Design and Construction Standards

of the

Clarke County Sanitary Authority

129 Ramsburg Lane
Berryville, Virginia 22611

Adopted September 17, 2019
Revised Through April 22, 2020

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Chapter 1: Introduction and Service Areas

1.1 Introduction

A. Basis and Intent

By action dated September 24, 2019, the Board of the Clarke County Sanitary Authority (herein "Authority") has adopted these *Design and Construction Standards* (herein "Standards"), to ensure uniform and adequate installations of water and wastewater infrastructure within the utility's service areas. These standards will be amended and updated from time to time. The Authority reserves the right to amend or modify this publication without notice, and to interpret the meaning of all statements made herein.

Many of the design and construction criteria and procedures established by these standards are similar to or the same as those promulgated by the public utility Loudoun Water in the document titled *Engineering Design Manual.* However, certain criteria differ between the two utilities. Appendix H of these standards contains the Authority's construction detail. Many of these details are those of Loudoun Water, incorporated herein by reference. See standard details G-1 and G-3 for a complete listing of drawings that are part of these standards. Appendix I, the Approved Materials List, shall be the latest Approved Materials List of Loudoun Water.

These Standards document the accepted practices and procedures for projects, serving two audiences.

1. Engineers, developers, applicants for new service, builders and installers may find guidance needed to prepare construction plans and specifications, and work through the administrative procedures that support their projects.

2. The Authority's staff and authorized representatives will use this information to implement and administrate construction projects, conforming to established policies, standards and procedures.

B. Limitations

1. Due to the wide variety of situations that arise, it is impossible to address all scenarios. Exceptional measures may be required to address project-specific conditions. Many criteria listed are minimums. The Authority reserves the right to exercise engineering and judgment, and will make the final determination as to the acceptability of each design. Final design decisions will be made, favoring the minimum life-cycle costs.

   Where the designer believes that project-specific conditions warrant a variance to or waiver from the provisions of these Standards, they should forward a request for such consideration to the Authority's staff or representative assigned to the project. In cases where the applicant wishes to dispute the determination of staff, a request for further consideration is to be made in writing. Further review of the matter will be given by the Board of the Authority, in consultation with staff and the Authority's consulting engineer, whereupon the Board will render a final decision.

2. All designs and installations must comply with the requirements of all applicable regulatory agencies including Virginia Department of Health (VDH), Virginia Department of Environmental Quality (DEQ), Virginia Department of Transportation (VDOT), and the ordinances of Clarke County.

3. Conflicts between these Standards and project–specific contract documents (specifications and drawings) will be resolved as follows. Where the Authority has advertised work and entered into a construction contract, the project-specific documents shall govern. Where an applicant has entered into a contract for installation of facilities, the provisions of these Standards shall govern, unless otherwise determined by the Authority.

C. Legal Authority

The Clarke County Sanitary Authority was created January 6, 1969 as a public utility, body politic and corporate under the provisions of the Virginia Water and Waste Authorities Act (Title 15.2, Subtitle IV, Chapter 5100 et. seq., Code of Virginia, as amended). Powers conferred by the Virginia Water and Waste Authorities Act include that of issuing rules, regulations and standards for the design, construction and/or installation of any facilities to be operated and maintained by the Authority.

D. Relationship to the County of Clarke

The Authority is not a department of the Clarke County. As a public utility, we are financially separate from the County. However, through an agreement with Clarke County, County staff and Clarke's Joint Administrative Services perform many day-to-day activities in support of the Authority's administration and operations, and may represent the Authority in these matters. The Clarke County Board of Supervisors appoints our Board of Directors.

Under an agreement between the Authority and Clarke County, the Authority provides operational services, maintenance, and advisory oversight of the wastewater collection and treatment system serving Boyce, Millwood, and Waterloo. This wastewater system is owned by Clarke County. As owner, the County maintains responsibility for policy and finance of this system. These Standards govern the design and construction of extensions of this system.

E. Fees, Charges, Rules, and Regulations

The document titled *Clarke County Sanitary Authority, Rules and Regulations for Water and Sewer Service* (herein the "*Rules and Regulations*") establishes the terms of receiving service from the Authority, all fees and charges for such service, and all fees pertaining to the application, permitting, and construction processes discussed in these Standards. Designs of service connections must conform to principles established in the *Rules and Regulations*.

