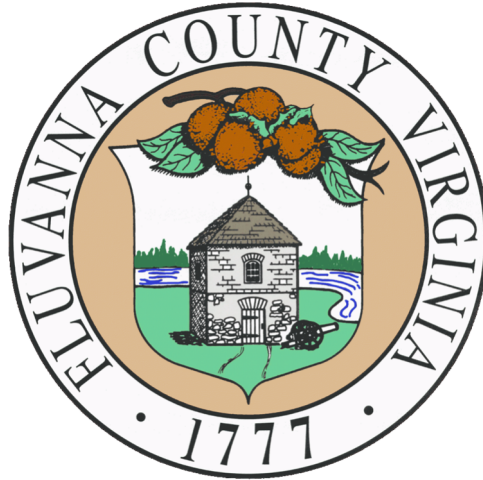


FLUVANNA COUNTY ZION CROSSROADS COMMUNITY WATERWORKS

UTILITY STANDARDS MANUAL



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Fluvanna County Utility Standards Manual

Table of Contents

1	General Conditions	1
1.01	Purpose and Authorization.....	1
1.02	Definitions and Abbreviations.....	1
1.03	Project Plans Review Process	3
1.04	Project Plans Submittal Requirements.....	3
1.05	Project Plans Preparation Requirements	4
1.06	Project Construction Requirements.....	6
1.07	Engineer’s Completion Statement & As-Built Drawings.....	7
1.08	Variances from USM Requirements.....	8
1.09	Easements and Plats	9
1.10	Applicable References	12
1.11	Preliminary Plan/Plat Preparation Requirements	12
1.12	Federal, State, and Local Approvals	13
1.13	Contractor Qualifications.....	13
1.14	Discrepancies	14
1.15	Correction of Work.....	14
1.16	Job Safety.....	15
1.17	Existing Structures.....	15
2	Water Supply Systems	15
2.01	General.....	15
2.02	Capacity and Fire Flows.....	16
2.03	Public Water Service Connections	19

2.04	Private Water Services	19
2.05	Large Meter Installations.....	19
2.06	Water-Only Accounts.....	20
2.07	Valve Boxes.....	20
2.08	Cross Connections.....	20
3	Water Supply Systems Design Parameters	21
3.01	General.....	21
3.02	Line Sizes	22
3.03	Depth of Cover.....	22
3.04	Intersections and Valve Locations.....	22
3.05	Separation of Water Facilities and Sanitary Sewers.....	22
3.06	Blow-Offs, Flushing Hydrants, and Air Releases.....	23
3.07	Hydraulic Design.....	24
3.08	Termination of Water Mains	26
3.09	Fire Hydrant Locations.....	26
3.10	Surface Water Crossing.....	27
3.11	Fire Lines.....	28
4	Water Supply Systems Construction	28
4.01	General Procedures.....	28
4.02	Excavation and Bedding and Backfill	28
4.03	Installation of Pipe.....	29
4.04	Line Location Markers.....	30
4.05	Installation of Fittings and Accessories	30
4.06	Installation of Valves	31

4.07	Installation of Hydrants	31
4.08	Above Water Crossing	32
4.09	Under Water Crossing	32
4.10	Crossings of Railroads, Major Roadways and Other Major Structures	33
4.11	Wet Taps	33
4.12	Testing.....	33
4.13	Disinfection of Water Mains	35
5	Water Supply System Materials and Standards - Pipe and Fittings	36
5.01	Pipe Materials	36
5.02	Pipe Fittings	38
5.03	Pipe Supports	38
5.04	Gate Valves	40
5.05	Butterfly Valves.....	40
5.06	Hydraulic Control Valves.....	40
5.07	Valve Boxes.....	40
5.08	Reduced Pressure Zone (RPZ) Backflow Preventer	41
5.09	Curb Boxes.....	41
5.10	Fire Hydrants	41
5.11	Automatic Air Release Valves.....	41
5.12	Pressure Gauges	41
5.13	Tracer Wire and Access Boxes	42
5.14	Service Saddles.....	42
5.15	Corporation Stops and Curb Stops	42
5.16	Water Meters	42

5.17	Construction Within Public Rights of Way	43
6	Sanitary Sewer Systems.....	43
6.01	General.....	43
6.02	Private Sewer Service.....	44
6.03	Relationship to Waterworks Structures	44
6.04	Vertical and Horizontal Separation from Other Utilities.....	44
6.05	Location of Sewers in Relation to Streams, Estuaries, Lakes and Reservoirs.....	44
6.06	Sewer-Only Accounts	44
6.07	Pretreatment.....	45
6.08	Grease Traps.....	45
6.09	Inverted Siphons.....	45
7	Gravity Sanitary Sewer Design Parameters.....	45
7.01	Tributary Population.....	45
7.02	Design Capacity.....	46
7.03	Hydraulic Design Criteria	46
7.04	Structural Design	48
7.05	Separation of Water Mains and Sanitary Sewers & Location of Sanitary Sewers.....	49
7.06	Location of Gravity Sewers	50
7.07	Water Crossings	52
7.08	Manholes	52
7.9	Water Tightness.....	54
7.10	Service Connections.....	54
7.11	Pipe Material Selection and Depth of Cover.....	54
7.12	Casings and Tunnels	56

7.13	Anchors	56
7.14	Force Main Service Connections	56
7.15	Private Building Sewer Connections	56
8	Sanitary Sewer System Construction.....	57
8.01	General.....	57
8.02	Excavation and Trenching.....	57
8.03	Pipe Embedment and Backfill	58
8.04	Pipe Installation	58
8.05	Bores and Tunneling.....	60
8.05	Service Connections	60
8.06	Private Building Sewers	60
8.07	Manholes	60
8.08	Pipe Connections at Manholes.....	61
8.09	Frames and Covers	61
8.10	Acceptance Tests	62
8.11	Force Main Testing	65
8.13	Coordination	65
8.14	Grades, Lines and Levels	66
8.15	Measurement and Payment – Classified Construction	66
9	Sewer System Materials and Standards - Pipe and Fittings	68
9.01	Pipe Materials	68
9.02	Pipe Fittings	69
9.03	Pipe Supports	70
9.04	Gate Valves	71

9.05	Plug Valves.....	71
9.06	Valve Boxes.....	71
9.07	Tracer Wire and Access Boxes.....	72
9.08	Automatic Air Release Valve.....	72
9.09	Manholes.....	72
9.10	Construction Within Public Rights of Way.....	73
9.11	Marker Posts.....	73
10	Sewage Pumping Stations and Force Mains.....	74
10.01	Sewage Pumping Stations.....	74
10.02	Force Mains.....	76
11	Supporting Construction.....	77
11.01	Driveways and Access Roads.....	77
11.02	Clearing and Grubbing.....	78
11.03	Abandonment.....	80
12	Appeals.....	81
12.01	Appealable Decisions.....	81
12.02	Written Appeals.....	82
12.03	Board Consideration of Appeal.....	82
12.04	Decision on Appeal.....	82
12.05	Deadline for Board Action.....	82
12.06	Form of Appeal.....	82

Utility Standards Manual

1 General Conditions

1.01 Purpose and Authorization

The Fluvanna County Utility Standards Manual (USM) details the policies, procedures and standards required for the design and construction of water mains, sanitary sewers and their appurtenances which are to be owned and/or operated by the County.

As a policy and standards document, this Utility Standards Manual (USM) is supplementary to the Commonwealth of Virginia State Water Control Board Sewage Treatment and Collection Regulations (SCAT Regulations), the Uniform Statewide Building Code, and the Virginia Department of Health Waterworks Regulations (Waterworks Regulations) and is not intended to supersede these regulations. Where conflicts exist, the more stringent requirements shall apply. Nothing herein shall be deemed to waive or modify other requirements of existing regulations and law. Conflicts are encouraged to be brought to the attention of the Director of the Department of Public Works, County Engineer or the County Administrator.

These Standards are not intended to address all situations encountered in the design and construction of water and sewer facilities. It is understood that variances, as well as exceptions, may be warranted depending upon the nature of the specific application. Variances are addressed in Section 1.08.

These Standards, policies and regulations have been adopted by the Fluvanna County Board of Supervisors. Amendments to the Standards, when approved by the Board, shall take effect immediately. Plans submitted and accepted for review shall be reviewed to comply with the standards existing at the time of submittal.

1.02 Definitions and Abbreviations

A) Definitions - The following definitions are used throughout the text:

Board -	The Board of Supervisors of Fluvanna County, Virginia.
County Administrator -	The County Administrator of Fluvanna County, Virginia. The County Administrator may delegate his authority hereunder to the Director of Public Works.
Design Engineer -	The professional engineer or licensed surveyor representing the Developer, and responsible for the project plans and specifications.
Developer -	The owner, or designated representative of the owner, of a project or subdivision for which water and/or sewer systems are to be owned and/or operated by the County.

- County Engineer - The County Engineer, if one is so serving, or his designee; however, if the County does not have an acting County Engineer, then the County Engineer shall mean the Director of Public Works, or his designee. The County Engineer (including the Director of Public Works) may hire or use an outside contract engineer as needed with respect to reviews of any engineering matters affecting this Chapter or applications, submittals or plans of any kind submitted under this Chapter.. The Department of Public Utilities is a department of the Department of Public Works.
- Plan Amendments - Changes to Project Plans initiated by the Developer which are made after the Plans have been approved by the County.
- Plan Revisions - Changes and/or corrections made to Project Plans during the review process to render them approvable by the County.
- Project Plans - The site plan, subdivision plan or public improvement plan containing the design and specifications for water and sewer systems as well as any other public improvements or construction plans associated with the project.

B) Abbreviations - In order to remain concise and enhance readability, the following abbreviations are used throughout these standards:

- AASHTO - American Association of State Highway Transportation Officials
- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials
- AWWA - American Water Works Association
- BOCA - Building Officials Code Administration
- dft - dry film thickness
- fps - feet per second
- gpm - gallons per minute
- ISO - Insurance Services Office
- I.D. - Internal Diameter
- Kip - 1,000 pounds
- KSI - Kips per square inch
- MGD - million gallon per day
- psi - pounds per square inch
- USM - The Fluvanna County Utility Standards Manual
- V - Velocity
- VDEQ - Virginia Department of Environmental Quality

VDH -	Virginia Department of Health
VDOT -	Virginia Department of Transportation
VUSBC -	Virginia Uniform Statewide Building Code
% -	Percent

1.03 Project Plans Review Process

Complete applications for review of Project Plans by the County shall be submitted by the Developer to the County Department of Community Development.

Review and approval of Project Plans by the County is required for all projects which propose to construct or connect to Public and/or Community Water and/or Sewer systems in Fluvanna County. Project Plans are reviewed for conformance with the requirements in the USM

Applications which require review by VDH and/or VDEQ shall be submitted by the Developer directly to those agencies for concurrent review. The applicant shall provide evidence of submission to the applicable agency or agencies at the time of initial plans submission to the County. In situations where review by the VDH and/or VDEQ is required, modifications to project plans required by the County shall be incorporated in final submissions to those agencies (and vice versa). In this manner, Project Plans reviewed by the County and by the VDH and/or VDEQ will be the same document.

Evidence of approval by the VDH and/or VDEQ as applicable shall be provided by the applicant prior to final approval by the County of any Project Plans.

An Engineer's Completion Statement and As-Built Drawings, prepared in accordance with Section 1.07 of the USM, shall be submitted to the County before final construction inspection of water and/or sewer utilities will be approved, beneficial use certificate(s) issued and/or associated bonds released.

1.04 Project Plans Submittal Requirements

A) A complete submission package shall be submitted to the County, as directed by the County Engineer, prior to the County's review of the Project Plans. The following items MUST be in the submission package in order for it to be deemed complete:

- 1) Completed Fluvanna County Application for Utility Extension Form (Form No. ENGR-0001).
- 2) One completed Fluvanna County Plans and Profiles Submission Package Checklist (Form No. ENGR-0002).
- 3) A fee check in the amount computed using the appropriate Water and Sewer Construction Plan Review Fee Computation Sheet (Form No. ENGR-0003).
- 4) One (1) complete set of Project Plans, including all water and/or sewer utility plans and profiles prepared in accordance with the requirements in Section 1.05 of the USM.
- 5) A digital file, prepared in a format of PDF and GIS shapefile, of the geometric layout of all water and sewer lines proposed on the Project Plans.

- 6) One completed Fluvanna County Water Meter Sizing Form (Form No. ENGR-0006) if applicable.
- B) Incomplete submittal packages shall be returned to the applicant or his agent without review.
- C) All material submitted to the County become the property of the County. The County shall have unrestricted use of such materials.
- D) An easement plat or plats prepared in accordance with Section 1.09 of the USM shall accompany the second submission of the Project Plans.
- E) An Inspection Fee computation prepared on Form No. ENGR-0004, shall accompany the second submission of the Project Plans.
- F) A Bond Estimate prepared on Form No. ENGR-0005, shall accompany the second submission of the Project Plans.
- G) Each resubmission of Project Plans shall be accompanied by a detailed, itemized comment response letter indicating how each comment from the County's previous review was addressed.

1.05 Project Plans Preparation Requirements

All water and sewer facility designs shall be performed in accordance with the requirements in the USM. The following information is required on all Project Plans submitted to the County:

- A) Plans shall be prepared on 36" x 24" print paper.
- B) The Plans for water and sewer facilities, including plans, profiles, details, computations and related materials shall be on sheets which are grouped together within the overall set of Project Plans.
- C) A single plan view sheet shall be provided, as part of the Project Plans, at appropriate scale to clearly show all proposed water and sewer lines and facilities, as well as their connection point(s) to existing facilities. For subdivisions, this sheet shall clearly indicate which lots are to be provided water and sewer service with the Project Plans, as well as any construction phasing proposed. This sheet shall be placed at the beginning of the water and sewer portion of the Project Plans.
- D) All existing water and sanitary sewer facilities and easements within and immediately adjacent to proposed limits of construction shall be clearly shown on the plans. Profiles of existing water and sewer lines shall also be included if cover is to be increased or decreased over the lines, or if new connections are proposed to them.
- E) Details of all proposed connections to existing facilities shall be provided. These shall be clearly labeled on the plan view with appropriate test-pit locations shown and labeled.

- F) Plan and profile sheets in standard VDOT Plan & Profile format, with plan and profile views on the same sheet, shall be provided for all proposed water and sewer lines. These shall be presented separately from other plans and/or profiles associated with the project. Scale shall be Horizontal: 1"=50' and Vertical: 1"=5'. Plan views shall clearly show all required water and sewer lines and appurtenances highlighted or bold. Other items related to construction, including but not limited to roads, right of way and property lines, easements, lot numbers, building locations, driveways, curb and gutter, sidewalk, storm sewer lines and structures and grading shall be clearly shown but screened back so as to accentuate the water and sewer utilities. Stationing shall be along the centerline of the pipe and shall be complete and consistent in all views. The plan view(s) shall be placed in the upper portion of the sheet with accompanying profile(s) presented below.
- G) All pipe crossings shall be shown and labeled in both plan and profile views. Minimum cover and minimum "outside wall to outside wall" vertical separation distances shall be noted on profiles.
- H) For water lines and sewer force mains, complete call-outs, stationing, size and type of all pipes and appurtenances (valves, hydrants, bends, tees, service connections, etc.), along with all other information necessary for construction of the lines shall be clearly shown on the profiles. Stationing, pipe size and materials, and types of appurtenances shall be clearly labeled on the plan view. All information shall be consistent between plan and profiles.
- I) The location(s) of all proposed siamese connections to buildings receiving service for fire suppression shall be clearly shown on the plans.
- J) For gravity sewer lines, stationing, inverts, lengths, slopes, pipe size and material, manhole top elevations, manhole labels and all other related information necessary for construction of the sanitary sewer lines shall be clearly shown on the sanitary sewer profiles. Manhole top elevations shall be shown as spot-shots in the plan view. All information shall be consistent among plans, profiles and design tables.
- K) Complete call-outs of all manholes and lateral connections on sewer mains shall be clearly labeled on plan and profile views, and shall be consistent among plans, profiles and design tables. Flow direction arrows shall be shown at each sanitary manhole on the plan view.
- L) A table which provides Northing and Easting coordinates, in NAD 83 coordinate system, for each sanitary manhole shall be included in the plans.
- M) A complete gravity sewer design table consistent with Detail G-6 in the USM and a separate sanitary lateral table shall be included in the plans.
- N) All lot numbers, property lines, easements and rights of way shall be clearly shown on water and sewer utilities plan and profile sheets.
- O) For each lot or building on the plans, the lowest finished floor elevation to be served by sewer, and the difference between this elevation and the invert of the main at the connection point, shall be indicated in the sanitary lateral table. These elevations shall be calculated in accordance with, and demonstrate compliance with, Section 7.08 of the USM.

- P) All stream crossings, road crossings, bores and jacks and crossings of other utilities by proposed water and/or sewer lines shall be clearly shown and labeled in both the plan and profile views for those lines.
- Q) Detail Sheet(s), showing all applicable Standard Details, and including the County's Standard Water and Sewer Construction Notes shall be included in the Project Plans.
- R) Plan and profile views shall be consistent from sheet to sheet across "match lines".
- S) All plans shall be produced in NAD 83 State Plane Coordinate System.
- T) The seal and signature of the Professional Engineer registered in the Commonwealth of Virginia who prepared the plans shall be on each sheet.
- U) A Vicinity Map at an appropriate size and scale to clearly show the location of the project within the County.
- V) North Arrow (each plan view).
- W) The scale shall be correctly depicted on all plans and profiles as well as other applicable sheets. A Graphic Scale shall be provided for all plan views.
- X) The lot numbers, building numbers and/or other unique identifying information for each proposed connection to the water and sewer utilities presented on the Project plans shall be clearly delineated on the cover sheet along with the main title. The total number of lots, buildings, structures and other facilities proposed to be served shall be clearly noted on the plans.

1.06 Project Construction Requirements

All construction of water and sewer facilities shall be performed in accordance with the approved Project Plans, this manual, Applicable Law as defined by Chapter 21 of the Fluvanna County Code, and all other applicable portions of the Fluvanna County Code. Prior to the start of construction of a particular project, the following items must be addressed:

- A) Project Plans must be approved by the County prior to the start of construction.
- B) All required Inspection Fees shall be paid.
- C) All required Bonds shall be posted.
- D) Shop drawings and materials certifications for all water and sewer related construction shall be submitted to the County for review and comment prior to the required Pre-Construction conference. All submittals for a given project shall be made simultaneously.
- E) A Pre-Construction conference must be held. This shall be scheduled with the County's Construction Inspector. Attendees shall include, but not be limited to, the developer, the construction contractor and the consulting engineer.

1.07 Engineer's Completion Statement & As-Built Drawings

After completion of construction of the facilities, but prior to requesting a Beneficial Use Inspection, the Developer or Owner responsible for construction shall submit an Engineer's Completion Statement and As-Built drawings.

The Engineer's Completion Statement shall be prepared, signed and sealed by a professional engineer registered to practice in the Commonwealth of Virginia. The statement shall conform to the requirements contained in the Commonwealth of Virginia State Water Control Board Sewage Treatment and Collection Regulations and the Virginia Department of Health Waterworks Regulations.

As-built drawings shall accurately depict the actual locations and elevations of all water and sewer facilities constructed as part of the approved plans. They shall be based on a field survey and on the red-line drawings maintained by the Owner or his contractor during the construction process. The as-built drawings shall clearly indicate any/all areas where construction substantially deviated from the approved plans. The as-built drawings, and all subsequent revisions to the drawings, shall be properly sealed and signed by a Professional Engineer registered in the Commonwealth of Virginia. One complete copy of the Owner/contractor's red-line construction drawings and two paper sets of as-built drawings shall be submitted to the County's Department of Community Development, along with a CD-ROM containing AutoCad 2002 (or compatible) files of all as-built plan and profile information. Individual AutoCad Plot files with borders are not required so long as a complete set of plans is included on the CD-ROM as pdf file(s). The as-built drawings shall, at a minimum, include the following:

A) As-Built Information for Water Mains and Sewage Force Mains

- 1) Plans and profiles corrected to accurately depict the location of all water lines and fittings.
- 2) Exact measurements showing the positive locations of all valve boxes, blind or blank-flanged fittings and plugged terminals of mains.
- 3) The measurements taken for these positive locations shall be taken from at least two reasonably adjacent and available fixed and permanent objects or reference points, such as fire hydrants, centers of sanitary or storm sewer manhole casting covers, corners or extended lines of buildings, power or telephone poles etc.

B) As-Built Information for Gravity Sewers

- 1) Plans and profiles corrected to accurately depict the locations of all manholes, with inverts and top elevations and numerical notations of the exact elevations of same.
- 2) Indications of lengths and grades of lines between manholes and numerical notations of the exact lengths and grades.
- 3) Locations of all cradles, encasements or special construction.

- 4) The measurements taken for these positive locations shall be taken from at least two reasonably adjacent and available fixed and permanent objects or reference points, such as fire hydrants, centers of sanitary or storm sewer manhole casting covers, corners or extended lines of buildings, power or telephone poles etc.

C) As-Built Information for Water Pump Stations, Sewage Lift Stations and Building Structures

- 1) As-built drawings and specifications shall accurately indicate all approved deviations from, or changes in, location, and/or types of equipment installed, or materials used from the approved plans and/or specifications.
- 2) Complete listings of the name of the manufacturer of all operating equipment installed, together with model or style numbers, ratings, pump curve capacities and other pertinent information shall be provided as part of the as-built plans for the project.
- 3) At least three complete sets of shop drawings, operations and maintenance manuals of all operating equipment, all Certificates of Inspections, Approvals, Warranties and Guaranties of Equipment, Materials and Installations thereof, required by the plans and specifications approved by the County, shall be provided as a part of the as-built plans for the project.

1.08 Variances from USM Requirements

- A) Materials & Equipment Variance - The design and construction of all facilities shall be in strict accordance with this manual and the approved plans and specifications. Variances are defined as approval of specific engineering design practices when deemed to be exceptional and reasonable by the County Engineer or County Administrator. Requests for variances are to be included in the cover letter, or letter of transmittal, accompanying the application. Variances shall be fully described and justified by the Design Engineer.
- B) Where noted herein and on the approved plans and specifications, the use of equivalent equipment and materials will be permitted subject to the following criteria:
- C) A formal request to furnish or use substitute material and equipment that is equal to specified material and equipment must be made in writing to the County Engineer or County Administrator. All pertinent information, plans, shop drawings, documents, drawings, certifications and other data which may be necessary for the Engineer or County Administrator to evaluate the suitability of the substitute material and equipment shall be attached. The property owner shall be responsible for all expenses associated with the determination of suitability or unsuitability of substitute materials and equipment.
- D) By submitting such a request, it is warranted and represented that the proposed substitute will perform properly, be of similar and of equal design, construction and quality to that specified, and be suited to the same use and be capable of performing the same function as the specified material or equipment. A replacement bond in the face value of 150 percent of the cost of the substitute material and equipment will be provided if required by the County. The County Administrator will determine the necessity for and the amounts of all replacement bonds.

