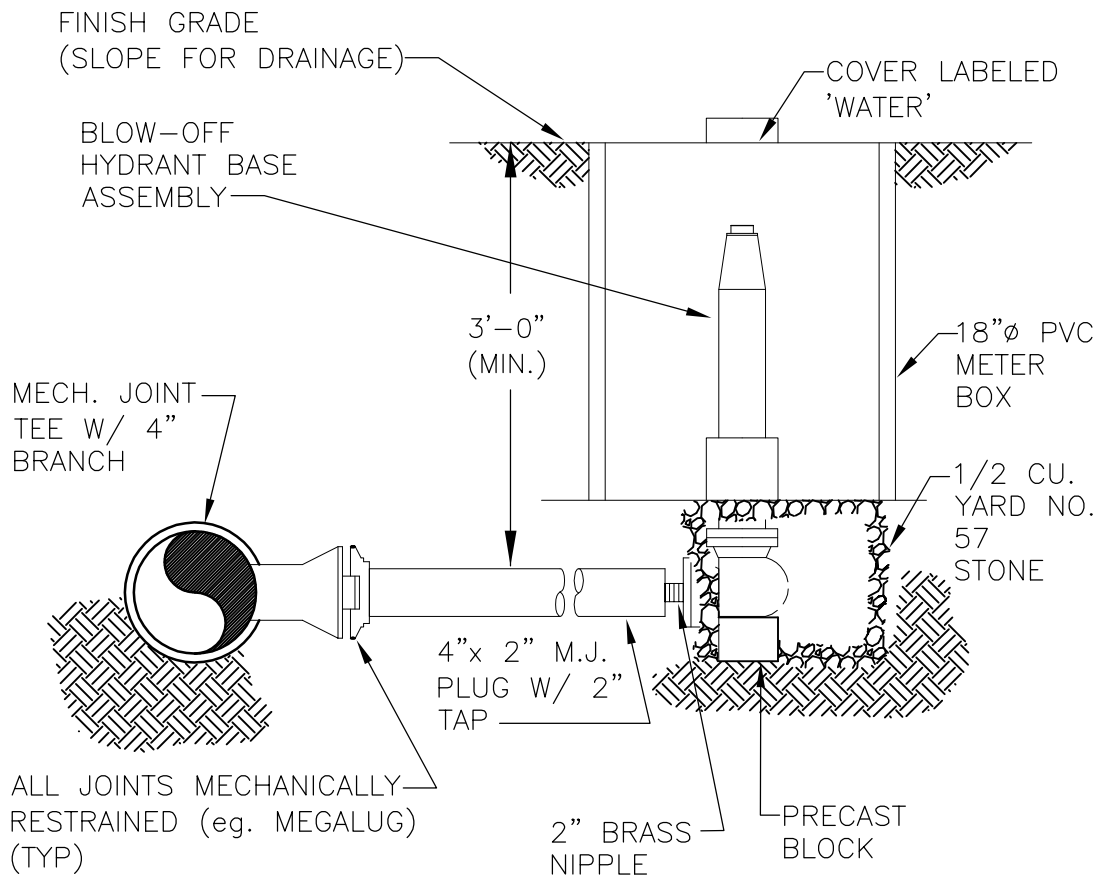
DATE
JUNE 2008

LCWA/TOL

TYPICAL VALVE SETTING DETAIL

DRWG. NO.

WAT-1



NOTES:

1. ALL JOINTS SHALL BE MECHANICALLY RESTRAINED (eg. MEGALUG)
2. ALL SUPPORTING CONCRETE SHALL BE 3000 PSI.
3. CONTRACTOR SHALL PROVIDE FLUSHING/SAMPLING HYDRANT THAT IS MODEL 2000-B AS MANUFACTURED BY KUPFERLE FOUNDRY, OR APPROVED EQUAL.
4. IF HIGH WATER TABLE IS ENCOUNTERED DURING INSTALLATION, CONTRACTOR SHALL NOTIFY ENGINEER AND OWNER IMMEDIATELY TO COORDINATE POSSIBLE RELOCATION OF BLOW-OFF HYDRANT (PER VDH WATERWORKS REGULATIONS 12 VAC 5-590-1160)

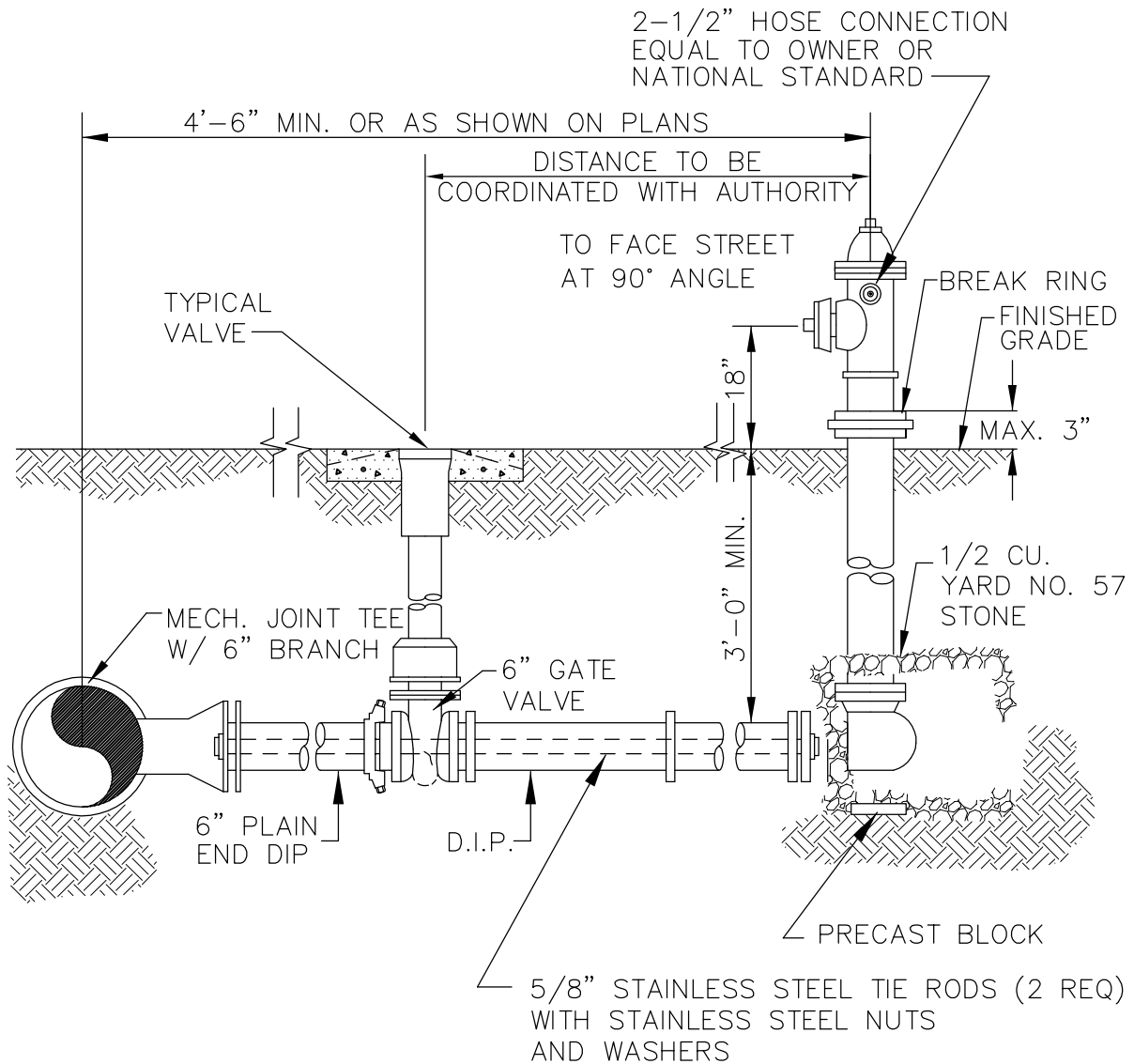
DATE
JUNE 2008

FLUSHING HYDRANT
(BLOW-OFF)

DRWG. NO.