1.2 Service Areas

Appendix A provides maps showing the locations where service may be available from an existing public system.

A. Water System

The Authority owns and operates a potable water system that currently serves residents and businesses in Boyce, Millwood, White Post, and at the Waterloo Intersection. The Prospect Hill Treatment Facility supplies this system. Drinking water is stored at three tank sites, and distributed through a network of public water mains.

By Resolution dated October 18, 2005, Clarke County has adopted policy, whereby buildings constructed after the date of the Resolution on properties along the Authority's water distribution system are required to receive their water supply from this system. Where a residence is planned on a property in the AOC or FOC zoning district, and the distance to the public water main is prohibitively long, a waiver to the mandatory connection policy may be considered, pursuant to the Resolution. The Authority set policy on this matter by action dated October 11, 2005, and reaffirmed this policy on July 16, 2013. If planning a construction project on a property along the public water main, the applicant should contact the Authority's staff to determine the availability of public water service, and how the mandatory connection policy applies to the contemplated work.

B. Wastewater System

The Authority provides operational services, maintenance, and advisory oversight of the wastewater collection and treatment system serving Boyce, Millwood, and the Waterloo Commercial Area. Wastewater is treated at the Boyce Wastewater Treatment Facility. Customers within the Town of Boyce are served by a gravity collection system and two central wastewater pumping facilities. Customers in the Millwood are served by means of a low-pressure collection system, employing grinder pumps at the points of service. Customers in the area of the Waterloo Intersection are served by a pumping station and a force main that conveys flow to the Boyce system. The sewer service areas have been established by Clarke County, pursuant to the Code of Clarke County, Chapter 180, Articles V, VI, and VII. Within these service areas, public wastewater collection service may be obtained. Lands exterior to these boundaries may not be served, without an action of Clarke County to extend the applicable service area.

The Code of Clarke County, Chapter 180 – 34.13 makes mandatory the connection of newly constructed or renovated buildings within these service areas.

C. Future Systems

Future service areas and Authority systems may be established throughout Unincorporated Clarke County, subject to the land use policies of the County, and the Clarke County Comprehensive Plan.

1.3 Initiation of Service

Prospective applicants for service should consult the Authority to determine whether the property in question can be served. The Authority will determine whether sufficient public main is available to support the desired connection. In addition to making service connections, it is necessary to extend the public main in all situations where the property in question does not have immediate access to an existing public water main and/or public sewer. Generally, the property in question must have a frontage upon the public main or direct access to a main, without the need to traverse another parcel of land. However, the Authority will consider short, incidental segments of private service easement across an intervening parcel, where conditions so warrant.

To receive new water service, the building to receive service must have fire protection from hydrants according to the Authority's standards. If adequate main is not available, then the applicant will need to extend the main. Extensions of the public main entail design and installation of new pipeline, in accordance with the provisions of these Standards.

Where it has been determined that adequate public water main and/or public sewer facilities are available to provide the desired service, applicants for new or expanded service may apply in accordance with the procedures established in the *Rules and Regulations*. The applicant will need to obtain the Authority's approval of the purchase capacity, and make reservation of this capacity.

1.4 Connection Permit

In all situations involving the initiation of new service from one of the Authority's systems, or the modification of an existing service, the landowner is responsible for acquiring the appropriate Connection Permit from the Authority, prior to beginning work. Often this procedure is delegated to the owner's contractor or builder.

The applicant and Authority's staff will work to determine an appropriate layout and size for the service line and/or meter. The applicant must prepare a drawing addressing the pertinent details to describe the work. A load letter and/or fixture count may be necessary as basis of meter size. Once the layout and sizes are approved, the Authority will prepare the Connection Permit and the applicant may execute it by paying the applicable fees and charges.

1.5 Easement Conveyance in Support of Connection

Should easements by required in support of the new service line, then such must be conveyed prior to execution of the associated Connection Permit. The Authority may require the conveyance of any easement on the applicant's land that is determined by the Authority to be needed for the present or future continuation or completion of the public system(s). Easement is to be conveyed to the Authority free of charge, and may be required for the purpose of extending any of the public systems (water or sewer), regardless of the type of service that the applicant seeks. Conveyance entails the preparation of the necessary easement plat by a licensed land surveyor. Review, approval, conveyance and recordation procedures are found in Appendix E of these Standards.