- E) A written certification of satisfaction of the above requirements shall be submitted by the person making the application, and shall additionally include the certification of the substitute material and equipment supplier.
- F) No substitute materials or equipment shall be ordered or installed without the written acceptance of the County Engineer or County Administrator.
- G) In all cases, the decision of the County Administrator shall be final. Each request for variance will be considered individually on its own merits.

1.09 Easements and Plats

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

- A) Minimum easement widths shall be 20 feet for water mains and sewage force mains and 25 feet for gravity sanitary sewers, except as noted herein.
 - 1) Increased or decreased easement widths may be required, when so determined by the County Engineer or County Administrator.
 - 2) Decreased easement widths along rights of way of internal subdivision streets will be permitted with the approval of the County Engineer or County Administrator and in accordance with the appropriate Utility Location & Easement Layout Detail.
- B) In cases deemed necessary by the Engineer or County Administrator, and in order to assure routine and emergency maintenance, access (ingress/egress) easements shall be provided.
- C) Final Subdivision/Site Plan Utility Plats are required to have the following labels and notes prior to approval by the County for their recordation:
 - 1) Each Utility Easement and or Fee Lot shall be labeled "HEREBY CONVEYED TO FLUVANNA COUNTY"
 - 2) The width of Each Utility Easement shall be noted (i.e. "15' Utility Easement", "20' Utility Easement" etc.) and, in cases of irregularly shaped Utility Easements shall be noted as "Variable Width Utility Easement".
 - 3) The area of each Utility Easement and/or Fee Lot shall be calculated and noted in square feet. This notation may be done in the form of a Table on the Plat so long as each easement is clearly labeled on the Plat and can be easily associated with its corresponding entry in the Table.
 - 4) OWNER(S) CONSENT STATEMENT AND DEED OF EASEMENT AND CONVEYANCE TO FLUVANNA COUNTY (the "County"): In consideration of the County's approval, the conveyances made hereby and the consideration received therefore by the Owner(s), the receipt and sufficiency of which are hereby acknowledged, the Owner(s) hereby

grants, conveys and transfers to the County the easements and areas specifically identified on this Plat of Subdivision/Site Plan/Utility Plat as "HEREBY CONVEYED TO FLUVANNA COUNTY" over and upon the property for the purpose of installing, constructing, operating, maintaining, inspecting, repairing, replacing, adding to or altering, changing the size of, and removing one or more present or future water and sewage utility lines, plus necessary valves, hydrants and appurtenances for the collection, distribution and transmission of water and sewage through the property subject to the terms and conditions noted thereon. Further, the conveyance hereby of all water and sewage utility lines, valves, hydrants or appurtenant facilities which are constructed and installed or are hereafter constructed and installed within those areas in accordance with the County's Utility Standards Manual as it exists or may be hereafter amended, is with the free consent and in accordance with the desires of the undersigned Owner(s), and/or Proprietor(s)/Trustee(s), if any. Finally, the aforesaid Owner(s), and/or Proprietor(s)/Trustee(s), if any, further assert that he/she/it/they has/have the right to grant the rights and privileges thereto.

- 5) A County Approval Block.
- 6) The following Easement Terms and Conditions (1-7, and 8 where applicable) shall be included on the Plat:

Easement Terms and Conditions:

- 1) All streets, service drives, trails and driveways and all other appurtenant facilities installed by the Landowner(s) in the Easement(s), with the prior written approval of the County, shall be and remain the property of the Landowner(s) its/their(s) successors and assigns, who shall at their sole expense maintain the property and such facilities.
- 2) The County and its agents shall have full and free use of the Easement(s) for purposes of the construction, grading, operation, maintenance and/or replacement of water and sewage lines, any and all appurtenant facilities, and related activities; and shall have all rights and privileges reasonably necessary to the enjoyment and exercise of the Easement(s), including the right of access to and from the Easement(s) and the right to use adjoining land of the Landowner(s) to the extent necessary to facilitate the uses named; provided, however, that this right to use adjoining land shall be exercised only during periods of actual surveying, installation, construction, reconstruction, replacement, alteration, maintenance, inspection, operation and/or repair of the water and sewage lines and their appurtenant facilities, and then only to the minimum extent necessary for such work; and further, this right to use adjoining land shall not be construed to allow the County to erect any building or structure of a permanent nature on such adjoining land.
- 3) The County shall have the right to trim, cut and remove trees, shrubbery, fences, structures, or other obstructions in or near the Easement(s) being conveyed, deemed by the County to interfere with the proper and efficient construction, grading, operation, maintenance and/or replacement of water and sewage lines, any and all appurtenant facilities, and related activities; provided, however, that the County at its own expense shall restore the premises, such restoration to include the backfilling of

trenches and the reseeding of lawns or pasture areas, but not the replacement of pavement, curb & gutter, sidewalks, structures, trees, shrubbery, fences or other obstructions within the Easement(s).

- 4) The Landowner(s) may reserve(s) the right to make any use of the Easement(s) being granted which may not be inconsistent with the rights being conveyed, or interfere with the use of the Easement(s) by the County for the purposes named, provided, however, that the Landowner(s) shall not erect any building or other structure, including a fence, on the Easements, without obtaining the prior written approval of the County.
- 5) The County shall not be liable for any damages to shrubbery or other obstructions within the Easement(s), for all trees outside the Easements trimmed or felled during the initial construction stage of the County's facilities, or for any damages to the residue of the property during the construction period.
- 6) The County shall have the right to install, construct, operate, maintain, inspect, add to or alter, repair and replace electric and telephone lines and any appurtenant facilities for the transmission or distribution of electric power and communication service within the Easement(s) which serve(s) only the County's facilities. The County may assign these rights in whole or in part to one or more Virginia public service corporations.
- 7) Any easement granted by this plat which overlaps, or whose boundaries coincide with, an easement granted to the County, shall be subordinate to the County's easement and any exercise of rights by the subordinate easement holder shall be subject to the written approval of the County.

In cases where the County, in its sole discretion, determines that either Temporary Easements(s) and/or Construction Easement(s) are required as part of the project, the following condition shall be added to the aforesaid list:

- 8) Temporary/Construction Easement(s) shall automatically terminate after the utility lines have been installed, all pipelines have been satisfactorily tested and the disturbed areas have been adequately stabilized and restored.
- D) Requisite legal instruments (Deeds/Utility Easements/Subordination Agreements etc.) shall be formatted in accordance with County guidelines and recorded concurrently with the Final Subdivision and/or Site Plan Utility Easement Plats. The County requires Title Insurance for all real property conveyed to it in Fee Simple. The coverage provided and terms of such insurance shall be as deemed necessary by the County. Legal instruments are subject to review, approval and acceptance by the County and approval as to form by the County Attorney. The County must sign all such instruments prior to their recordation. The plat or plats associated with a particular set of project plans must convey all easements required for the completion of the construction proposed by the plans and for the acceptance of the associated water and/or sewer facilities by the County.

1.10 Applicable References

The following standards and regulations are applicable to water and sewer utility projects. The applicant shall address appropriate requirements of the same:

- A) American Water Works Association (AWWA), latest edition.
- B) American National Standards Institute (ANSI), latest editions.
- C) American Society for Testing and Materials (ASTM), latest editions
- D) Commonwealth of Virginia Sewage Control and Treatment Regulations, latest edition.
- E) Commonwealth of Virginia Waterworks Regulations, latest edition.

1.11 Preliminary Plan/Plat Preparation Requirements

All preliminary designs for water and sewer facilities associated with Preliminary Plans/Plats shall be performed in accordance with the applicable design requirements in the USM. The following information is required on all Preliminary Plans/Plats submitted to the County:

- A) All preliminary water and sewer facilities plans, profiles and details shall be on sheets which are grouped together in the Preliminary Plan/Plat set.
- B) A single plan view sheet shall be provided, as part of the Preliminary Plan/Plat, at appropriate scale to clearly show all proposed water and sewer lines and facilities, all connection point(s) to existing facilities, all proposed off-site facilities and all required Master Plan facilities proposed as part of the project. This shall be placed at the beginning of the water and sewer plans and profiles section of the Project Plans.
- C) Preliminary plan sheets of all proposed water lines shall be presented separately from other plans and/or profiles associated with the project. Scale shall be 1"=50'. The plan view shall show and label water lines and appurtenances "highlighted" with other items (e.g. roads, curb and gutter, sanitary & storm sewer lines, grading, etc.) shown but "screened".
- D) Preliminary water line plans shall include labeling of proposed line sizes and materials as well as call-outs of major appurtenances (hydrants, bends and tees) on proposed water lines.
- E) Preliminary Plan & Profile sheets (with P&P together on the same sheet in standard "VDOT format"), of all proposed sewer lines, shall be presented separately from other plans and/or profiles associated with the plan/plat. Scale shall be Horizontal: 1"=50' and Vertical: 1"=5'. The plan view shall show and label sewer lines and appurtenances "highlighted" with other items (e.g. roads, curb and gutter, water lines, storm sewer lines, grading, etc.) shown but "screened". The profile may be conceptual in nature but must depict the existing grade and preliminary finished grade above the pipe. Stationing shall be complete and consistent in all views.

- F) Depiction of all existing water and sanitary sewer facilities and easements within and immediately adjacent to proposed limits of construction.
- G) Consistency from sheet to sheet across "match lines".
- H) Preliminary Plan produced in NAD 83 State Plane Coordinate System.
- I) Seal and signature of Professional Engineer who prepared the plans shall be on each sheet.
- J) Vicinity Map.
- K) North Arrow (each plan view).
- L) Plans prepared on 36" x 24" Sheets.
- M) Scale (correctly depicted on all plans and profiles as well as other applicable sheets).
- N) The standard Fluvanna County Plan/Plat Approval Block shall be displayed on the cover sheet of the Preliminary Plan/Plat set.

1.12 Federal, State, and Local Approvals

- A) Permit conditions for construction and maintenance shall be shown on the plans where any USACE Nationwide or Individual Permit, DEQ Virginia Water Protection Permit, Virginia Department of Health or Virginia Department of Environmental Quality Construction Permit, Plan of Development, Virginia Power Right-of-Way Crossing Permit, Railroad Crossing Permit, etc. is required.
- B) The Department shall approve all plans for erosion and sediment control before construction of water and sewer facilities may commence. The Department may require a preconstruction meeting at the project site prior to beginning such construction.
- C) Where VDOT Right of Way (ROW) is used, the contractor shall obtain a VDOT permit before construction is started. The contractor shall video tape the ROW and adjacent properties to assess the condition and provide a guideline for restoration of the property after completion.
- D) All wetlands shall be indicated on the plans. The contractor shall obtain permits, prior to going through, under or in any way impacting the wetlands, from all authorities having jurisdiction.

1.13 Contractor Qualifications

- A) All utility work must be performed by a Class A licensed contractor deemed acceptable to the Department of Public Works. The Department of Public Works may allow service laterals to be installed by a licensed plumber. All utility construction shall be subject to inspection, testing, and approval by the Department of Public Works.

- B) The contractor shall personally supervise the work and when not personally present shall be represented by a superintendent who shall have full authority to act as the contractor's representative and all orders and instructions given to the superintendent shall have the same force and meaning as if given to the contractor in person. The superintendent or contractor shall be on duty at all times while construction work is being done.
- C) The Contractor shall take all responsibility for the work, and take all precautions to prevent injuries to persons and property in or about the work.
- D) Until final acceptance of the work by the County, it shall be under the charge of the Contractor, and he shall take every care and necessary precaution against injury or damage to the work or any part thereof by the action of the elements or any other cause whatsoever, whether arising from the execution or the non-execution of the work.
- E) The Contractor shall rebuild, repair, restore and make good, at his expense, all injuries or damage to work occasioned by any of the above causes before it will be accepted.

1.14 Discrepancies

Any discrepancies found between the plans and the County's specifications and site conditions or any inconsistencies or ambiguities in the plans or specifications shall be immediately reported to the County Engineer and County Administrator, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the Contractor's risk.

1.15 Correction of Work

- A) The Contractor shall promptly remove from the premises all work rejected by the Engineer or County Inspector for failure to comply with the County's specifications, whether incorporated in the construction or not, and the Contractor shall promptly replace and re-execute the work in accordance with the County's specifications and shall bear the expense of making good all work of other Contractors that may potentially be destroyed or damaged by such removal or replacement.
- B) All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of Written Notice, the County may remove such work and store the materials at the expense of the Contractor.
- C) The contractor shall promptly remove from the premises all work rejected by the engineer or County for failure to comply with the County's specifications, whether incorporated in the construction or not, and the contractor shall promptly replace and re-execute the work in accordance with the County's specifications and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement. If the contractor does not take action to remove such rejected work within 10 days after receipt of

written notice, the County may remove such work and store the materials at the expense of the developer.

1.16 Job Safety

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

1.17 Existing Structures

A) Existing Structures

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

B) Care of Existing Structures

- 1) The contractor shall be liable for all damage done to any structure or property arising through his negligence or carelessness. He shall take care of and maintain all underground, overhead or surface utilities encountered in the performance of the work.
- 2) Prior to commencing work contractor shall contact the Utility Information Center ("Miss Utility"), telephone 1-800-552-7001 for marking of existing underground utilities.
- 3) The contractor shall observe all precautions with respect to fire and avoid the indiscriminate mutilation or cutting down of trees. Any damage to property not in the work area or easements will be the contractor's responsibility to repair and restore.

2 Water Supply Systems

2.01 General

The requirements of these standards must be satisfied for all water systems and water system extensions which are to be incorporated into the County inventory. Such systems include

construction within areas of existing or proposed easements on private property dedicated to the County or within a public right-of-way. Specific variances to these standards must be approved and authorized in writing by the County Administrator upon request of the applicant.

All standards referenced in this section shall refer to the latest edition of the referenced standard at the time of final approval. The authority for amendment to water standards shall vest with the County Engineer, County administrator, or the Board. Any references to acceptance and/or approval shall mean acceptance and/or approval by the County.

2.02 Capacity and Fire Flows

All water systems and water system extensions shall be designed so as to adequately supply the projected peak day flow within the subdivision or project under consideration while maintaining a pressure of not less than 35 psi at all points of delivery in the system (existing and proposed). Additionally, all water systems and water system extensions shall be designed to provide the fire flows specified by the Fluvanna County Code or as determined by the County, plus the maximum day demand required by the County, with a residual pressure of not less than 20 psi at any point in the distribution system (existing and proposed).

Fire flow calculations must be included with all project plans submitted for review and approval. The flow calculations will be prepared using Hazen-Williams Equation methodology with WaterCad Version 6.5 software, or other model approved by the County Engineer.

For pipes 12 inches in diameter and larger, Hazen-Williams pipe roughness factor, $C=120$, shall be used for the water system model. For pipes smaller than 12 inches in diameter, $C=100$ shall be used. Given the conservative values used for the pipe roughness factors, it is not necessary to consider friction losses from valves, tees and other fittings when preparing the water system model. Velocity of flow shall not exceed 10 fps in any pipe under any design flow condition.

A water model report shall be submitted to the County for review. Approval by the County of the model must be obtained prior to final plans approval.

The following flow conditions shall be modeled using 24 hour extended period simulation:

- A) Maximum Day demands.
- B) Maximum Day demands with 2-hour, 1,500 gpm fire flow event applied during Peak Flow period.

The following diurnal demand patterns shall be utilized when running extended period simulations:

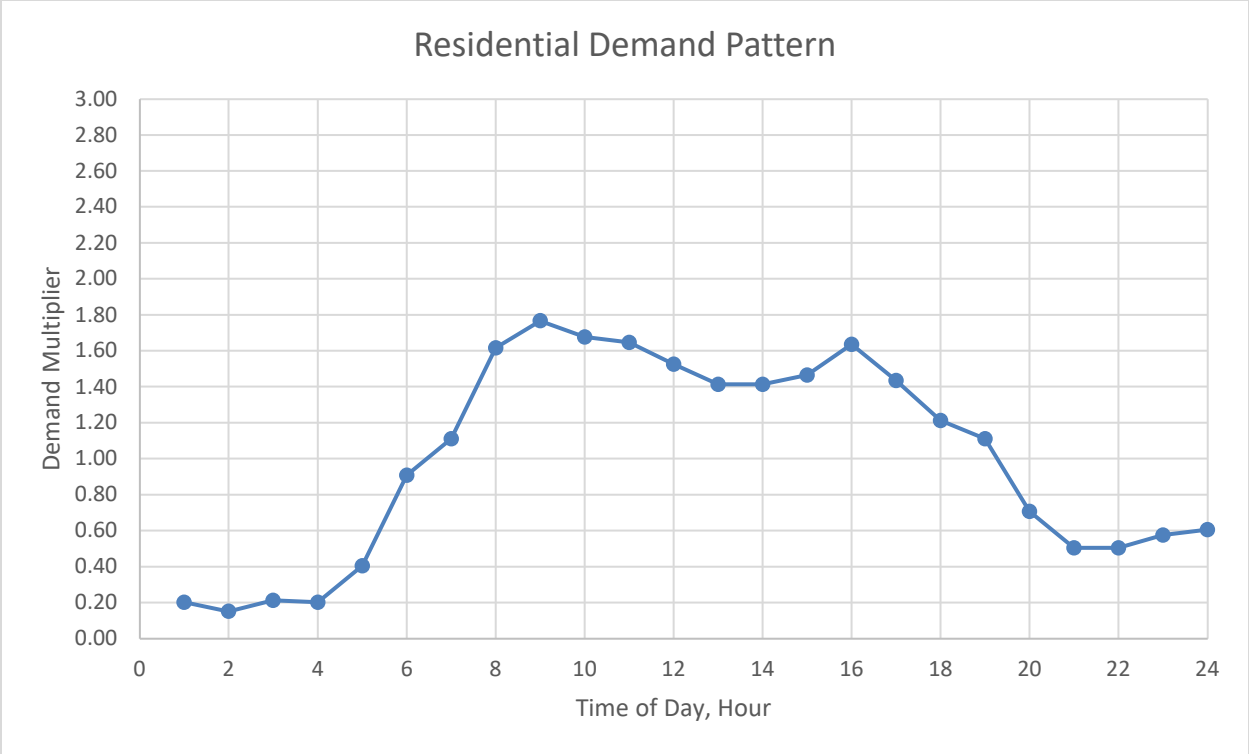


Figure 1. Typical Residential Demand Pattern (AWWA M32)

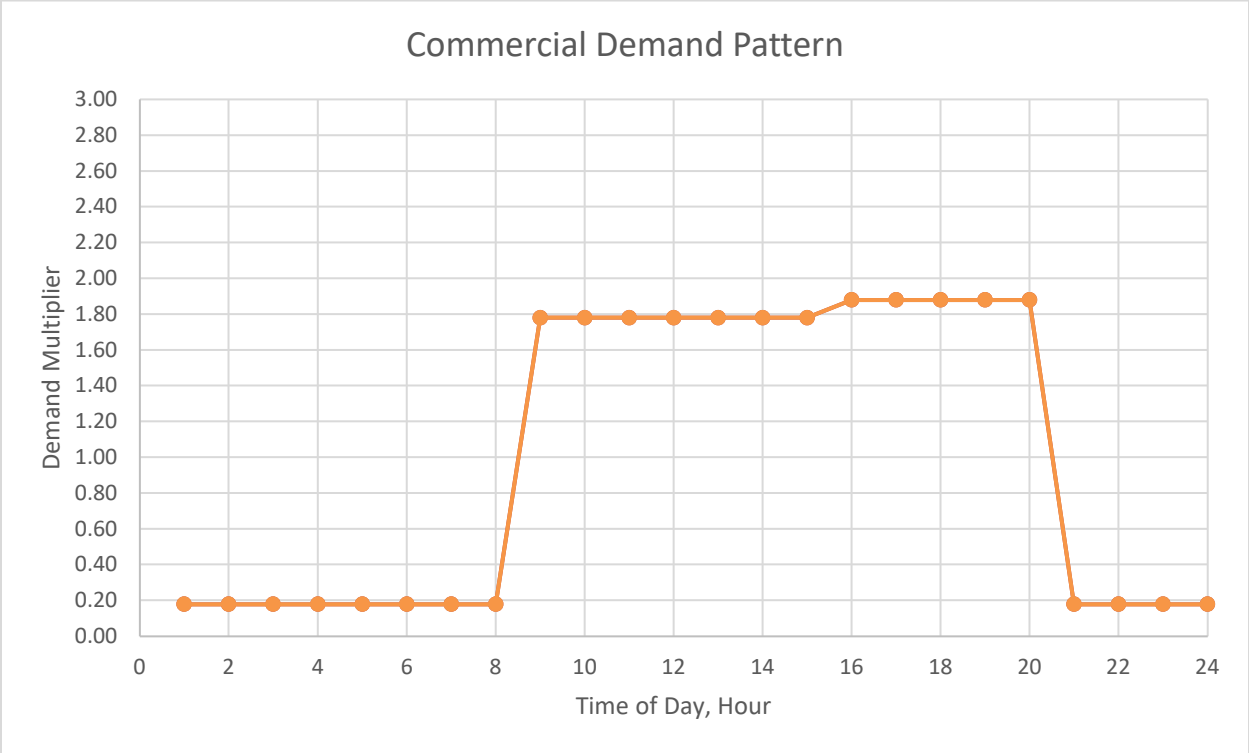


Figure 2. Typical Commercial Demand Pattern (AWWA M32)