WAT-2

LCWA/TOL



NOTES:

1. ALL SUPPORTING CONCRETE SHALL BE 3000 PSI.
2. ALL JOINTS MECHANICALLY RESTRAINED (eg. MEGALUG).
3. FIRE HYDRANT SHALL BE KENNEDY OR MUELLER FOR LCWA AND KENNEDY FOR TOL.
4. IF HIGH WATER TABLE IS ENCOUNTERED DURING INSTALLATION, CONTRACTOR SHALL NOTIFY ENGINEER AND OWNER IMMEDIATELY TO COORDINATE POSSIBLE RELOCATION OF FIRE HYDRANT (PER VDH WATERWORKS REGULATIONS 12 VAC 5-590-1160)

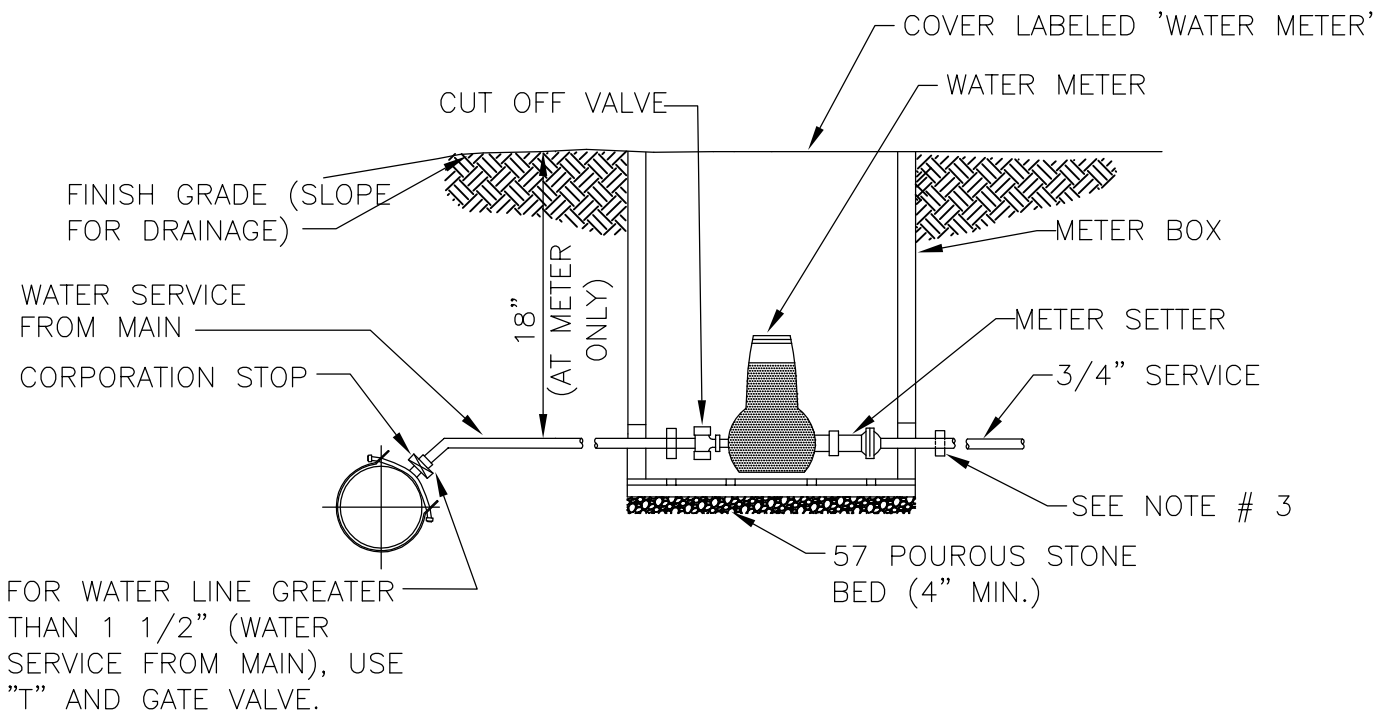
DATE
JUNE 2008

LCWA/TOL

TYPICAL FIRE HYDRANT ASSEMBLY

DRWG. NO.

WAT-3



NOTES:

1. METER SHALL BE MOUNTED SUCH THAT IT CAN BE EASILY READ FROM GRADE LEVEL.
2. FOR METER ON EXISTING SERVICE CONTRACTOR, SHALL PROVIDE ALL FITTINGS AND PIPE REQUIRED TO MAKE CONNECTION.
3. INSTALL DIELECTRIC COUPLING EQUAL TO WATTS SERIES 3000 WHEN CONNECTING TO EXISTING SERVICE.

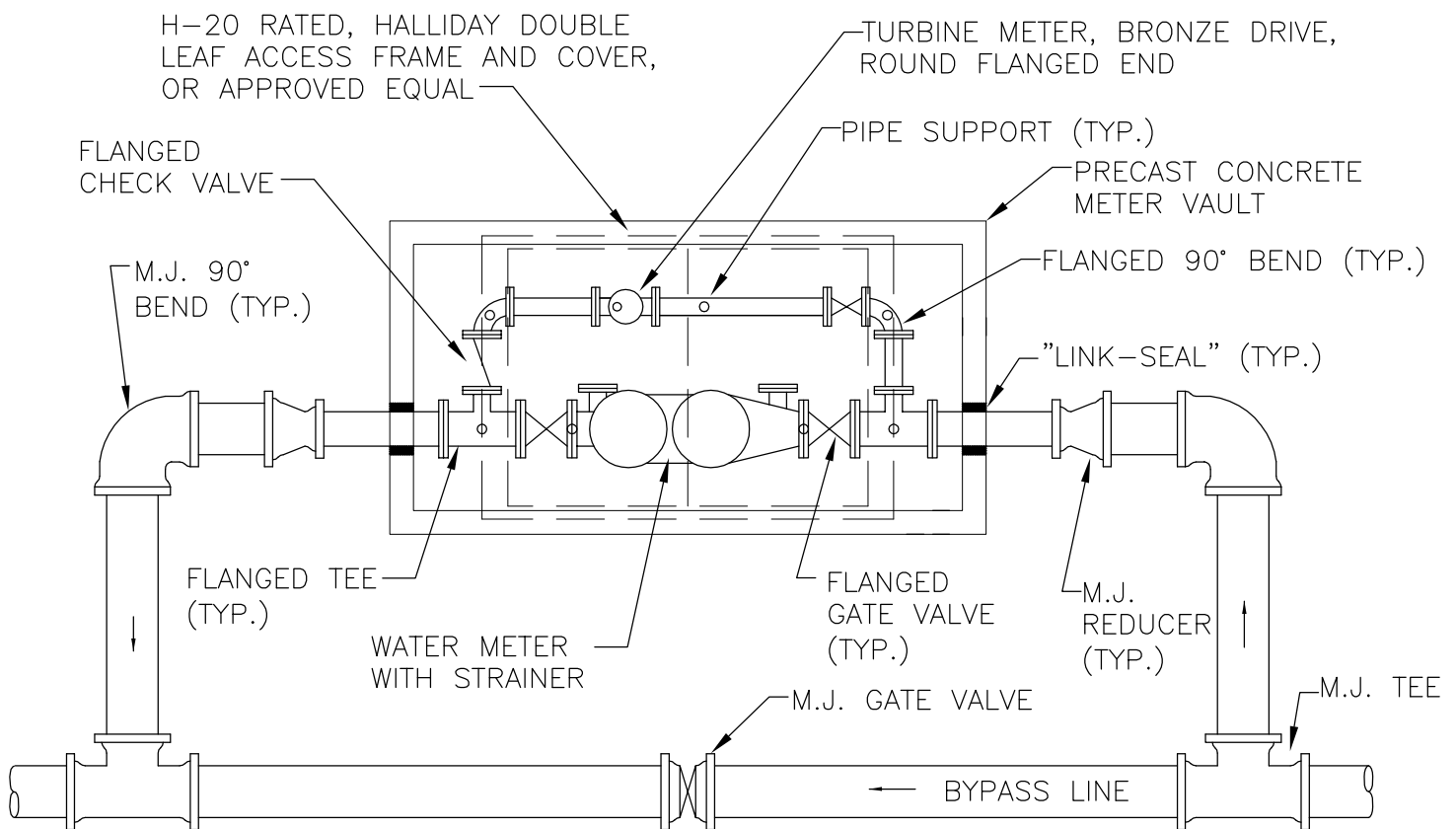
DATE
JUNE 2008

WATER METER SETTING

DRWG. NO.

LCWA/TOL

WAT-4



NOTE:

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.

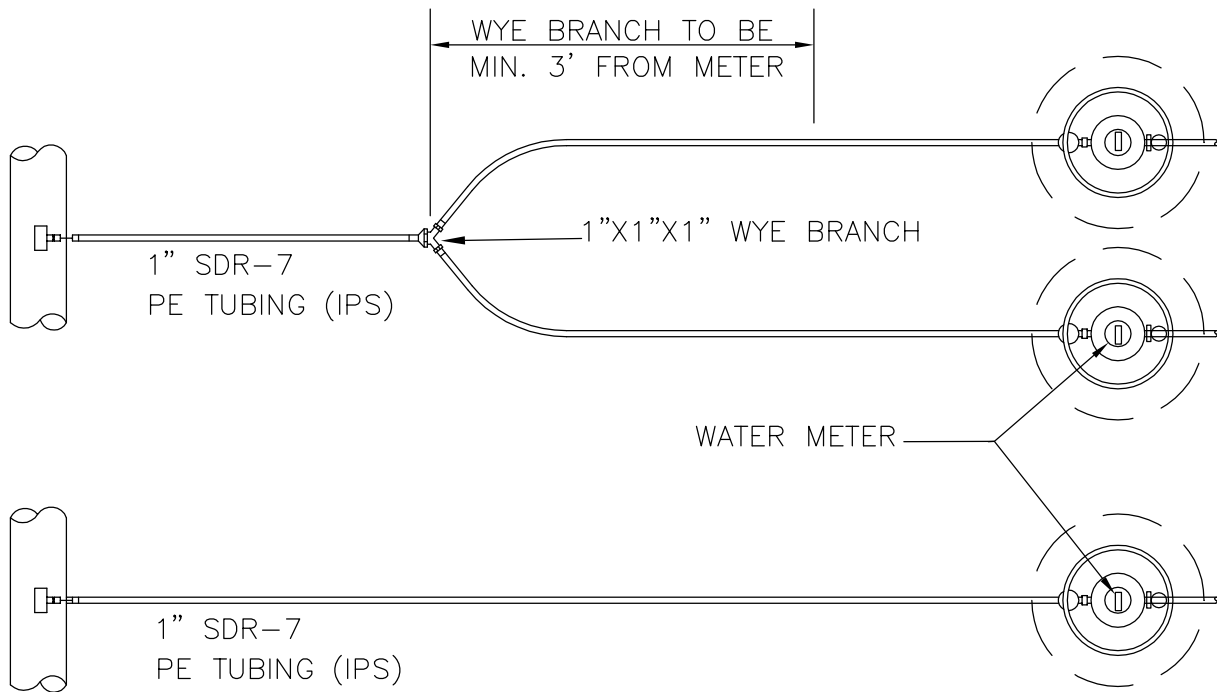
DATE
JUNE 2008

LCWA/TOL

TYPICAL MASTER METER VAULT

DRWG. NO.

