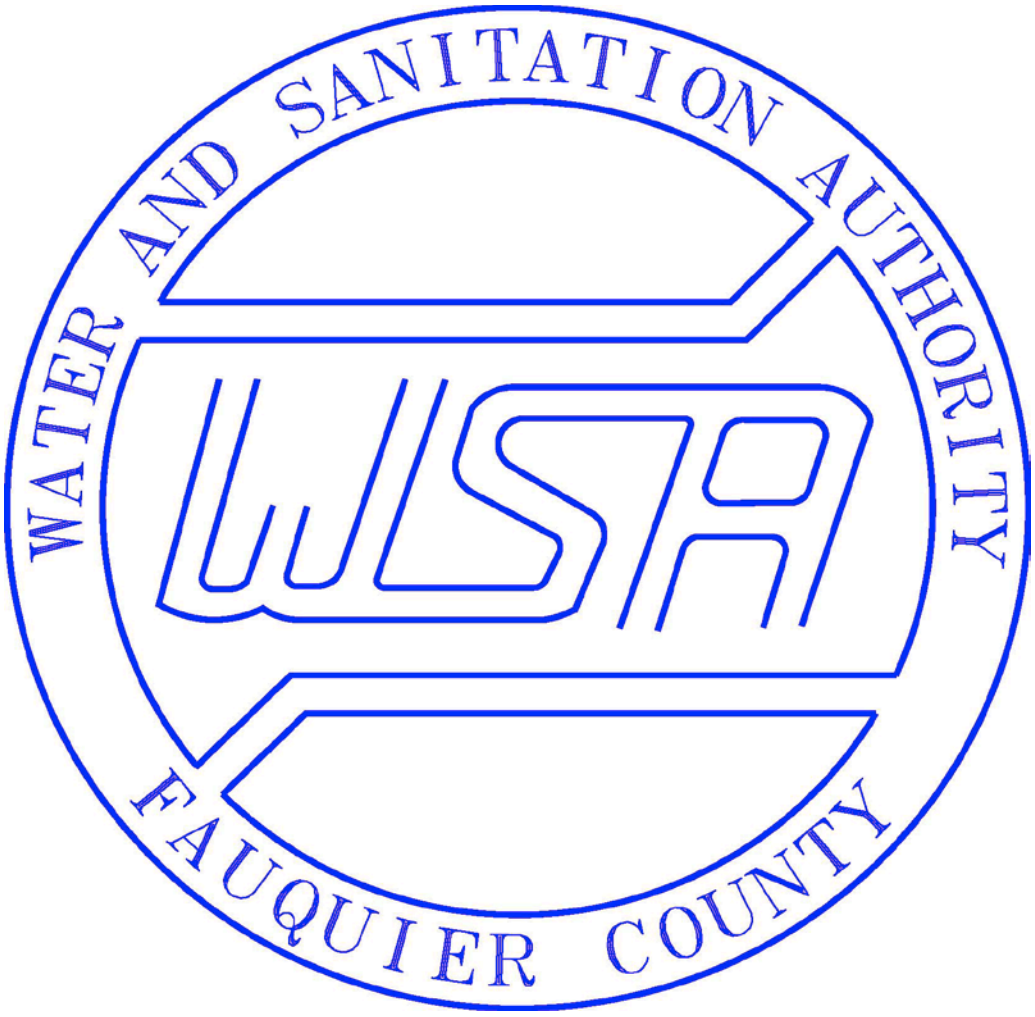
VOLUME 5 – Design and Construction

Part A - Utility Standards Manual



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1. General Conditions

1.01 Purpose and Authorization

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

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 and the Virginia Department of Health 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 Engineer or General Manager of the Authority.

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 engineering application. Variances are addressed in Section 1.08.

These Utility Standards, policies and regulations have been adopted by the Fauquier County Water and Sanitation Authority Board. Conditions and modifications to these standards, including additional materials and equipment, are subject to the approval of the General Manager.

Amendments, when approved by the General Manager, 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:

Authority -	The Fauquier County Water and Sanitation Authority.
Board -	The Board of Directors of the Fauquier County Water and Sanitation Authority.
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 Authority.

Engineer - The Engineer of the Fauquier County Water and Sanitation Authority.

General Manager - The General Manager of the Fauquier County Water and Sanitation Authority.

Plan Amendments - Changes to Project Plans initiated by the developer which are made after the Plans have been approved by the Authority.

Plan Revisions - Changes and/or corrections made to Project Plans during the review process to render them approvable by the Authority.

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 gallons per day
psi -	pounds per square inch
USM -	The FCWSA 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 by the Authority shall be submitted to the Authority's Developer Services Representative.

The Authority reviews the Project Plans for all projects which will connect to public water and/or sewer systems in Fauquier County (exclusive of the Town of Warrenton). Construction plans are reviewed for conformance with the requirements in the USM

Applications which require review by VDH and/or VDEQ shall be submitted 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 Authority. In situations where review by the VDH and/or VDEQ is required, modifications to project plans required by the Authority shall be incorporated in final submissions to those agencies (and vice versa). In this manner, the plans reviewed by the Authority and 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 Authority of any Project Plans. (Note: Administrative details of the Review Process are described in Part C of the Authority's Administration Manual).

An Engineer's Completion Statement and As-Built Drawings, prepared in accordance with Section 1.07 of the USM, shall be submitted to the Authority before final construction inspection of utilities will be approved and bonds released.

1.04 Project Plans Submittal Requirements

A) A complete submission package shall be submitted to the Authority, as directed by the Engineer, prior to The Authority'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 FCWSA Application for Utility Extension Form (FCWSA Form No. ENGR-0001)
2) A fee check in the amount computed using the appropriate Water and Sewer Construction Plan Review Fee Computation Sheet (FCWSA Form No. ENGR-0003)
3) 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
4) For projects which will be connecting to a public water system, a water model prepared using WaterCad Ver.6.5 (or compatible) water modeling software. The water model must show the effects of the proposed water extensions and usage addition on the existing/proposed water system, as well as calculating available fire flow. A summary report must be included along with a CD-ROM containing all the files necessary to run the model using WaterCad Ver.6.5
5) One completed FCWSA Plans and Profiles Submission Package Checklist (FCWSA Form No. ENGR-0002)

B) Incomplete submittal packages shall be returned to the applicant or his agent without review.

C) All material submitted to the Authority become the property of the Authority. The Authority 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 FCWSA Form No. ENGR-0004, shall accompany the second submission of the Project Plans.

F) A Bond Estimate, prepared on FCWSA 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 made as a result of the Authority's previous review was addressed.

1.05 Project Plans Preparation Requirements

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

A) Plans shall be prepared on 36” x 24” print paper.

B) All water and sewer facilities plans, profiles, details, computations and related materials shall be on sheets which are grouped together in 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 additional construction phasing proposed. This shall be placed at the beginning of the water and sewer plans and profiles section of the Project Plans.

D) Plan and profile sheets, in standard VDOT Plan & Profile format with plan view and profile view 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'. The plan view shall 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 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.

E) All pipe crossings shall be shown in both plan and profile views, with minimum cover and "outside wall to outside wall" separation distances noted on profiles.

F) Complete call-outs including stationing, size and type of all appurtenances (valves, hydrants, bends, tees, service connections, etc.) on water lines, along with all other information necessary for construction of the water lines shall be clearly shown on the water line profiles. Stationing, pipe materials and types of appurtenances shall be clearly shown on the plan view. All information shall be consistent between plan and profiles.

G) Stationing, inverts, lengths, slopes, pipe 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. All information shall be consistent among plans, profiles and design tables. Manhole top elevations shall be shown as spot-shots in the plan view.

H) Complete call-outs of all manholes and lateral connections on sewer mains shall be clearly labeled and shall be consistent among plans, profiles and design tables. Flow direction arrows shall be shown at each sanitary manhole on the plan view.

I) A table shall be provided giving Northing and Easting coordinates, in NAD 83 coordinate system, for each sanitary manhole.

J) 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.

K) The location(s) of all proposed siamese connections to buildings receiving service for fire suppression shall be clearly shown on the plans.

L) All existing water and sanitary sewer facilities and easements within and immediately adjacent to proposed limits of construction, including profiles of existing pipeline(s) if cover is to be increased or decreased or if connections are proposed to such existing line(s), shall be clearly shown on the plans.

M) All lot numbers, property lines, easements and rights of way shall be clearly shown on water and sewer utilities plan and profile sheets.

N) 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.

O) All stream crossings, road crossings, bores and jacks and crossings of other utilities shall be clearly shown on both plan and profiles for proposed water and sewer lines.

P) Detail sheet(s), showing all applicable details and FCWSA standard water and sewer construction notes shall be included in the Project Plans.

Q) All existing water and sanitary sewer facilities and easements within and immediately adjacent to proposed limits of construction shall be depicted on the plans, including profiles of existing pipelines if cover is to be increased or decreased.

R) 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 noted.

S) Plan and profile views shall be consistent from sheet to sheet across "match lines".

T) All plans shall be produced in NAD 83 State Plane Coordinate System.

U) The seal and signature of the Professional Engineer registered in the Commonwealth of Virginia who prepared the plans shall be on each sheet.

V) Vicinity Map.

W) North Arrow (each plan view).

X) Scale (correctly depicted on all plans and profiles as well as other applicable sheets).

Y) On subdivision plans, the lot numbers to be served by the utilities presented on the plans and profiles shall be clearly delineated on the cover sheet below the main title(s). The total number of lots to be served shall be clearly indicated on the plans.

Z) Fire hydrant coverage map to demonstrate compliance with section 3.09 of this manual.

AA) FCWSA Approval Block with disclaimer, "This is not an assurance that the FCWSA intends to offer its water and/or sewer services or to own and/or operate the facilities associated with the project depicted on these plans. This Approval is good for five (5) years from the below date."