1.6 Installation and Inspection of Services

All installations of water and sewer service connections, water services, and sanitary laterals must conform to the standards of the Authority in materials, methods, and workmanship. Requirements of the *International Plumbing Code* may also apply. Work must be witnessed and approved by the Authority's representative prior to covering pipe and placing backfill, or placing it into service.

For water and sewer service connections, water services, and sanitary laterals occurring through and active site plan, subdivision plan, or public improvement plan, inspections of work will occur through the agreement between the applicant and the Authority for the project, and will be permitted under the Authority's Construction Permit for the project.

For connections to be made independently of an active Construction Permit, the owner and/or contractor should contact the Authority to arrange for a preconstruction conference. The Authority's representative and the contractor doing the installation will review the location of each connection, and the methods and materials to be used. The contractor will need to arrange for each service line to be fully viewed and approved by the representative prior to backfilling, and will be responsible for all required testing. The representative must witness the testing.

A. Acquiring the Meter

Once the Authority's representative has approved placing the supporting mains and service connections into service, the owner or builder may request that a temporary water meter be installed. The Authority will furnish the meter once the meter fee has been paid. A permanent meter will be placed once availability fees are paid. On new construction projects, this is typically done just prior to completion of the building's plumbing system. The meter must be in place for successful completion of the final plumbing inspection by the Clarke County Building Department.

The Authority will install all primary meters of sizes 1-inch and smaller. Meters 1.5-inch and larger must be installed by the contractor.

Where the installation is sewer service only, the Authority will provide the meter to be installed in the building's water supply line. The meter must be installed by the contractor prior to the sewer service becoming active.

-- end of Chapter 1 --

Chapter 2: Project Administration

2.1 Extension of Public Facilities

The applicant, as referred to in this and the following Chapters, is the project's owner or developer, with whom the Authority will enter into agreement for the construction of facilities. The term applicant shall also be understood to include engineers, employees, agents, contractors, subcontractors, and vendors providing support to the project's owner. It is the prime responsibility of the applicant to execute the project per the approved construction plans and specifications, and within the current guidelines and standards of federal, state, and local governing agencies.

The extension of the Authority's facilities, or construction of new facilities, must be in accordance with the limits of any corresponding service area as may be established by the ordinances of Clarke County, and will be in accordance with the policies established in the Clarke County Comprehensive Plan.

The applicant will be required to furnish, install and construct all water and sewerage facilities required within the area being developed, and shall agree to transfer to the Authority, all property and facilities thereof, free of debts, liens and/or other legal encumbrances, for ownership, operation and maintenance. Once the Authority has approved the facilities for acceptance, the applicant will continue to be responsible for their repair and maintenance for one year, after which the facilities will be considered for final acceptance. Facilities not complying with the Authority's standards will not be accepted, and will not be supplied with water or sewer service until the deficiencies are corrected to the satisfaction of the Authority.

Applicants will be required to provide enlarged water mains and/or sewers within the area developed as required by the Authority to serve other lands, according to utility master plans and area facilities plans, as may be adopted by the Authority from time to time.

2.2 Offsite Facilities

Offsite Facilities shall include, but not be limited to: (1) supply mains, including pumping or pressure reducing installations, necessary to extend from existing transmission or trunk mains, to the development area; (2) trunk sewers from the development area to existing trunk sewers or sewage treatment plants, or to new sewage treatment plants or interceptors; (3) temporary sewage pumping stations or treatment plants for the development area only; (4) capacity in existing and/or proposed consolidated sewage treatment plants; (5) sewage lift stations; and (6) all necessary accessories and appurtenances to the water and/or sewerage systems.

A. Construction by the Authority

Where determined appropriate by the Authority, an applicant may enter into contract with the Authority, and to deposit with the Authority, a sum of money equal to the estimated construction cost, including engineering, legal and administrative costs, of all facilities required beyond the limits of the area under development, referred to hereafter as the "Offsite Facilities", said facilities to be constructed by the Authority. This contract will

establish the responsibility for complete funding of the project, and the terms of accounting for funds advanced by the applicant.