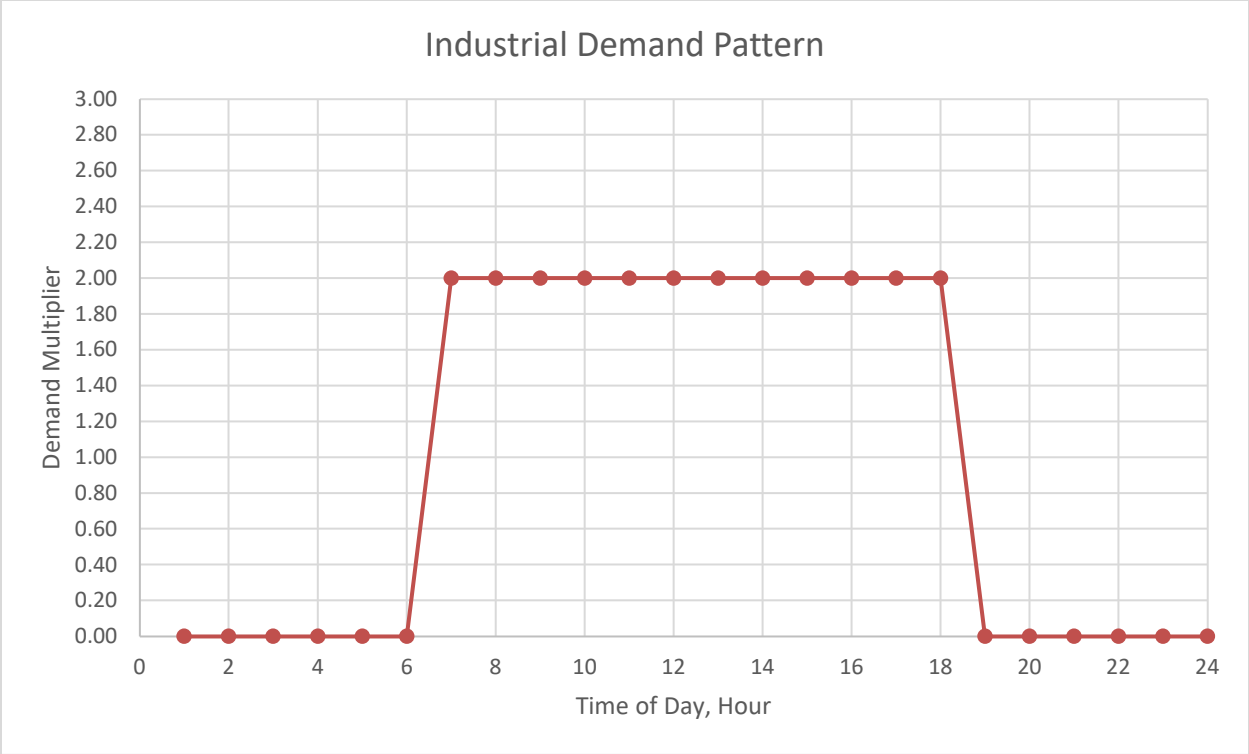


Figure 3. Typical Industrial Demand Pattern (AWWA M32)

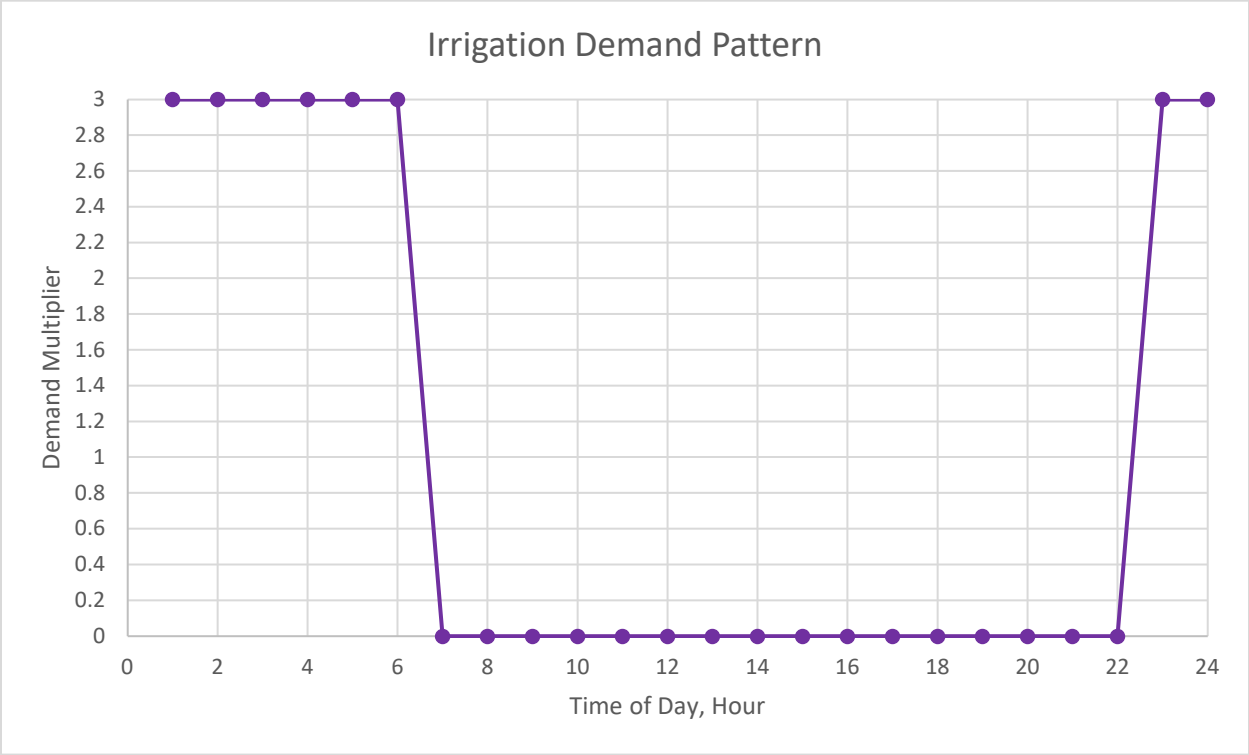


Figure 4. Typical Irrigation Demand Pattern (AWWA M32)

The water model report shall state assumptions made about the existing system, provide calculations and model results to show available flows at proposed hydrants, as well as node pressures throughout the system. If a project will be developed in sections or phases, the fire flow calculations will indicate the available fire flows for each proposed section or phase of the project as well as for the entire project. For small sites that propose no major water line extensions, an evaluation of the existing available fire flows may be substituted for the fire flow calculation.

Water lines shall be interconnected (looped) wherever feasible to enhance the reliability and operation of the water system.

The available water storage system shall have adequate capacity to sustain required fire flows for a minimum duration as specified in the Fluvanna County Code or as determined by the County, while simultaneously providing for maximum day demand.

2.03 Public Water Service Connections

The water meter box and accessories therein necessary for meter installation, and as shown in the Standard Details Section in this manual, shall be furnished and installed by the developer or owner. Meters sized 5/8" by 3/4" and Full 3/4" will be installed by the County upon construction approval and payment of appropriate fees. Larger meter sizes shall be installed by the developer upon construction approval and payment of appropriate fees.

In residential areas the water meter will be installed immediately adjacent to the outer edge of the Utility Easement or ROW, as applicable.

All proposed water meter(s) and service line size(s) and locations shall be shown on the Project Plans. Sizing of service lines and water meters shall be based on the fixture loading imposed by the proposed Building/Use, and in accordance with the procedures of AWWA Manual M22, *Sizing Water Service Lines and Meters*. The County shall have final approval authority of all service line and meter sizes.

The County shall have the option to provide and install any and all size water meters, or in lieu thereof, establish a list of approved water meter types and manufacturers to be incorporated in the development or building. In any event, the developer or owner shall pay for the meters.

2.04 Private Water Services

Private water service connections from the outlet of the meter box to the building are regulated by the County Building Official, the VUSBC and/or BOCA and will be maintained by the property owner.

2.05 Large Meter Installations

Water meters 2 inches and larger shall be installed with a bypass to allow for isolation of the meter for repairs. For all water meter installations, the County shall retain the option of specifying the use of appropriately sized vaults in lieu of meter crocks. Separate Plans & Details for the installation of meters 2 inches and larger shall be submitted for approval.

2.06 Water-Only Accounts

When the water used at a site is not to be discharged into a County-owned sanitary sewer, a water-only account may be established. Water-only accounts will not be charged fees for sewer use. Typical examples of the types of uses with water-only accounts are irrigation systems and public/commercial swimming pools. Each water-only account will be served by independent connection to the public water main with separate domestic service line and meter. No "subtraction" meters will be allowed. The location and size of the domestic service lines and meters serving water-only accounts shall be shown on the project plans. Water-only accounts will comply with the adopted cross connection and backflow policies set forth in Chapter 21, Article II, Division 5 and the County's current Cross-Connection Control and Back Flow Prevention Program Manual.

The size of the water meter for an irrigation system will be based on the peak flow rate needed to operate the system. The design engineer will provide the County with the necessary information to determine the meter size. The developer must acquire all of the necessary approvals and permits from Fluvanna County prior to the installation of an irrigation system. The location of the irrigation meter shall be shown on the project plans.

A water-only account may be established for a swimming pool only when the pool drain and the filter backwash discharge line do not discharge into the sanitary sewer. The location of the pool drain, filter backwash discharge line and pool meter shall be shown on the project plans.

2.07 Valve Boxes

Where valve boxes are placed in the pavement, the covers shall be flush with the pavement surface. Valve boxes placed outside pavement shall be set and adjusted such that covers shall be exposed and 1" to 2" above finished grade. A concrete collar as specified on Standard Detail GN-03 shall be provided around any valve box placed outside pavement.

If additional grading is done and elevations are changed in the vicinity of the valve(s) by the developer or owner after the water system has been approved and accepted by the County, but while such areas are still the obligation of the developer or owner, the valve boxes therein shall be readjusted to proper location relative to the new grades.

2.08 Cross Connections

Water service and backflow prevention devices shall be provided in compliance with the adopted cross connection and backflow portions of the Fluvanna County Code. See Chapter 21, Article II, Division 5 of the Fluvanna County Code, Sections 21-2-101 through and including 21-2-111.

A) Subdivision Streets

In subdivision streets that have curb and gutter, water mains should generally be located 5 feet in front of the face of curb (3 feet from the gutter pan) except in streets less than 30 feet in width from face of curb to face of curb where the water main may be located behind the curb at least 3 feet if there is also sewer located in the street. In subdivision streets without curb and gutter or along existing subdivision streets, water mains should be located 3 feet to 5 feet off of the edge

of pavement or behind the ditch line if there is sufficient right-of-way to allow this. Future widening of the roadway shall be considered during the design of the water main.

B) Arterial and Collector Streets

In arterial and collector streets with curb and gutter, water mains should generally be located 5 feet behind the curb. In arterial and collector streets without curb and gutter, water mains should generally be located 5 feet behind the edge of pavement. Water mains adjacent to arterial and collector streets are allowed to be located under turn lanes. If, on an arterial or collector street, it is not possible or feasible to locate the water main behind the curb, the water main shall generally be located 5 feet in front of the face of curb (3 feet from the gutter pan). In no case shall the water main be located closer than 2 feet to the front of the gutter pan or less than 3 feet behind the curb. Future widening of the roadway shall be considered during the design of the water main. Ductile iron pipe shall be utilized for water mains constructed adjacent to arterial and collector streets unless otherwise directed by the Department.

C) Four Lane or Greater Roadways

The location of water mains along major roadways (roads 4 lanes or greater in width) shall be determined on a case-by-case basis. Generally, water mains shall be located on both sides of major roadways so that service connections need not cross the major road with appropriate interconnection points between the parallel water mains.

D) Future Roadway Improvements

Future widening of roadways shall be considered during the design of any water main. Where water mains are to be installed in proposed or existing roads expected to be widened in the future, they shall be located in easements unless the future road cross section is known and location of water main is designed to avoid future relocation. Water mains shall be designed so that they will not need to be lowered when the road is widened, or driveways are installed.

3 Water Supply Systems Design Parameters

3.01 General

Wherever applicable, water lines will be designed to facilitate the implementation of the County Master Water and Sewer Plan. Water lines shall be designed and located to provide for a looped system, and loops shall be completed wherever feasible at the discretion of the County Administrator or County Engineer. In general, water lines shall be located in utility easements dedicated to the County and shall run parallel to and along the routes of roads and/or travel ways. Alternate locations for water lines will be permitted only with the approval of the County Administrator.

Water lines shall not be located within Stormwater Management (SWM) and/or BMP facilities or their associated easements.

3.02 Line Sizes

The minimum size of water line shall be as follows:

- A) In residential districts, any water line that forms, has the potential to form, or is planned to form a portion of a loop, shall be minimum 8 inches.
- B) In commercial and industrial areas, any water line that forms, has the potential to form, or is planned to form a portion of a loop, shall be minimum 12 inches.
- C) Unless otherwise approved by the County Engineer, dead-end runs shall terminate with a fire hydrant, and shall be sized to provide adequate fire flow. In no case shall they be less than 6 inches.
- D) Fire hydrant connections shall not be installed on lines less than 6 inches in diameter.
- E) Four-inch water lines may only be used with specific approval of the County. In all cases, the minimum water line size shall be four inches.

3.03 Depth of Cover

All water lines shall be designed for 42 inches of cover. Water services shall be designed for 36 inches of cover. Except where completely impractical, water lines shall cross over storm and sanitary sewer lines. Where water lines cross over other pipes, cover on the water line may be reduced to 32 inches and the vertical pipe separation (edge to edge) at the crossing point may be reduced to 6 inches if necessary.

3.04 Intersections and Valve Locations

A valve shall be installed at least every 1,000 feet on distribution mains.

Valves shall also be installed at intersections of water lines. The valving of the water system will be designed so as to allow segments of the system to be isolated for repairs and maintenance while leaving the rest of the system in service.

Generally, two valves will be used at each tee; however, three valves may be required depending on the system design.

Cross-fittings are not permitted at 4-pipe intersections; two adjacent tees shall be used in their place. These shall be installed and buttressed as shown on Standard Detail BH-06.

3.05 Separation of Water Facilities and Sanitary Sewers

In general, separation of water lines, water appurtenances, wells and sanitary sewers shall be in accordance with the latest editions of the Commonwealth of Virginia Sewerage and Waterworks Regulations. A minimum of 10 feet edge to edge horizontal separation shall be maintained between water lines and building foundations, retaining walls or other permanent structures. A

minimum of 10 feet edge to edge horizontal separation shall be maintained between water meter boxes or vaults and sanitary sewer manholes.

3.06 Blow-Offs, Flushing Hydrants, and Air Releases

The engineer should use the following guidelines with regard to location of flushing hydrants, air release valves, blow offs, etc. during the design of water main extensions:

- A) Access to flush points by the Department of Public Works personnel shall be provided. Flush points serve no purpose if access to the flush points cannot be obtained.
- B) Emphasize (through appropriate notes) to contractor to maintain adequate erosion control and flushing procedures. Erosion control and environmental impact consideration must be considered whenever a flush point is chosen; therefore, certain controls may be needed at the time the water main is installed.
- C) Engineer needs to advise contractor to coordinate his work through the inspector. The inspector will coordinate with the Department of Public Works Operations section regarding when to flush (time of day and season, etc.).
- D) Attempt to locate the flush points as near to the roadways as possible or at a stream (keep in mind adverse effects to downstream ponds, etc.).
- E) Contractor is to perform flushing prior to acceptance of the new water main.
- F) Minimize the number of blow offs, and strategically place them so proper flushing can be performed.
- G) Minimize the number of air release valves, taking into consideration the depth that the water main is to be placed.
- H) The chlorine in heavily chlorinated water flushed from mains shall be neutralized before discharge. Contractors must provide equipment for neutralizing heavily chlorinated water flushed from mains during construction prior to discharging the water.
- I) Automatic air release valves shall be located at pronounced high points in the system to provide for the release of trapped air and/or relieve vacuums. Air release valves will be installed in accordance with Detail WD-03 and shall be located as shown on the plans.
- J) Dead-end lines shall terminate with a fire hydrant. Dead-end lines less than 8" in diameter shall terminate in a flushing valve as shown in Detail WD-02. A temporary Blow-off assembly shall be used in lieu of a hydrant or flushing valve when the termination point is temporary. Temporary Blow-offs shall be as shown in Detail WD-01.
- K) Fire hydrants shall be installed as a means of flushing at low points in the system. If authorized, a flushing valve, as shown in Detail WD-02, may be installed in lieu of a fire hydrant.
- L) Automatic air release valves shall be located at pronounced high points in the system to provide for the release of trapped air and/or relieve vacuums. Air release valves will be installed in accordance with Detail WD-03 and shall be located as shown on the plans.

3.07 Hydraulic Design

- A) Water distribution systems shall be designed to provide adequate flow and pressure for both domestic supply and fire flow based on sound hydraulic analysis. Design shall be based on a maximum flow velocity at peak flows (excluding fire flow) of 5 feet per second and a Hazen- Williams “C” Value of 120. Values of existing demand and supply pressures shall be coordinated with the Department of Public Works. If required, the engineer shall contact the Department of Public Works to schedule a fire flow test. The Department of Public Works must be present during any test but will not provide equipment or manpower for a test. The County is not responsible for the results of any test or for any design made on the basis of any test. The County does not imply or warrant that conditions occurring during a test are necessarily representative of the system’s ability to provide water under all or even normal conditions.
- B) The engineer shall submit with all water plans, information and calculations on water demands for the project. If requested, the engineer shall provide a detailed analysis for evaluation by the Department of Public Works to ensure that the requirements of this section have been followed and that the proposed water system design meets these specifications 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 when requested. Whether the detailed analysis is requested or not, the engineer is responsible for ensuring that the design as proposed meets the requirements of these Standards. If the design does not meet any part of these Standards; the engineer is responsible for notifying the Department of Public Works of all deficiencies.
- C) The water distribution system and any extensions thereto shall be designed to supply the demands of all customers while maintaining the following minimum pressures at all points in the system:
- a) 20 psi for the greater of maximum day or peak hour domestic demand plus fire flow.
- D) The following criteria shall be used in estimating average daily demands:

Table 3-1 Average Daily Demands by Land Use

<u>Land Use</u>	<u>Gallons per Day per Acre</u>	<u>Equivalent Persons per Acre</u>
Residential - 1 to 2 dwellings/acre	500	5
Residential - 1 to 4 dwellings/acre	1,200	12
Residential - 4 to 8 dwellings/acre	2,500	25
Residential - Low	500	5
Residential - Medium	1,000	10
Residential - High	2,500	25
Agricultural	1,000	10

Commercial - Retail	2,000	20
Commercial - Office	1,500	15
Industrial - Light Water Use	1,000	10
Industrial - Medium Water Use	2,000	20
Industrial - Heavy Water Use	3,000	30

- a) Where site specific determinations can be made, flows shall be determined by using the following design information in Table 3-2:

Table 3-2 Design Flows

<u>Discharge Facility</u>	<u>Design Units</u>	<u>Flow gpd</u>
Single Family Residential	3.5 people/unit	350
Three Bedroom Apartment	3.5 people/unit	350
Two Bedroom Apartment	3 people/unit	300
One Bedroom Apartment	2 people/unit	200
Three Bedroom Condo	4.0 people/unit	400
Two Bedroom Condo	3 people/unit	300
Elementary School	per person	10
High School	per person	16
Motel and Hotels	per room	130
Trailer Courts	per trailer	300
Restaurants	per seat	50
Service Stations	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 for 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

- E) Flows for other uses may be determined by using demands approved by the County.
- F) To determine maximum daily demands and peak hourly demands the following multipliers shall be used:
 - a) Maximum Daily Demand (residential) = 2.0 times Average Daily Demand
 - b) Maximum Daily Demand (non-residential) = 2.0 times Average Daily Demand
 - c) Peak Hourly Demand = 4.0 times Average Daily Demand

3.08 Termination of Water Mains

Water lines which terminate, and are planned for future extension, shall meet the following requirements:

- A) Water lines shall not terminate under pavement, sidewalk, curb and gutter, or other structures that may interfere with future extension.
- B) Water lines shall terminate within easements and shall extend to a property line wherever feasible. The developer or landowner shall provide all easements needed for future extensions, as determined by the Engineer or County Administrator.
- C) A means of flushing shall be provided as indicated in Section 3.06.
- D) A restrained isolation valve shall be installed on the terminating line to allow complete testing and uninterrupted service upon future extension.

3.09 Fire Hydrant Locations

In general, fire hydrants shall be located as follows:

- A) At street intersections, the ends of dead-ends, low points and at intermediate locations where necessary. The maximum distance between fire hydrants shall be 800 feet. All distance measurements are to be taken along the centerline of accessible streets, travel ways or other unobstructed path used by the fire department.
- B) In areas with curb and gutter, the center of the fire hydrant shall typically be not less than 18 inches nor more than 84 inches behind the face of the curb, but in all cases shall be located within a utility easement dedicated to the County, unless location within a road right of way is expressly permitted by the County Administrator.. All parts of a fire hydrant shall clear sidewalks, trails, and vehicular travel ways by a minimum 9 inches.

- C) On roads without curb and gutter, the center of the fire hydrant shall typically be not less than 18 inches or more than 36 inches behind the ditch, but in all cases shall be located within a utility easement dedicated to the County, unless location within a road right of way is expressly permitted by the County Administrator. Where no ditch is present, the fire hydrant shall be not less than 18 inches or more than 36 inches behind the shoulder, but in all cases shall be located within a utility easement dedicated to the County.
- D) In parking areas where the proposed site improvements do not provide adequate protection of fire hydrants from vehicular traffic, bollards or other protective measures shall be provided.
- E) No plantings, structures or other obstructions shall be installed within 4 feet of any fire hydrant.
- F) The location of all new and existing hydrants that are to serve the property shall be shown on the project plans.

3.10 Surface Water Crossing

Surface water crossings, both over and under water, present special problems and should be discussed with the County before final plans are prepared. The Design Engineer should arrange a site visit with the County to view the crossing and discuss any related issues. In no case shall water lines be located within Stormwater Management (SWM) and/or BMP facilities or their associated easements. The Developer or Design Engineer shall be responsible for obtaining all required State and Federal permits to install a surface water crossing (e.g. Virginia Marine Resources Commission Permit, Nationwide Permit, etc.).

A) Above Water Crossings – On above water crossings the pipe shall be:

- 1) Adequately supported (plans will include details of the piers and supports).
- 2) Protected from damage from freezing.
- 3) Accessible for repair or replacement.
- 4) Above the 100-year flood level.
- 5) Constructed of mechanically restrained joint pipe.
- 6) A valve will be installed on each side of the crossing.

B) Under Water Crossings – On under water crossings the pipe shall be:

- 1) Of special construction, having flexible watertight joints.
- 2) Provided with valves at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible.

- 3) Provided with an available blow-off at one end of the crossing between the isolation valves; the blow-off shall be easily accessible.

3.11 Fire Lines

All water lines serving a fire suppression system in a building shall be shown on the project plans. All fire lines shall be owned and maintained by the property owner. A valve shall be located on the fire line at the point it connects to the public water system. The minimum size fire line shall be a 3-inch I.D. All fire lines shall be metered as shown in Detail MET-9.