1.06 Project Construction Requirements

All construction of water and sewer facilities shall be performed in accordance with the approved Project Plans, this manual and all other applicable portions of the Authority's Operating 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 Authority prior to 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 Authority 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 Authority'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 from the approved plans and/or specifications, but prior to requesting a Final 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.

The 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 the red-line drawings maintained by the Owner or his contractor during the construction process. The as-built drawings shall clearly indicate 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 three paper sets of as-built drawings shall be submitted to the Authority's Developer Services Representative, along with a CD-ROM containing AutoCad 2002 (or compatible) files of all as-built plan and profile information. Individual plot files with borders are not required so long as all information for both plan views (In NAD 83 coordinate system) and profiles can be adequately derived from model space using the files submitted. The as-built drawings shall show, but are not limited to the following:

A. Water Main Construction

(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.

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. Sewer Construction

(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.

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. 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 Authority, shall be provided as a part of the as-built plans for the project.

1.08 Variances

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 Engineer or General Manager. 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.

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:

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 Engineer or General Manager. All pertinent information, plans, shop drawings, documents, drawings, certifications and other data which may be necessary for the Engineer

or General Manager 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.

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 Authority. The General Manager will determine the necessity for and the amounts of all replacement bonds.

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.

No substitute materials or equipment shall be ordered or installed without the written acceptance of the Engineer or General Manager.

In all cases, the decision of the General Manager shall be final. Each request for variance will be considered individually on its own merits.

B. Utilities Location Variance – No water or sewer lines may be designed to be constructed within a public road right of way without first obtaining a Utilities Location Variance from the Authority. Such variance shall be approved by the General Manager for projects which are designated by the County of Fauquier as Planned Residential Development (PRD) or for which reduced building set-backs have been approved by the County in accordance with the requirements of the Fauquier County Zoning Ordinance.

1.09 Easements and Plats

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

A. Minimum easement widths shall be 15 feet for water mains and 20 feet for sanitary sewers except as otherwise permitted below. Increased or decreased easement widths may be required, when so determined by the Engineer or General Manager. Decreased easement widths along rights of way of internal subdivision streets will be permitted with the approval of the Engineer or General Manager and in accordance with the appropriate Utility Location & Easement Layout Detail.

B. In cases deemed necessary by the Engineer or General Manager, 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 Authority for their recordation:

(1) Each Utility Easement and or Fee Lot shall be labeled "HEREBY CONVEYED TO THE FCWSA"

(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 THE FAUQUIER COUNTY WATER AND SANITATION AUTHORITY (the “FCWSA” or the “Authority”): In consideration of the Authority’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 Authority the easements and areas specifically identified on this Plat of Subdivision/Site Plan/Utility Plat as "HEREBY CONVEYED TO THE FCWSA" 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 Rules and Regulations and Utility Standards Manual of the Authority as they now exist 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) An FCWSA Approval Block.

(6) NOTE: All of the FCWSA’s easements shall be subject to the following 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 Authority, 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 Authority 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 Authority to erect any building or structure of a permanent nature on such adjoining land.

3) The Authority 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 Authority 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 Authority 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 Authority 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 Authority.

5) The Authority 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 Authority's facilities, or for any damages to the residue of the property during the construction period.

6) The Authority 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 Authority's facilities. The Authority 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 Authority, shall be subordinate to the Authority's easement and any exercise of rights by the subordinate easement holder shall be subject to the written approval of the Authority.

In cases where the Authority, in its sole discretion, determines that either Temporary Easements(s) and/or Construction Easement(s) are required, the following condition ***shall be added*** *to the aforesaid terms and NOTES:*

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 Authority guidelines and recorded concurrently with the Final Subdivision/Site Plan Utility Plats. The Authority 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 Authority. Legal instruments are subject to review, approval and acceptance by the Authority. The Authority 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 sewer facilities by the Authority.

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: American Water Works Association (AWWA), latest edition.

A) American National Standards Institute (ANSI), latest editions.

B) American Society for Testing and Materials (ASTM), latest editions.

C) Department of Health; State Water Control Board "Sewerage Regulations," latest edition.

D) Commonwealth of Virginia; State Board of Health "Waterworks Regulations," latest edition.

1.11 Preliminary Plan/Plat Preparation Requirements

All preliminary designs 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 Authority:

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 FCWSA Plan/Plat Approval Block shall be displayed on the cover sheet of the Preliminary Plan/Plat set.

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 Authority inventory. Such systems include construction within areas of existing or proposed easements on private property dedicated to the Authority or within a public right-of-way where specifically permitted by the Engineer or General Manager. Specific variances to these standards must be approved and authorized in writing by the General Manager 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 General Manager of the Authority. Any references to acceptance and/or approval shall mean acceptance and/or approval by the Authority.

2.02 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 site under consideration and maintain a pressure of not less than 35 psi at all points of delivery in the system. Additionally, all water systems and water system extensions shall be designed to provide the fire flows specified by the Fauquier County Code, or as determined by the Authority, plus the maximum day demand required by the Authority, with a residual pressure of not less than 20 psi at any point in the distribution system. Fire flow calculations must be included with all project plans submitted for review and approval. The flow calculations will be prepared using WaterCad Version 6.5, or other model approved by the General Manager. The pipe roughness factor, "C", will be equal to 120 for pipes 12 inches in diameter and larger. "C" will equal 100 for pipes smaller than 12 inches in diameter. Since a conservative "C" factor is used, losses from valves and other fittings need not be considered. The line velocity shall not exceed 10 fps under any flow condition. A water model report shall be submitted to the Authority for review. Approval by the Authority of the model must be obtained prior to final plans approval.

Computations are to be provided for:

A. Maximum day demands.

B. Maximum day with 1 hour fire flow applied simultaneously.

The water model report shall state assumptions made about the existing system, provide calculations and model results to show available flows at the 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 during each 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 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 Fauquier County Code or as determined by the Authority, and to provide 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 Details Section in this manual, shall be furnished and installed by the developer or owner. Meters sized 5/8” by 3/4” will be installed by the Authority upon construction approval and payment of appropriate fees. In residential areas the water meter will be installed within the utility easement, immediately adjacent to the outer edge. The water meter and service line size(s) and locations shall be shown on all construction plans. Sizing of service lines and water meters shall be based on the fixture loading imposed by the building and in accordance with the procedures of AWWA M-22, Sizing Water Service Lines and Meters and as more particularly described in Section 4 of Volume 2, Part A, (Rules and Regulations) and as shown at Exhibit "B" of Volume 2, Part C (Developer Services Procedures) of the Authority's Operating Code. The Authority shall have final approval authority of all service line and meter sizes.

The Authority 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 to the building are regulated by 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 in order to isolate the meter for repairs. For all water meter installations, the Authority shall retain the option of specifying the use of appropriately sized vaults in lieu of meter crocks. Plans 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 the Authority's 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 ordinance.

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 Authority with the necessary information to determine the meter size. The developer must acquire all of the necessary approvals and permits from Fauquier 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

Valve boxes shall be set and adjusted such that covers shall be exposed and 1” to 2” above finished grade. Where valve boxes are permitted to be placed in the pavement, the covers shall be flush with the pavement surface. 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 Authority, 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 ordinance, as more particularly described in Volume 2, Part C (Cross-Connection Control Plan) of the Authority's Operating Code.

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 to provide for a looped system wherever feasible at the discretion of the General Manager or Engineer to eliminate dead ends, thereby promoting water quality, adding reliability of service, and efficiently conveying fire flows. In general, water lines shall be located in utility easements dedicated to the Authority, and shall run parallel to and along the routes of roads and/or travelways. Routes for pipes shall be selected so as to provide the required separations from buildings and other utilities, while minimizing the use of horizontal and vertical bends, and minimizing the number of crossings with curbing and sidewalks. Alternate locations for water lines will be permitted only with the expressed approval of the General Manager.

Water lines shall not be located within Storm Water Management (SWM) and/or BMP facilities or their associated easements. In addition, water lines shall not be located under parking spaces. Storage or stockpiling of dirt or any other materials over buried water lines is prohibited.

Cross fittings are specifically prohibited on water mains. Generally, 2 tees are to be used instead of a cross.

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 12 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 General Manager, dead-end runs shall be sized for the installation of a fire hydrant at their termination, but in no case shall they be less than 8 inches.

D. Fire hydrant connections shall not be installed on lines less than 8 inches in diameter.

Six inch and four-inch water lines may only be used with prior approval of the Authority. 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. At such crossings, cover on the water line may be reduced to 36 inches and vertical pipe separation (edge to edge) may be reduced to 6 inches if necessary. Should it be necessary to construct a water line below the storm or sanitary sewer lines, a minimum vertical separation of 18 inches is required.

3.04 Valve Locations

Valves shall be installed at the 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, three valves will be used at each tee; however, additional valves may be required depending on the system design. A valve shall also be installed at least every 1,000 feet on distribution mains.

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 15 feet edge to edge horizontal separation shall be maintained between water lines and building foundations, retaining walls or other above-ground structures. A minimum of 10 feet edge to edge horizontal separation shall be maintained between water lines and sanitary sewers, including manholes.

3.06 Blow-Offs and Flushing Points, and Sampling Stations

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.

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.

Sampling stations are to be located and installed at the discretion of the Authority and shall be Kupferle #88 Eclipse Sampling Station.

3.07 Air Release

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,

3.08 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 General Manager.

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 Authority, unless location within a road right of way is expressly permitted by the General Manager.. 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 Authority, unless location within a road right of way is expressly permitted by the General

Manager. 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 Authority.

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.