B. Construction by Applicant

The Authority, in its sole discretion, may permit construction of Offsite Facilities by others with such facilities to be donated to the Authority after inspection and acceptance. In determining whether to allow construction of Offsite Facilities by others, the Authority shall consider the following factors: (1) complexity of the Offsite Facility in terms of its cost and engineering and construction detail; (2) the total area to be served by the facility; (3) number of properties to be crossed, including public ways and water courses for which governmental approvals or permits may be required.

In situations where the level of complexity suggested by the factors listed above is great, the Authority generally will maintain responsibility for and control over such Offsite Facilities and shall construct the same in its own name.

In the event the Authority permits construction of Offsite Facilities by others, it shall require execution of an agreement by the applicant or landowner proposing to construct and donate such facilities. The agreement shall require, as a minimum, that the applicant provide:

1. benefit of review and approval by the Authority of location and design details.

2. benefit of review and approval of the contractor proposed to undertake the construction, and of the construction contract. The construction contract shall include the right of the Authority to inspect and approve the work during all phases of construction, and the right (but not the responsibility) to require the contractor to suspend construction on account of his failure or refusal to construct the facilities in accordance with the terms of the contract.

3. a Labor and Material Payment Bond and a Performance Bond in the amount of 100% of the estimated construction cost with the Authority named as beneficiary.

4. a Certificate of Insurance naming the Authority as additional insured.

2.3 Special Contracts

The Authority may enter into contracts with any person, firm, or corporation, including municipalities, sanitary districts and other political subdivisions and public bodies, for the rendering of any unusual or extraordinary water and/or sewerage service; provided, however, that the rates or charges to be paid under such contract shall not be less than an amount which is fair and equitable, taking into account the cost to the Authority of providing such service.

2.4 Service to Developed Communities

Developed communities, which may be served by the Authority, are defined as those areas already populated by separate owners and/or renters, including commercial and/or

industrial establishments, not provided with water supply and/or sewage disposal service. The establishment of service to a developed community must be in accordance with the limits of any corresponding service area as may be established by the ordinances of Clarke County, and will be in accordance with the policies established in the Clarke County Comprehensive Plan.

The Authority may, at its option, provide the necessary facilities within a developed community, together with water and sewer mains leading to and from the community, provided that Clarke County or other public body enters into an agreement with the Authority, providing for the advance to the Authority of sufficient funds to construct the facilities.

2.5 Agreements

Upon the Authority's approval of the application, the applicant shall enter into a contract with the Authority, agreeing to perform all construction in accordance with the approved plans and specifications, and in accordance with all features of design and construction presented in the Standards. Standard forms of agreement are used, specifying the responsibilities of the respective parties. Where applicable and in accordance with current policy, terms of reimbursement will be incorporated, to compensate the applicant the enlargement of facilities.

All water and sewerage lines shall be constructed on public right of way or upon private land with perpetual easements, providing free, unobstructed and uninterrupted right of way for inspection, operation, maintenance, enlargement, replacement, alteration and extension of the installation. Lift stations, booster stations, storage tanks, and treatment works must be located on property dedicated to the Authority, or where so approved, in perpetual easement. The agreement for the project will establish the applicant's responsibility for acquiring the supporting conveyances and dedications, free of cost to the Authority.

2.6 Current Construction Plans Required

Where approved construction plans no longer accurately depict conditions of the subject land and/or its surroundings, updated construction drawings must be submitted for review and approval. Proposed construction on or around the area of the subject work must be accurately reflected. Where standards of design or construction have changed, subsequent to the Authority's approval of a construction plan or specification, the subject engineering shall be brought into conformance with the latest standard, such that all installations are made according to current standards. Construction drawings and specifications that have been approved for 5 years or more in advance of construction permitting shall be resubmitted, to determine their suitability.

2.7 Construction Permit

The applicant must fulfill his obligations to the Authority before obtaining the Construction Permit, needed to perform any work associated with the Authority's facilities. If work is conducted without the applicable permit(s), or is not inspected by the Authority, such is deemed to be at applicant's risk and may result in rejection and removal.

Once plan approval is obtained, the Authority will issue a letter to the project's owner, outlining items that must be furnished in support of the Construction Permit. These include, but are not limited to:

executed Agreement

Performance Bond and Labor and Materials Payment Bond

Certificate of Insurance, naming the Authority as additional insured. Certificate must cite the project in question, using its Authority Project ID Number.

materials submittal including shop drawings, as applicable

recordation of supporting easement

2.8 Preconstruction Meeting

Prior to the commencement of any permitted work approved by the Authority, the applicant shall request a pre-construction conference by contacting Authority staff. Requests should be made a minimum of 5 days before the intended start of work.