4 Water Supply Systems Construction

4.01 General Procedures

Pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists to avoid shock or damage. Under no circumstances shall such be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall be handled so that the coating and lining shall not be damaged. Damaged items shall be either repaired or replaced at the discretion of the County.

The water main shall be laid and maintained to the required lines and grades with fittings, valves, hydrants and accessories set at the required locations as indicated on the approved plans for the project. All valve and hydrant stems shall be set plumb. Wherever obstructions not shown on the plans are encountered during progress of the work and which interferes to such an extent that an alteration in the plans is required, the County or its authorized representative shall be advised and approval given before such alterations are put into effect.

All pipe shall be installed according to the manufacturer's recommendations as approved by the County. No pipe shall be laid in water, or when, in the opinion of the County, trench conditions are unsuitable.

4.02 Excavation and Bedding and Backfill

Excavation of whatever substance may be encountered shall be performed to the dimensions and depths specified or shown on the Applicant's approved drawings. Ledge rock, boulders and large stones shall be removed to provide a clearance at least 6 inches below and on each side of all pipe, valves and fittings for pipes 24 inches in diameter or less, and 9 inches for pipe larger than 24 inches in diameter. The specified minimum clearances are minimum clear distances which will be permitted between any part, projection or joint of such rock, boulder or stone.

In the event that unstable material is encountered at or below the excavation depth, the County shall be notified. Such materials shall be removed and replaced with suitable materials which shall be furnished as an ordinary and integral part of excavation and backfill. If excavation of any nature has been made deeper than necessary, then a layer of suitable backfill shall be placed to secure a firm foundation for the pipe.

The trench shall be dug so that the pipe can be laid to the alignment and depth required and it shall be excavated not more than 200 feet in advance of the complete pipe laying operation. The width of the trench shall be ample to permit the pipe to be laid and jointed properly and the backfill to be placed and thoroughly compacted in accordance with the plans and specifications. Trenches shall be of such extra widths when required as will permit the convenient placing of timber supports, sheeting and bracing and the handling of special fittings. Bell holes shall be provided at each joint to permit proper joint construction and inspection. In no case shall the pipe bells be used to support the body of the pipe.

Grading shall be controlled in the vicinity of excavations so that the surface of the ground will be properly sloped to prevent water from running into trenches or other excavated areas. Any water which accumulates in the excavation shall be removed promptly. Trenches shall be kept dry while pipe is being laid.

Normally, pipe embedment and backfill shall be done in accordance with the drawings contained in the Details Section of this manual. Additional bedding and backfill requirements may be required in situations where the County feels it is necessary.

4.03 Installation of Pipe

Stockpiled pipe materials shall be handled by mechanical equipment and placed to avoid interference with traffic and the trenching operation.

Adequate supports shall be provided for all pipes. In all cases and at all locations, the sub-grade shall be made by back-filling with crushed stone as indicated on Details G-01 and G-02 in the USM and shall be thoroughly compacted. Continuous and uniform stone bedding shall be provided in the trench for all pipe so that the pipe barrel bears on and is supported by the stone bedding at every point between bell holes. The finished sub-grade shall be prepared accurately by means of hand tools. Trenching below the specified grade shall be back-filled with approved materials and thoroughly compacted.

Before the pipe is lowered into the trench, each section of pipe shall be thoroughly inspected for defects and shall be swabbed or brushed out to ensure that no dirt or foreign material gets into the finished main. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in line.

When installing pipe in the trench, proper implements, tools and facilities satisfactory to the County and as recommended by the material manufacturer shall be provided and used by the contractor for the safe and convenient prosecution of the work. All pipe, valves, fittings and hydrants and accessories shall be carefully lowered into the trench piece by piece by means of derricks, ropes, slings, or other suitable tools or equipment in such a manner as to prevent damage to water main materials and satisfactorily rated to handle the pipe and fittings shall be kept fully closed by a test plug to prevent earth, water, or other substances from entering the pipe.

Pipe shall be laid true to line and grade and shall be joined together such that the completed pipe will have a smooth invert. After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipeline and the pipe pushed home with a bar. THE USE OF

LIFTING AND HYDRAULIC EQUIPMENT TO MAKE PIPE JOINTS IS SPECIFICALLY PROHIBITED.

All joints shall be watertight and any leaks or defects discovered, shall be immediately repaired to the satisfaction of the County. Any pipe which has been disturbed after being laid, shall be taken up, the joints cleaned and flushed or removed by means of an approved follower or scraper after joints are made. Installation of fittings and pipe joints shall be in strict accordance with the manufacturer's recommendations.

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 or lining and so as to leave a smooth end at right angles to the axis of the pipe. Only qualified and experienced workmen shall be used on this work. The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.

Whenever it is necessary to deflect pipe from a straight line either in the vertical or horizontal plane to avoid obstructions or plumb stems, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory joining of the pipes, as specified by AWWA Specification and the manufacturer's recommendations. If the specified or required alignment requires deflections exceeding those recommended, the developer or contractor shall provide bends as approved by the County.

Road crossings shall be installed in accordance with the requirements of the Virginia Department of Highways and Transportation, which governs the method and materials of such construction. The owner shall obtain the necessary permit prior to actual installation.

Roadways and driveways, grass plots, sod, shrubbery, ornamental trees, signs, fences, or other improvements on public or private property which have been damaged or removed in excavating, shall be restored to conditions equal to or better than existed prior to construction. Materials for roadways, alleys, or driveways shall be compacted to at least 95 % of the maximum density as determined by the AASHTO Method T-180. The cost of this compaction and furnishing new materials shall be at the expense of the owner or developer.

The site restoration of the entire construction area shall be finished in a neat and uniform condition, acceptable to the County.

4.04 Line Location Markers

For purposes of future line location, all new construction will include 3M-Brand ScotchMark water full-range disc type line marker devices. The markers are to be placed on top of the pipe, along the pipe route, at each change in direction, tee, cross, corporation stop, and all other fittings. In any case, the maximum spacing between markers shall be 40 feet. Marker tape shall be buried 18 inches above the pipe for the entire length of the pipe. (Note: This requirement also applies to sewer force mains).

4.05 Installation of Fittings and Accessories

All tees, bends, plugs, caps and fire hydrants shall be substantially braced, blocked, and/or anchored to prevent any movement by providing adequate reaction backing. This backing shall

be 3,000 psi concrete. Backing shall be placed between solid undisturbed earth and the fitting to be anchored and shall be so placed that pipe and fitting joints will be accessible for repair.

Required thrust blocks shall be as shown in the Details Section of this manual. The type of fitting, maximum pressures and type of soil in the thrust area shall be subject to the review and approval of the County.

Where thrust blocking is not feasible due to the soil conditions, a harnessing detail for each type of intended application shall be submitted for approval by the County. A special dead-man block with a harness arrangement is generally required in this situation.

4.06 Installation of Valves

Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrants or valve shall be inspected in opened and closed positions to see that all parts are in working condition.

All valves shall be provided with valve boxes, as shown in the Detail G-03 and the necessary wrenches with extension handles shall be provided where necessary due to the depth of the valve. Valves and the valve boxes shall be set plumb with the valve boxes centered directly over the valve operators. After being correctly positioned, earth fill shall be carefully tamped around the valve box to a distance of at least 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet. Before installing any valve, care shall be taken to see that all foreign material is removed from the interior of the barrel and the valve operated to see that all parts are in working condition.

Valves and valve boxes shall be located outside the area of existing or proposed paved roads, streets and sidewalks. They shall be set and adjusted so that the covers are exposed and 1" to 2" above finished grade. Where valves and valve boxes are or will be located within paved areas, they shall be set and adjusted so that the cover is exposed and flush with the finished surface. If ground elevations in the vicinity of valve boxes are revised by the Developer or Owner after the related water system has been approved and accepted by the County, but while such areas are still the obligation of the Developer or Owner, the valve boxes shall be adjusted relative to the elevation of the finish surface at the Developer/Owner's expense.

No water main shall terminate under a concrete gutter and no valve shall be located under a concrete gutter.

4.07 Installation of Hydrants

The hydrant shall be set upon a slab of stone or concrete not less than four inches thick and fifteen inches square. The back of the hydrant opposite the pipe connection shall be firmly blocked against the vertical face of the trench with a cast-in-place 3,000 psi concrete thrust block to prevent the hydrant from blowing off the line, as shown in the Detail WD-02. Not less than seven cubic feet of crushed stone shall be placed around the base of the hydrant to insure proper drainage.

The pipe connecting the hydrant to the water main shall be a nominal size of 6 inches and equipped with a valve and valve box. Hydrants shall be set with the invert of the pumper

connection 18 inches above finished grade, with the pumper connection facing the street. The connecting pipe will have the same depth of cover as the distributing mains. The backfill around hydrants shall be thoroughly compacted to the grade line.

4.08 Above Water Crossing

Water mains constructed on piers or hung from bridges 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. Where a water main crosses above surface water, the pipe shall be adequately supported, completely insulated to protect it against damage from freezing, accessible for repair or replacement and above the level of a 100-year flood and any floating debris it may carry.

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

4.09 Under Water Crossing

Water mains entering or crossing streams shall be restrained joint ductile iron pipe. 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 County 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 methods.

Subaqueous water main installations will be permitted only when it can be demonstrated that no other practical alternative exists. Special attention shall be directed to foundation conditions and thrust restraint for the pipe.

The water main pipe shall be of special construction, having flexible watertight joints. The pipe material used shall be subject to the County's approval. In some instances, the Owner or Developer may be required to install the pipe in a concrete encasement, as shown in Detail G-04.

Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair. The valves shall be easily accessible and not subject to flooding.

Sample taps shall be available at each end of the crossing and at a reasonable distance from each side of the crossing. Permanent taps shall be made for testing and locating leaks.

4.10 Crossings of Railroads, Major Roadways and Other Major Structures

Crossings under roads shall be installed in accordance with Detail G-05 in this manual and the requirements of the Virginia Department of Transportation (VDOT). Road crossings shall be completed prior to the installation of adjacent sections of pipe.

Steel pipe casings shall be installed by either boring or jacking the casing beneath the roadbed of primary roads. To insure successful completion of bored road crossings, the Contractor should make use of test holes, pilot drill holes, etc.

Casing pipe required for bored installation of mains shall be uncoated steel with 36,000 psi yield strength. Such pipe sections shall be continuously welded at joints as the casing is advanced. Where open-cut crossings are permitted, casing pipe shall be reinforced concrete. Casing pipe is required for all water services crossing roads or sidewalks and shall be 2-inch Schedule 40 PVC.

Water mains within bores or tunnels shall be ductile iron pipe (minimum thickness Class 52) with restrained joints. All casing pipes shall have an exterior corrosion protective coating.

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 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 Department of Public Works prior to the approval of construction plans for the project by DPW. Isolation valves are generally required to be installed on either side of the crossing.

4.11 Wet Taps

All wet taps require the approval of the County. Sleeve and valve assemblies shall be tested in accordance with Section 4.12 for 10 minutes before the actual tap is made.

Wet taps shall employ a ductile iron mechanical joint sleeve, or other fitting specifically designed for this purpose as approved by the County Administrator.

4.12 Testing

Tests shall be made on all sections of pipe throughout the entire project and shall be conducted only in the presence of the County or its authorized representative. Tests shall be made between adjacent valves.

Care shall be taken to ensure that the entire test run of pipe is securely braced and blocked against thrust when pressure is applied. All thrust blocks must be completely set and approved. All pipe must be firmly supported and weighted down by partial backfill soil on top.

All water for testing purposes shall be potable water and procured and paid for by the Owner or Developer or his Contractor. Prior to testing, the pipe shall be filled slowly and carefully with water from the nearest practical source, or by other approved methods. Under normal atmospheric pressure the pipe shall be allowed to soak for a minimum period of 24 hours. All entrapped air shall be expelled. The Owner, Developer or Contractor shall provide all the apparatus or other accessories necessary to conduct the tests.

The completed piping shall be subjected to a hydrostatic pressure test equal to 150 % of the rated working pressure of the pipe or not less than 150 psi. This pressure shall be maintained for a minimum two hours, or until the County Inspector is satisfied with the results. All pipe, joints, valves and fittings in the test section shall be examined. Leakage shall not exceed the amount given by:

$$L = \frac{S \times D \times P^{1/2}}{148,000}$$

Where: L = allowable leakage, in gallons per hour;
 S = length of pipe tested, in feet;
 D = nominal pipe diameter, in inches;
 P = test pressure, in psi.

If the flow of water or loss of air pressure is in excess of the allowable limits, or if leaks of appreciable size are encountered, the Contractor shall repair or rebuild, at his expense, those portions of the piping which are faulty. These tests will be repeated until the work is deemed acceptable in accordance with the allowable limits.

Services shall be tested to the yoke angle valve at working pressure by visual inspection in the open trench and shall show no signs of leakage.

Defective material disclosed as a consequence of the tests shall be removed and replaced by sound material at the Owner's or Developer's expense. Any joint showing visible leakage shall be made airtight. The test shall be repeated until its results are satisfactory to the County or its authorized representative.

No water shall be drawn from the County's facilities for testing or other purposes until suitable arrangements have been made with the County Inspector.

Allowable Leakage Table			
Water Line Test Based on 150 PSI		Water Line Test Based on 150 PSI	
Size	Max Allowable Leakage	Size	Max Allowable Leakage
3/4"	0.0124 (Gal/2 hrs)/100 L.F.	16"	0.2648 (Gal/2 hrs)/100 L.F.
1"	0.0166 (Gal/2 hrs)/100 L.F.	20"	0.3310 (Gal/2 hrs)/100 L.F.
1-1/2"	0.0248 (Gal/2 hrs)/100 L.F.	24"	0.3972 (Gal/2 hrs)/100 L.F.
2"	0.0331 (Gal/2 hrs)/100 L.F.	30"	0.4965 (Gal/2 hrs)/100 L.F.
3"	0.0497 (Gal/2 hrs)/100 L.F.	36"	0.5958 (Gal/2 hrs)/100 L.F.

4"	0.0662 (Gal/2 hrs)/100 L.F.	42"	0.6951 (Gal/2 hrs)/100 L.F.
6"	0.0993 (Gal/2 hrs)/100 L.F.	48"	0.7944 (Gal/2 hrs)/100 L.F.
8"	0.1324 (Gal/2 hrs)/100 L.F.	54"	0.8937 (Gal/2 hrs)/100 L.F.
12"	0.1986 (Gal/2 hrs)/100 L.F.		

4.13 Disinfection of Water Mains

During the course of the work, all reasonable precautions shall be taken to protect the pipe interiors, fittings and valves against contamination. When pipe-laying is not in progress, all openings in the pipeline shall be closed by watertight plugs.

The water main shall be closed and flushed prior to disinfection with a sufficient flow to produce a flushing velocity of at least 2 ½ feet per second. Finished water shall be flushed through the system until no traces of foreign matter are visible. This water shall be discharged or wasted only at points specifically designated by the County. All valves and hydrants shall be operated during the flushing prior to disinfection.

The new pipeline shall be disinfected by chlorination in accordance with AWWA Specification C651-14 or latest revision. The disinfection agent of the chlorine solution shall be sodium hypochlorite solution, Grade D, conforming to Federal Specification O-S-602b, or dry hypochlorite equal to "HTH" as manufactured by Olin Chemical Co.

The chlorine solution at any point in the line, shall have a minimum concentration of 50 parts per million (ppm) or 50 milligrams per liter (mg/l) and shall be applied to the system at a constant, measured rate by pumping in accordance with the continuous feed method, AWWA Specification C651-14 or latest revision. Finished water from an approved source shall be made to flow at a constant, measured rate into the new pipeline. The two rates shall be properly proportioned so that the chlorine concentration in the pipeline is maintained at a minimum of 50 ppm available chlorine. To ensure that this concentration is maintained, the chlorine residual shall be measured at regular intervals in accordance with procedures described in the current edition of Standard Methods and AWWA Specification M12.

When considered applicable, disinfection will also be permitted by the following methods:

- A) Tablet Method - Disinfection may be accomplished with the use of five-gram HTH tablets as applied to the interior of the pipe. The tablets shall be placed in each section and in all appurtenances. Enough tablets shall be used to ensure that a chlorine concentration of 25 ppm is provided in the water. Tablets shall be attached by an approved adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The velocity of the potable water in the main shall be less than 1 fps. The water shall remain in contact with the pipe for 24 hours, and all valves and appurtenances shall be operated while chlorinated water is in the system.
- B) Slug Method - Disinfection may also be accomplished by the "slug" method. A chlorine gas-water mixture shall be applied to the system by means of an approved chlorinating device. The method of application of the chlorine applied shall be sufficient to provide a

concentration of 300 parts per million of free chlorine. The chlorinated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria, or a minimum retention period of at least three hours. During the sterilization period, all valves and other appurtenances shall be operated while the system is filled with chlorinating agent.

Chlorine application shall not cease until the entire main is completely filled with solution. The chlorinated water shall be retained in the system for at least 24 hours, during which time all valves and hydrants shall be operated in order to disinfect the appurtenances. At the end of the 24-hour period, the pipeline water shall contain not less than 25 parts per million (ppm) chlorine throughout the entire pipeline. After the specified retention period, the chlorinated water shall be flushed from the main until the residual chlorine concentration is no higher than that prevailing in the existing system or less than .20 parts per million.

After final flushing and before the water main is placed in service, not less than two samples of water at points not to exceed 2,000 feet apart shall be collected at least 24 hours apart in sterile bottles treated with sodium thiosulfate. All sampling shall be witnessed by a representative of the County. The samples shall be forwarded to a laboratory certified by the Virginia Department of Health for bacterial examination. If this examination indicates the presence of coliform organisms, the entire disinfection process shall be repeated or continued until the examination indicates the absence of such pollution.

Pipe, taps and fittings used at connections to the existing system shall be thoroughly disinfected before installation. Excavation for such connections shall be kept free from water until the connection is completed, and extreme care shall be exercised to prevent contamination of the pipe and connection fittings. The inside of the existing pipe within 3 feet of the point of connection shall be disinfected by spraying with a solution containing not less than 200 ppm of chlorine immediately before connection is made. If at any time the water in the existing piping becomes contaminated, this piping shall be disinfected as specified for new piping, back to the nearest gate valve or valves, or beyond those points as necessary to include all contaminated piping.

The complete disinfection process and methods followed, especially if materially different from those specified, shall be in accordance with the directives of the Virginia Department of Health, and all methods employed shall meet with this approval. Definite instructions as to the collection and shipment of the samples shall be requested from the Department of Health and shall be followed explicitly. Final approval of the bacterial examination shall be received from the Department of Health prior to placing the new pipeline into operation.

5 Water Supply System Materials and Standards - Pipe and Fittings

5.01 Pipe Materials

The following pipe materials are approved for use in water systems to be owned by the County. All water lines 4" and greater in diameter constructed for use in water systems to be owned by the County shall be Ductile Iron Pipe (DIP) or Polyvinyl Chloride Pipe (PVC)..

- A) Ductile Iron Standard Mechanical Joint Pipe - Ductile iron standard mechanical joint pipe shall conform to ANSI/AWWA C151/A21.51 or latest revision and shall be double-lined with cement mortar, seal coated and have a protective exterior coating. Thickness class shall be

minimum Class 52. A greater thickness class may be required when conditions so dictate. Polyethylene encasement, in accordance with ANSI A21.5 (AWWA C105) may be required under certain soil conditions.

- B) Ductile Iron "Push-On" Joint Pipe - "Push-on" or "slip" joint ductile iron pipe shall conform to ANSI/AWWA C151/A21.51 or latest revision, as manufactured by U.S. Pipe, Tyton Joint Pipe or approved equal. It shall conform to the requirements for mechanical joint pipe in regard to strength, class, protective coating, and lining.
- C) Ductile Iron Flanged Pipe - Ductile iron flanged pipe shall conform to ANSI ANSI/AWWA C151/A21.51 or latest revision. Thickness class shall be a minimum Class 53. Threads shall conform to ANSI B1.20.1. The pipe shall conform to the requirements for mechanical joint pipe in regard to protective coating and lining.
- D) Ductile Iron Polyurethane-Lined Pipe - Polyethylene lined ductile iron pipe shall be as manufactured by U.S. Pipe, "Polythane Lined", or approved equal.
- E) Ductile Iron Restrained Joint Pipe - Where restrained joint pipe is to be used, it shall conform to ANSI/AWWA C151/A21.51, and shall be as manufactured by U.S. Pipe, TR Flex Restrained Joint Pipe, or approved equal.
- F) Polyvinyl Chloride (PVC) Pipe – All PVC water pipe shall be molecularly oriented polyvinyl chloride (PVCO) pressure pipe and shall conform to AWWA Standard C909, and be minimum Pressure Class 200. Wall thickness and Outside Diameter shall be as indicated in Table 1 of AWWA Standard C909. NOTE: The use of PVC pipe for water lines 4" and greater in diameter constructed for use in water systems to be owned by the County is prohibited without the specific written approval of the County Administrator or the Director of Engineering.
- G) Galvanized Steel Pipe - Galvanized steel pipe shall be Schedule 80, National Pipe Thread (NPT).
- H) HDPE Pipe - Will be considered for installation for transmission lines only with no branches or taps allowed. Its general installation will be reviewed on a case-by-case basis when normal open trench construction and/or jack and bore casing pipe with internal carrier pipe is not practical. The design engineer shall specify the particular pipe and the rating shall meet or exceed 150 psi operating pressure. These installations will generally be by directional drilling.
- I) Polyethylene Tubing - Polyethylene tubing shall be CTS, O.D, Class 200, SDR-9, and shall be "indent" marked with class, size and NSF-PW rating.
- J) Copper Tubing - 1 inch and smaller for underground services shall be seamless, annealed copper tubing Type K, in conformance with ASTM B88. Fittings shall be case bronze with flared joints. Copper Tubing 1-1/4 through 2" for underground services shall be seamless hard copper tubing Type K, in conformance with ASTM B88. Fittings shall be wrought copper with soldered joints. Solder shall be 95-5 lead free solder meeting the requirements of NSF 61.