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 Authority before final plans are prepared. The Design Engineer should arrange a site visit with the Authority 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 WM-05.

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 Authority.

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 Authority 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 Authority. No pipe shall be laid in water, or when, in the opinion of the Authority, trench conditions are unsuitable.

4.02 Excavation, 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 Authority 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. Ductile iron restrained joint pipe is required for all water lines constructed in fill.

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 Authority 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 insure 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 Authority 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 Authority. 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 Authority.

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 Authority.

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 2,500 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 Authority.

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 Authority. 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 Authority, 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 2,500 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.

Once final grade is achieved around a hydrant, the hydrant will be painted with a fresh coating of Rust-Oleum model# 245478: V7400 System, Alkyd Enamel, Safety Red paint; or approved equal.

4.08 Above Water Crossing

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.

4.09 Under Water Crossing

The water main pipe shall be of special construction, having flexible watertight joints. The pipe material used shall be subject to the Authority'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 Road Crossings and Casing Pipe

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. Casings will also be required where, in the opinion of the Authority, such is needed to 1) protect the water pipe from freezing, superimposed loads, or impact and 2) protect the public in the event of a water main break.

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 conform to detail WS-01. Electrical conduit shall not be used as casing.

4.11 Wet Taps

All wet taps require the approval of the Authority. 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 General Manager.

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 Authority or its authorized representative. Tests shall be made between adjacent valves.

Care shall be taken to insure 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 Authority 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:

$$L = \frac{S \times D \times P^{1/2}}{133{,}200}$$

Where: L is allowable leakage, in gallons per hour;
S is the length of pipe tested, in feet;
D is the nominal pipe diameter, in inches;
P is the 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 Authority or its authorized representative.

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 Authority. 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 C651-92 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 C651-92 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 insure 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 insure 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 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 Authority. 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.

4.14 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 the *Approved Materials List* 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 the *Approved Materials List* of this manual.

A. Tapping Saddles – Where tapping saddles are permitted to be used they shall be of stainless steel construction.

4.15 Water Supply System Materials and Standards

See the FCWSA *Approved Materials List* in Appendix D for additional design requirements and approved manufacturers for water construction.

5. Sanitary Sewer Systems

5.01 General

The requirements of these standards must be satisfied for all systems to be incorporated into the Authority inventory. Such systems include construction within areas of existing or proposed easements on private property dedicated to the Authority or within a public right-of-way where specifically permitted by the Engineer or General Manager. Specific variances to these standards must be approved and authorized, in writing, by the General Manager 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 General Manager of the Authority. The authority for discretionary provisions for sewer designs shall rest with the General Manager. Any references to acceptance and/or approval shall mean acceptance and/or approval by the Authority.

5.02 Private Sewer Service

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

5.03 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.

5.04 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 Storm Water Management (SWM) and/or BMP facility or its associated easement.

5.05 Sewer-Only Accounts

The Authority 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 Authority 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.

5.06 Pretreatment

All users of the Authority's sewer system shall comply with the Fauquier County Pretreatment Ordinance and the Authority's Pretreatment Program.

5.07 Grease, Oil, and Sand Traps

Grease, oil and sand traps shall be provide when in the opinion of the Authority they are necessary for the proper handling of liquid wastes containing such ingredients or any other of a flammable or harmful nature. All restaurants are required to install a grease interceptor. All automotive facilities (except for completely dry shops) are required to install an oil-water separator, outside of the building.

All grease, oil and sand traps shall be of a type and capacity approved by the Authority. 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.

5.08 Inverted Siphons

Inverted siphons shall not be allowed without the written approval of the General Manager and only in cases where other alternatives make the use of inverted siphons in the best interest of the Authority.

6. Sanitary Sewer Systems Design Parameters

6.01 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 sewered. The estimated average daily flow will be computed using the unit flows from Table 5-A-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 is/are part of the Authority's Sewer Master Plan.`

6.02 Design Quantities

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). The peak flow will be computed by multiplying the average daily flow by the appropriate peaking factor from Table 5-A-2. The unit flows from Table 5-A-1 will be assumed to cover infiltration. When deviations from the flow rates of Table 5-A-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 5-A-1 requires the written permission of the Authority.

6.03 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 Tables 5-A-3 and 5-A-4. 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 <= 0.80). Capacity and velocity computations for gravity sewers shall be done using the Manning formula with units as follows:

V = velocity (fps)
Q = flow rate (gpm)
S = pipe slope (% or ft/ft)

A = pipe cross-sectional area (sf)
R= pipe hydraulic radius (ft
A 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 of the sewer being extended in the near future. Sewers shall be designed such that the maximum velocity is 10 fps. Where velocities must exceed 10 fps, the sewer shall be constructed of ductile iron pipe conforming to Section 5 of this manual. The minimum size sewer main 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.

All sewers will be designed with slopes sufficient to provide a velocity during peak flow conditions of not less than 2.25 feet per second or a waiver must be obtained from the General Manager.

6.04 Separation of Mains & Location of Sanitary Sewers

A. General - The following factors shall be considered in providing adequate separation:

(1) Materials and types of joints for water and sewer lines.

(2) Soil conditions.

(3) Service branch connections into the water line and sewer lines.

(4) Compensating variations in the horizontal and vertical separations.

(5) Offsetting of pipes around manholes.

B. Parallel Installation

(1) Normal conditions - Sewer lines shall be laid at least 10 feet horizontally from other utilities whenever possible, the distance shall be measured edge-to-edge.

(2) Unusual conditions - When local conditions prevent a horizontal separation of 10 feet, the sanitary sewer line may be laid as close as 5 feet from water lines provided that:

(a) The bottom (invert) of the water main shall be at least 18 inches above the top (crown) of the sewer.

(b) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe, pressure tested in

place without leakage prior to backfilling.

(c) The sewer manholes shall be of watertight construction and tested in place.

(3) Unusual conditions - When 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 General Manager.

C. Crossing

(1) Normal conditions - Sanitary sewer lines crossing below water lines shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

(2) Unusual conditions - When local conditions prevent a vertical separation described above, 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 Section 5.

(b) Water lines passing under sewers shall, in addition, 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 must 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.

D. Location of Sewers and Sewer Manholes

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

In general, sewers shall be placed in utility easements dedicated to the Authority, adjacent 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 will not be located in areas where water backs up during a storm and shall be located beyond the spread of gutter flow. Manholes shall not be located in highway rights of way, and except at road crossings sewers shall also not be located in highway rights-of-way. Alternative sewer and manhole locations will be permitted only with the expressed approval of the General Manager and in accordance with the appropriate Utility Location & Easement Layout Detail.

A minimum of 15 feet edge to edge horizontal separation shall be maintained between sewer lines and building foundations, retaining walls or other above-ground structures. This requirement may be increased for deep and/or large diameter sewers, as determined by the Authority.

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 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. The test pit information will be shown on the project plans.

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 Authority may require the sanitary sewer to be constructed of ductile iron pipe when the 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.

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

6.05 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. Sewers laid on piers across ravines or streams shall be allowed only 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. Design information and details of the aerial crossings and piers will be included in the project plans.

The design engineer shall be responsible for obtaining all required State and Federal permits to install a surface water crossing. At stream crossings, the top of the sewer will be a minimum of 1 foot below the stream channel when the stream bed is rock, and 3

feet when the stream bed is an unconsolidated material. When the sanitary sewer runs parallel to a stream, the invert of the sewer will be a minimum of 3 feet below the invert of the stream channel to insure that adequate crossings can be made. The invert of the stream channel will be shown on the sanitary sewer profile.

6.06 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 of connector used. The inside diameter of the manhole shall be noted on the sanitary sewer profiles whenever the lines connecting to the manhole are greater than 12 inches in diameter. 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 diameter of 5 feet. Where permitted, manholes equal to or greater than 25 feet deep 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 grade, 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. The minimum angle between influent and effluent lines is 90-degrees.

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 Detail SC-07.

Where there is an increase in pipe size at a manhole, the difference in elevation of the influent and effluent inverts shall be as indicated in Table 5-A-3.

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 General Manager.

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

All manholes shall have an external manhole chimney seal between the manhole casting, adjusting rings, and cone section, as shown in Detail SC-03, to prevent inflow and infiltration into the manhole.

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

Manholes within 1,000 feet of discharge points for sanitary sewer force mains, 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. When force mains are tied into existing manholes, the interior of downstream manholes as described above shall be thoroughly cleaned and protected from corrosion by the application of a lining system approved by the Authority. 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 Engineer. Manholes must be of watertight construction and tested in place for leakage.

Manholes constructed on fill will have a false bottom extending to undisturbed ground or 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 assigned by the Authority to the Design Engineer during the preparation of Project Plans.

6.07 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.

6.08 Service Connections

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 Detail SC-08 or Detail SC-09 in this manual. All service connections must be connected by means of a manhole connection or a pre-manufactured tee or wye, or with an approved saddle type connection approved by the Authority. 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 of the Authority.

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 Authority or a pumping operation is utilized.

Sewer laterals shall not be tied directly into a trunk sewer unless specifically approved by the General Manager. Over-pumping of any force main shall not be permitted unless specifically approved by the General Manager.

6.09 Pipe Material Selection and Depth of Cover

Sanitary sewer pipe must be made of Polyvinyl Chloride (PVC) conforming to AWWA C900/905 or of ductile iron conforming to AWWA C151 in accordance with the design standards of this manual. All pipes must be pressure tested in place and exhibiting no leakage prior to backfilling. PVC pipe subject to gravity flow shall have a dimension ratio (DR) of 25 or better. DR 18 may be required by the Authority for deep or shallow installations for additional strength and will be determined at the time of review of final construction plans. In lieu of Ductile Iron Pipe, PVC pipe conforming to AWWA C900/905 with a wall thickness of DR 14 may be used at the discretion of the Authority. 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 and dimension ratio along a pipe run, from manhole to manhole, unless approved by the General Manager.