WAT-5



NOTE:
ALL WATER SERVICES IN VDOT ROADWAY SHALL BE PLACED IN CASINGS.

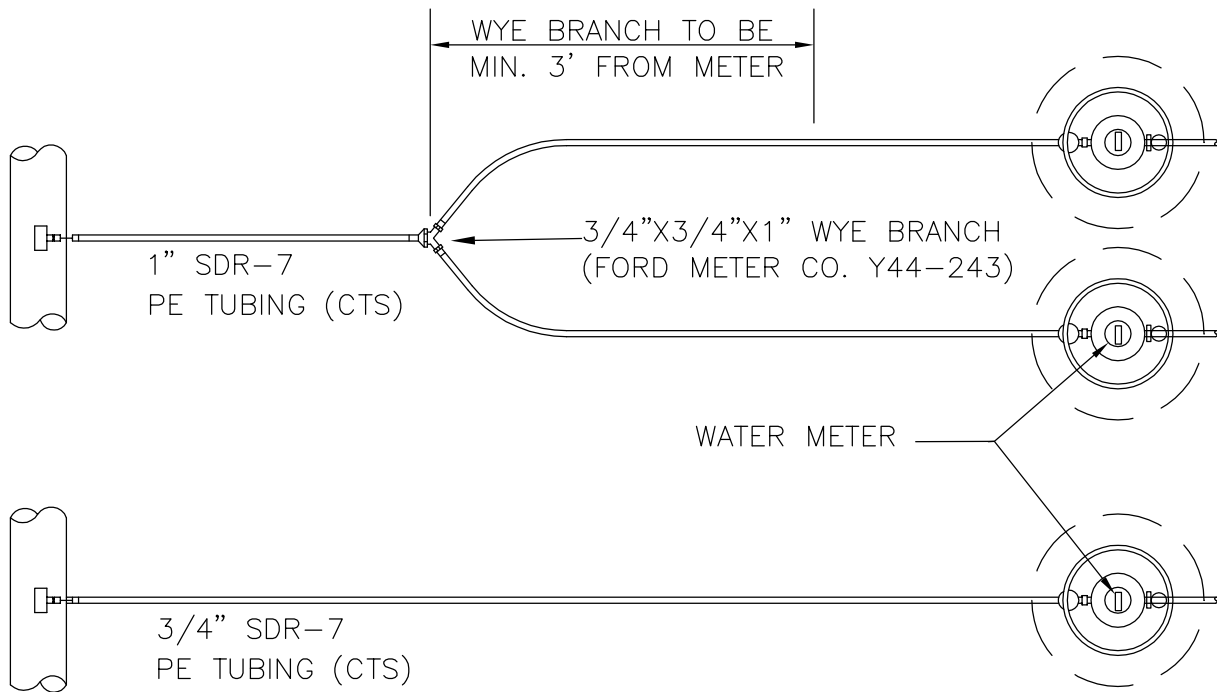
DATE
JUNE 2008

LCWA

LCWA - TYPICAL $\frac{3}{4}$ " WATER
METER SERVICE CONNECTION

DRWG. NO.

WAT-6



NOTE:
ALL WATER SERVICES IN VDOT ROADWAY SHALL BE PLACED IN CASINGS.

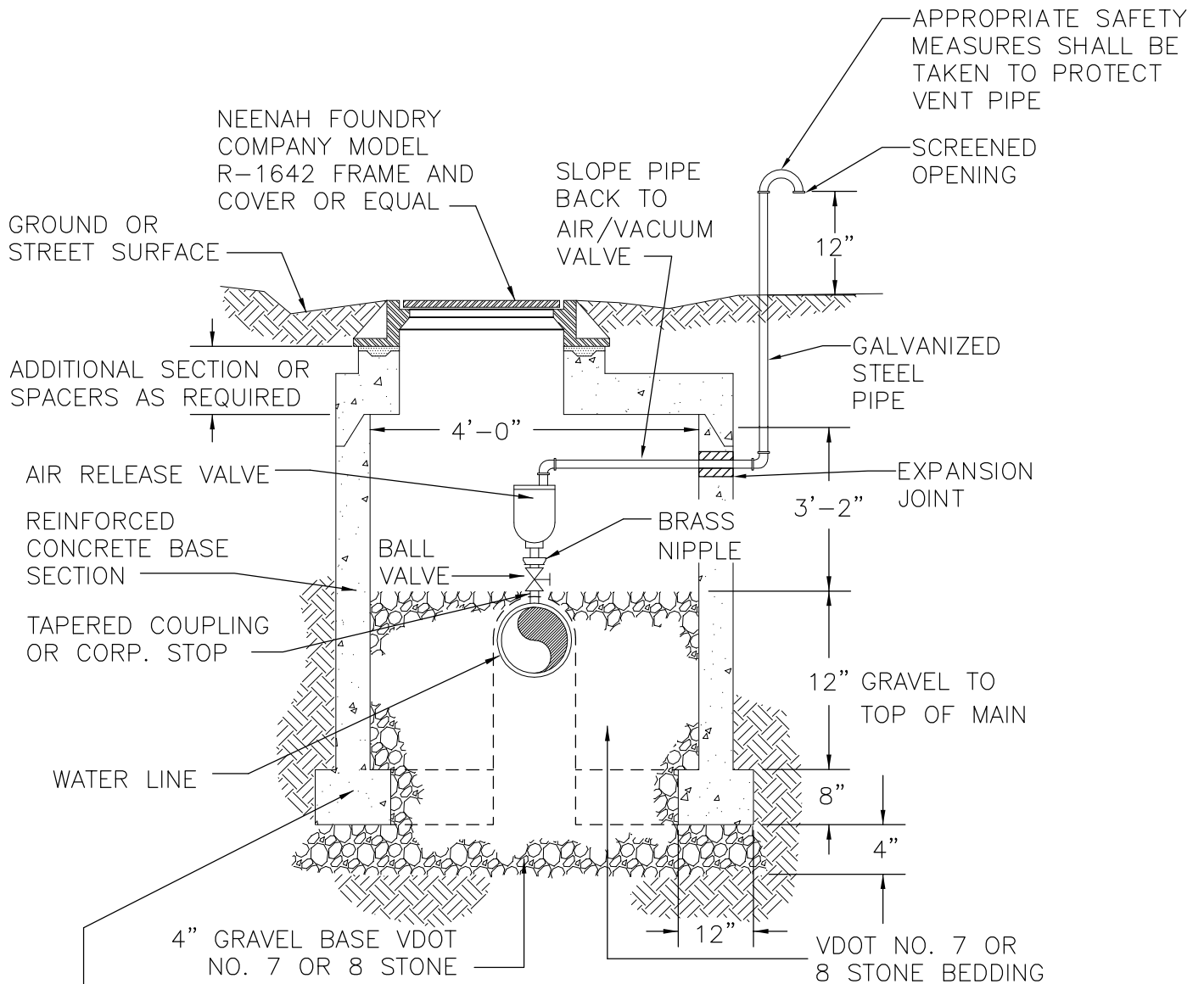
DATE
JUNE 2008

TOL

TOL - TYPICAL $\frac{3}{4}$ " WATER
METER SERVICE CONNECTION

DRWG. NO.

WAT-7



PLACE CONCRETE BLOCK ASTM C-139, OR POUR 12"X8" CONCRETE RING FOOTING TO SUPPORT CHAMBER, BUT LEAVE OPENING BELOW PIPE. FILL SPACE INSIDE RING WITH CLEAN GRAVEL FOR DRAINAGE. ELIMINATE CONCRETE FOOTING IF SOLID ROCK IS ENCOUNTERED.