The applicant shall make proper arrangements to accommodate and conduct a formal pre-construction meeting. Attendees may include the applicant, design engineer, utility contractor superintendent, his estimator, principal subcontractors, suppliers-manufacturers as appropriate, the Authority's representative, and any other governmental agents.

Utility contractors and land disturbers that have projects involving construction within or near the Authority's easements, which may potentially expose or come in contact with its utilities or facilities, must call Authority staff at least 5 days before work is to start, to schedule a pre-construction conference.

The individuals conducting the pre-construction conference shall have on hand a complete copy of the most recent approved plans of the project along with all permits (VDOT, Clarke County, etc.) and approved submittals.

A clear understanding as to the scope of work must be agreed upon by all participants and their agents, to ensure a safe, productive and quality project. Project schedules and sequence timelines must be carefully planned and shared with participants for comments and commitments.

2.9 Progress Meetings

Formal or informal meetings shall be conducted regularly as the project progresses, to ensure and maintain open communication between committed participants.

2.10 Construction

A. Notification

At least 72 hours prior to any work associated with the installation, repair, replacement, maintenance or exposure of the Authority's facilities, the applicant and/or utility contractor shall contact the Authority's representative, to request inspections.

B. Approved Construction Plans

A copy of the approved plans for the project shall be on the project site throughout duration to final acceptance of the work. Approved copies of submittals, revised plan sheets, and engineer's cut sheets shall be readily available.

C. Protection of Existing Utilities

The Authority does not participate in the Virginia Miss Utility system. Where excavation is planned within the Authority's service area, call 540-955-5185 for water or sewer locate.

For excavations in the vicinity of the Authority's existing facilities, a Miss Utility ticket number that has been cleared must be available upon the request of the Authority's representative. The contractor must take all measures to ensure that existing facilities are not damaged by his operations. Specific requirements are listed in the *Virginia Professional Excavator's Manual*, issued by the Virginia State Corporation Commission.

Contractors shall take such provisions as are determined necessary by the Authority to ensure that existing facilities are not damaged, and to verify their condition after adjacent construction is complete. Where construction traffic must cross an Authority facility, or where substantial grading is to occur, the Authority may require loading calculations, sealed by a Professional Engineer, to demonstrate that the existing line can accommodate the proposed live loads and earth surcharge.

Blasting is restricted by the Code of Clarke County, Chapter 86. Blasting is prohibited within 100 feet of the Authority's lines. Blast monitors may be required where blasts are large, or where facilities are deemed by the Authority to be at risk.

D. Safety

Applicant and all contractors are responsible for the safety and protection of persons and property that may be directly or indirectly affected by construction activities. All activities shall be performed within current industry standards and guidelines set forth by federal, state, and local governing agencies.

E. Responsible Supervision

Applicant and/or utility contractor shall appoint a full-time, competent and reliable employee or consultant, who will be responsible for supervising and maintaining:

1. quality control per the Authority's standard and guidelines as specified herein.

2. health and safety of project workers and the general public.

3. protection of stored materials and equipment, existing utilities, facilities and properties per federal, state, and local agencies.

4. corrective measures as necessary to ensure safety and quality assurance.

5. discipline or dismissal of any employee from the project who does not demonstrate proper industry safe and healthy work habits.

F. Protection of New Work

Applicant and/or utility contractor shall be fully responsible to protect all work completed or under construction, materials, and equipment from theft and damage until the project's final acceptance by the Authority.

G. Operations within VDOT Right of Way or Private Roadways

All industry related activities within VDOT right of way or privately maintained roadways, shall implement and maintain safety precautions and procedures outlined on the approved VDOT maintenance of traffic/sequence of construction plans or current federal, state, and local governing standards and policies.