Normally, sewers constructed in a street, travel way or other paved surface shall have a minimum cover of 5 feet and maximum cover of 22 feet. Such sewer lines may be installed with between 3½ and 5 feet of cover, provided that the sewer is constructed of minimum Class 50 Ductile Iron Pipe, but may be installed with greater than 22 feet of cover only with prior approval of the General Manager.

Sewer constructed in unpaved areas will have a minimum cover of 4 feet and a maximum cover of 22 feet. Such sewer lines may be installed with between 2½ and 4 feet of cover provided that the sewer is constructed of minimum Class 50, Ductile Iron Pipe, but may be installed with greater than 22 feet of cover only with prior approval of the General Manager. 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 18 feet or greater will be constructed of minimum Class 50 Ductile Iron Pipe. The class of pipe used will be in accordance with Table 5-A-5. All sewers constructed on fill will be constructed of minimum Class 50 Ductile Iron Pipe.

Sewage force mains shall be constructed of Class 50 or greater ductile iron, and shall be H_2Sewer Safe pipe as manufactured by Griffin Pipe Products, or an approved equal.

6.10 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 50, 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.

6.11 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

PERCENT SLOPE	ANCHOR SPACING (Center to Center)
20 - 35	36 - ft.
35 - 50	24 - ft.
Over 50	16 - ft.

6.12 Sewer Service Connections

The following standards shall apply to sewer service connections that are located within dedicated rights-of-way and easements. These service connections will be constructed of

hub and spigot cast iron pipe (extra heavy conforming to ASTM A-74); PVC Sewer Pipe conforming to AWWA C900/905 or Class 50, ductile iron pipe. Sewer connections with a depth of cover of 18 feet or greater will be constructed of Class 50, ductile iron pipe to the property line. PVC C900/905 joints shall be made with integral rubber ring wall with bonded-in-bell elastomeric seal.

6.13 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.

7. Sanitary Sewer System Construction

7.01 General

Construction of sanitary sewers and appurtenances within the Fauquier County Water and Sanitation Authority service areas shall be in accordance with plans and specifications approved by the Authority. 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 Authority 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 Authority for review and approval before the changes are constructed.

7.02 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 5-5.

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 existing ordinances 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 Authority's Inspector as soon after completion of each day's blasting activities as is practical.

7.03 Pipe Embedment and Backfill

Crushed stone, pea gravel or other material approved by the Authority 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. In these areas compaction shall achieve a density of at least 95 % of the maximum density as determined by the AASHTO Method T-180.

7.04 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 Authority 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 Authority. 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 2,500 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 Authority.

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 Authority.

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.

7.05 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 Authority 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 Authority.

All connections and wyes that are for future use shall be capped as directed by the Authority. No pipe shall be cut for service connections except as approved by the Authority. 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.

7.06 Private Building Sewers

The installation of building sewer connections from the property line to the building, except when within a dedicated right-of way or easement, are regulated by the VUSBC.

7.07 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 ¼ 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 General Manager. 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.

Doghouse type manholes constructed over existing sewer lines shall not be permitted. It shall be accomplished by sawcutting out an appropriate length of existing sewer main and inserting a precast manhole with new pipe sections that are joined to the ends of the existing sewer line by using an approved coupling. During the installation of the new manhole, the contractor shall pump all sewage flows from the manhole immediately upstream to the manhole immediately downstream.

Where grading is being proposed at preexisting manholes, specify adjustment of tops so as to conform to the new grade. Due to the limited adjustment available within the manhole chimney, the components of the manhole will typically need to be disassembled, and new sections installed to accomplish the necessary stack-out. Joints in new components must be made with dimensions that conform to the joints of existing components, where new and old must mate. The new assembly will be subject to

exfiltration testing, and watertight construction is required. If watertight joining to existing components cannot be attained, the entire manhole must be replaced.

7.08 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 Authority. 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 Authority, shall be made by coring the manhole and installing a rubber boot.

7.09 Frames and Covers

All frames shall be securely anchored to the related structures as directed by the Authority, 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 Authority, 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 Authority.

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.

7.10 Acceptance Tests

Sewers will be inspected to determine if any deviation from line and grade has occurred. The pipe alignment will be checked by Closed Circuit Television camera (CCTV) prior to acceptance by the Authority. The CCTV inspection will be performed under the supervision of the Authority's Field Inspector. Any deficiencies, such as: Sags (bellies) in the pipe, rolled joints, leaks, damaged or out of round pipe, or excessively dirty pipe shall be corrected before acceptance by the Authority. Contractor shall clean sewers prior to each television inspection.

An acceptance test is required for all sanitary sewer mains and manholes. The preferred method of testing for mains is air and vacuum testing for manholes. Vacuum

testing methods and acceptability criteria shall be in accordance with ASTM-C1244; with the exception that vacuum testing shall be done after backfill has been placed around structure.

An exfiltration test using water for mains and/or manholes is an option only if approved by the Authority's Field Inspector.

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 ¼ 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 Authority.

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 Authority at least 48 hours in advance. Each section of completed sewer shall be tested to the satisfaction of the Authority 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 Authority 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 1-1 and 1-2.

(8) Pipe failing to maintain the stipulated pressure for a period equal to or greater than the holding time shown in Tables 1-1 and 1-2 shall be deemed not to have passed the low pressure air test and is unsatisfactory for acceptance by the Authority. 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 Authority.

(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.

7.11 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.

7.12 Construction Within Public Rights of Way

On projects in which the General Manager 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 50 Ductile Iron, or approved equal, and shall meet the applicable portions of the specifications in the *Approved Materials List* of this manual.

B. Tapping Saddles – Where permitted for use, tapping saddles shall be epoxy-coated cast iron with stainless steel bands.

7.13 Sewer System Materials and Standards

See the FCWSA *Approved Materials List* in Appendix D for additional design requirements and approved manufacturers for sewer construction.

8. Sewage Pumping Stations

8.01 General Requirements

All sewage pumping stations must conform to the latest edition of the Sewage Collection and Treatment (SCAT) Regulations (9VAC25-790) as published by the Virginia Department of Environmental Quality (DEQ). The sewage pumping station standards presented herein shall supplement the minimum design requirements set forth in the SCAT Regulations. Additionally, all sewage pumping stations located within the Occoquan Basin must comply with the design requirements of the Occoquan Policy (9VAC25-410). In cases where State or Federal law differs from these standards, the designer shall be required to comply with the more stringent requirement.

The Authority will consider allowing sewage pump stations only in areas where a thorough study of all alternatives clearly indicate a gravity collection and disposal system is not practical or feasible. The inability to obtain off-site public easements for a gravity sewer extension will not in itself be justification to install a pump station. The Authority will determine the feasibility of gravity sewer in each case and may not base its decision on cost to the developer/owner(s). The ultimate goal is to minimize the number of pumping stations for the area to be served while keeping the depth of the gravity sewer and pump station within a constructible and maintainable depth. These criteria assist the Authority in providing efficient, cost effective, and reliable service to our customers.

A detailed Preliminary Engineering Report (PER) for the proposed pumping station shall be submitted to and approved by the Authority prior to design of the facility. The report shall fully comply with all the requirements listed herein as well as applicable Virginia Department of Health and DEQ requirements. The report shall evaluate the entire proposed sanitary sewer service area and shall evaluate overall effect on downstream facilities. The force main, wet well, and all yard piping shall be designed for the ultimate build-out capacity of the pump station unless otherwise approved by the Authority.

Sewage pump stations with design capacities greater than 1 MGD may require additional design measures as determined by the Authority as the stations often include more complex control systems, equipment, and configurations.

The sewage pumping station will not be accepted by the Authority until the following items have been provided.

A. All required State and local permits shall be pulled by the contractor and closed out at project completion.

B. The pump station property shall be transferred to the Authority. All force main, gravity sewers, and access easements shall be recorded in accordance with Section 1.09 of these Standards.

C. A “Certificate to Operate” the pumping station from the Virginia DEQ.

D. Five copies of the Operation and Maintenance Manual and one digital copy approved by the Authority and Virginia DEQ.

E. Certified pump curves

F. A certificate of substantial completion issued by the Authority.

8.02 Site Layout

A. Sewage pumping stations shall be located above the 100-year flood elevation. Hydrologic and hydraulic analysis of the nearby stream or river may be required to determine compliance with this standard.

B. Each new station site shall include provisions and adequate area for future pump station replacement or expansion, while allowing the station to remain in service.

C. The pump station site shall be located or designed in a manner that will be protected from storm runoff entering the pump station site. Site grading shall prevent local ponding and provide positive drainage away from structures.

D. The grading of the land beyond the perimeter fence shall be compatible with the slope stability of the soil type encountered but shall not exceed 3:1 slopes. Lesser slopes wherever possible are preferred. The use of retaining walls adjacent to the pump station site is not permitted.

E. The sewage pump station shall be placed at a sufficient distance from developed areas and designed with adequate odor control measures to limit the detection of odors within the developed area to an acceptable level. In residentially-zoned areas, the pump station perimeter fence shall be no closer than 200 feet to the property line of the residentially-zoned property.

F. All sewage pumping stations shall be sited to permit access by all-weather surface roads capable of accommodating a large tanker truck. Design of access roads must minimize turns and achieve the straightest possible alignment. Adequate provisions shall be made for parking and turning large maintenance vehicles around at the station.

1. The access road surface shall have a minimum width of 12 feet and the slope of the road shall not exceed 8 percent. The access road surface shall be designed to be above the water level caused by a 25-year storm event.