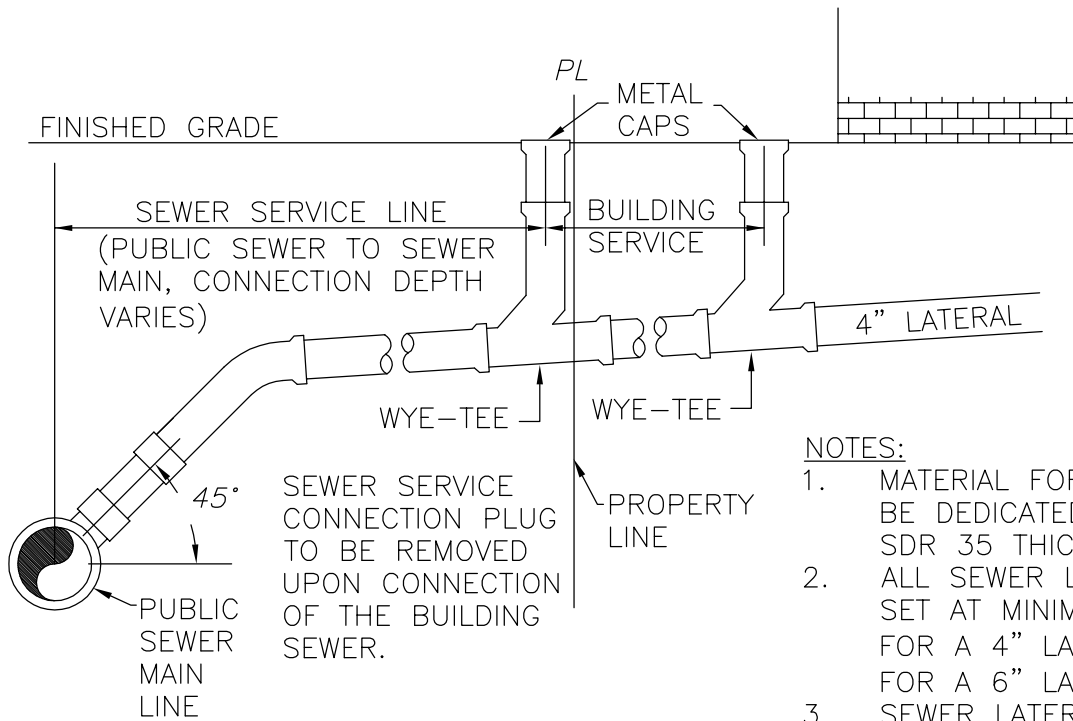
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DATE
JUNE 2008

LCWA/TOL

AIR RELEASE VALVE

DRWG. NO.
WAT-8

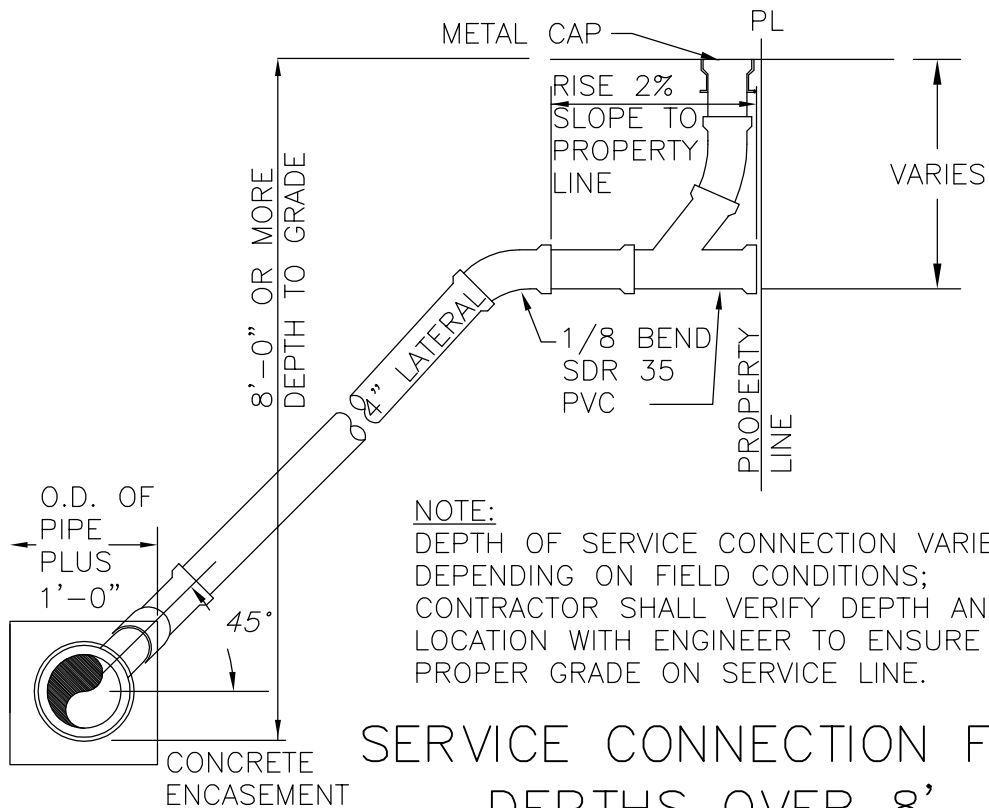


NOTES:

1. MATERIAL FOR LATERALS TO BE DEDICATED SHALL BE SDR 35 THICK WALL.
2. ALL SEWER LINES SHALL BE SET AT MINIMUM 2% SLOPE FOR A 4" LATERAL AND 1% FOR A 6" LATERAL.
3. SEWER LATERAL TO BE SET IN 4" MIN. OF 57 STONE.

TYP. SERVICE CONNECTION

N.T.S.



SERVICE CONNECTION FOR
DEPTHS OVER 8'

N.T.S.

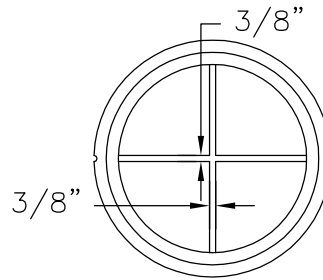
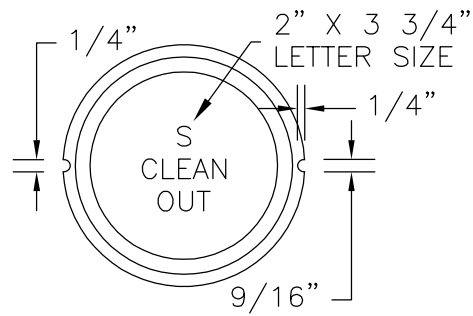
DATE
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LCWA/TOL

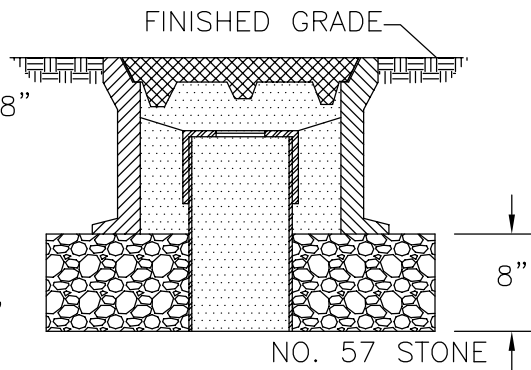
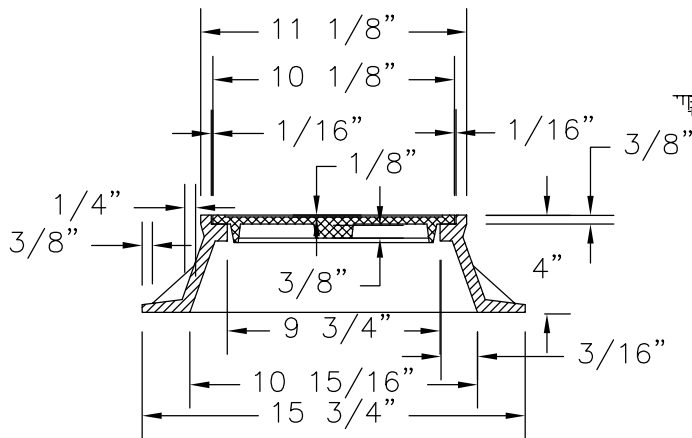
SANITARY SEWER
SERVICE CONNECTION

DRWG. NO.

SEW-1



BOTTOM VIEW OF COVER



N.T.S.

NOTE:
CLEAN-OUT COVER ASSEMBLY SHALL BE TRAFFIC RATED.