- K) Special Pipe Coatings - Where required, ductile iron pipe shall be coated inside with 24 mils dft of Kop Coat 300M by Carboline Company, or approved equal, in accordance with manufacturers recommendations. Coating shall be applied and tested by the pipe manufacturer in accordance with manufacturers recommendations. Certification of coating shall be submitted to the Engineer.
- L) Bored Steel Casing - Steel casing pipe shall be welded or seamless or smooth wall, consisting of Grade "B" steel as specified in ASTM A-139. Minimum yield strength shall be 35,000 psi, and pipe thickness shall be as specified on the construction plans. All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. Welds shall be a full penetration welds subject to visual inspection. All burrs at pipe ends shall be removed. Encasement pipe must be approved by the appropriate controlling agency (V.D.O.T., R.R., etc.) and the Engineer prior to ordering. Spiral weld casing pipe will not be allowed.

5.02 Pipe Fittings

The following fittings are approved for use in systems to be owned by the County.

- A) Ductile Iron Pipe Fittings - Ductile iron fittings shall be cement-mortar lined with seal coating, mechanical joint ductile iron with a minimum pressure rating of 250 psi. Standard fittings shall conform to ANSI/AWWA C110/A21.10 or latest revision. Compact fittings shall conform to ANSI/AWWA C153/A21.53 or latest revision. Fittings shall be as manufactured by Griffin Pipe Products, U.S. Pipe or approved equal.
- B) Field Installed Joint Restraints - Field installed mechanical joint restraints shall have a minimum working pressure of 250 psi, a minimum safety factor of 2:1, and shall be 'Megalug', as manufactured by EBAA Iron, Inc., or approved equal.
- C) Field Installed Restrained Flange Adapters - Field installed restrained flange adapters shall be ductile iron, have flange bolt circles that are compatible with ANSI/AWWA C115/A21.15 or latest revision. The flange adapters shall have a minimum pressure rating of 250 psi, and shall be 'Megaflange', as manufactured by EBAA Iron, Inc., or approved equal.
- D) Pipe Skids and Casing End Seals - Pipe skids shall be configured to suit the specific installation, and shall be Model S-12G as manufactured by Pipeline Seal and Insulator (PSI), Inc., or approved equal. Casing end seals shall be standard pull-on type, Model S as manufactured by PSI, Inc., or approved equal.

5.03 Pipe Supports

- A) Pipes shall be supported by steel pipe hangers, clamps, brackets, rods and inserts as required to support the imposed pipe loads. Hangers in general shall be new, manufactured of carbon steel and hot dipped galvanized after fabrication or 304 stainless steel.
- B) Pipes 2 ½ inches and larger shall be supported with adjustable floor stand type pipe supports as detailed on the drawings. Pipe supports shall be Standon Model S89 flange support, Standon Model S96 cradle support as manufactured by Material Resources, Inc. or approved equal.

C) Pipes 2" and smaller shall be supported from the floor, walls or ceiling depending on the type of building construction. Pipe supports for these size pipes shall be as manufactured by Unistrut Building Systems, B-Line or approved equal. Supports shall consist of floor stands, wall brackets or clevis type hangers. Strut and appurtenances shall be stainless steel. Clips for copper tubing shall be copper coated. Minimum threaded rod size shall be 3/8 inch.

D) Ductile Iron and steel pipe supports shall be spaced in accordance with the following schedule:

Pipe sizes (inches)	1/2 -3/4	1- 1 1/4	1 1/2 - 2	3 - 4
Max spacing (feet)	4	6	8	10

E) Copper tubing pipe supports shall be spaced in accordance with the following schedule:

Nominal tubing size (inches)	1/2 -3/4	1- 1 1/4	1 1/2 - 2
Max spacing (feet)	4	5	6

F) PVC pipe supports shall be spaced in accordance with the following schedule:

Nominal pipe size (inches)	1/2 -3/4	1- 1 1/4	1 1/2 - 2	3 - 4
Max spacing (feet)	2.5	3	4	6

G) Maximum spacing between pipe supports shall be 10 feet for all pipes 6" and above. This is a maximum spacing and does not take into account valves, fittings, flow meters, risers, drops and other devices. Locations where these are installed will require additional supports.

H) In addition to the above, pipe supports shall be located as per the following:

1. Maximum spacing as indicated above.
2. Maximum of 12 inches from all horizontal and vertical changes in direction.
3. On the suction and discharge of pump piping to eliminate pipe stresses on the pump flanges.
4. On the connections to all equipment to eliminate pipe stresses on the equipment connections and allow equipment removal.
5. On the inlet and outlet piping to the water meter to allow the removal of the water meter.

6. At the location of valves, fittings or other devices that cause additional weight to the piping.
7. Additional pipe supports as indicated on the drawings.

5.04 Gate Valves

Valves 3 inches to 12 inches shall be resilient wedge gate valves, ductile iron bodied, non-rising stem with 2-inch operating nut, counter-clockwise opening, mechanical joint or flanged ends, designed for bubble tight closure at 200 psi working pressure.

Gate valves shall conform to AWWA C509, and shall be manufactured by American Flow Control, Kennedy, Mueller, or approved equal.

Gate valve extensions shall have a 2-inch square wrench nut on top end and socket to fit 2-inch square nut on bottom. Valve extensions shall be Mueller A-26441, or approved equal.

5.05 Butterfly Valves

Valves greater than 12 inches shall be butterfly valves, iron bodied with rubber-seated, self-adjusted disc seal.

Buried valves shall be provided with operators with non-corrosive type of construction for input shaft, seals, bushings and bolting. Operators shall be totally enclosed and permanently lubricated for direct burial of the valves and frequent submergence in water up to 20 feet of head. The operator shall open the valve on a counterclockwise rotation of the operator wrench. Valve ends shall be mechanical joint or flanged.

Butterfly valves shall meet or exceed AWWA C-504, and shall be as manufactured by Mueller, American Darling, or approved equal.

5.06 Hydraulic Control Valves

Hydraulic operated control valves shall consist of pressure reducing valves, pressure sustaining valves, altitude valves, pump control valves, surge relief valves, surge anticipator valves, flow control valves or other similar type hydraulically controlled valves.

5.07 Valve Boxes

Valve boxes, base extensions, head and cover shall be cast iron and heavily coated with asphalt-based paint. The cover or head shall be round and shall have the word "WATER" cast upon it. Valve boxes shall meet or exceed ANSI/AWWA C110/A21.10-82 or latest revision, and shall be as manufactured by East Jordan Iron Works, Tyler, Bingham & Taylor or approved equal.

5.08 Reduced Pressure Zone (RPZ) Backflow Preventer

Backflow prevention devices shall be installed on all new development structures as required per VDH Waterworks Regulations, Fluvanna County Code, and DPW's Cross Connection Control and Backflow Prevention Program and Policies. Type, size, and locations shall be shown on the construction plans for facilities where these devices are required. These devices (domestic, irrigation, and fire) must be tested and a Backflow Prevention Device Certification form submitted to DPW prior to DPW sign-off on the certificate of occupancy. See Section 10 for a copy of the Backflow Prevention Device Certification form.

5.09 Curb Boxes

Curb boxes, extensions, foot pieces, and lids shall be cast iron, heavily coated with asphalt-based paint, as manufactured by Mueller or approved equal.

5.10 Fire Hydrants

Hydrants shall be of the compression type with main valve openings not less than 5 ¼ inches in diameter, double O-ring seals and safety flange, and shall conform to AWWA C502 requirements. Hydrants shall have a cast iron body with full bronze trim. Hydrants shall have a minimum 6-inch connection base for setting with a minimum of 42-inch cover on connection pipe. Hydrants shall be equipped with hose connections as follows:

- A) Two each 2½ inch, N.S.T. hose connections.
- B) One each 4½ inch, N.S.T. pumper connection.

Hydrants shall be operated by a National Standard 1½ inch pentagon shaped operating nut, opening counterclockwise. The direction of opening shall be clearly marked by an arrow cast on the outside of the hydrant.

Hydrants shall be traffic model either Mueller Centurion, Kennedy K81-A, or approved substitute.

5.11 Automatic Air Release Valves

Air release valves shall be the universal type, orifice with the same diameter as the inlet, with a working pressure from 0 to 300 psi, stainless steel float, and resilient seat. Valves shall be type "U" with minimum 1-inch diameter screwed NPT connection as manufactured by Crispin Multiplex Manufacturing Co., or approved equal.

5.12 Pressure Gauges

Pressure gauges shall be of all stainless steel construction, 3.5 to 4 inch case size, accuracy of 1% over the entire dial arch and a ¼" NPT bottom connection, Pressure range shall be as indicated on the drawings. Pressure gages shall be Ashcroft stainless steel case 1009 pressure gauges or approved equal. All pressure gages shall be installed with a ¼" stainless steel ball valve and stainless steel nipples. Gages shall be graduated so the system operating pressures

are in the middle third of the scale. All pressure gages shall be mounted with fittings or on fitting bosses. NO TAPPING OF PIPE OR SADDLES WILL BE ALLOWED.

5.13 Tracer Wire and Access Boxes

Non-ferrous water mains shall have tracer wire attached to the pipe and a detectable tracer tape buried in the trench 18 inches above the main but no less than 24 inches below grade.

Copper tracer wire shall be THHN, 12-gage, insulated with a blue colored insulated tracer wire access boxes are to be utilized and spaced no more than 1000 feet apart. Tracer wire access boxes shall be installed adjacent to all fire hydrants. A concrete mow collar shall be installed at finished grade around all tracer wire access boxes.

The tracer wire access boxes shall be made of cast iron with a permanently attached 3" x 12" ABS tube with a flared end to secure it in the ground with tamper-resistant cast iron locking lid and stainless steel terminal connectors on the bottom side to which tracer wires are attached. Lid shall be opened using a standard AWWA pentagon key. Enough slack shall be coiled inside the box to allow the removal of the lid. Lid shall be marked sewer.

5.14 Service Saddles

Service saddles shall be of non-corrosive material (e.g. bronze, stainless steel, or epoxy-coated ductile iron). They shall have a rubber gasket or "O"-ring type seal. Service saddles with a single strap shall have minimum strap width of 1½ inches. Double-strap saddles shall have minimum ¾ inch flat-faced straps. Straps and fasteners shall be constructed of stainless steel. Service saddles shall be as manufactured by Ford, Mueller or approved equal and shall meet the applicable sections of ANSI/AWWA C-800.

5.15 Corporation Stops and Curb Stops

Corporation Stops shall be of the ball type with CTS pack joint outlet. Inlet threads shall be AWWA taper thread for all corporation stops used on direct taps. Ball-type corporation stops shall be of brass construction, shall meet AWWA C-800-84, and shall be as manufactured by Ford, Mueller, or approved equal.

5.16 Water Meters

The size and type of all water meters shall be determined by the County Administrator based on fixture count and the proposed use(s).

All water meters shall be equipped with a Radio Frequency Meter Interface Unit (MIU) appropriate to the type of meter specified and as manufactured by Neptune Technology Group, Inc. and compatible with the County's radio read system.

Positive displacement meters shall meet AWWA – C700, latest revision "Standard Specifications for Cold Water Meters", and shall be a Model T-10, as manufactured by Neptune Technology Group, Inc.

Turbine type meters shall meet AWWA – C701, latest revision, and shall be a Model HP Turbine, as manufactured by Neptune Technology Group, Inc.

Compound type meters shall meet AWWA C702, latest revision, and shall be a Model Tru/Flo Compound, as manufactured by Neptune Technology Group, Inc.

All meters greater than Full 3/4" in size shall be provided by the property owner or his contractor.

5.17 Construction Within Public Rights of Way

On projects in which water lines are to be designed and constructed within public right(s) of way, the following additional materials specifications shall apply:

- A. Pipe Materials – Class 52 Ductile Iron Pipe which meets the applicable portions of the specifications in Section 5.01 of this manual shall be used for all waterlines constructed within public right(s) of way.
- B. Service Lines – Service lines smaller than 3" in diameter shall be polyethylene tubing in accordance with the specifications in Section 5.01.H of this manual. Service lines 3" or larger in diameter shall be Class 52 Ductile Iron Pipe which meets the applicable portions of the specifications in Section 5.01 of this manual.
- C. Tapping Saddles – Where tapping saddles are permitted to be used they shall be of stainless steel construction and shall be Model FTSS or FAST as manufactured by Ford Meter Box Company, or approved equal.

6 Sanitary Sewer Systems

6.01 General

The requirements of these standards must be satisfied for all systems to be incorporated into the County inventory. Such systems include construction within areas of existing or proposed easements on private property dedicated to the County or within a public right-of-way where specifically permitted by the Engineer or County Administrator. Specific variances to these standards must be approved and authorized, in writing, by the County Administrator upon request of the applicant.

All standards referenced in this section shall refer to the latest edition of the referenced standard at the time of final approval. The authority for amendment to sewer standards shall vest with the County Engineer. The authority for discretionary provisions for sewer designs shall rest with the County Engineer. Any references to acceptance and/or approval shall mean acceptance and/or approval by the County.

6.02 Private Sewer Service

Building sewer connections, or portions of building sewer connections outside the VDOT right-of-way or County easement shall be privately owned, operated and maintained.

6.03 Relationship to Waterworks Structures

Public wells, other public water supply sources, structures, and sewers shall meet the requirements of the Virginia Waterworks Regulations with respect to minimum distances from water supply wells or potable water supply sources and structures. No sewer line shall pass within 50 feet of a potable water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection. The Design Engineer shall identify and adequately address the protection of all potable water supply structures within 100 feet of the proposed project. A minimum 10 feet edge to edge horizontal separation shall be maintained between sanitary manholes and water services, meter boxes or meter vaults.

6.04 Vertical and Horizontal Separation from Other Utilities

Normally where storm sewers or other utilities pass over or under sanitary sewers, a minimum of 18 inches of separation should be maintained. The County may allow the separation to be less than 18 inches but no less than 12 inches on a case-by-case basis. Ductile iron pipe (Class 52 minimum) must be utilized for the sanitary sewer where the separation is less than 18 inches.

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 by the County. If a sanitary sewer is located more than 5 feet below the bottom of a parallel storm sewer, the Department of Public Works may require that the distance between the pipes be increased.

6.05 Location of Sewers in Relation to Streams, Estuaries, Lakes and Reservoirs

Sewers entering or crossing streams shall be of sufficient depth below the natural bottom of the streambed to protect the sewer line, but with a minimum of 24 inches of cover on the pipe. In paved channels, the top of sewers shall be placed a minimum 18 inches below the bottom of channel pavement. Sewers shall remain fully operational during a 25-year storm event. Sewers and their appurtenances located along streams shall be protected against the 100-year storm event. In no case shall a sewer line be located within a Stormwater Management (SWM) and/or BMP facility or its associated easement.

6.06 Sewer-Only Accounts

The County will allow sewer-only accounts. Sewer-only accounts will not be charged water use fees, but the private wells supplying such accounts must be fitted with meters. Meters must be accessible to and will be read by the County in order to establish quantities per billing cycle for applicable sewer charges. The size and location of the water meter shall be shown on the project plans. All water meters must meet or exceed AWWA specification C700, C701 or C702 latest revision as approved for the size and type of meter to be installed.

6.07 Pretreatment

All users of the County's sewer system shall comply with the Fluvanna County Pretreatment Ordinance and the County's Pretreatment Program. See Chapter 21, Article III, Division 3 of the Fluvanna County Code.

6.08 Grease Traps

Grease, oil and sand traps shall be provided when in the opinion of the County they are necessary for the proper handling of liquid wastes containing such ingredients or any other of a flammable or harmful nature.

All grease, oil and sand traps shall be of a type and capacity approved by the County. They shall be of substantial construction, watertight and equipped with easily removable covers which when bolted in place shall be gas and watertight.

All grease, oil and sand traps shall be maintained by the owner at his expense in continuously efficient operation at all times.

6.09 Inverted Siphons

Inverted siphons shall not be allowed without specific written approval of the Director of Public Works, and only in cases where other alternatives make the use of inverted siphons in the best interest of the County.

7 Gravity Sanitary Sewer Design Parameters

7.01 Tributary Population

Sewer systems shall be designed to carry the peak flows generated by the estimated future population from all contributing points under consideration. The estimated future service population will be based on the adopted County Comprehensive Plan for the drainage area to be served. The estimated average daily flow will be computed using the unit flows from Table 3-1.

Consideration will be given to the domestic, commercial, institutional, and industrial wastes plus groundwater infiltration in determining the necessary capacity of the sewer system. A design analysis and design summary in the format contained in Detail G-06 in this manual shall be submitted with all project plans. A sewer shed map and overall design analysis showing all potential tributary connections shall be provided with the plans for any project which includes construction of any sewer line(s) which are included in the County's Water and Wastewater Master Plan.

7.02 Design Capacity

New sewer systems will be designed to carry the estimated peak flow from the contributing watershed plus any flows pumped into the watershed from pump station(s). Peak flows shall be determined as follows:

- A) 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 flow. ($Q_P = 4.0 \times Q_A$)
- B) 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.
- C) For average daily flows greater than 6.0 mgd, peak flows shall be 2.5 times the average daily flow. ($Q_P = 2.5 \times Q_A$)

The unit flows from Table 3-1 will be assumed to cover infiltration. When deviations from the flow rates of Table 3-1 are proposed, a description of the procedure used for the sewer design shall be included with the submission of the site development plans. The use of flows other than those listed in Table 3-1 requires the written permission of the County.

7.03 Hydraulic Design Criteria

Sewers shall have a uniform slope and straight alignment between manholes, with uniform slope maintained along the entirety of each branch of the sewer system to the greatest extent practicable.

Sewers will be designed to be free flowing with a hydraulic grade below the crown of the pipe. All sewers will be designed with slopes in accordance with Table 7-1 below:

Table 7-1 Minimum Slope

<u>Sewer Size (Inches)</u>	<u>Minimum Slope (feet/100 Feet)</u>
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

36	0.05
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All sewers will be designed so that the actual depth of flow in the pipe during peak flow conditions will not exceed 80% of the pipe's nominal inside diameter ($d/D \leq 0.80$). Capacity and velocity computations for gravity sewers shall be done using the Manning formula with units as follows:

Manning Equation:
$$V = \frac{k}{n} R_h^{2/3} S^{1/2}$$

V = velocity (fps)

Q = flow rate (gpm)

S = pipe slope (% or ft/ft)

A = pipe cross-sectional area (sf)

R = pipe hydraulic radius (ft)

k = conversion factor between [SI](#) and [English units](#). (It can be left off, as long as you make sure to note and correct the units in your "n" term. If you leave "n" in the traditional SI units, k is just the dimensional analysis to convert to English. k=1 for SI units, and k=1.49 for English units)

Manning roughness coefficient, n, of 0.013 shall be used for all pipe materials.

Upper or terminal sewer runs shall have an absolute minimum slope of 1.00% regardless of diameter, unless there is a distinct possibility that the sewer line will be extended within five (5) years of construction.

Minimum grades shall not be less than those required to produce a velocity of approximately two and one quarter (2.25) feet per second when the sewer size selected is flowing full or half full. Pipe sizes shall not be arbitrarily increased in order to take advantage of a flatter grade.

Gravity sewers shall be designed such that the maximum velocity in any pipe will be 10 fps. Where site slope conditions dictate that velocities must exceed 10 fps, the sewer shall be constructed of ductile iron pipe conforming to USM 5.01.

Computations for velocity of flows shall be based upon the following values of "N" as used in the Manning formula for velocity of flow:

- a) Sizes 8 inch through 21 inches, N = 0.013
- b) Sizes 24 inch and above, N = 0.012

In cases where the calculated depth of flow is less than pipe flowing full, the velocity at actual depth of flow shall be computed. For sewage flow depth less than 1/4 full, an allowance shall be made for increased value of "N" and in no case shall velocities of less than 1.3 feet per second be permitted. The improved velocities shall be accomplished by steeper grades and not by changing pipe diameter.

The minimum size for gravity sewer mains shall be 8 inches in diameter. The diameter, length, and slope of all proposed sanitary sewer runs shall be shown on the profile views of the sewer on the project plans. The pipe length, size and material shall be shown in the plan view(s) of the sewer on the project plans.

Generally, the sizes of pipe shall be continually increasing with increase of tributary areas. However, when steep grades are available and length is such that a significant cost savings will result without jeopardizing the system, the size of pipe may be reduced a maximum of two nominal diameters, but not below 12 inches, with approval of the County Engineer. Proper hydraulic allowances must be made for resulting head losses.

Where pipe diameters increase at manholes in direction of flow, effluent invert shall be lowered below influent elevation to match crowns.

Special consideration shall be given to cases where pipe diameters decrease in direction of flow to prevent surcharging of the incoming pipe.

Where velocities greater than 15 feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity. The pipe shall conform to appropriate ASTM or AWWA specifications which provide protection against internal erosion.

7.04 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:

- A) Special Structures - Whenever possible sanitary sewer structures shall be built as shown in the Standard Details. Structures other than those shown in the Standard Details shall be considered special structures and shall be designed and detailed by a professional engineer licensed in the State of Virginia.
- B) Pipe Foundation - In all cases the proper strength sewer pipe shall be specified for the proposed depth, width of trench and bedding condition. Soil conditions should be considered with samples being obtained where necessary to verify pipe selection and foundation design.
- C) Flotation - Sewer shall be designed to resist flotation where such conditions may be reasonably expected to exist, i.e. – large diameter PVC pipe in high ground water areas.

The proper strengths shall be determined and indicated for sewer pipe materials being specified. Strength shall be based upon pipe size, proposed depth, width of trench, bedding

conditions, existing ground conditions, etc. This is a matter of detail design not subject to simple generalizations. Minimum bedding shall be Class C.

In deep cuts, it is generally preferable to change pipe strengths to obtain proper design rather than vary bedding conditions. However, pipe strength or class shall be shown on plans with stations to indicate the location.

No change in strength or material shall be made between manholes unless it can be substantiated that a considerable cost savings would result and integrity of system would not be jeopardized. Proper precautions shall be taken regarding correct location(s) of varying strength of pipe.

The thickness of precast concrete manhole walls shall be increased when total depth of manhole exceeds 30 feet. The minimum manhole diameter shall be increased to 60 inches when the total depth equals or exceeds 24 feet.

Gravity systems receiving pumped flows shall be protected against sulfide attack for a distance of 1200 feet downstream from point of pumped flow entry. This shall be accomplished by the use of acid-resistant pipe and manholes. The Department shall approve the materials and design for the conditions at each individual location. Existing receiving manhole and manholes within 1200 feet shall be internally coated with an approved sulfide resistant lining or coating.

Where odor may be a problem, chemical addition or other odor control method approved by the County Engineer shall be added at the pump station or to the system.

Ductile iron pipe shall be used where sewers enter or cross streams, estuaries, lakes or reservoirs; cross jurisdictional wetland areas; or as a carrier pipe within any bore or tunnel crossing.