2. The minimum road section shall consist of a compacted sub-grade, 6 inches of VDOT 21A stone, 4 inches of compacted VDOT BM-25.0A base mix and 2 inches of compacted VDOT SM-9.5A surface mix.

3. The roadway pavement shall be crowned and not super-elevated. Accommodations for drainage shall be provided on both sides of the road by means of open ditches. If drainage must cross the road, it shall do so beneath the road within a culvert.

4. Unrestricted ingress and egress shall be granted to the Authority from a public right-of-way to the pumping station access road. On all access roads, a locking gate shall be provided at the entrance to the access road from the public right-of-way.

G. The facility shall be connected to a public water supply. Potable water supply brought to the station shall comply with conditions stipulated in the Virginia Waterworks Regulations. An approved reduced pressure zone (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. Supply is to be adequate for facility wash down and cleanup operations. Where public water is available, a fire hydrant shall be provided.

H. All sewage pumping stations must have an 8 foot fabric height chain link fence surrounding the parking area, electrical equipment, wet well and vault. Fencing shall be black, PVC-coated (ASTM F668 Class 2b) chain link with 3 barbed wire strands on top and no top rail. Gateposts shall be 4 inches in diameter and corner post shall be 2.625 inches in diameter.

I. The wet well and valve vault shall be located a minimum of 10 feet from the site fencing to the outer edge of the structure.

J. All areas inside the fence not covered with an impervious surface shall be surfaced with dense gravel or stabilized with vegetative cover. Gravel shall consist of 6 inches of 21A dense grade aggregate with a geotextile fabric installed between the soil and aggregate bedding. The geotextile fabric shall extend 2 feet beyond the fence line. If selecting vegetative cover, top soil shall be applied on all denuded areas prior to applying seed and straw. Grass shall be well established throughout the entire site. The site shall also be leveled and free of debris/rocks that could impede lawn mowing equipment.

K. All sewage pumping station sites shall be screened as appropriate from surrounding development. This may consist of wood or plastic slats interwoven into the chain link fence. Trees shall not be planted in the proximity of the pump station site. Non-invasive shrubs shall be selected based on maximum height, foliage thickness, and compatibility with existing vegetation. Landscaping shrubs shall be aesthetically pleasing and require minimal maintenance (watering, fertilizing, trimming, etc).

L. Suitable backfill around the wet well and valve vault shall be compacted to 95% of maximum dry density as determined by the standard Proctor curve (ASTM D-698). Foundation subgrade for these structures shall be compacted to 100% of maximum dry density. All fill material shall be non-plastic in nature and free of

roots, vegetative matter, waste, construction material, rocks, or other objectionable matter. Materials deemed unsuitable by the inspector shall be removed and replaced with suitable fill.

8.03 Pump Selection

A. All pumps shall be submersible, non-clog type and be equipped with an electric motor supplied with adequate cable suitable for submersible pump applications.

B. The maximum pump motor speed shall be 1,800 rpm. Motors shall be suitable for 480 volt, 60 Hz, and 3-phase operation as well as explosion proof.

C. The design engineer shall select the most efficient pumps from approved pump manufacturers for the given head-capacity situation. The use of constant speed pumps is preferred to meet the minimum to maximum flow range without exceeding the maximum allowable number of starts per hour.

D. The pump sizing shall be determined from a system pipe friction loss analysis of the pumping station piping and force main to its discharge point. Losses shall include pump suction and discharge minor type losses for piping, valves and fittings as well as static head.

E. For new pump stations, prepare Total Dynamic Head (TDH) calculations based on the initial new pipe C factor and the anticipated C factor after the force main has been in service for several years. The pump motor specified must be adequate over the full range of TDHs that will exist. The C values used for the selected pipe material are presented below. When expanding the capacity of existing pump stations which have been in service for many years, the actual C factor of the force main should be determined by field measurements.

Hazen-Williams Coefficient 'C' Values

Pipe Type	New	After 20 years
Ductile Iron (lined)	140	120
Plastic - PVC	150	130

F. Certain pump designs may have limitations on the lowest allowable pump speed. The minimum speed may be dependent on proper operation of a cooling system, shaft resonance frequencies and other issues. Consult the pump manufacturer to make sure any limitations are identified.

G. Pump stations shall have a minimum of two pumps and shall be designed such that peak flow can be handled with the largest pump out of commission.

H. All pump openings and passages shall be large enough to permit the passage of a sphere 3 inch in diameter and must have no less than 4 inch diameter suction and discharge openings.

I. The pump(s) shall be firmly connected to the discharge connection and guided by no less than two guide bars extending from the top of the station to the discharge connection. No portion of the pump shall be directly on the sump floor.

J. Pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Each pump must be furnished with a discharge connections system, which will permit removal and installation of the pump without the need for the operator to enter the wet well.

K. A welded, stainless steel chain of adequate size shall be permanently attached to each pump. Provisions shall be made for attaching the upper end of each chain to the wet well access frame and cover.

L. Sewage pump selection should allow for upsizing or downsizing of impellers as dictated by sewage flows.

M. All pumps shall be warranted against defects in workmanship and material for a period of 5 years or 10,000 hours of operation under normal use, operation and service. The warranty shall be non-prorated. All pumps using a center shaft shall be equipped with oversized bearings (Class B).

N. Submersible sewage pumps shall be manufactured by ABS, Fairbanks Morse, Flygt, Grundfos, or Vaughan (Chopper Pump).

8.04 Protection Against Clogging

A. A grinder shall be installed to reduce or shred influent solids for protection of downstream equipment. The grinder shall be wet-well mounted, two shafted unit powered by a submersible electric motor, intended for use in raw sewage.

B. A wall mounted frame of suitable dimension and strength shall be provided to support the grinder in place and direct flows toward cutters. The frame shall be stainless steel type 316 construction and firmly anchored to the circular interior vertical wall of the wet well.

C. An overflow bar rack shall be provided to assure screening upon possible failure of grinder.

D. A guide rail system and lifting bar shall be provided to permit easy removal of the grinder for maintenance.

E. An aluminum basket strainer shall be provided for installation in the wall frame to ensure continued screening when the grinder is removed for maintenance or inspection.

F. Sewage grinder shall be Muffin Monster (30K Series) as manufactured by JWC Environmental.

8.05 Wet Well

A. Wet well volume must be established with respect to pump type and operation (i.e. constant-speed or variable-speed drive) as defined by the following formula:

$V = (T \times Q) / 4$ where,

V = volume of wet well between the lead pump start and pump stop elevations in gallons

T = pump cycle time in minutes (time between pump starts)

Q = design flow rate of the pumping station in gallons per minute

1. Variable speed drives shall be designed for a minimum pump cycle time of 10 minutes. Constant speed drives shall be designed for a minimum pump cycle time between 20 to 30 minutes to prevent short cycling of the pump. The minimum time between pump starts must be verified with the particular pump manufacturer.

2. Sewage pumping stations shall be designed for peak flow from the contributing area. The peak flow for a sewage pumping station shall be a minimum of 2.5 times the average daily flow. Pump and system curves, flow calculations and a contributing area map must be included in the project plans.

B. The retention capacity shall have the wet well and incoming gravity sewer lines designed to insure that no discharges of untreated wastewater will occur at the station or any point upstream for a period of time equal to 180 minutes of the average daily flow.

C. Supporting design calculations shall be provided to show that the wet wells are sized adequately to counteract buoyant forces based on the ground water table located at finished grade. Calculations shall not add the weight of the pumps, internal piping and appurtenances, or wastewater present in the wet well. A minimum safety factor of 1.5 shall be used for buoyancy resistance.

D. Wet wells shall be a minimum of 72 inches in diameter to accommodate pumping equipment.

E. Wet wells shall be designed with an additional 2 feet depth above the highest alarm as a safety factor to accommodate unexpected increase in station capacity.

F. Wet wells shall be approved polymer concrete or be lined with approved HDPE protective liner. The precast concrete sections shall have a minimum compressive strength of 5,000 psi. Bottom of wet well shall be grouted to a

minimum slope of 45 degrees toward the pump suction inlet in order to facilitate solids removal.

G. Construct precast wells with a monolithic base structure. The minimum wall thickness must be 8 inches for all wet wells. The minimum base thickness must be 12 inches. The precast top slab must have a minimum thickness of 10 inches.

H. The wet well shall be placed on compacted native soil (or rock) with a minimum of 12 inches of compacted #57 stone bedding to support the base of the structure and prevent settlement.

I. All weather butyl joint sealant material shall be used to seal precast concrete joints exposed to high groundwater pressures. All lifting holes shall be plugged and sealed watertight as recommended by the manufacturer.

J. The exterior of precast wet well must be coated with a coal-tar epoxy system. Coating must be continuous, free of “pin holes” and/or voids, and applied in accordance with manufacturer’s instructions and recommendations.

K. No fixed ladders are permitted in the wet well.

L. All interior metal work and mounting hardware shall be type 316 stainless steel materials.

M. An access hatch shall be provided on top of the wet well and include a fall protection grating panel. Hatch shall be a least two leaf design with enough area to safely and easily remove the pumps. Access hatches shall be capable of withstanding a 300 psi live load. Door leafs shall be aluminum diamond pattern plate. The frames shall be extruded and have type 316 stainless steel hinges and tamper resistant bolts/locknuts. The frame shall be cast into the concrete tops of the wet well and properly placed to facilitate removal of the pumps. All hatches will have locking hasps and automatic hold-open arms. A handle on the inside shall permit inside door opening.

N. The top of the concrete slab of the wet well shall be elevated 6” higher than the surrounding grade.

O. Ventilation shall be provided for pumping stations during all periods when the station is occupied. Pumping station wet wells shall be ventilated in accordance with the SCAT Regulations and constructed of corrosion resistant material.