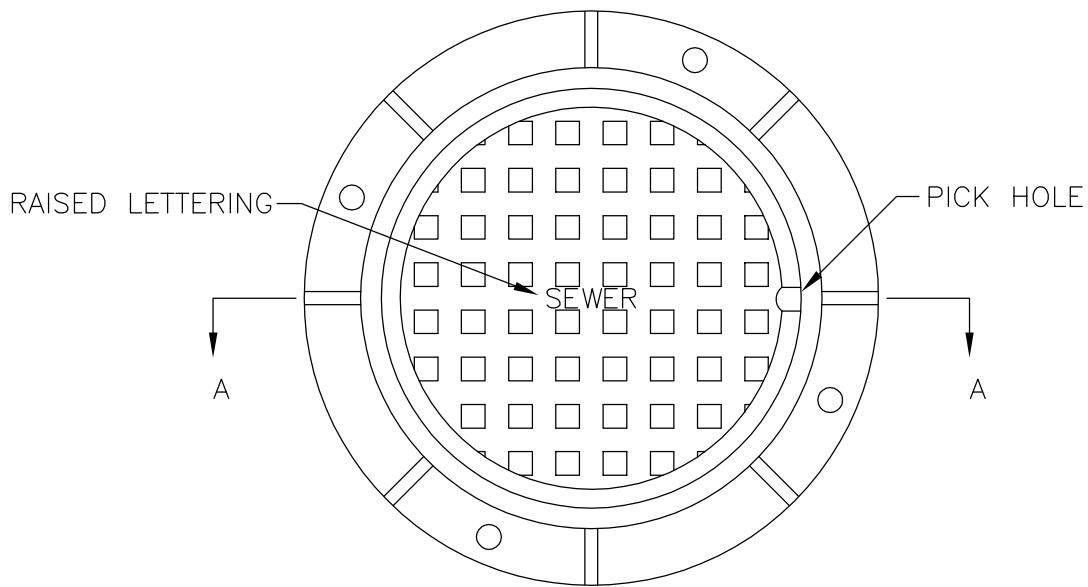
CLEAN-OUT COVER
ASSEMBLY

DATE
JUNE 2008

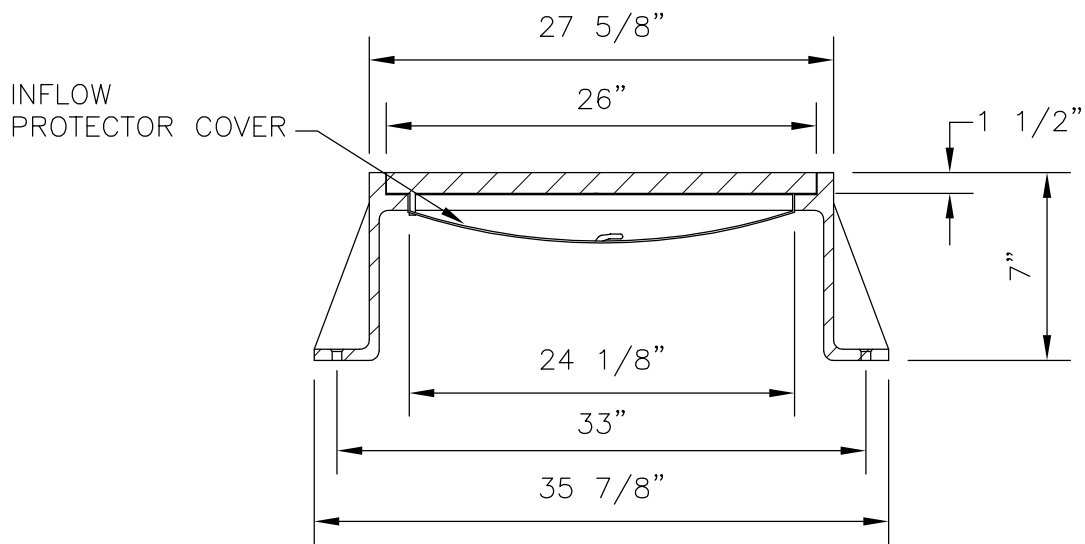
LCWA/TOL

DRWG. NO.

SEW-2



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 $1/8'' \pm$.
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.

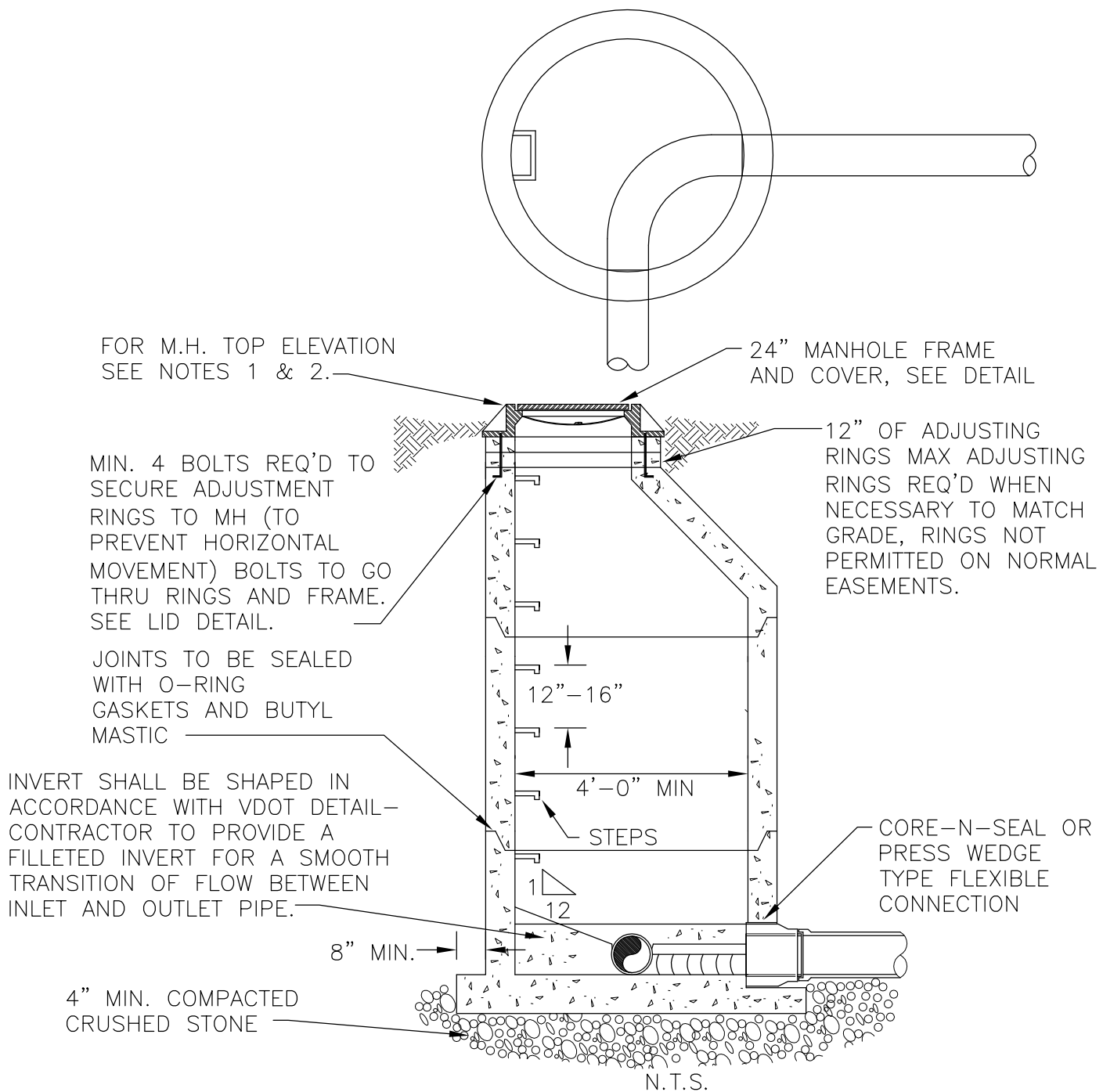
DATE
JUNE 2008

STANDARD MANHOLE FRAME & COVER

DRWG. NO.

LCWA/TOL

MAN-1



NOTES:

1. THE TOP ELEVATION OF THE FRAME & COVER SHALL BE SET BY THE FOLLOWING CONDITIONS UNLESS NOTED ON PLANS:
 - a) FLUSH WITH GRADE IN UNPAVED SHOULDER OF ROAD.
 - b) FLUSH WITH GRADE IN PAVED AREAS.
 - c) 12"-18" ABOVE GRADE IN EASEMENTS.
2. USE ECCENTRIC TAPER TOP. USE OF A FLAT SLAB TOP MUST BE APPROVED BY OWNER AND ENGINEER.
3. BEDDING THICKNESS REQUIREMENTS SHOWN ARE MINIMUM AND SHALL BE SPECIFICALLY DETERMINED BY THE CONSULTANT FOR THE SOIL CONDITIONS.
4. ALL JOINTS, LIFT HOLES, INLETS, OUTLETS TO BE SEALED WITH NON-SHRINK GROUTED INSIDE & OUT. THE EXTERIOR OF SANITARY MH'S SHALL BE WATERPROOFED USING BITUMASTIC WATER PROOFING.

DATE
JUNE 2008

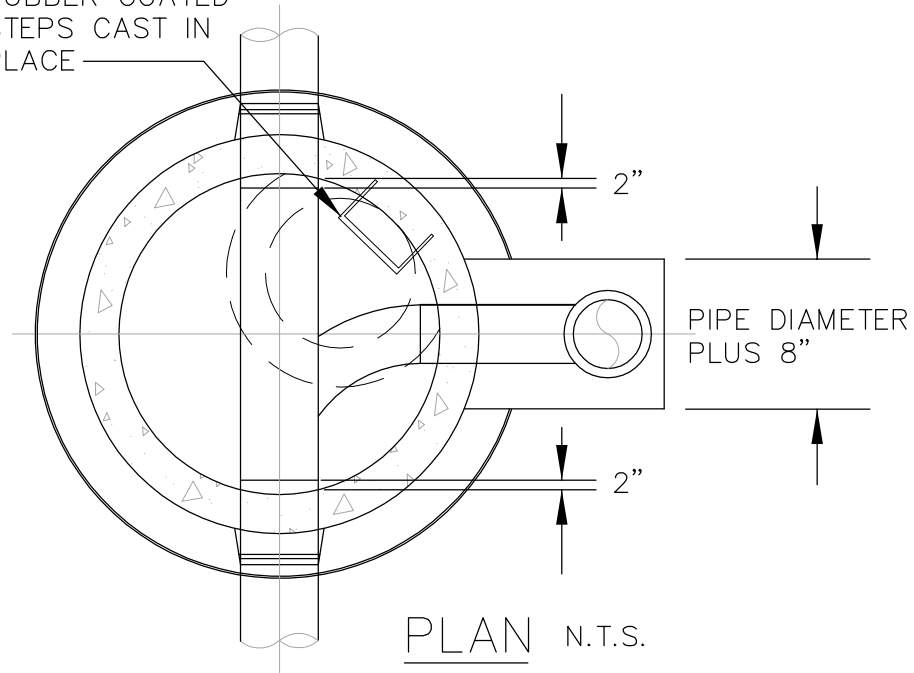
LCWA/TOL

PRECAST MANHOLE

DRWG. NO.