2.11 Field Engineering

During construction, where it is determined by the applicant, the utility contractor, and/or the Authority that changes or corrections to the approved plans are warranted, such changes or corrections shall be brought to the attention of the Authority's representative. Minor changes to alignment; certain additions, deletions, and substitutions; and minor changes to grading may be approved by the representative. More significant changes, and all changes to utility sizing, require the approval of the Authority's engineer. Where the scope of the change is sufficiently limited, this approval may take the form of a red line revision, whereby a markup of the plan is made to reflect the desired change, and submitted for approval, without a full submission of a revision to approved plan. Where significant changes to line and grade or utility size are desired, a revision to approved plan will be submitted, with review fee, for comment and approval.

All changes made during construction will be recorded and reflected on record drawings prepared by the applicant.

2.12 Inspection

The Authority or any governing agents shall be permitted to safely access the project at any time to perform inspections, to ensure quality of work and safe construction methods. Work not conforming to the approved construction plans, the Authority's standards or complying with industry standards is subject to rejection. Any work that has been rejected must be replaced or corrected to the satisfaction of the Authority.

Testing and start-up of any Authority facilities shall be conducted by contractor and witnessed by the Authority's representative in order to ensure operation and performance per manufacturer's and industry standards, and the satisfaction of the Authority.

A Beneficial Use inspection may be requested by applicant and/or contractor to be conducted by the Authority's representative. Beneficial Use may be issued for completed

portion or all of proposed work that is completed to be put into service. Once the entire project has passed a Beneficial Use inspection, the performance and payment bond may be reduced at the request of applicant up to a maximum of 80%.

At the completion of the project, the applicant and/or utility contractor may make a request for final inspection. The Authority shall conduct a complete field inspection and testing to ensure that the applicant/contractor has fulfilled their obligation in delivering a quality product. Any deficiencies or failing testing must be corrected to the satisfaction of the Authority. At time of final acceptance applicant/contractor will request a final bond release package.

2.13 Connection Permit

Where service is to be initiated to a structure by the project, a Connection Permit for each such service connection is to be acquired. Procedures are outlined at Chapter 1, Section 1.4.

2.14 Project Closeout

A. As-built Survey and Record Drawings

The applicant's engineer will conduct the as-built survey and prepare the record drawings, reflecting the facilities as actually installed, using information from the Applicant, contractor, and Authority.

B. Bond Reduction

To obtain a bond reduction, the applicant must obtain and provide the following items.

1. The subject improvements must have received Beneficial Use status, issued by the Authority's representative.

2. Provide copies of lien releases and affidavits of payments, ensuring that contractors/suppliers have been paid.

3. Submit a request to the Authority's staff. Include the project name, Authority Project ID Number, and bond number.

C. Bond Release

To obtain Performance and Payment Bond release, the applicant must obtain and provide the items listed below.

1. The subject improvements must have received Final Inspection approval, issued by the Authority's staff.

2. Provide copies of lien releases and affidavits of payments, ensuring that contractors/suppliers have been paid.

3. Submit total water and sewer installation cost in writing.

D. Land Use Permit

The Virginia Department of Transportation (VDOT) requires that the Authority's facilities within public rights of way be permitted, using the form known as Land Use Permit (LUP). Where the applicant wishes to dedicate improvements within a public right of way to Clarke County and VDOT, and the Authority's lines have been installed therein, the LUP-IPP form must be included in the road acceptance package, which is submitted to Clarke County. This Land Use Permit serves as an "in place permit" for the Authority's facilities.

To initiate the preparation of this LUP-IPP, the applicant must obtain and provide the following items.

1. The subject improvements must have received Final Inspection approval by the Authority.

2. Provide 3 copies of the approved construction plan and profile sheets, whereby the roadway improvements have been built. Water and sewer lines must appear on these sheets. Include cover sheet of plan set. Other sheets should not be included.

3. Provide name, address, and telephone or e-mail address of the applicant's representative, who is handling the road acceptance package.

The Authority will provide the completed LUP-IPP form and attach it to the plan sets, all of which will be returned to the applicant's representative.

-- end of Chapter 2 --

Chapter 3: Application and Plan Preparation

3.1 Purpose

The Authority's engineer reviews the construction plans for all projects that will extend its water or wastewater systems, on referral from the Clarke County Department of Planning. Conformance to the procedures and standards outlined in these standards will expedite the review process. This application and review process ensures that projects are built to conform to the Authority's standards.