1. The ventilation for the wet well shall be designed as a passive gravity ventilation system where the air volume in the wet well is either increased or decreased as the wastewater level fluctuates due to inflow and outflow. The passive ventilation shall be sized to vent at a rate equal to the maximum pumping rate of the station but not to exceed the maximum permissible design airflow through vent pipe of 600 feet per minute (fpm).

Passive “gooseneck” vents shall be turned down so that the opening faces the top slab of the wet well. The minimum allowable passive vent diameter shall be 6”. Type 316 stainless steel screens shall be required to prevent birds and/or insects entry into the wet well. Vent outlets must be at least 1 foot above the 100-year flood elevation.

2. Provide permanent mechanical ventilation for dry wells located below the ground surface and for wet wells having screens or mechanical equipment requiring regular maintenance and inspection. Provide manual ventilation switches to override automatic controls installed for intermittently operated venting equipment. Connection between wet well and dry well ventilation systems is not allowed.

P. A pump station must have permanent hoisting equipment or be accessible to portable hoisting equipment for removal of pumps, motors, pipes, etc.

Q. Fiberglass wet wells may be used for small sewage pumping stations contingent to prior approval by the Authority. Fiberglass reinforced polyester (FRP) wet wells shall be manufactured from commercial grade unsaturated polyester resin or vinyl ester resin, with fiberglass reinforcements. The wet well shall be manufactured in one-piece including body, bottom and top, and it shall sit over a concrete slab design to counteract buoyancy forces. Design engineer shall design the top concrete slab. The FRP wet well shall be installed in strict accordance with the wet well manufacturer recommendations.

8.06 Backup Power

A. All sewage pumping stations shall achieve Class I reliability as defined in the SCAT Regulations. All pumping stations shall be provided with a standby generator with automatic transfer switches in the event of a power failure. Pumps shall be capable of automatic restart after power failures. Generator shall be rated for primary service and have a permanent magnet excitation. Automatic transfer switches should be supplied by the manufacturer of the generator.

B. The equipment supplied and installed shall meet the current requirements of the National Electrical Code (NFPA 70), the Standard for Emergency and Standby Power Systems (NFPA 110), and all applicable local and state codes and regulations.

C. Standby power generator shall be sized to run the entire station at full load for a minimum of 48 hours and shall be natural gas/diesel fueled engine. Natural gas is preferred where readily available. A fuel storage level indicator shall be provided in the generator. Fuel storage shall be accomplished by the use of corrosion-resistant double wall sub-base fuel tank only, no underground storage will be allowed.

D. All conduits and gas lines shall be installed underground.

E. Generator enclosure shall be designed to optimize both noise control and thermal management. Outdoor weather-protective housing with critical grade exhaust muffler shall be installed. The housing shall have hinged side access doors and a rear control door. All doors shall be lockable. Hinges and all exposed fasteners shall be stainless steel. The enclosure shall be constructed of 14 gauge sheet metal reinforced to be vibration free in the operating mode. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color. Roof shall be constructed to allow drainage of rain water.

F. Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base to facilitate engine servicing.

G. A suitable number of spring-type vibration isolators with a ¼-inch noise isolation pad attached to baseplate underside shall be provided to support the generator set. Isolators shall be freestanding and include seismic restraints. Mounting hardware shall include an adjustable equipment mounting and leveling bolt that acts as blocking during installation.

H. All generators shall be mounted on a concrete slab with rebar independent from other concrete slabs or structures. The finished surface of the concrete slab shall be a minimum of 1 foot above the 100-yr floodplain elevation. Concrete slab thickness shall be in accordance with the generator manufacturer's specifications and shall extend 2 feet from all sides of the unit. Concrete pad shall have a minimum compressive strength of 5,000 psi. Generator shall be secured to the concrete slab with stainless steel anchor bolts and nuts. Bolts shall have a "J" bend anchoring the generator set into the concrete. Anti-seize compound shall be applied to the threads of all stainless steel bolts before assembly.

I. Generators shall have a minimum of a 5 feet clearance on all sides from walls, fences, buildings or other obstructions.

J. For phased facilities, the design must address the need to supply standby power for the ultimate pump station configuration.

K. The complete electrical power system (generator, weatherproof enclosure, engine, controls, automatic transfer switch and accessories) shall be warranted by the manufacturer against defects in materials and workmanship for a period of five (5) years from the date of substantial completion. Coverage shall include parts, travel expenses and labor to remove and install the necessary parts and equipment.

L. Generators shall be manufactured by Caterpillar or Generac.

8.07 Piping and Appurtenances

A. Pump station piping shall be Class 52 ductile iron lined with Protecto 401 ceramic epoxy and shall have flanged connections to allow for removal of pumps and valves without interruption of the pump station operations.

B. An influent manhole collecting all of the gravity sewers and force mains that flow to the pumping station shall be provided if practical. The influent manhole shall be located on the same site as the pumping station as close as possible to the wet well. A short gravity sewer shall carry sewage from the influent manhole to the wet well. The influent manhole shall be capable of being isolated from the pumping station wet well by means of a buried resilient wedge valve with the valve box to grade. The influent manhole shall have Argu Sure Grip interior lining as manufactured by Concrete Pipe and Precast or approved equal to prevent corrosion.

C. Valves shall be located on the suction and discharge lines of each pump to allow the pump to be isolated. A check valve shall be installed on each discharge line between the pump and the valve. Isolation and check valves must be housed in a below grade, concrete valve vault, separate from but immediately adjacent to the wet well. Isolation valves for pumps shall be plug valves installed in the horizontal position so that the plug is in the top when open.

D. Pipe suction velocities must be between 2 and 6 feet per second.

E. All pumping stations shall be provided with a magnetic type flow meter equipped for wastewater service to record the quantity of flow being pumped. Range of flow meter shall be twice the normal pump output. All flow meters shall have an adequate length of straight pipe both upstream and downstream of the meter in accordance with manufacturer's recommendations.

F. Valves shall be installed on each side of the flow meter.

G. A pressure gauge with diaphragm mounted seals shall be located on the top of each discharge pipe in the valve vault, upstream of the check valve. Each pressure gauge shall be directly mounted, stainless steel case, with a four and one-half inch diameter dial. All gauges shall be weather proofed and isolated by stainless steel ball valve for maintenance purposes.

H. A tee and necessary valves shall be provided on the discharge force main to allow the force main to be drained, while operating with the auxiliary by-pass force main.

I. Flexible connections shall be provided for all below grade pipe connections to concrete structures while excluding exfiltration or infiltration. Pipe wall penetrations shall be made at right angles. Skewed or diagonal wall penetrations will not be allowed.

J. Pumping stations shall be provided with a bypass pumping connection downstream of the valve vault to enable the station to be taken off-line for periodic maintenance or repairs.

K. All flange bolting hardware throughout the pump station and valve vault shall be stainless steel. Anti-seize compound shall be applied to the threads of all stainless steel bolts before assembly.

L. All pump discharge pipe and fittings within the wet well, except for type 316 stainless steel and PVC, shall receive after installation a 100% solids coal-tar epoxy coating system. Surface preparation and application shall be in accordance with manufacturer's instructions and recommendations.

M. All exposed pipe, valves, and fittings outside the wet well shall be ordered with factory applied exterior coat of epoxy lining. Pipes shall be labeled in accordance with ANSI Standard A13.1, "Scheme for the Identification of Piping Systems".

8.08 Water Hammer

The Engineer shall evaluate if water hammer or damaging pressure surges will result from the closing of the check valve(s) on the force main and appurtenances. Water hammer is typically a concern on long force mains or where static pumping heads are high. The Engineer shall incorporate special provisions in the design to overcome the surge pressure if the combined effects of static head and water hammer do not exceed the design working pressure of the weakest component in the piping system by a safety factor of 1.1. In such circumstances, the Engineer shall re-evaluate pipe size and velocities, or select an appropriate device to control the water hammer. Such devices may include hydraulically operated, time adjustable, pump check service valves and spring-type, oil-cushioned elbow hydraulic surge relief valves.

8.09 Vaults

A. The valve vault for each pump station shall be poured concrete or pre-cast box. Precast concrete vault shall have a compressive strength of 5,000 psi in 28 days. The exterior walls of the structure shall have a minimum thickness of 6". The valve vault shall be placed on compacted native soil (or rock) with a minimum of 8 inches of compacted #57 stone bedding to support the base of the structure.

B. Valve vault shall be designed to resist buoyancy due to the presence of the ground water table located at finished grade and without equipment and piping installed.

C. The floor of the valve vault should be sloped to a sump and include a drain that is routed to the wet well. Floor drains from valve vaults to wet wells shall include a "P" trap to prevent gas from entering the valve vault. A backwater valve shall be installed in the drain line to prevent flooding of the valve vault by backflow from the wet well.

D. All pipe penetrations through the valve vault shall be permanently sealed using Link-Seal modular seals.

E. The top of the concrete slab of the valve vault shall be elevated 6” higher than the surrounding grade.

F. Provide type 304 stainless steel supports for pipes.

G. The valve vault access frames and covers shall be a minimum 48 inch x 48 inch double leaf hatches of all aluminum diamond plate construction reinforced for a 300 psi live load. The frames shall be extruded and have type 316 stainless steel hinges and tamper resistant bolts/locknuts. The frame shall be cast into the concrete tops of the valve vault and properly placed to facilitate removal of the piping and valves. All hatches will have locking hasps and automatic hold-open arms. A handle on the inside shall permit inside door opening.

H. Ladders shall be heavy-duty aluminum with non-skid rungs and must comply with all OSHA 1910.27, Fixed Ladders requirements. Install on fixed ladders below hatch cover(s), LadderUP safety post Model LU-3 as manufactured by the Bilco Company or approved equal. Device shall be type 304 stainless steel. It shall be designed with a telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism.