MAN-2

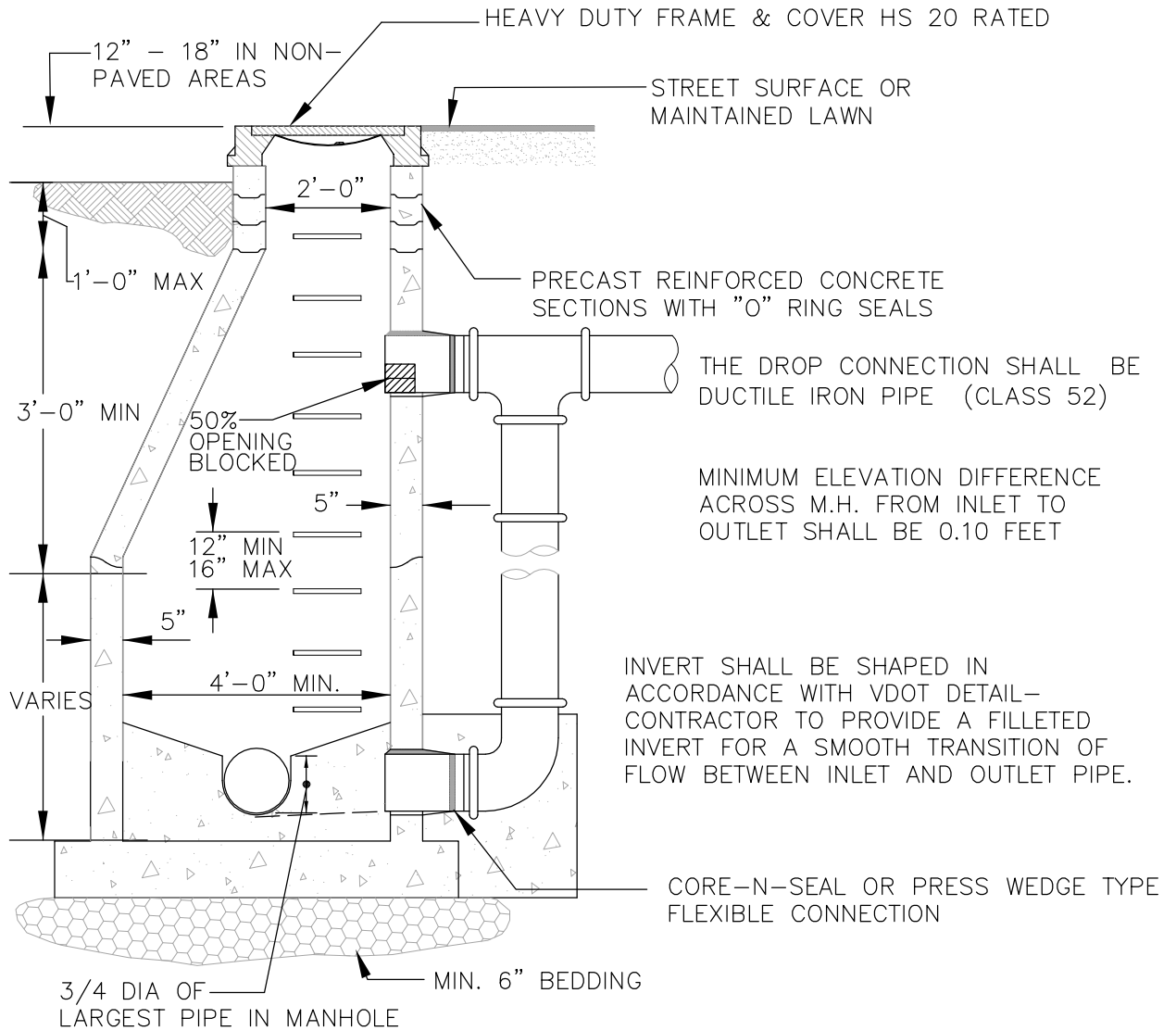
RUBBER COATED STEPS CAST IN PLACE



PLAN N.T.S.

BEDDING THICKNESS REQUIREMENTS SHOWN ARE MINIMUM AND SHALL BE SPECIFICALLY DETERMINED BY THE CONSULTANT FOR THE SOIL CONDITIONS

ALL JOINTS, LIFT HOLES, INLETS, OUTLETS TO BE SEALED WITH NON-SHRINK GROUTED INSIDE & OUT. THE EXTERIOR OF SANITARY MH'S SHALL BE WATERPROOFED USING BITUMASTIC WATER PROOFING.



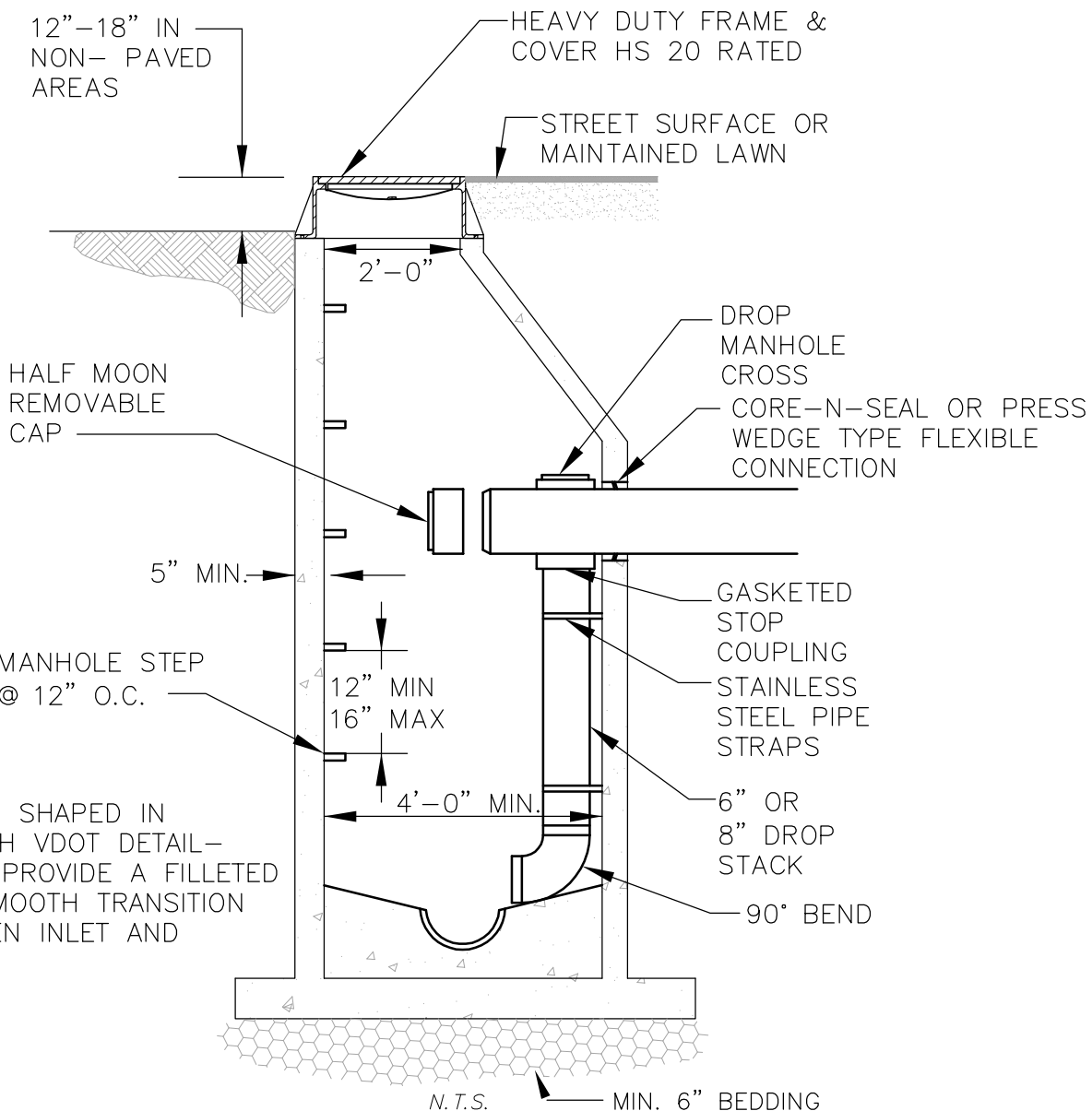
PROFILE N.T.S.

DATE
JUNE 2008

LCWA/TOL

PRECAST DROP MANHOLE

DRWG. NO.
MAN-3



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.