3.2 Land Use Applications to Clarke County

Prior to submission of construction plans and profiles to the Authority for review, any zoning applications (rezoning, special use permit, site development plan, or subdivision plat review) must first be approved by Clarke County. Applications in the Town of Boyce, (rezoning, special use, site development plan, and subdivision plat), approval by the Town of Boyce Planning Commission or Town Council is required. The County Planning Department provides planning and zoning staffing services to the Town of Boyce under a memorandum of understanding between County Board of Supervisors and Town Council. Applications should be filed with the Clarke County Department of Planning. The Authority participates in the County's referral system as an outside agency. Review of the application can result in the following responses from the Authority.

Comment is provided on general location and configuration of proposed water and sewer system.

Need for special studies to determine feasibility of providing service is identified.

Water mains, sanitary sewers, and other facilities traversing or needed to serve the proposed development are identified.

Areas for easement and/or line extensions necessary to provide access to water and sewer lines to adjacent properties are identified.

3.3 Application Procedures for Construction Plans and Profiles

The applicant is required to contact the Clarke County Planning Department, VDOT, etc. for their individual submission requirements. The Authority's review will be conducted parallel to the Planning Department's review. The Authority's approval will be noted in conjunction with the Clarke County Planning Department's approval.

A. CCSA Initial Application

Initial submission to The Authority must include the following:

1. Application for Extension Form (AFE) found in Appendix B

2. Agreement concerning CCSA costs of plan review (hourly plus 10%) and inspection

3. Construction plans – three (3) full sets

B. Subsequent Submissions

After addressing comments, subsequent plan submissions include:

1. AFE Form

2. Estimate of construction cost, using the form in Appendix A

3. Response letter, stating how each comment has been addressed and/or reason for action taken

4. Revised construction plans – three (3) full sets

C. Signature Sets

Once the construction plans are approved, the Authority will request signature sets, consisting of three (3) full sets for the Authority's use. If the project's owner would like to have sets signed to indicate the Authority's approval, these copies may be sent with instructions for return. Also, furnish one full set of plans as digital Portable Data Files (PDF format).

D. Easement Documents

If only easements to the Authority are required for the project, submit easement plat and instrument directly to the Authority. Applicant should verify with Clarke County Planning that no zoning review is required.

For projects involving subdivision, dedication, boundary adjustment and/or conveyances to other entities, easement approval is obtained through the Clarke County review process. The Authority will review such documents and plats on referral from the County Planning Department.

For additional information and forms used in the conveyance and processing of easements, see Appendix C of these Standards.

E. Revisions to Approved CCSA Construction Plans

Revisions to approved plans require:

1. AFE Form

2. CCSA Review Fee – hourly plan review plus 10%

3. Letter listing the impacted sheet numbers and the nature of design modifications

4. One copy of each plan sheet that has been revised, with the proposed changes highlighted. Each sheet must have a revision block, reflecting each date of revision since initial approval.

Revisions to approved construction plans may require subsequent submissions, additional fees, revised bonds, and/or revised easements, depending on the nature of the revision. Once the revision is to be approved, provide three (3) copies of each plan sheet that has been revised. Where revision has affected many plan sheets, provide three (3) full plan sets. Also, furnish one full set of plans as digital Portable Data Files (PDF format).

3.4 Local Review Authority

A. Water

The Authority has not been granted local review authority by the Virginia Department of Health (VDH). Hence, for all construction on the public water system, the applicant will need to acquire a Virginia Waterworks Permit. The Authority will forward the application for this permit to VDH. In support of submission to VDH, the applicant shall provide plan sets and complete the application for Waterworks Permit. Plans for submission to VDH shall bear the design engineer's original signature and seal (wet stamp) on the cover sheet. Seals and signatures must appear on all plan sheets. The initial submission requires one set of construction drawings on paper. Once the design is approved, one final set of paper plans and an electronic set (PDF file) on CD are needed.

Construction of the project may not begin until this permit has been obtained.

B. Wastewater

The Authority has not been granted local review authority by the Virginia Department of Environmental Quality (DEQ). For all construction on the public wastewater collection or treatment facilities, the applicant shall obtain a Certificate to Construct (CTC) from the Virginia Department of Environmental Quality (DEQ). Construction of the project may not begin until the CTC has been obtained. At the completion of certain projects, a Certificate to Operate (CTO) shall be obtained by the applicant. The CTO will be required for project closeout.