8.10 Force Mains

A. The design of a force main must be coordinated with the design of the sewage pump station. Force main sizing shall be based on a hydraulic analysis of the required flows, pipeline velocities, and receiving gravity sewer capacities. The receiving gravity sewer system shall be designed to convey the maximum pump discharge without surcharge plus all flows to be conveyed by the service area of the gravity sewer.

B. All public force mains will be constructed of Class 52, ductile iron pipe lined with Protecto 401 ceramic epoxy. All buried ductile iron pipe and fittings shall be polywrapped.

C. The design velocities in the force main shall be between 3 and 6 feet per second. Measures may be required to reduce the velocity before the wastewater is discharged to the gravity sewer system.

D. The minimum diameter for a public force main shall be 4 inches except for grinder pump systems.

E. The minimum depth of cover shall not be less than 3.5 feet.

F. A minimum 10 feet edge to edge horizontal separation shall be maintained between the force main and other utilities. Dual force mains shall have a minimum horizontal separation of 3 feet between pipe edges.

G. A minimum of 15 feet edge to edge horizontal separation shall be maintained between the force main and building foundations, retaining walls or other above-ground structures.

H. All force mains shall cross below water mains in accordance with the standards below.

1. When a force main must cross a water main, the crossing shall be perpendicular (90^{o}) or as close to perpendicular as is practical. A vertical separation of at least 18 inches shall be provided between the bottom of the water line and the top of the force main.

2. When a new force main crosses under an existing water main, all portions of the force main within 10 feet horizontally of the water main shall be enclosed within a continuous steel casing pipe.

3. When a new water main crosses over an existing force main, the water main shall be constructed of pipe materials with a minimum rated working pressure of 200 psi or equivalent pressure rating.

I. Any necessary bends, both horizontal and vertical, in the force main should be kept to a minimum.

J. The effect of hydraulic thrust must be countered by the use of thrust blocking, pipe anchorage, or other suitable means to prevent movement of piping. The force main and fittings, including all restrained joint fittings and thrust blocking, shall be designed to withstand pump operating pressures and pressure surges, but not less than 150 psi.

1. The dimensions and design details for concrete thrust blocks are provided in the Standard Details.

2. Restrained joints shall be provided at all bends, valves, and other required locations. The Design Engineer shall determine the locations and distances required for the installation of restrained joint piping. The factor of safety used in the calculations should not be less than 1.5. The extent of the restrained joints shall be shown on the force main profile sheet and include the stationing on both sides of the fitting.

K. The force main should be routed at a positive grade to the receiving gravity sewer to avoid the need for air release valves. If it is not possible to do so, air release valves shall be placed at high points to prevent air locking and relieve negative pressures. Minimize or avoid vertical offsets.

L. No segment of the force main can have zero slopes to limit the accumulation of gases. Low points must also be avoided to prevent the accumulation of solids. Downhill pumping is prohibited.

M. A casing pipe shall be used wherever a force main crosses a public road, sidewalk, and/or other pedestrian travel ways.

N. Stream crossings shall be avoided to the maximum extent practical. If unavoidable, the top of the force main shall be at least 3 feet below the stream bed and encased in watertight casing pipe. Plug valves shall be located on both sides of stream crossings.

O. Force mains shall not be located under parking spaces.

P. Force mains shall not be installed under any part of water impoundments. Storage or stockpiling of dirt or any other materials over buried force mains is prohibited.

Q. Force mains must transition into a gravity line within a manhole in a manner that minimizes agitation of sewage. Invert of incoming force main shall be 0.2 feet higher than the invert of the outlet gravity pipe, with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle. Force mains 6" in diameter or greater must connect to the manhole at a minimum 135 degrees to the outlet gravity pipe. The minimum manhole diameter shall be 5 feet when connecting dual force mains.

R. A force main shall have a plug valve installed every 2,000 feet to facilitate initial testing and subsequent maintenance and repairs.

S. Install solid copper tracer wire with all non-metallic force mains in accordance with the standards and Approved Material List of this manual.

T. Private force main connections require the owner to execute a Hold Harmless Agreement with the Authority. Owners shall also install a backflow control device at the upstream end of the force main connection located on the private side. All portions of any force main located within a public right-of-way and/or the Authority's Utility Easement(s) shall meet the Authority's material specifications.

8.11 Electrical Design

A. The Design Engineer shall determine the availability of electrical service and coordinate the available electrical service with that required for the facility.

B. In all pump stations, a main disconnect shall be installed between the meter and the automatic transfer switch. Disconnect shall be rated for the maximum available fault current from the utility serving the pump station with electrical power and shall meet the standards of the governing utility company.

C. All conduit runs in initial construction shall be sized to meet ultimate electrical and instrumentation needs.

D. The distribution lines and generator shall have a means of being disconnected before the transfer switch. The generator will automatically switch sources in the event of a power failure, under voltage, over voltage, phase loss, or phase reversal. The transfer switch will be fully automatic with the ability to sense a single-phase power condition and switch to the generator power system with a minimum time delay. Both power sources shall be protected by fuses or breakers prior to the transfer switch. The transfer switch shall be capable of being operated manually.

E. A lightning arrestor and surge capacitor shall be installed and wired to protect motors and control equipment from lightning induced line surges and transient voltage surges.

F. A final step-down transformer shall be provided on each electric feed line with adequate physical separation between them to prevent a common mode failure. Separate fuses or breakers shall be provided for each power source.

G. The electric transmission line and the standby generator will remain separate and form separate distributions up to the internal fuse system to preclude a common mode failure of both sources.

H. Breaker settings or fuse ratings shall be coordinated to effect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activations of other breakers or fuses to the degree practical.

I. All motors and control enclosures will be adequately protected from moisture, the weather and water under pressure.

J. All equipment shall be installed in accordance with the manufacturer's recommendations. When laying out the location of the equipment, the engineer shall consider the necessary separation between devices to provide adequate ventilation and the location of doors, hatches and panel covers to avoid conflicts between these items when they are opened and closed.

8.12 Electrical Equipment

A. All electrical work and materials shall comply, as a minimum, with the National Electrical Code as well as applicable State and local requirements. All material and equipment shall be Underwriters Laboratories (UL) listed.

B. The contractor shall furnish and install all necessary panels, meter cabinets, disconnects, conductors, conduits, and other associated electrical components for a complete electrical system. All electrical equipment/panels and controls shall be above ground.

C. Electrical equipment and wiring shall be insulated and properly grounded. Switches and control shall be of the non-sparking type.

D. Electrical service shall be 277/480-volt, 3-phase, and 4-wire. Minimum service size shall be 200 amps. General lighting and power transformer shall be at least 10KVA. Single-phase systems are not allowed.

E. Three-phase motors and their starters will be protected from electric overload and short circuits on all 3 phases.

F. Soft start/stop electrical control equipment shall be installed to significantly reduce surge pressures.

G. All motors will have a low voltage protection device which will cause and maintain the interruption of power to the motor upon the reduction or failure of voltage.

H. To indicate overheating problems, temperature detectors shall be provided in the pump bearings, stators, and the bearings of larger motors.

I. All wires installed in underground conduits will have moisture resistant insulation as identified in the National Electric Code. Electrical cables shall be type SO with sunlight and ultraviolet protection. All 4 – 20 milliamp signal cables shall have shielding properly terminated on one end of the cable run.

J. All electrical fixtures in the wet well are to be explosion proof, corrosion resistant, and located in serviceable locations.

K. A 20 amp, 120 volt convenience receptacle shall be provided at the electrical control panel, generator and inside the valve vault to help facilitate maintenance. Convenience receptacles shall be corrosion resistant, duplex type enclosed in an “in-use” weatherproof box with clear cover. All receptacles shall have individual circuit breakers and provided with ground fault interruption.

L. A minimum of 2 inch Schedule 80 PVC electrical conduit shall be used for all wiring. Underground conduit shall be buried a minimum of 18 inches. All conduits shall be non-corrosive. Seals shall be installed in the conduit to prevent gases from traveling to the panel box. Seals shall be readily accessible and located so that the motor may be electrically disconnected without disturbing the seal.

M. All cables shall be continuous (no splices allowed) and intended for wastewater service applications. Any cable subjected to stress or strain shall be equipped with a type 316 stainless steel wire mesh strain relief fitting that is properly sized for the cable. All cables shall be routed and installed so as to be protected from stress, crush and abrasion hazards.

N. All pump station control panels shall be covered by a constructed canopy to shield the operator from precipitation.

1. Control canopy shall have a pitched roof with a minimum 6'x15' outside dimensions that will provide a minimum 7 foot vertical clearance. Roof shall be supported by 6"x6" pressure treated wood posts anchored to a concrete slab using noncorrosive, steel post bases to keep wood out of direct contact with concrete.

2. Canopy shall include (2) 4 foot fluorescent lights under the shed canopy operated by a weatherproof toggle switch. Light switch shall be installed in a weatherproof box with an "in-use" clear weatherproof cover.

3. Provide an asphalt shingle roof sloped at least 3 inches per foot.

4. The electrical concrete pad shall be a minimum of 6 inches thick and reinforced with welded wire mesh. The concrete shall have a well-compacted 6" stone base (minimum).

O. All pump station electrical components and controls must be housed in a weather proof, water tight, 14 gauge, NEMA 4x rated enclosure manufactured from type 304 stainless steel. The cabinet shall be wall mounted type with a rain drip shield and sized to adequately house all the components. The door shall open a minimum of 180 degrees. The cabinet shall have a lockable handle on the outside of each door. Cabinet doors shall be rubber-gasket with continuous hinge.