Ductile iron pipe shall be used in easements where, in the opinion of the Department, the sanitary sewer is not accessible from a street, parking lot, or driveway.

7.05 Separation of Water Mains and Sanitary Sewers & Location of Sanitary Sewers

- A) General - The following factors shall be considered when determining whether separation between two different pipes is adequate:
- 1) The materials and types of joints for each pipe
 - 2) Soil conditions.

- 3) Service branch connections into the pipes.
- 4) Offsetting of pipes around manholes.

B) Separation of Parallel Pipe Installations

- 1) Sewer lines shall be laid at least 10 feet horizontally from other utilities whenever possible. In all cases, sewer lines shall be installed at least 10 feet horizontally from water lines. Horizontal distance shall be measured outside-edge to outside edge.
- 2) If local conditions prevent a horizontal separation of 10 feet, the sanitary sewer line may be laid up to 5 feet from utility lines other than water lines with the permission of the Director of Public Works.

C) Separation of Pipe Crossings

- 1) Sanitary sewer lines crossing below water lines shall be laid to provide a separation of at least 18 inches between the bottom edge of the water line and the top edge of the sewer line whenever possible.
- 2) When local conditions prevent the required vertical separation from being met, the following construction shall be used:
 - (a) Sewers passing over or under water lines shall be constructed of AWWA approved water pipe as described in USM 5.01.
 - (b) Water lines passing under sewers shall be protected by providing:
 - (i) A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line.
 - (ii) Adequate structural support for the sewers to prevent excessive deflection of the joints and the setting on and breaking of the water line.
 - (iii) The length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.
 - (c) All pipes shall be tested in place without leakage prior to backfilling.
- 3) A minimum of 12 inches will be maintained between sanitary sewer lines and utility lines other than water lines.

7.06 Location of Gravity Sewers

Since all sanitary sewers must be accessible for operations and maintenance:

- A) In general, sewers shall be placed in utility easements dedicated to the County, and shall run adjacent to, and parallel to, the street or travel way. On curved streets, the sewer main

shall not be closer than 5 feet to the highway right of way line except at street intersections or as otherwise permitted. Manholes shall not be located in areas where water backs up during a storm. Detailed reasons why alternate routes cannot be used must be submitted for substantiation. Projected cost alone is not an acceptable reason.

No water line shall pass through or come in contact with any part of a sewer manhole.

- B) When sanitary sewer lines cross gas transmission lines the sanitary sewer will be constructed of Class 52 ductile iron pipe, or the sewer line will be installed in a steel casing running the entire width of the gas line easement. If the sanitary sewer is constructed of ductile iron pipe, the line will be polyethylene encased in accordance with ANSI/AWWA C105. If the gas transmission main is constructed of steel pipe, the distance to the nearest anode bed will be shown on the project plans. Test pits will be dug on the transmission main at the proposed crossings. Test pit locations will be shown and labeled on the Project Plans.
- C) Sanitary sewers shall be designed to run below the water system. All water lines will cross above sanitary sewers with a minimum vertical separation of 18 inches. The County may require the sanitary sewer to be constructed of ductile iron pipe when minimum separation is provided. At all utility crossings, except for water, a minimum vertical separation of 12 inches will be maintained between the utility line and the sanitary sewer.
- D) Sanitary sewer lines shall not be located within any public or private Stormwater Management (SWM) and/or BMP facilities, or their associated easements.
- E) Construction shall be along the centerline of rights-of-way or easements except when this location has been previously used by another utility, or when the width of a road right-of-way justified the use of two sewer lines. Exception to this specified location will be allowed only when it can be established that it is not practical to adhere to the standard location.
- F) All sewers shall be on continuous grade between manholes.
- G) Sewers should intersect in manholes at angles not less than 90 degrees. Additional manholes shall be installed as required or an alternate route used.
- H) Where sewer depth is 10 feet or less, sewer mains and manholes shall be located a minimum of 10 feet horizontally from any part of a building, structure, or its foundations. Where the depth of sewer is greater than 10 feet, the sewer mains and manholes shall be located a minimum of 15 feet from any part of a building, structure, or its foundation or a distance equal to the depth of the excavation whichever is greater.
- I) Sewer lines shall be protected from a 100-year flood by either raising manhole tops above flood plain or by the use of watertight frames and covers. Where watertight frames and covers are used, unventilated length of sewer cannot exceed 1000 feet. Manhole covers shall be no more than 30 inches above ground level.
- J) Vandal proof manhole frames and covers shall be used on all manholes not in paved streets unless watertight covers are required.

- K) Where possible in unpaved areas, manhole covers shall be approximately 12 inches above final grade.
- L) At the upstream manhole in a cul-de-sac, the maximum number of sewer connections allowed into the manhole is 3.

7.07 Water Crossings

All crossings of streams, estuaries, lakes and reservoirs shall be constructed of Class 52 ductile iron pipe. The pipe and joints shall be tested in place and shall exhibit no infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical, longitudinal, vertical and horizontal loads and erosion and impact.

Construction of sewers on piers across ravines or streams shall only be permitted when it can be demonstrated that no other practical alternative exists. Such sewers on piers will be constructed of Class 52 ductile iron pipe with mechanically restrained joints. Detailed design information and details of such aerial crossings and piers shall be included in the Project Plans.

The Developer or his Design Engineer shall be responsible for obtaining all required State and Federal permits to install a surface water crossing, and for all expenses associated with such permit(s). At stream crossings, the top of the sewer shall be a minimum of 1 foot below the stream channel when the stream bed is rock, or 3 feet when the stream bed is sand or other unconsolidated material.

When a sanitary sewer runs parallel to a stream, the invert of the sewer shall be a minimum of three (3) feet below the invert of the adjacent stream channel to ensure that adequate crossings can be made. A profile of the stream channel invert shall be shown on the sanitary sewer profile.

7.08 Manholes

The minimum inside diameter for a manhole shall be 4 feet. A larger inside diameter may be required depending on the pipe diameter and the type(s) of connector(s) used. The inside diameter of each manhole shall be noted on the sanitary sewer profiles. Pipes larger than 24 inches in diameter shall have minimum 5-foot diameter manholes.

Manholes equal to or greater than 18 feet deep shall have minimum inside diameter of 5 feet. Manholes equal to or greater than 25 feet deep (where permitted) shall have a minimum diameter of 6 feet.

Manholes shall be provided at all junctions with other sewers, at all points of change in alignment or pipe slope, and at the terminal point of the main. The maximum distance between manholes shall be 400 feet.

At all collector system manholes, the difference between the influent and effluent inverts shall be 0.20 feet unless otherwise stated in this manual.

Drop connections at manholes shall be avoided wherever practicable. However, where the proposed difference in invert elevations is equal to or greater than 36 inches a drop connection may be used. All drop connections shall conform to Standard Detail SC-07.

Where there is an increase in pipe size at a manhole, the crown elevations of the pipes shall match.

Manholes shall extend above the known level of flooding or, if this is not possible or practical, watertight manhole frames and covers shall be installed. On watertight gravity sewer lines manhole vents conforming to the Details Section in this manual will be provided at least every 1,000 feet.

Manhole tops located in open areas out of yards, roads, travel ways, and parking areas will be set a minimum of 2 feet above the surrounding finished grade unless otherwise directed by the County.

All manholes shall be provided with a watertight manhole insert as described in USM Standard Detail SC-02. The manhole insert shall be a No Flow/Inflow Insert, or Rainstopper Insert as manufactured by Southwest Packing and Seals, or approved substitute.

To assist in preventing infiltration/inflow, all newly installed manholes shall be constructed with an external manhole chimney seal between the manhole casting, adjusting rings, and cone section, as shown in USM Standard Detail SC-03.

Under no circumstances shall manholes be located in sidewalks or other pedestrian travel ways. Manholes shall not be located within parking spaces unless expressly permitted by the County.

Manholes within 1,000 feet of the discharge point for a sanitary sewer force main, or the first 3 manholes downstream of such discharge point, whichever encompasses the greater number of manholes, shall have interior linings to prevent corrosion. On new manholes, such lining shall be T-loc or approved equal. In situations where a force main is being connected to an existing manhole, the affected manholes (as described above) shall be thoroughly cleaned, and protected from corrosion by the application of a lining system approved by the County. The proposed lining system will be shown and specified on the project plans.

Manholes must be placed at a minimum of 10 feet horizontally from water mains (edge to edge) wherever possible. Exceptions to this separation distance must be submitted in writing to the Director of Public Works. Manholes must be of watertight construction and tested in place for leakage.

Manholes constructed on fill shall be constructed with a false bottom extending to undisturbed ground, or some another approved means of preventing settlement of the manhole.

All manholes in a project will be assigned a unique alphanumeric identifier on the project plans. Such designation shall consist of a two-letter designation and a four-digit number (XX-####).

7.9 Water Tightness

Watertight manhole frames and covers shall be provided whenever manholes may be flooded. As a minimum, watertight frames and covers shall be used in areas where the frames will be below the 25-year flood level. Watertight systems shall be vented at least every 1,000 feet.

7.10 Service Connections

Gravity sanitary sewer service connections shall be installed from the main to the property line or easement line (at a minimum) and shall have a minimum 4-inch inside diameter and shall be designed in accordance with Standard Detail SC-07 or Detail SC-08 in this manual. All service connections must be connected by means of a manhole connection or a pre-manufactured tee or wye, or with a saddle type connection approved by the County. Service connections to terminal manholes shall not exceed three in number at any one manhole. Service connections to in-line manholes must obtain prior approval from the County.

A sanitary sewer lateral table shall be included in the project plans. For residential subdivisions the table shall be organized in order of ascending lot numbers. For each sanitary sewer lateral, the table shall provide, as a minimum, the following information: identification of the upstream and downstream manholes from the connection point of the lateral to the main; the size of the main; the distance along the main from the downstream manhole to the connection point; the invert of both the main and the lateral at the connection point; the size, slope and length of the lateral; the elevation of the lowest proposed finish floor with plumbing fixtures of the building to be served by the lateral; and the difference in elevation between the crown of the main at the connection point and the lowest proposed finish floor with plumbing fixtures of the building to be connected to the lateral. If risers are to be used on the lateral, the length and height of the riser shall be included in the lateral table.

The lowest floor elevation of any structure to be served by gravity shall be a minimum of 4 feet above the invert elevation of its sewer service connection at the sewer main. For existing structures, connection to the public sewer with plumbing fixtures located on a floor of the structure that is less 4 feet above the sewer main as specified above shall not be allowed unless a written waiver is obtained from the County or a pumping operation is utilized.

Sewer laterals shall not be tied directly into a trunk sewer unless specifically approved by the County Administrator.

7.11 Pipe Material Selection and Depth of Cover

The applicable pipe materials listed in Section 9 of this manual have been generally approved for use. However, the acceptability of specific pipe materials for use within the County's service area shall be determined by the County on an individual basis at the time of review of final plans. This will necessitate that prospective developers/builders or their engineers contact the County directly to ascertain its specific pipe material requirements. The type or types of pipe allowable for use on any specific project shall be shown on the approved project plans. There will be no change in pipe material along a pipe run, from manhole to manhole, unless approved by the County Administrator.

Normally, sewers constructed in a street, travel way or other paved surface shall have a minimum cover of 5 feet and maximum cover of 20 feet. Such sewer lines may be installed with between 3½ and 5 feet of cover, provided that the sewer is constructed of minimum Class 52 Ductile Iron Pipe but may be installed with greater than 20 feet of cover only with prior approval of the County Administrator.

Sewer constructed in unpaved areas will have a minimum cover of 4 feet and a maximum cover of 20 feet. Such sewer lines may be installed with between 2½ and 4 feet of cover provided that the sewer is constructed of minimum Class 52, Ductile Iron Pipe, but may be installed with greater than 20 feet of cover only with prior approval of the County Administrator. Any time the depth of cover is less than two pipe diameters for a significant distance, calculations will be provided showing that buoyant forces will not cause floatation of the line.

All sewers with a depth of cover of 20 feet or greater will be constructed of minimum Class 52 Ductile Iron Pipe. The class of pipe used will be in accordance with Table 7-2. All sewers constructed on fill will be constructed of minimum Class 52 Ductile Iron Pipe.

Table 7-2					
<u>Maximum Depth of Cover (FT) and Trench Widths (IN)</u>					
Type 4" Laying Condition Cement-lined D.I.P.				Class 1 Gravel Bedding PVC** SDR-35	Max Trench Width (inches)
Pipe	Class 50	Class 51	Class 52		
8	40	40	40	18	42
10	38	40	40	18	42
12	36	40	40	18	42
14	33	38	40	--	42
15	--	--	40	18	42
16	30	34	40	--	44
18	29	32	36	18	44
20	27	30	34	--	42
21	--	--	--	18	48
24	23	27	30	18	51
27	--	--	--	18	55
30	18	21	24	--	60
33	--	--	--	--	63
36	17	20	24	--	69
42	16	19	22	--	78
48	15	18	21	--	87
54	15	18	21	--	96
** For depths in excess of 18 feet, Engineer shall provide design data.					

Sewer force mains shall be constructed of Class 52 or greater ductile iron, and shall be H2Sewer Safe pipe as manufactured by Griffin Pipe Products, or an approved equal.

7.12 Casings and Tunnels

Pipelines that must be bored or tunneled under a roadway, or other obstruction, shall be installed in a steel casing or tunnel as shown in Detail G-05 in this manual. Pipe in casings and tunnels shall be constructed of a minimum of Class 52, ductile iron pipe with restrained joints. Casing spacers shall be as manufactured by PSI, or approved equal. Casings and tunnels on a slope shall be installed so that they will drain. Casings will conform to the details provided in this manual. Complete design information for any utility tunnel shall be included in the project plans.

7.13 Anchors

Sewer lines approved for slopes of 20 % or greater shall be anchored securely with concrete anchors or other approved method. Sewers with slopes greater than 14 % will be constructed of ductile iron pipe. Structural and installation details of anchors shall be included in the project plans. Spacing of anchors shall be as follows:

ANCHOR SPACING REQUIREMENTS

<u>Slope (%)</u>	<u>Anchor Spacing (Center to Center)</u>
20 - 35	36 - ft
35 - 50	24 - ft
> 50	16 - ft

7.14 Force Main Service Connections

All properties connecting to the public sewer system shall be served by a gravity sanitary sewer connection. Service connections to force mains shall not be allowed unless formally reviewed and approved in writing by the County.

7.15 Private Building Sewer Connections

The design of all building sewer connections outside of the state road right-of-way or other dedicated easements is regulated by the VUSBC.

8 Sanitary Sewer System Construction

8.01 General

Construction of sanitary sewers and appurtenances within the County service areas shall be in accordance with plans and specifications approved by the County. Prior to the construction of an approved sanitary sewer, the Design Engineer shall place adequate line and grade stakes identifying the sewer, manholes, sanitary lateral stub-outs located at the property line, and other appurtenances to insure the system can be constructed in accordance with the approved plans. The Design Engineer shall then prepare legible cut sheets at 100-foot stations. Cut sheets will contain all data pertinent to the construction of the sewer main, the station and length of service connections, the location of all concrete encasements or cradles and the finished grade of all manhole rims. Three sets of all cut sheets shall be submitted to the County for review and approval.

If a deviation from the approved plans in the horizontal location or grade of any sewer, structure or appurtenance is necessary, a revision to the approved plans showing the proposed deviation must be submitted to the County for review and approval before the changes are constructed.

8.02 Excavation and Trenching

Excavation shall conform to the lines and grades shown on the approved project plans and cut sheets. The slope of the sides of the excavation shall be kept as nearly vertical as possible consistent with worker safety and the types of materials encountered. Where required to maintain safe working conditions, trench walls will be sloped or benched. 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. The contractor shall provide sheeting, bracing and shoring necessary to perform the work, and protect existing structures and excavations in accordance with the Virginia OSHA Regulations. The width of the trench from the foundation to 12 inches above the pipe shall not exceed the maximum width as shown in Table 7-2.

The bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil along the entire length of the pipe, except where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes and depressions for joints shall be only of such length, depth and width as required to make a proper joint. Bell holes and depressions for joints shall be backfilled with granular material and compacted. Excavation shall not be carried below the established grades unless unsuitable materials incapable of supporting the pipe are encountered. Wherever the soils encountered at the trench bottom are incapable of adequately supporting the pipe, the trench shall be over excavated until a stable foundation is reached. The over excavation shall be filled with suitable backfill material having a maximum particle size of 1 inch, placed in 6-inch lifts and compacted until the trench bottom is brought to grade.

All water entering the trench excavation shall be removed and disposed of properly. Dewatering equipment shall be sized to maintain the trench in a satisfactory condition for pipe laying. Pipe laying will be permitted only where the depth of water is maintained below the invert of the pipe joint. Water shall be disposed of in a suitable manner without damage to adjacent property and in a manner protective of public health and convenience.

No more than 200 feet of trench shall be excavated in advance of completed pipe laying. Excavation at manholes and similar structures shall be sufficient to have a minimum of 12 inches of clear area between their outer surface and the embankment or sheeting.

Blasting operations shall be conducted in accordance with Applicable Law, as defined in Chapter 21 of the Fluvanna County Code, and all other applicable sections of the Fluvanna County Code and other applicable laws and regulations. After blasting or other approved methods of removal, no projection of rock shall remain nearer than 6 inches to any part of the sewer pipe when laid, nor shall they project beyond the lines and grades of masonry structures. Blasting shall not be done within 40 feet of a completed sewer. The ends of sewers adjacent to blasting operations shall be covered so as to prevent debris from entering the sewer. All blasting operations shall be monitored for air blast and vibration. Reports shall be provided to the County's Inspector as soon after completion of each day's blasting activities as is practical.

8.03 Pipe Embedment and Backfill

VDOT Type B stone, sand, or other material approved by the County shall be used for pipe bedding. Material suitable for pipe bedding shall be deposited and compacted to eliminate the possibility of lateral displacement of the pipe. Bedding material shall be solidly hand tamped around the pipe in 6-inch lifts up to a level at least 6 inches above the top of the pipe. Pipe embedment shall be carried out simultaneously on both sides of the pipe.

The pipe backfill shall consist of clean earth loam, sand or gravel and shall not contain large stones or rocks, frozen material, cinders, ashes, refuse, vegetable or organic material. The backfill shall be deposited and compacted by mechanical tampers except in areas where paving is to be placed over the backfilled trench. Compaction shall achieve a density of at least 95 % of the maximum density as determined by the AASHTO Method T-180.

8.04 Pipe Installation

Stockpiled pipe materials shall be handled by mechanical equipment and placed to avoid interference with traffic and the trenching operation. When installing pipe in the trench, proper implements, tools, and facilities satisfactory to the County and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings or other suitable tools or equipment in such a manner as to prevent damage to the materials and any protective coatings and linings. Under no circumstances shall such materials be dropped or dumped into the trench.

Adequate supports shall be provided for all pipes. In all cases and at all locations the subgrade shall be made by backfilling with crushed stone as indicated in Details G-01 and G-02 in this manual and shall be thoroughly compacted. Continuous and uniform stone bedding shall be provided in the trench for all pipes so that the pipe barrel bears on and is supported by the stone bedding at every point between bell holes. The finished subgrade shall be prepared accurately by means of hand tools. Trenching below the specified grade shall be backfilled with approved material and thoroughly compacted.

The pipe may be laid in a manner best adapted to securing speed and good results, however, the method of pipe laying and jointing shall be in accordance with the manufacturer's recommendations and shall be approved by the County. Damaged or unsound pipe or fittings shall not be accepted. Gravity sewers 24 inches or less shall be constructed with straight alignment between manholes.

Rubber gasket, "O" ring type joints shall be laid true to line and grade and shall be jointed together such that the completed pipe will have a smooth invert. After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipe previously laid and the pipe pushed home with a bar. **THE USE OF LIFTING AND HYDRAULIC EQUIPMENT TO MAKE PIPE JOINTS IS SPECIFICALLY PROHIBITED.** The trench pipe interface shall be shaped to the curvature of both the bell and barrel of the pipe. The trench shall be kept free of water while the work is in progress. The ends of the pipe shall be brushed clean so that proper joints can be made. As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other superfluous material. The exposed end of all pipes shall be fully closed to prevent earth, water, or other materials enter the previously installed pipe, the pipe shall be immediately cleaned with care taken to preserve any coatings. Gravity sewer pipe shall be laid on standard bedding in accordance with the standard details. Where mechanical joints are specified for ductile or cast-iron pipe and fittings, the joint shall be thoroughly coated with lubricant, the gasket and gland properly positioned, bolts inserted and diametrically opposite bolts drawn up until all bolts are tight. All bolts shall be tightened with a torque wrench set at 55 pounds.

Pipe cutting shall be accomplished with a mechanical cutter or a saw in a manner that will not damage the pipe. Ends of cut pipe shall be beveled to prevent damage to gaskets, fittings, etc.

All bends, tees, plugs and dead ends of pipe for force mains or gravity sewers shall be substantially braced or blocked in the adequate reaction backing. This backing shall be a thrust block of 3,000 psi concrete. The backing shall be placed between solid undisturbed earth and bear solidly against the pipe. All fittings to be braced, blocked and/or anchored shall be placed so that the pipe and fitting joints will be accessible for repair. Required bearing areas shall be determined by the Owner's or Developer's engineers based on pipe size, type fitting, maximum pressures, and type of soil in the thrust area, all subject to the review and approval of the County.

Materials for roadways or driveways shall be compacted to at least 95 % of the maximum density as determined by AASHTO Method T-180.

The site restoration of the entire construction area shall be finished in a neat and uniform condition acceptable to the County.

On gravity sewer lines, 3M-Brand ScotchMark sewer full range disc type line marker devices shall be installed on top of the pipe at the tee of each individual service connection, 5 feet from the stub-out end of each service connection, and at each change in direction along the route of the individual service connection. Marker tape shall be buried along the pipe route, 18 inches above the line, on each individual service connection.

8.05 Bores and Tunneling

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

8.05 Service Connections

Pipe between the sewer and the property line shall conform to the applicable sections of this manual and in no case shall be less than four inches inside diameter. Only materials approved by the County may be used from the property line to the building. All pipes from the sewer to the building shall be laid to a grade of not less than ¼ inch per foot unless otherwise approved by the County.

All connections and wyes that are for future use shall be capped as directed by the County. No pipe shall be cut for service connections except as approved by the County. The ends of pipe that enter sewer lines shall be neatly cut to fit the inner face of the pipe. When directed, such cutting shall be done before the pipes are built in. No service connections shall be made into any manholes.