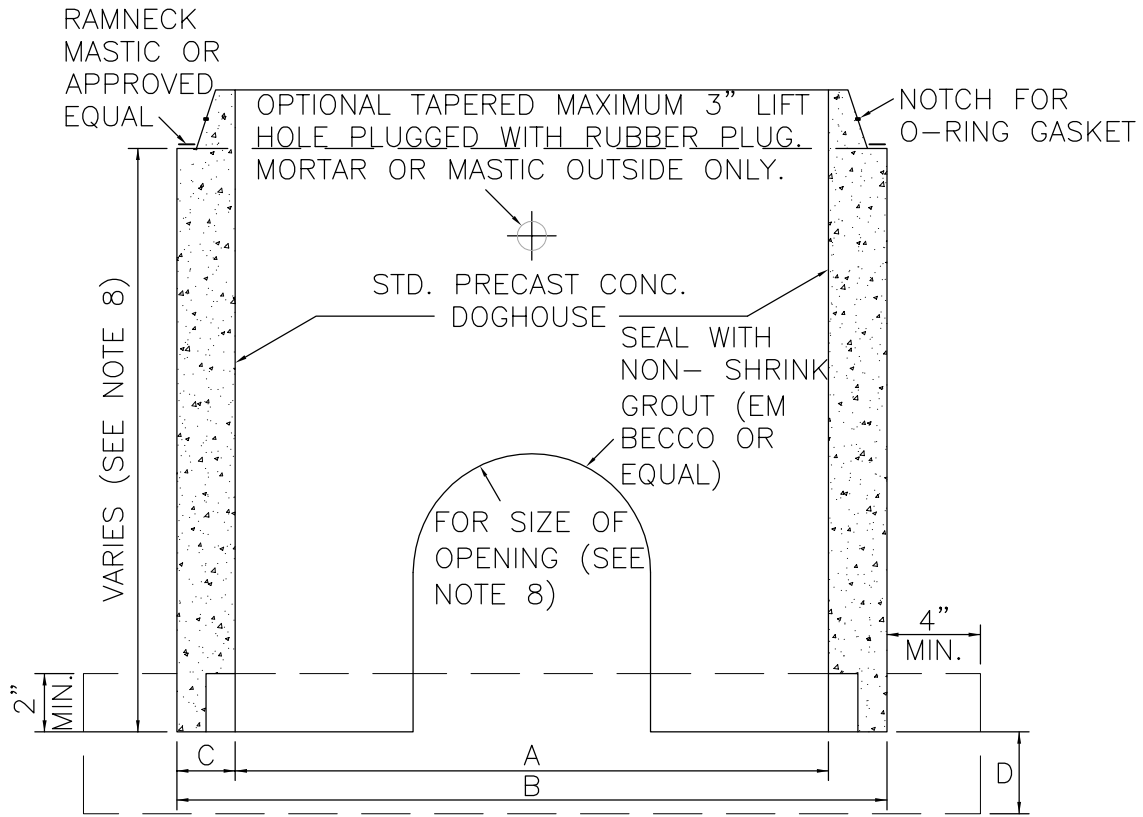
NOTE:
 PRECAST INSIDE DROP MANHOLE SHALL ONLY BE USED WHEN APPROVED IN ADVANCE BY OWNER.

DATE
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LCWA/TOL

PRECAST INSIDE DROP MANHOLE

DRWG. NO.
 MAN-4



PRECAST CONCRETE MANHOLE DOGHOUSE BASE

CHART "A"

N. T. S.

MINIMUM DIMENSIONS			
MH	4'-0"	5'-0"	6'-0"
A	48"	60"	72"
B	58"	72"	86"
C	5"	6"	7"
D	6"	8"	10"

DIMENSIONS OF "D" SHALL BE TAKEN
FROM BOTTOM OF KEY (SEE DRAWING)

NOTES:

1. CONCRETE TO BE CLASS "C"
2. ALL REINFORCING TO MEET REQUIREMENTS OF CURRENT A.S.T.M. SPECIFICATION C-478.
3. MANHOLE SECTIONS TO MEET REQUIREMENTS OF CURRENT A.S.T.M. SPECIFICATION C-478.
4. TAPERED JOINT WITH O-RING GASKET TO MEET CURRENT A.S.T.M. SPECIFICATION C-361.
5. DOGHOUSE OPENING ONLY BE USED WHEN PLACING A NEW MANHOLE OVER AN EXISTING LINE; OTHERWISE, THE OPENING MUST BE CAST. SIZE, LOCATION AND ANGLE OF ENTRY SHALL BE AS REQUIRED BY THE PLANS.
6. JOINT CONFIGURATION MAY BE CAST BELL-UP OR SPIGOT-UP.
7. HOLES IN PRECAST UNITS ARE TO BE 4" MIN. TO 8" MAX. LARGER THAN THE OUTSIDE DIAMETER OF THE PROPOSED PIPE.
8. BASE SECTION TO PROVIDE 6" MIN. CLEARANCE BETWEEN TOP OF PIPE OPENING AND BOTTOM OF BELL AND SPIGOT JOINT.

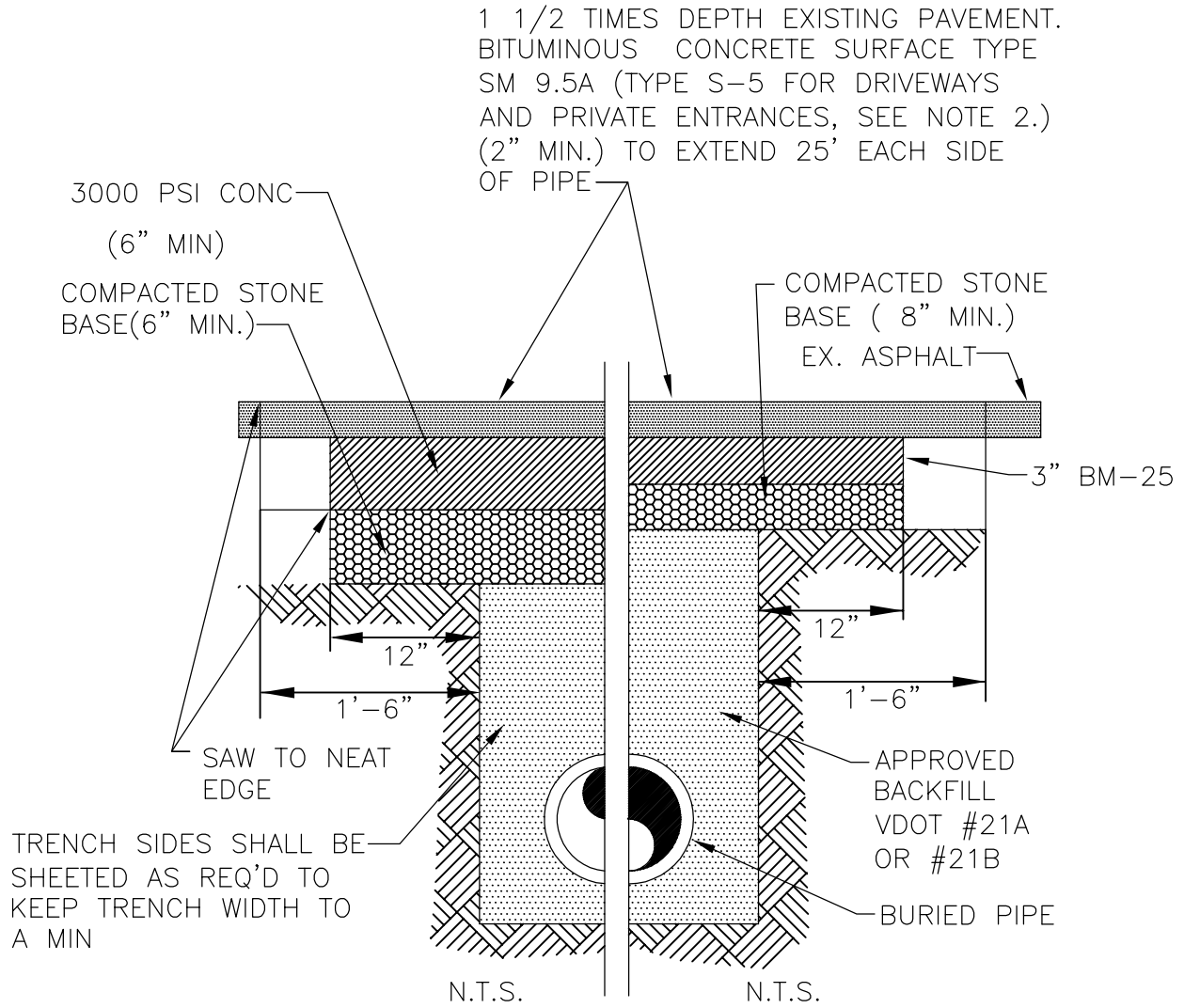
DATE
JUNE 2008

LCWA/TOL

PRECAST DOG HOUSE MANHOLE

DRWG. NO.

MAN-5



VDOT PAVEMENTS AND
 ASPHALT OVER CONCRETE

VDOT PAVEMENTS AND
 ASPHALT WITH BASE

NOTES:

- 1) ALL PAVED SURFACES OWNED BY THE STATE SHALL BE RESURFACED 25' EACH SIDE OF CUT, AS PER V.D.O.T. SPECIFICATIONS
- 2) THIS DETAIL ALSO APPLIES TO ALL PAVED DRIVEWAYS AND ENTRANCES-EXCLUDING 25' RESURFACING EACH WAY.
- 3) WHERE EXISTING SURFACE IS GRAVEL, REPLACEMENT SURFACE TO BE CRUSHER RUN STONE NO. 25.