1. Control panel rack to be fabricated from 6" standard aluminum channel with crossmembers notched and bolted to uprights with 316 stainless steel fasteners. No wooden poles or back plate will be allowed. Number and spacing of crossmembers shall be as needed to provide mounting for all necessary panels, disconnects and other hardware. Engineer shall confirm that rack design, mounting, and concrete foundation is adequate for expected wind loading and weight of components. Apply 2 coats of bitumastic coal tar epoxy where aluminum channel is in contact with concrete.

2. Control panel enclosures shall be equipped with vents, fans, heaters and/or other equipment to maintain normal operating temperatures and humidity controlled conditions for all interior equipment.

3. All transformers, control panels, terminal boxes, and other electrical equipment shall be mounted a minimum of 24 inches above the top of the concrete slab to provide accessibility for maintenance.

4. All LCD screens shall have an aluminum sunshield painted white with hinged flap covering the screen surrounding the manufacturer's enclosure.

P. Outdoor security lights shall be a LED style light with photoelectrical control and impact resistant lens. Each light pole must be equipped with a hinge, pin, and

winch system that allow the pole and light to be lowered to the ground for maintenance and bulb changing, and then to be raised back into an upright position.

8.13 Controls

A. The motor control center shall control the operation of all pumps. The motor control center shall contain starters for each pump, pump alternation and level sensing circuits, alarm circuits, and control devices as specified and as required.

B. Operating Sequence: At a preset point during a rise in wet well level, the first pump (the lead pump) shall be started, and it shall run as long as necessary to pump out the wet well to a low level pump cut off point. If the level continues to rise, the second pump (the lag pump) shall be started, and the two pumps then on line shall operate in parallel as long as necessary to pump out the wet well to the cut off point. This procedure continues for stations with three or more pumps. The automatic alternating control circuitry shall switch the operating sequence of the pumps (i.e. pumps alternate as lead pump) at each instance when all pumps are stopped. Provide a manual selector switch which shall allow manual selection of pump sequence or automatic alternation.

C. The pumps shall be controlled by means of a solid-state, submersible pressure transducer with corrosion resistant 316 stainless steel housing. The transducer shall be suitable for continuous submergence in the wet well and installed in accordance with manufacturer's instructions. The sensor shall be mounted using stainless steel cable system and suspended in a 6 inch PVC stilling tube attached to the wet well with type 316 stainless steel supports. The bottom of the diaphragm face of the sensor shall be installed approximately 6 inches above the wet-well floor while the stilling tube shall terminate 4 inches above the wet-well floor. The pressure transducer shall be programmed to turn the pumps on or off at various levels in the wet well.

D. An elapsed run time indicator shall be provided for each pump.

E. The pumping station shall also have a back-up float system for turning the individual pumps on and off if the primary pressure transducer malfunctions. All float switches shall be non-mercury type and suitable for use under corrosive environments. Float switches shall be mounted on a stainless steel bracket within reach from the access hatch. Each float switch shall be mounted on its own cord and include ample extra cord to allow easy adjustment of float switches.

F. Place the control system transducer and float controls in an area of the wet well which is removed from the turbulent effects of the influent flow(s) being received.

G. All control wiring and interface wiring shall be number coordinated with schematic. All panel and field wiring shall be identified with non-repeating

numbers. All instrumentation and control devices shall be wired with stranded copper conductors.

8.14 SCADA System

A. Pumping stations shall be monitored by the Authority's SCADA system. The SCADA will be consistent with the most current type being utilized for existing pump stations and must be acceptable to the Authority. The SCADA telemetry system shall be supplied by a reputable company approved by the Authority and experienced in installation of SCADA systems.

B. Dry, normally open contacts will be provided for all status alarm circuits. This will include pump run/fail, generator run/fail, high wet well, AC power status, generator starting system loss of charge and pump overload. Visual alarms (red flashing light) must be provided for all pumping stations on the side of the SCADA cabinet and shall be a waterproof, shatterproof fixture. No holes shall be drilled in the top of the cabinet. A press-to-test circuit will be installed for all of the control and alarm panel indicator lights. High wet well, generator fail and power fail alarms shall function upon complete loss of power. All alarms shall clear after events return to normal (no latching alarms to SCADA). Detection of moisture or motor over-temperature shall cause the motor to be taken out of service which shall be restarted by only manual means.

C. At a minimum, the following telemetry shall be provided at each pumping station:

1. Pump On (each pump)
2. Pump Fail (each pump)
3. High Wet Well Water Level Alarm
4. Low Wet Well Water Level Alarm
5. Loss of Primary Power
6. Generator/Secondary Power On/Fail
7. Grinder Failure
8. Generator Failure
9. Generator Fuel Low
10. UPS Run/Fail
11. Flow Rate/Total
12. Wet Well Level (in feet)

D. SCADA cabinet shall be sized to allow access around all the instruments for ease of operation and maintenance. The cabinet shall be designed to prevent overheating of instruments. Cabinet shall include a heater unit with thermostat control for protection of equipment inside the enclosure.

1. The SCADA cabinet minimum dimensions shall be 36 inch wide by 36 inch high by 12 inch deep.

2. The cabinet shall be NEMA 4X weatherproof construction with a rain drip shield.

3. Cabinet shall be fabricated out of type 304 stainless steel with a minimum thickness of 14 gauge.

E. SCADA panel must include isolation relays for all digital inputs. Isolation relays must be located within the SCADA panel to separate 120Vac circuits or others from SCADA 24Vdc.

F. The Verizon cellular Machine to Machine (M2M) communications shall be used to integrate with the Authority's existing SCADA system.

G. Install a din rail mounted transient voltage surge protector inside the SCADA panel.

H. SCADA panel shall be provided with an uninterruptible power supply (UPS) for a minimum of 2 hours. The wet well level controller and any other 24Vdc load located within the pump control panel and automatic transfer switch (if any) shall not be powered by the SCADA power supply.

8.15 Spare Parts

A. For each size and type of pump, the manufacturer is to furnish all recommended spare parts including, at a minimum, two sets of mechanical seals, O-rings, gaskets, and wear rings. Each pump shall also be provided with an extra full size impeller.

B. Equipment manufacturer shall furnish the proper lubricants for initial operation of each piece of equipment. Each type of lubricant shall be furnished in a separate sealed container, clearly labeled showing the type of lubricant, equipment for which it is intended, and instructions for use.

C. Provide five (5) spare fuses for each type and rating provided. Provide five (5) spare relays and relay sockets for each type provided.

D. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for. Spare parts shall be of the same type and quality as the parts

provided in the original equipment package. The spare parts shall be provided by the start-up date.

E. Special tools will also be required for a given station that uses special (non-standard) equipment.

9. Supporting Construction

9.01 Driveways and Access Roads

A. General

Required driveways and access roads for the Authority'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) Aggregate

The crushed aggregate shall be Type 21A.

(2) Semi-Permeable Filter Fabric

The 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	4/0 min.
(b)	Thickness (mils) ASTM D-1777	50 max.
(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) Base Course

(a) 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.

(b) 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.

(c) 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.

9.02 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

Federal, State and Local laws and code requirements shall control the disposal of trees and shrubs.

C. Products

Materials shall be at the Contractor's option.

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 Authority.

(b) All operations shall be confined to the width of the Rights-of Way secured by the Authority 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 Authority 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 Authority.

(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 Authority.

(b) Trees in construction zones or Rights-of-Ways shall not be removed until inspected and/or tagged by the Authority

(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.

(c) 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 Authority at the Contractor's expense.

(d) Vegetation within the areas to be cleared, which may be designated to be saved by the Authority shall be left standing and uninjured.

(e) 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

(f) 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
(v)	Fills	6 inches

(4) Trimming of Trees

(a) When required, with the Authority'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

(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.

(7) 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 Authority. A copy of the agreement shall be furnished to the Authority. Contractor's Disposal shall comply with all Federal, State and Local laws and regulations.

10. Appeals

10.01 Appealable Decisions

Any Applicant for sewer service or water service from the Authority who is denied a variance under Section 1.08, or who is denied a variance under the variance implementing provisions of this Volume 5, Part A, Part B, or Part C, or Part C of Volume 3 of the Authority's Operating Code, hereinafter collectively referred to as an "Appealable Decision," shall have the right to appeal any such determination by the General Manager to the Chairman of the Board of the Authority. In a case of a denial of a variance, the Applicant shall have the right to request a Written Determination by the General Manager of the reasons for such denials, if not already received.

10.02 Written Appeals

The Applicant shall have the right to appeal an Appealable Decision by filing a written request filed no later than thirty (30) days after the date of any written decision. The General Manager 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 Board of the Authority, within five (5) business days of a receipt of the appeal.

10.03 Board Consideration of Appeal

The Chairman shall place the appeal on the agenda of the next Board meeting of the Authority, or in the event that the appeal is received within fourteen (14) days of the next Board meeting, on the agenda of the Board meeting next following.

10.04 Decision on Appeal

The Board, on consideration of the appeal, may affirm or reverse, in whole or in part, any Appealable Decision of the General Manager. The Board may also direct that the General Manager 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 General Manager 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 General Manager.

10.05 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.

10.06 Form of Appeal

All appeals shall be filed upon the forms provided by the Authority and shall be accompanied by a written statement of the reasons any such Applicant disputes the determination of the General Manager. All such forms shall be filed at the main offices of the Authority at 7172 Kennedy Road, Warrenton, Virginia 20187 during normal business hours.

Appendix A: Tables

Refer to **www.fcwsa.org** for latest tables.

Appendix B: Construction Notes

Refer to **www.fcwsa.org** for latest standard notes.

Appendix C: Construction Details

Refer to **www.fcwsa.org** for latest standard details.

Appendix D: Approved Materials List

Refer to **www.fcwsa.org** for latest approved materials list.