Wyes for service connections shall be installed where indicated on the approved plans. Wye and service connections shall be installed in conformance with these Construction Standards. Each service lateral shall terminate at the property line with a line location marker placed above the stub-out.

In a structure to be served by gravity, the lowest elevation of any floor containing plumbing fixtures shall be a minimum of 4 feet above the crown elevation of the sewer main at its sewer connection. If the structure is ultimately served by a lift station, the lowest elevation of any floor containing plumbing fixtures shall be a minimum of 5 feet above the top elevation of the lift station wet well.

8.06 Private Building Sewers

Building sewer connections from the property line to the building, except those portions which lie within a dedicated right-of way or easement, are regulated by the VUSBC.

8.07 Manholes

The pre-cast base section of sanitary sewer manholes shall be installed on a compacted granular foundation prepared similarly to that required for the proper installation of the sanitary sewer.

Manhole lifting holes shall be plugged with rubber stoppers and an approved non-shrink grout after installation. The non-shrink grout will be applied to the inside and outside of the manhole. Joints shall be formed entirely of concrete employing a round rubber gasket, and when assembled, shall be self-centering and make a uniform watertight joint.

The invert channels of the manhole shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in the size and grade of the channels shall be made gradually. The invert channels the bench of the manhole outside of the channels shall be brought to grade and formed with poured in place concrete. The bench of the manhole outside of the channels shall be an even float finish and shall slope toward the channels with a minimum slope of $\frac{1}{4}$ of an inch per foot of run. The invert channel will be at least 0.8 times the diameter of the pipe for lines 8 to 12 inches in diameter. The difference in the elevation of the inverts of incoming and outgoing pipes shall be 0.2 feet.

Standard manhole drop connections shall be installed where indicated on the project plans. Drop connections shall conform to Detail SC-07 in this manual.

Adjusting rings may be used to bring the top of the manhole to the final grade, when this cannot be accomplished with standard pre-cast sections upon approval of the County Administrator. The number of adjusting rings shall be minimized. Manholes shall have an internal or external manhole chimney seal between the manhole frame, adjusting rings and cone section, as shown in Details SC-04 and SC-03, respectively.

Frames and covers shall be of the type and duty shown on the project plans and as specified in this manual.

8.08 Pipe Connections at Manholes

Manholes shall be supplied with an approved, flexible pipe connection suitable for the pipes and manholes specified. Flexible gaskets for pipe connections to manholes shall be made with a flexible rubber manhole sleeve with a flanged waterstop cast into the manhole base by the manufacturer or other flexible connectors acceptable to the County. Flexible gasket for pipe connections shall meet the requirements of ASTM C-923. The sleeve shall be secured to the pipe by means of stainless steel clamps. Manholes with extra connections or openings that must be bricked up, or otherwise changed in configuration, are not acceptable. Connections to existing manholes, when approved by the County, shall be made by coring the manhole and installing a rubber boot.

8.09 Frames and Covers

All frames shall be securely anchored to the related structures as directed by the County, and shall be installed so that the cover shall be exposed and flush with the street surface. If street surfaces are renewed or replaced by the Developer or Owner after the sewer system has been approved and accepted by the County, but while such streets are still the obligation of the Developer or Owner, the frames and covers shall be readjusted to proper location relative to new street surfacing. The frame and cover of manholes or cleanouts located in off-street areas shall be so installed that the covers shall be exposed and either flush or above the immediate surface as deemed advisable by the County.

Pursuant to Section 21.07.06 of the Virginia Sewerage Regulations, watertight manhole covers shall be provided and installed where required so that the cover is to at least the designated elevation of the 25-year flood/wave action. In addition thereto, adequate ventilation shall be provided when such a watertight section of gravity sewer exceeds 1,000 feet in length.

8.10 Acceptance Tests

Sewers will be inspected to determine if any deviation from line and grade has occurred. The pipe alignment will be checked by illuminating the interior of the pipe. If the pipe shows poor alignment, displaced pipe, or other defect, including a visible leak, the defect shall be corrected before acceptance.

An acceptance test shall be specified for all gravity sewer lines. The test may be either a water test or air test. Where water testing is specified (exfiltration), the leakage outward shall not exceed 100 gallons per inch of nominal pipe diameter per mile per day (2,500 gpd/mi maximum) for any section of the system including manholes. Where the exfiltration test is employed, a minimum of 4 feet of head at any point in the line and a maximum head of not more than 10 feet shall be used.

Where air testing is specified, test methods and acceptability criteria shall be in accordance with ASTM F1417. Air testing of gravity lines shall generally be acceptable for all types of pipe materials.

If air testing is employed, manholes shall be tested by exfiltration. Use inflatable stoppers to plug all lines into and out of the manhole being tested. The stoppers shall be positioned in the lines far enough from the manhole to insure testing to those portions of the lines not air tested. The manhole shall then be filled to the top with water. A 24-hour soak shall be allowed. Leakage shall not exceed $\frac{1}{4}$ gallon per hour for a 4-hour test period.

The contractors shall furnish weirs, standpipes, pipe plugs, water, pressure gauges, stop watches, air compressor, hose and such materials and assistance as required to perform these tests. All acceptance tests shall be conducted by the contractor in the presence of the County.

Acceptance tests shall not be made until the sanitary sewer, manholes and required sewer service connections, as shown on the approved project plans, have been installed, sewer trenches backfilled and compacted to finished subgrade.

Sanitary sewers, including manholes, shall be inspected prior to acceptance testing, and any water leakage into the system sufficient to constitute any noticeable trickle or dribble, first shall be corrected and eliminated prior to undertaking the acceptance test.

Whenever it has been necessary to construct underdrains or place gravel under pipelines in order to dewater the trench during construction of the sewers, the acceptance test will not be made until pumps (which have been used in the dewatering process) have been disconnected.

All acceptance tests shall be scheduled with the County at least 48 hours in advance. Each section of completed sewer shall be tested to the satisfaction of the County Inspector. Sewers shall be tested from manhole to manhole. In general, the test procedure shall be as follows:

A) Low Pressure Air Testing Procedure

- 1) All debris, silt, earth or other materials shall be removed from the sewer prior to acceptance testing. The pipe may be flushed or sprayed with water. None of this water or debris shall be allowed to enter the existing sewer.

- 2) Test plugs shall be supplied and installed within the pipe at each manhole. Each plug shall be securely braced.
- 3) If the pipe to be tested is expected to be below the groundwater table:
 - (a) A small diameter perforated vertical pipe shall be installed from the invert elevation of the sewer to the surface prior to backfilling; or
 - (b) A pipe probe shall be inserted by boring or driving into the backfilling material adjacent to the invert elevation of the pipe, and the depth of the groundwater level above the pipe invert shall be determined immediately prior to acceptance testing the sewer.
 - (c) All gauge pressures in the test shall be increased by the amount of this back pressure due to ground submergence over the end of the probe.
- 4) Air shall be slowly added to the portion of the pipe under test until the internal air pressure is raised to 4 psi gauge plus the groundwater pressure.
- 5) As a safety precaution, no one should be allowed in the manhole after the air pressure is increased in the sewer line. If the County suspects that the test plug may be leaking, the pressure shall be relieved before any adjustments are made to eliminate air leakage at the plug. The contractor may pre-coat the plug with a soap solution to check plugs for leakage.
- 6) The contractor may allow the air temperature to stabilize for at least 2 minutes with the pipe subjected to an internal pressure of 4 psi by adding only the amount of air to maintain 4 psi.
- 7) If the internal air pressure decreases, the time required for the pressure to drop from 3½ to 2½ psi gauge will be observed and recorded. The time interval shall be compared with the established standards in accordance with Tables 8-1 and 8-2.
- 8) Pipe failing to maintain the stipulated pressure for a period equal to or greater than the holding time shown in Tables 8-1 and 8-2 shall be deemed not to have passed the low pressure air test and is unsatisfactory for acceptance by the County. The contractor shall replace sewers or house connections that fail to pass this test. A single repair clamp will be allowed between manholes to facilitate the replacement of defective materials or workmanship.

B) Exfiltration Testing

- 1) Service laterals, stub and fittings into sewer lines being tested should be properly capped or unplugged, and carefully braced to resist the thrust actions developed by the internal water pressure. In preparing the blocking of plugs or end caps, it should be recognized that the 5 to 10 feet of head in the standpipe will exert considerable thrusts against the plugs or caps. For example, a 10-foot head will generate a total force of 215 pounds against an 8-inch plug. Further considerations must be given to the fact that

greater pressure will be developed in the downstream portion of the line, due to lower elevations, than in the upper reaches of the sewer line.

- 2) A tapped, plumber's type plug shall be inserted and tightened in the inlet pipe of the downstream manhole to which the water supply connection is made for filling the pipe.
- 3) The upstream (upper) manhole shall be securely plugged for connection to the standpipe. The standpipe shall then be placed in this manhole and connected to the tapped plug. The standpipe must be capable of handling from 5 to 10 feet of water head to determine the tightness and soundness of the sewer line, as specified and directed by the County.
- 4) Water shall be introduced into the line at the downstream (lower) manhole until the standpipe in the upstream manhole has been completely filled. By filling the line from the lowest level, the air in the line is easily pushed ahead and finally dispelled through the standpipe at the upper end of the test section. Since entrapped air will give distorted test results, all entrapped air will be expelled. The rate of drop in the standpipe may be quite rapid until the air has been expelled.
- 5) After filling with water, the line should be allowed to stand for at least several hours before beginning the test. During this time, some water absorption into the manhole structures will take place. After the water absorption has been stabilized, the water level in the standpipe should be checked and water added, if necessary.
- 6) The test shall now begin. The drop in the standpipe shall be measured and recorded over a 10-minute period. To verify the first results, a second 10-minute test is required. This will also verify whether a stable condition exists in the line.
- 7) The measured drops in the standpipe shall be converted to leakage in terms of gallons per inch diameter per mile per day. (Caution should be taken about conducting exfiltration tests on sewer lines laid on steep grades. Consideration must be given to the downstream portion of the system to prevent excessive pressures in these lower lines). For these installations and where the upstream manholes are very deep, it is not advisable to fill the standpipe or manhole to the top when performing the test.
- 8) The contractor shall replace sewer and house connections that fail to pass this test. A single clamp shall be allowed between manholes to facilitate the replacement of defective materials or workmanship.

TABLE 8-1
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR PVC SEWER PIPE

1 Pipe Diameter (In.)	2 Min. Time (min: sec)	3 Length for Min. Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	

4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

Normal Pipe Size in	T (Time) Min/100 ft	Nominal Pipe Size in.	T (Time) Min/100 ft
4	0.3	15	2.1
6	0.7	18	2.4
8	1.2	21	3.0
10	1.5	24	3.6
12	1.8		

D ₁ Nominal Pipe Size in	Q ft ³ /min	D ₂ Nominal Pipe Size in	Q
4	2	15	4
6	2	18	5
8	2	21	5.5
10	2.5	24	6
12	3		

REV-1

8.11 Force Main Testing

Sewer force main testing shall be in accordance with water main leakage tests. Specific procedures shall be detailed on the construction plans.

8.13 Coordination

Phases of the construction which involve the temporary interruption of essential services shall be scheduled in consultation with the Utility Provider, Property Owners or Utility Users and the County or their representative and shall not be of longer duration than essential to accomplish the purpose for such interruptions. Liaison in this matter shall be required before beginning any work. The Contractor shall notify the County not less than 48 hours in advance of commencing work. The Contractor shall give not less than 48 hours' notice in advance of the time and date of making any connections to the existing water or sewer system. The County may disapprove the

time and date of any and all connections and will advise the Contractor as to a suitable time and date.

The contractor shall not operate any valves on the County system or make connections to existing sewer and water lines before proper notification is made to the County so that inspection of this work can be made.

8.14 Grades, Lines and Levels

The Design Engineer shall establish baseline and control points. From these points the Contractor shall furnish necessary personnel and equipment to establish line and grade as required for the work. The Contractor shall furnish detailed construction documents to the County before beginning construction. The data on the documents shall include all information as specified in these specifications but as a minimum shall include, but not be limited to, centerline elevations (existing and proposed), centerline cut, centerline invert, manhole locations, manhole top and invert elevations, grade between manholes, and bench mark locations and elevations. Stationing intervals shall be every 50 feet.

The Contractor shall be responsible for the preservation of all stakes and marks established by the Design Engineer, and if any of the stakes and marks are carelessly or willfully disturbed, the cost of replacing them shall be charged against the Contractor.

Design Engineer shall certify that all streets, including curb and gutter, are to the correct finish grade prior to acceptance of utility construction by the County.

8.15 Measurement and Payment – Classified Construction

For purposes of measurement and payment the following terms shall have the meaning assigned to each.

- A) Main Trench: A trench essentially parallel to rights-of-way or property lines and in which the proposed utility lines are to be installed.
- B) Service Trench: A trench essentially perpendicular to main trenches and in which the proposed utility service pipes are to be installed.

Classified Excavation: The removal and disposal of earth, hardpan or rock materials according to the following:

- A) Earth Excavation: The removal and disposal of pavement, less than 4 inches thick, underground structures and utilities indicated to be demolished and removed, and all other materials encountered not classified as hardpan or rock excavation.

- B) Hardpan Excavation: The removal and disposal of material that cannot be removed from the trench without the use of an air spade or blasting. Indurated clay, shale or sand with cementitious materials is typical of this material.
- C) Rock Excavation: The removal and disposal of all solid rock that cannot be excavated without continuous and systematic drilling and blasting or continuous use of rock excavation equipment. Boulders 1/2 cu. yd. or more in volume, solid rock, and rock in ledges are typical of this material.
- D) Hand Excavation: Excavation made with hand tools when in the opinion of the Engineer such excavation is necessary. Hand excavation where called for on the drawings will be considered part of the contract and will not be paid for under unit prices. Hand excavation shall be performed under the drip line of trees, at curb and gutters, pipe crossing utilities, sidewalks, driveways, utility poles and any other place where the contractor must hand dig to prevent damage to existing utilities or structures or for the safety of personnel.
- E) Test Hole Excavation: Excavation made at the direction of the Engineer for any purpose related to work.
- F) Concrete Paving Removal: Removal of paving greater than 4 inches thick, including concrete curbs, gutters and sidewalks.

Measurement and Payments for Excavation:

- A) Hardpan and Rock: Main line trench and force main trench shall be computed and paid for according to the actual depth of the hardpan or rock to the invert of the pipe plus the 6 inch bedding material and the actual length of the trench, and, for main line trench and force main trench, the actual width of the trench not to exceed the nominal pipe diameter plus 24" for pipes up to 30 inches and less in diameter. The width of the service trench shall be 2 feet. For pipe 36 inches, or greater in nominal diameter, the trench width shall be the outside diameter plus 36 inches and trench depth shall be based on the depth of rock to the outside barrel of the pipe plus 6 inches. Where the trench width is not calculated to a foot or half-foot, the measurement shall be rounded to the next 6 inches. Manhole and structure excavation shall be for the depth encountered including the base and 6 inch cushion of bedding material. The horizontal dimensions shall assume a square extending 1 foot beyond the exterior walls of the structure when forming is not required and 2 feet when forming is required. Payment for rock excavation in the pipe trench will not be allowed for this distance.
- B) Earth: Main line trench, force main trench and service trench, when payment is to be computed on a volumetric basis shall be computed as set forth for hardpan and rock, except that the depth shall be in accordance with the cut sheet, which is the bottom of the pipe for force mains and the invert of the pipe for gravity lines. When excavation payments are on a depth basis, measurements shall be from the ground surface at the centerline of the trench to the invert of the pipeline.

- C) Bedding in rock, hardpan or earth: Bedding required for pipe laid in rock, hardpan, or earth shall be included in the unit excavation price for these items.
- D) For trenches, the pay width for single pipe excavation shall be the nominal diameter of the pipe, plus 12 inches or a minimum width of 24 inches. When two or more pipes are laid in the same trench, the trench width shall be the sum of the nominal diameters of the pipe plus 12 inches plus 6 inches for each space between the pipes. For lowering or raising mains, the trench width shall be 48 inches. When pay width is not an even foot or half foot it shall be increased to the nearest foot or half foot.
- E) Unauthorized excavation consists of removal of materials beyond indicated elevations or specified widths, without written approval of Engineer. Unauthorized excavation shall be replaced at Contractor's expense.
- F) Hardpan or rock excavation shall not be backfilled until Engineer has verified that such excavation was required and has determined the hardpan or rock profile.

9 Sewer System Materials and Standards - Pipe and Fittings

9.01 Pipe Materials

The following pipe materials are approved for use in systems to be owned by the County.

- A) Ductile Iron Standard Mechanical Joint Pipe - Ductile iron standard mechanical joint pipe shall conform to ANSI/AWWA C151/A21.51 or latest revision and shall be double-lined with cement mortar, seal coated and have a protective exterior coating. Thickness class shall be minimum Class 52. A greater thickness class may be required when conditions so dictate. Polyethylene encasement, in accordance with ANSI A21.5 (AWWA C105) may be required under certain soil conditions.
- B) Ductile Iron "Push-On" Joint Pipe - "Push-on" or "slip" joint ductile iron pipe shall conform to ANSI/AWWA C151/A21.51 or latest revision, as manufactured by Griffin Pipe Products, Protecto 401 coated, or approved equal. It shall conform to the requirements for mechanical joint pipe in regard to strength and class. Protecto 401 coated pipe, or approved equal, shall be used for all portions of all sanitary sewer force mains 3" and larger.
- C) Ductile Iron Flanged Pipe - Ductile iron flanged pipe shall conform to ANSI ANSI/AWWA C151/A21.51 or latest revision. Thickness class shall be a minimum Class 53. Threads shall conform to ANSI B1.20.1. The pipe shall conform to the requirements for mechanical joint pipe in regard to protective coating and lining.

- D) Ductile Iron Polyurethane-Lined Pipe - Polyurethane lined ductile iron pipe shall be as manufactured by U.S. Pipe, "Polyurethane Lined", or approved equal.
- E) Ductile Iron Restrained Joint Pipe - Where restrained joint pipe is to be used, it shall conform to ANSI/AWWA C151/A21.51, and shall be as manufactured by U.S. Pipe, TR Flex Restrained Joint Pipe, or approved equal.
- F) Polyvinyl Chloride Pipe - PVC pipe shall conform to ASTM 3034 (SDR35). Pipe shall be clearly marked to show class, size, and manufacturer's name. Fittings for PVC pipe shall be mechanical joint ductile iron.
- G) High Density Polyethylene Pipe (HDPE) - will be considered for installation for sanitary sewer force mains only. Its general use will be reviewed on a case-by-case basis for all of the applicable methods of installation, i.e. normal open trench construction or horizontal directional drilling when jack and bore casing pipe with internal carrier pipe is not practical. The design engineer shall specify the particular pipe and the rating shall meet or exceed 150 psi operating pressure.
- H) Steel casing Pipe - for boring or jacking under highways and railroads shall meet the requirements of ASTM A139, Grade B. Nominal pipe diameter and wall thickness shall be as indicated on the Standard Drawings. No protective coating or lining will be required. Casing pipe laid in an open cut shall be, steel pipe.
- I) Special Pipe Coatings - Where required, ductile iron pipe shall be coated inside with 24 mils dft of Kop Coat 300M by Carboline Company, or approved equal, in accordance with manufacturers recommendations. Coating shall be applied and tested by the pipe manufacturer in accordance with the manufacturer's recommendations. Certification of coating shall be submitted to the Engineer.

9.02 Pipe Fittings

The following fittings are approved for use in systems to be owned by the County.

- A) Ductile Iron Pipe Fittings - Ductile iron fittings shall be cement-mortar lined with seal coating, mechanical joint ductile iron, with a minimum pressure rating of 250 psi. Standard fittings shall conform to ANSI/AWWA C110/A21.10 or latest revision. Compact fittings shall conform to ANSI/AWWA C153/A21.53 or latest revision. Fittings shall be as manufactured by Griffin Pipe Products, U.S. Pipe or approved equal.
- B) Field Installed Joint Restraints - Field installed mechanical joint restraints shall have a minimum working pressure of 250 psi, a minimum safety factor of 2:1, and shall be as manufactured by EBAA Iron, Inc., Megalug, or approved equal.
- C) Field Installed Restrained Flange Adapters - Field installed restrained flange adapters shall be ductile iron, have flange bolt circles that are compatible with ANSI/AWWA C115/A21.15 or latest revision. The flange adapters shall have a minimum pressure rating of 250 psi, and shall be as manufactured by EBAA Iron, Inc., Megaflange, or approved equal.

D) Pipe Skids and Casing End Seals - Pipe skids shall be configured to suit the specific installation, and shall be Model S-12G as manufactured by Pipeline Seal and Insulator (PSI), Inc., or approved equal. Casing end seals shall be standard pull-on type, Model S as manufactured by PSI, Inc., or approved equal.

9.03 Pipe Supports

A) Pipes shall be supported by steel pipe hangers, clamps, brackets, rods and inserts as required to support the imposed pipe loads. Hangers in general shall be new, manufactured of carbon steel and hot dipped galvanized after fabrication or 304 stainless steel.

B) Pipes 2 ½ inches and larger shall be supported with adjustable floor stand type pipe supports as detailed on the drawings. Pipe supports shall be Standon Model S89 flange support, Standon Model S96 cradle support as manufactured by Material Resources, Inc. or approved equal.

C) Pipes 2” and smaller shall be supported from the floor, walls or ceiling depending on the type of building construction. Pipe supports for these size pipes shall be as manufactured by Unistrut Building Systems, B-Line or 12-12 approved equal. Supports shall consist of floor stands, wall brackets or clevis type hangers. Strut and appurtenances shall be stainless steel. Clips for copper tubing shall be copper coated. Minimum threaded rod size shall be 3/8 inch.

D) Ductile Iron and steel pipe supports shall be spaced in accordance with the following schedule:

Pipe sizes (inches)	1/2 -3/4	1- 1 1/4	1 1/2 - 2	3 - 4
Max spacing (feet)	4	6	8	10

E) PVC pipe supports shall be spaced in accordance with the following schedule:

Nominal pipe size (inches)	1/2 -3/4	1- 1 1/4	1 1/2 - 2	3 - 4
Max spacing (feet)	2.5	3	4	6

F) Maximum spacing between pipe supports shall be 10 feet for all pipes 6” and above. This is a maximum spacing and does not take into account valves, fittings, flow meters, risers, drops and other devices. Locations where these are installed will require additional supports.