DATE
 JUNE 2008

LCWA/TOL

OPEN CUT ROAD AND
 PAVEMENT REPAIR

DRWG. NO.

RD-1

GENERAL:

All waterlines shall be disinfected prior to being placed in operation. Prior to disinfection all waterlines shall be flushed unless the tablet method of disinfection is used. All valves and hydrants shall be operated during this operation. Flushing velocities shall not be less than 2.5 ft./sec. If ductile iron pipe is being used, the water used to disinfect the waterline should not remain in contact with the waterline for more than 24 hours.

Methods of Chlorine Application

Continuous Feed Method – Potable water shall be introduced into the pipe line at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/l. The chlorinated water shall remain in the pipe line at least 24 hours, after which, the chlorine concentration in the water shall be at least 10mg/l. All valves and appurtenances shall be operated while the chlorinated water remains in the pipe line.

Slug Method – Potable water shall be introduced into the pipe line at a constant flow rate. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/l in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the pipe are exposed to the 100 mg/l chlorine solution for at least 3 hours. The chlorine residual shall be checked at regular intervals not to exceed 2,000 feet to insure that adequate disinfection is occurring. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances.

Tablet Method – This method shall not be used if non-potable water or foreign material have entered the lines or if the water temperature is below 5°C (41°F). The tablets shall be placed in each pipe section and in all appurtenances. Enough tablets shall be used to insure that a chlorine concentration of 25mg/l is provided in the water. They shall be attached by an adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The adhesive shall be approved by the Engineer. The velocity of the potable water in the pipe line shall be less than 1 ft./sec. The water shall remain in contact with the pipe for 24 hours. All valves and appurtenances shall be operated while the chlorinated water is in the pipe.

Final Flushing – After the required retention period, the heavily chlorinated water shall be flushed from the pipe lines using potable water.

Testing – After the lines have been flushed, the waterlines shall be tested in the following methods:

All chlorine residual determinations shall be made using only these methods approved by the Virginia Department of Health. One approved method is the DPD Kit method.

Two water samples for bacteriological analysis must be collected at least 24 hours apart and analyzed by a certified laboratory. The results of these samples must indicate no contamination before the pipe, tanks or equipment can be utilized as part of the waterworks. If contamination is indicated, then the disinfection procedure must be repeated. Samples shall be collected at regular intervals, not exceeding 2,000 feet throughout the length of pipe line.

DATE JUNE 2008
LCWA/TOL

**WATERLINE
DISINFECTION**

DRWG. NO. TEST-1

TEST PROCEDURE:

A section of pipe shall be valved off. Each valved section of pipe shall be slowly filled with water, and the specified test pressure (150 psi or 1.5 time the working pressure at the point of testing, whichever is greater) shall be applied by means of a pump connected to the pipe. Before applying the specified test pressure, air shall be completely expelled from the pipe section being tested. The pipe section should be allowed to stabilize at the test pressure before conducting the leakage test. The test pressure shall not vary by more than ±5 psi for the duration of the test. Test duration shall be no less than 2 hours.

All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory results are obtained. All visible leaks are to be repaired regardless of the amount of leakage.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time. Acceptance shall be determined on the basis of allowable leakage. The allowable leakage for various pipe sizes at various test pressures is shown in Table 1. No pipe installation will be accepted if the leakage is greater than that determined by the following

formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

Where:

- L = allowable leakage, in gallons per hour
- S = length of pipe tested, in feet
- D = nominal diameter of the pipe, in inches
- P = average test pressure during the leakage test, in pounds per square inch (gauge)

TABLE 1 ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPE (GAL / HOUR)													
Avg. Test Pressure	Nominal Pipe Diameter (Inches)												
	3	4	6	8	10	12	14	15	18	20	24	30	36
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.38	1.66	1.84	2.21	2.76	3.31
175	0.30	0.40	0.60	0.79	0.99	1.19	1.39	1.49	1.79	1.99	2.38	2.98	3.58
200	0.32	0.42	0.64	0.85	1.06	1.27	1.49	1.59	1.91	2.12	2.55	3.19	3.82
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.69	2.03	2.25	2.70	3.38	4.05
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.78	2.14	2.37	2.85	3.56	4.27
275	0.37	0.50	0.75	1.00	1.25	1.49	1.74	1.87	2.24	2.49	2.99	3.73	4.48
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	1.95	2.34	2.60	3.12	3.90	4.68
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.11	2.53	2.81	3.37	4.21	5.06
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.25	2.70	3.00	3.60	4.50	5.41
450	0.48	0.64	0.96	1.27	1.59	1.91	2.23	2.39	2.87	3.19	3.82	4.78	5.73

Note: If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

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LCWA/TOL

PRESSURE LINE –
ALLOWABLE LEAKAGE

DRWG. NO.
TEST-2

TEST PROCEDURE:

A section of pipe shall be sealed at both ends with plugs. Air shall be introduced into the plugs to 25 psi. Air shall be introduced into the sealed pipe to a pressure of 9 psi. The plugs shall withstand the pressure without bracing or movement. The line shall be allowed to stabilize for 2 minutes after pressurization. After the pressure has stabilized, the air pressure shall be decreased slowly to 3.5 psi and the timing shall commence. The time for the pressure to drop 1 psi from 3.5 psi shall be recorded. The minimal acceptable time durations are shown on Table 1. If the elapsed time to drop 1 psi is less than that shown on Table 1, then the air loss shall be considered excessive and the section of pipe has failed the test.

TABLE 1
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

PART 1A							
Pipe Diameter (in.)	Minimum Time (min : sec)	Length for Minimum Time (ft.)	Time for Longer Length (sec.)	Specification Time for			
				100'	150'	200'	250'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12

PART 1B							
Pipe Diameter (in.)	Minimum Time (min : sec)	Length for Minimum Time (ft.)	Time for Longer Length (sec.)	Specification Time for			
				300'	350'	400'	450'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	106:57	124:38	142:26	160:15
33	31:10	72	25.852 L	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	153:50	179:29	205:07	230:46

DATE
JUNE 2008

LCWA/TOL

SEWER LINE AIR TEST

DRWG. NO.

TEST-3

TEST PROCEDURE:

A vacuum test shall be performed by drawing a vacuum in the manhole to 10 inches Mercury vacuum. A manhole will pass the test if the time to drop to 9 inches of Mercury meets or exceeds the following values:

<u>MH HEIGHT</u>	<u>DIAMETER</u>	<u>TIME ALLOWED</u>
0' to 10'	4'	1 MIN 0 SEC
10' to 15'	4'	1 MIN 15 SEC
15' to 25'	4'	1 MIN 30 SEC

All waterproof frames and covers shall be tested in place. Manholes with standard frames and covers may be tested without the frame and cover. All pipes entering the manhole shall be plugged and braced. No person may be allowed inside the manhole during the test.

A plate with an inflatable rubber ring the size of the top of the manhole shall be installed by inflating the ring with air pressure adequate to prevent leakage of air between the rubber ring and manhole wall. Air shall then be pumped out of the manhole through an opening in the plate until vacuum is created inside the manhole equal to 10 inches of Mercury on an approved vacuum gauge. All equipment shall be recommended and used as recommended by their manhole supplier.

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MANHOLE VACUUM
TEST

LCWA/TOL

DRWG. NO.
TEST-4

TEST PROCEDURE:

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 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.

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

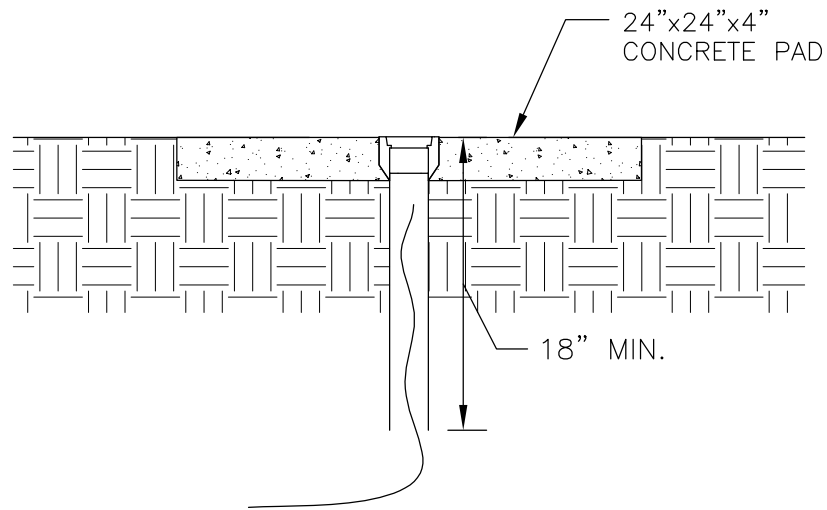
The test shall be made only under the supervision of the ENGINEER. The CONTRACTOR shall provide all equipment and perform all work required for the purposes.

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LCWA/TOL

DEFLECTION TEST FOR
PVC GRAVITY PIPE

DRWG. NO.
TEST-5



NOTES:

1. TEST BOX TO BE BINGHAM TAYLOR FIG. NO. 375, 2-1/2" SIZE OR EQUAL.
2. CONCRETE FOR PAD TO BE 3000 PSI CONCRETE.

N.T.S.

DATE
JUNE 2008

TEST STATION BOX

DRWG. NO.

LCWA/TOL

TEST-6