G) In addition to the above, pipe supports shall be located as per the following:

1. Maximum spacing as indicated above.
2. Maximum of 12 inches from all horizontal and vertical changes in direction.
3. On the suction and discharge of pump piping to eliminate pipe stresses on the pump flanges.
4. On the connections to all equipment to eliminate pipe stresses on the equipment connections and allow equipment removal.
5. On the inlet and outlet piping to the water meter to allow the removal of the water meter.
6. At the location of valves, fittings or other devices that cause additions weight to the piping.
7. Additional pipe supports as indicated on the drawings.

9.04 Gate Valves

Valves 3-inches to 12-inches shall be resilient wedge gate valves, ductile iron bodied, non-rising stem with 2 inch operating nut, counter-clockwise opening, mechanical joint or flanged ends, designed for bubble tight closure at 200 psi working pressure.

Gate valves shall conform to AWWA C509, and shall be manufactured by Mueller, American Flow Control, Kennedy or approved equal.

Gate valve extensions shall have a 2-inch square wrench nut on top end and socket to fit 2 inch square nut on bottom. Valve extensions shall be Mueller A-26441, or approved equal.

9.05 Plug Valves

Valves greater than 12 inches shall be Plug valves, semi-steel, mechanical joint or flanged end, nickel seat permanently welded to the body, resilient Neoprene covered eccentric plug, replaceable 316SS permanently lubricated upper and lower journal bearings and externally accessible, replaceable V-ring or U-cup valve shaft seals.

Underground valves shall be provided with operators with non-corrosive type of construction for input shaft, seals, bushings and bolting. Operators shall be totally enclosed and permanently lubricated for direct burial of the valves and frequent submergence in water up to 20 feet of head. The operator shall open the valve on a counterclockwise rotation of the operator wrench.

Plug valves shall meet or exceed AWWA C-504&507, and shall be as manufactured by DeZurik, Keystone, or approved equal.

9.06 Valve Boxes

Valve boxes, base extensions, head and cover shall be cast iron. The cover or head shall be round and shall have the word "Sewer" cast upon it. Valve boxes shall meet or exceed ANSI/AWWA C110/A21.10-82 or latest revision, and shall be as manufactured by East Jordan Iron Works, Tyler, Bingham & Taylor or approved equal.

9.07 Tracer Wire and Access Boxes

Non-ferrous force mains shall have a tracing wire installed during construction.

Copper tracer wire shall be THHN, 12 gauge, insulated with a green colored insulation. Wire shall be secured to the pipe every 8 feet and within 12 inches on either side of fittings. Tracer wire access boxes shall be installed no more than 1000 feet apart and adjacent to all inline valves on force mains. A concrete mow collar shall be installed at finished grade around all tracer wire access boxes.

The tracer wire access boxes shall be made of cast iron with a permanently attached 3" x 12" ABS tube with a flared end to secure it in the ground with tamper-resistant cast iron locking lid and stainless steel terminal connectors on the bottom side to which tracer wires are attached. Lid shall be opened using a standard AWWA pentagon key. Enough slack shall be coiled inside the box to allow the removal of the lid. Lid shall be marked sewer.

9.08 Automatic Air Release Valves

Air release valves shall be the combination air-vacuum type, with a working pressure from 0 to 300 psi, stainless steel float, and resilient seat. Valves shall be type "S/SL" with minimum 1 inch diameter screwed NPT or flanged connection as manufactured by Crispin Multiplex Manufacturing Company., or approved equal.

9.09 Manholes

Sanitary sewer manholes shall consist of precast reinforced concrete sections, an eccentric conical section, and an expanded base section, extending a minimum of 4 inches and a maximum of 8 inches beyond the outside vertical wall (riser section) of the manhole.

Manhole sections shall be precast and manufactured in accordance with ASTM C-478. Manholes shall be carefully made and shall have no honeycombs or other deteriorated surfaces. All surfaces shall be smooth. Each section shall have no more than two holes for the purpose of handling and setting. Joints shall be of the O - ring rubber gasket type or other jointing system approved by the County. The joint design shall meet the requirements of ASTM C-361. When assembled the joint shall be uniform and watertight.

In addition to the O-Ring gasket, 301 mastic joint sealer shall be used to assist in sealing the joint from either internal or external hydrostatic pressure. Other joint systems acceptable to the County may be used. The joint design shall meet the requirements of ASTM C443 and the gaskets shall meet ASTM C-361. No mortar joints will be permitted. The interior/exterior of all precast manhole sections shall be coated with a minimum of 16 mils dft of Kop Coat 300M by Carboline Company, or approved equal, in accordance with the manufacturer's recommendations

Steps for manholes shall be securely placed in position in the manhole sections during the manufacturing process and shall be made of minimum 0.5" diameter epoxy coated steel and shall have a polypropylene plastic coating. Steps shall be models ML-10, ML-11 and I-11 as manufactured by American Step Company, or approved equal. Steps will be set in the manholes as shown in the Details Section in this manual.

Insert holes for the required sewer connections shall be cast in the manhole sections during the manufacturing process and shall conform to the actual minimum diameters required to properly seal the connection. Riser sections shall be continuous where pipe enters the manhole. On pipes sized 18 inches and larger, sealing shall be accomplished by using an integrally cast rubber gasket as manufactured by A-Lok Corporation, or an approved equal. On pipes sized less than 18 inches, sealing shall be accomplished by flexible connectors comprised of rubber boots and dual stainless steel straps as manufactured by Kor-N-Seal, or an approved equal.

All manholes shall be equipped with a watertight manhole insert as shown in the Detail SC-02 in this manual. The manhole insert shall be a No Flow/Inflow insert, or Rainstopper insert as manufactured by Southwest Packing & Seals, or an acceptable substitute approved by the County.

When frames and covers will be subject to traffic loading, they shall be heavy weight, 350 pounds. Where there will be no traffic loading, the frames and covers may be light weight, 290 pounds.

Castings shall be of best quality, tough, gray iron, free from cold shunts, blow holes, and other imperfections and shall meet the requirements of ASTM A-48, Class 30. The castings shall be sound, true to form and thickness, cleaned by sandblasting and neatly finished. The bearing surfaces shall be machine ground and finished to insure satisfactory seating and anti-rocking. Covers shall receive one coat of black asphalt base paint at the factory.

Covers shall be furnished with two pick holes and two center lifting holes. Frames and covers subject to traffic loading shall be as manufactured by East Jordan Iron Works, Product Numbers 104514 and 104325 respectively, or an approved equal. Covers for use in easements and remote locations shall be of the cam-locking type as manufactured by East Jordan Iron Works, Product Number 104500, or an approved equal. The castings on all manholes shall be anchored to the manhole.

9.10 Construction Within Public Rights of Way

On projects in which the County Administrator has specifically allowed sanitary sewer system extension(s) to be designed and constructed within public right(s) of way, the following additional materials specifications shall apply:

- A) Pipe Materials – All gravity sewer lines, sewage force mains and sewer service laterals constructed within public rights of way shall be Protecto 401-coated Class 52 Ductile Iron, or approved equal, and shall meet the applicable portions of the specifications in Section 9.01 of this manual.
- B) Tapping Saddles – Where permitted for use, tapping saddles shall be epoxy-coated cast iron with stainless steel bands, by Genco or approved equal.

9.11 Marker Posts

In easements and in undeveloped wooded areas, plastic markers shall be installed every 200 feet, and at all manholes, valves, and fittings. Markers shall be as manufactured by Carsonite or

approved equal. Exceptions are where sanitary gravity and force main lines are installed in "kept" yards where the property owners may object to the placement of these markers. Contractors will be required to properly install the markers per manufacturer's recommendations, parallel to the sewer line facing roadway, or as additionally directed by the County.

10 Sewage Pumping Stations and Force Mains

Public sewage pumping stations will only be allowed when approved by the County and consistent with the County's Water and Wastewater Master Plan. Sewage pump stations will be used when it has been determined by the County that a pump station is the only practical way to provide sanitary service based upon a finding that:

1. It is economically impractical to extend a gravity sewer and the use of a pump station will not adversely affect the County's ability to serve the area with a gravity sewer at a future time; and
2. The proposed design and plan for the pump station and connecting lines do not adversely affect the current financial status of the County sewer system; and
3. The proposed design of the pump station permits replacement of the pump station with a gravity sewer without significant capital outlay at a future time; and
4. The pump station will not overload the existing sewage facilities and will not otherwise negatively affect the County's ability to efficiently manage the sewer system.

The design requirements for a sewage pumping facility shall be determined through discussions with the County prior to initiating the design of the proposed facility.

Firm capacity for the pumping station and force main shall be based on Section 7.02 Design Capacity of these Standards, and shall take into consideration such parameters as minimum, average and peak station inflows as well as minimum, average and maximum pumping rates.

Pumping into a common force main shall be avoided if possible. When it is necessary, the County may require the Developer to submit a hydraulic evaluation investigating potential impacts to other connected pumping stations to the County for review and approval. This may require an upgrade in electric service, pump size, controls and the installation of VFD's at the expense of the Developer.

10.01 Sewage Pumping Stations

- A) The type of equipment to be installed in the pumping station will be influenced by the interim and ultimate capacity of the station and an evaluation of the period of time that the service of the station will be required.

- B) A magnetic-type flow meter shall be installed in the discharge piping and analog wet well level indication instrumentation shall be installed to record wet well level and control pump operation.
- C) The architecture of the pumping station shall be consistent with the zoning and general appearance of the surrounding area.
- D) Site grading, seeding or sod, and trees or shrubs shall be provided to present a finished appearance, as approved by the County department having jurisdiction.
- E) Approved fencing with gates shall be provided as deemed necessary to properly protect the facility. Unless otherwise approved, an eight-foot chain link fence with three (3) rows of barbed wire shall be installed around the operational area with at least one 12 foot double gate.
- F) The Design Engineer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The engineer shall also determine the need for primary service extension and advise the Department if an extension is necessary. Minimum service shall be 240 volts single phase for up to 7.5 horsepower motors. Motors larger than 7.5 horsepower shall be 3-phase with VFD's to convert single phase to three phase or the pumping station supplied with 3 phase power. Control cabinets shall have HVAC as required for temperature and humidity control.
- G) "Reliability Class" shall be class 1 for all pump stations in accordance with the Virginia Department of Environmental Quality SCAT Regulations and shall comply with the requirements thereof. Each pumping station shall have a permanently installed emergency generator and automatic transfer switch. The transfer switch shall be installed inside a building. The fuel storage tank shall be sized to operate all pumps for 48 hours continuous operation.
- H) The Design Engineer shall consider the need for protection of the pumping station, force main, and receiving manholes against hydrogen sulfide attack and odor, and shall provide the proper equipment if such protection is found necessary.
- I) All motors, motor control and other electrical equipment shall be housed in a building. Adequate provisions shall be incorporated for the proper ventilation, drainage and flood protection in order to ensure maximum reliability, electrical and personnel safety.
- J) Pump Control and SCADA Telemetry shall be through a Programmable Logic Controller as specified by the Department. Telemetry shall be to the SCADA Control Center and be compatible with existing hardware and software.

- K) Where structurally separate wet well and dry wells are provided, adequate provision for differential settlement shall be incorporated by means of flexible pipe joints consisting of a minimum of at least two standardized mechanical joint bell connections or the approved equivalent.
- L) In all permanent sewage pumping stations over 1.0 MGD an adequate headwork structure and wet well shall be provided. The following items shall be provided: employee access via stairs; channel grinders for solids, bar rack for large solids and a davit hoist for removing screenings from headwork. A maintenance platform shall be provided in each wet well.
- M) All handrails, ladders and grating shall be aluminum. All pumping stations shall be of sufficient size and contain adequate clearances to provide ample room for maintenance and equipment replacement. In wet well/dry well stations a bridge crane shall be provided for removing pumps.
- N) The facility shall be connected to a public water supply. An RPZ type backflow preventer shall be installed on the water service. Where a public water supply is not available, a water supply well shall be installed.

10.02 Force Mains

- A) Force mains shall have a positive slope from the pumping station to the point of discharge unless unusual conditions make it impractical. Extra depth of bury shall be provided in lieu of air or air/vacuum relief valves wherever feasible. Every effort shall be expended to maintain the force main below the hydraulic gradient. Where a relief valve is required, an automatic valve shall be provided and installed inside a standard manhole with adequate means of drainage. When this is not possible, all high points shall have a combination air/vacuum valve installed
- B) Every effort shall be made to maintain a full force main under operating conditions.
- C) Sizing of main shall be such that velocity shall be a minimum of 2.5 feet per second for self-scouring velocity. A velocity of 6 feet per second should not be exceeded.
- D) All force mains shall be cement-lined ductile iron pipe, C900 PVC pipe or HDPE pipe. Where Hydrogen sulfide could be present the ductile iron pipe shall be epoxy lined.
- E) The Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection and polyethylene bagging where necessary.

- F) Steel casing pipe shall be in accordance with the Standard Drawings for casing pipe. There shall be a minimum of 4” clear space around the pipe and all appurtenances.

- G) The potential for sulfide and odor generation must be fully evaluated based on the characteristics and properties of odor causing compounds and the principals of control. The appropriate odor and/or sulfide control system shall be provided.

11 Supporting Construction

11.01 Driveways and Access Roads

- A) General - Required driveways and access roads for the County's Wells and Pumping Stations comply with the following and are typically unpaved, unless otherwise specified:

- B) Applicable Specifications - Virginia Department of Transportation Road and Bridge Standards and Specifications.

- C) Products
 - 1) Crushed aggregate shall be Type 21A.

 - 2) Semi-Permeable Filter Fabric shall be a synthetic (man-made) filter material to prevent the migration of soil fines from the subgrade and act as reinforcement for the road and meet the following specifications:

a) Weight (oz/sq.yd.) ASTM-D1910	4 (min)
b) Thickness (mils) ASTM D-1777	40-50
c) Tensile Strength (lbs.) ASTM D-1682	100 (min)
d) Elongation (%) ASTM - 1682	50 (min)
e) Fabric to retain soil greater than 106 microns (No. 140 sieve)	
f) Fabric to pass soil less than 25 microns.	

- D) Execution
 - 1) The subgrade for all paved areas shall be excavated to a depth and form sufficient to bring it, when thoroughly compacted, to the proper distance below and parallel with the prescribed level of the sub-base. The subgrade shall be completely tamped in an approved manner prior to placing the sub-base. Compaction shall conform to the Density Requirements in Section 304.04, Compaction Requirements, Virginia Department of Transportation Standard Specifications, which requires the subgrade to be compacted to not less than 98% of the determined dry-weight density.

- 2) The semi-permeable filter fabric shall be placed prior to the sub base construction. Roll widths shall overlap a minimum of 4 feet. Roll end overlap and placement on curves shall be as per the manufacturer's recommendations.
 - 3) The base of Type 21A Stone shall be a minimum of six (6) inches in thickness after compaction and shall be compacted to not less than 100% of the determined dry-weight density.
- E) Maintenance - Until the expiration of the warranty period, the road shall be maintained and all depressions and holes that may occur promptly filled with similar material so as to keep in a safe and satisfactory condition.

11.02 Clearing and Grubbing

A) Protection

- 1) Streets, roads, adjacent property and other works to remain shall be protected throughout the Work.
- 2) Existing trees, shrubs and bushes:
 - (a) Trees shall be protected by fencing, barricades, or wrapping as may be required.
 - (b) Shrubs and bushes shall be protected by fences or barricades as may be required.
 - (c) Shallow-rooted plants shall be protected at ground surface under and in some cases outside the spread of branches by fences, barricades or ground cover protection as may be required.

B) Requirements of Regulatory Agencies – Applicable Law as defined in Chapter 21 of the Fluvanna County Code, and including without limitation Federal, State and Local laws and code requirements shall control the disposal of trees and shrubs.

C) Products

D) Execution

1) General

- (a) When working within temporary or permanent Rights-of-Way, all means possible shall be used to protect from injury and damage, all property, including trees, shrubbery, lawns, fences, buildings, walls, roads, water courses, natural features or any improvements thereto, which may exist. Trees, shrubs or vegetation will not be maliciously injured or destroyed and will not be removed or cut without permission of the County.
- (b) All operations shall be confined to the width of the Rights-of Way secured by the County or property lines unless further restrictions are specified. All damage done to

property resulting from a Contractor's negligence shall be repaired without charge to the satisfaction of the County with the exception of those items (trees, shrubbery etc.) that must be removed for construction and have been agreed upon beforehand, in writing, between the Contractor and the County.

2) Clearing

- a) Limits of clearing shall be within the Rights-of-ways, to limits shown on the Drawings or to limits staked on the ground by the County.
- b) Trees in construction zones or Rights-of-Ways shall not be removed until inspected and/or tagged by the County.
- c) No trees shall be removed within the construction zones or Rights-of-ways except the following:
 - i) Trees or vegetation within VDOT's Rights-of-Ways shall not be removed or altered unless a separate specific permit is obtained from the District Roadside Development Specialist authorizing such removal or alteration.
 - ii) Trees within an excavated area such as footing or trench.
 - iii) Trees whose root system will be destroyed by the excavation.
 - iv) Trees that interfere with the movement of the Contractor's equipment with the approval of the Engineer. Any trees that interfere with the movement of the Contractor's equipment shall be reviewed by the Engineer before they are removed.
- d) All trees bordering any construction zone or Right-of Way shall be protected by acceptable methods. Trees damaged by the Contractor will be either repaired or replaced as determined by the County at the Contractor's expense.
- e) Vegetation within the areas to be cleared, which may be designated to be saved by the County shall be left standing and uninjured.
- f) Remove trees, sapling, shrubs, bushes, vines and undergrowth within the limits of clearing to the heights above ground given in the following table:
 - (i) Trees over 6-inches in diameter: 12 inches
 - (ii) Shrubs, saplings, bushes and trees under 6 inches in diameter: 3 inches
- g) Stumps required to be removed shall be to a depth of 18 inches. This depth shall be measured from the existing ground surface or the proposed finished grade, whichever is the lower.

Engineering requirements shall control removal of stumps under fills, foundations, or any construction in contact with the stumps.

3) Grubbing

- (a) Limits of grubbing shall coincide with the limits of clearing.
- (b) Remove all stumps, roots over 4-inches in diameter, and matted roots within the limits of grubbing to the depths below. Such depths shall be measured from the existing ground surface or the proposed finish grade whichever is the lower.
 - i) Footings 18 inches
 - ii) Walls 12 inches
 - iii) Roads 18 inches
 - iv) Parking Areas 12 inches
 - v) Lawn Areas 8 inches
 - vi) Fills 6 inches

4) Trimming of Trees

- (a) When required, with the County's approval, trees shall be trimmed to remove branches or roots which interfere with construction or traffic. Paint all cut branches and roots with wound paint as recommended for the application.
- (b) No trees or vegetation shall be removed or altered within VDOT's right-of-way unless a separate specific permit is obtained from the District Roadside Development Specialist authorizing such removal or alteration.

5) Disposal - Burning of materials on the site will not be permitted.

6) Removal of Materials

- a) Material to be removed shall be removed from the site daily as it accumulates.
- b) Should the Contractor elect to continue work beyond normal working hours, material to be removed shall not be allowed to accumulate for more than 48 hours.
- c) Disposal of surplus material within VDOT's right-of-way is prohibited. All surplus material must be disposed of as the work progresses and shall not be stored on VDOT's right-of-way for future removal.

E) Dumping - Prior to depositing surplus material at any off-site location, the Contractor shall obtain a written agreement between himself and the owner of the property on which the disposal is proposed. The agreement shall state that the owner of the property gives permission for the contractor to enter and deposit the material at no expense to the County. A copy of the agreement shall be furnished to the County. Contractor's Disposal shall comply with all Federal, State and Local laws and regulations.

11.03 Abandonment

A) **Abandonment of Sanitary Sewer Service** - Excavate at the main and expose the lateral connection. Sever the lateral pipe in the vicinity of the main and cap both ends of the pipe as

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

- B) **Abandonment of Sanitary Sewer Mains and Manholes** - Sanitary sewer mains and manholes to be abandoned shall be permanently disconnected from the remaining system. Details of special abandonment shall be approved by the Department on a case-by-case basis and per Detail MAN-19. All open ends on abandoned pipe to be permanently sealed by plugging with a pipe plug or cap unless otherwise approved by the County. Salvageable items shall be returned to the Department of Public Works.

- C) **Abandonment of 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. If the corporation stop is left in place, assist the inspector in referencing the location of the corporation stop for County records. Remove the meter box, yoke and service line. The inspector will deliver the meter to the Customer Service Section of the Department of Public Works.

- D) **Abandonment of 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 Department on a case-by-case basis. All open ends on abandoned pipe to be permanently sealed by plugging with a pipe plug or cap unless otherwise approved by the County. All valve boxes, fire hydrants, flushing hydrants (blow offs) or other appurtenances shall be removed. Salvageable items shall be returned to the Department of Public Works.

12 Appeals

12.01 Appealable Decisions

Any Applicant for sewer service or water service from the County who is denied a variance under Section 1.08, shall have the right to appeal any such determination by the County Administrator to the Chairman of the Fluvanna County Board of Supervisors. In a case of a denial of a variance, the Applicant shall have the right to request a Written Determination by the County Administrator of the reasons for such denials, if not already received.

12.02 Written Appeals

The Applicant shall have the right to appeal an Appealable Decision by filing a written request no later than thirty (30) days after the date of any written decision. The County Administrator shall note and record all such appeals as of the date of receipt thereof and shall forward the same to the Chairman and the members of the County Board of Supervisors, within five (5) business days of a receipt of the appeal.

12.03 Board Consideration of Appeal

The County Administrator shall place the appeal on the agenda of the earliest scheduled Board of Supervisor's Meeting, based upon date of receipt of the appeal.

12.04 Decision on Appeal

The Board, on consideration of the appeal, may affirm or reverse, in whole or in part, any Appealable Decision of the County Administrator. The Board may also direct that the County Administrator prepare an amendment to the Utility Standards Manual to address the issue raised by the appeal. In the case of a denial of service, the Board may direct the County Administrator to provide service to the Applicant upon such terms and conditions as may be established by the Board. The vote of a majority of the Board shall be required to reverse any decision of the County Administrator.

12.05 Deadline for Board Action

The Board shall render a decision on any such appeal within ninety (90) days after such appeal is first placed on the agenda of the Board, unless any such Applicant and the Board may mutually agree to an extended time period. Failure of the Board to act on such appeal shall be deemed a denial of the appeal.

12.06 Form of Appeal

All appeals shall be filed upon the forms provided by the County and shall be accompanied by a written statement of the reasons any such Applicant disputes the determination of the County Administrator. All such forms shall be filed at the main offices of the County at 132 Main Street, Palmyra, VA 22963 during normal business hours.