3.5 Requirements for Construction Plans

Plan sheets are to be prepared for printing on 24-inch x 36-inch paper. Certification will be made by a licensed Professional Engineer with a valid and current registration in the Commonwealth of Virginia, unless otherwise exempted in the Code of Virginia (§54.1-401).

A. Cover Sheet

Provide a Cover Sheet that includes the project name; the Authority's project identification number(s); a sheet index; a vicinity map; and a revision block. Cover Sheet shall bear the name, address, and phone number of the applicant, and of the engineering firm that

prepared the plans. List the national telephone number for the Miss Utility System, 811. For the Authority's Inspections and Operations, list telephone number 540-955-5185.

B. Vicinity Map

1. Typical scale is 1 inch=1000 feet.
2. Show and label the Virginia State Plane North Coordinate grid at suitable intervals.
3. Show and label the adjacent streets and roads.
4. Show the limits of the site.

C. Revision Block

Each sheet pertaining to water and sewer construction shall have a revision block, in which the engineer will log each revision requiring the Authority's approval.

D. Zoning Tabulations

Provide table including number of dwelling units and/or building square footages with respective proposed uses.

E. Scale

Identify the scale(s) by numeric conversion on all plan sheets. To make grading and utility plan views properly legible, 1 inch=30 feet is preferred. Scales that cannot be read with a standard engineer's box scale will not be accepted.

F. North Arrow and Coordinates

A north arrow and a minimum of four coordinate grid references (tic marks) must appear on each plan view used to establish the placement of water and sewer lines.

G. Horizontal Control

Horizontal control is to be based on the Virginia State Plane North Coordinate System, North American Datum of 1983, and High Accuracy Reference Network (NAD83HARN). Linear units shall be US Survey Feet (not International Feet). Plans shall clearly note the horizontal datum used.

H. Vertical Control

Vertical measurements, including elevations, shall be based on the North American Vertical Datum of 1988 (NAVD 88), with feet as the measurement unit. Plans shall clearly note the vertical datum used.

I. Property Identification

Show Property Identification Numbers (PIN) of all parcels that are part of the application, and where proposed water and sewer lines are to be installed. Show the name of each property's owner. Show property lines, owners' names and PIN numbers of properties adjacent to the proposed work.

J. Easements

In plan, views of water and sewer show all existing and proposed easements conveyed to the Authority. Also, show all existing and proposed easements benefiting the County of Clarke, other public or private entities, and purveyors of electricity, gas, and communications services.

K. Topography

Provide contours at maximum 2-foot interval.

L. Natural Features

Show limits of Wetlands and Waters of the United States, intermittent streams, ponds, and limits of tree canopy, and other features that may impact location or installation of proposed facilities.

M. Manmade Features

Show all buildings, above and below ground structures, roads, bridges, trails and sidewalks, fences and walls, wells and potable springs, and wastewater disposal systems.

N. Existing Utilities

Show and label all overhead and underground utility lines and associated facilities. Test pits may be required as basis of design to determine depth and nature of facilities.

O. Proposed Site Work and Utilities

Within water and sewer corridors, show all grading, roadway, utility, and building construction that is currently proposed by the project's owner and by others. Work being proposed in other plan sets must be reflected in all instances where the subject installation is impacted by this other work, or will be in future.

Pursuant to Section 2.6 of these Standards, coordination between designs must be effectively maintained throughout the entire design period, and continue through actual installation. Failure to incorporate into the water and sewer designs, features to be constructed by the project's applicant or by others, will result in withholding of plan approval, Construction Permitting, and/or acceptance of work.

P. Plan and Profile of Water and Sewer

Provide plan and profile of all proposed water and sanitary sewer mains with complete stationing, consistent among views. Show existing water and sanitary sewer facilities within and immediately adjacent to proposed limits of construction. Include profile of existing pipelines if their cover is to be increased or decreased.

Waterline profile shall include complete call outs of fittings and appurtenances. Sewer profiles shall include specification of pipe inverts at each manhole, distance between manholes, slopes of lines, and stations of service connections.

Show location of water and sewer service lines to each proposed structure and/or to each proposed lot. For water services, line size and meter size must be specified. Water services are to be profiled to the meter, except that no profile is required for the services of homes and townhomes. For sewer service line, provide profile or tabulation to establish length, slope, invert elevations, and diameter throughout each service.

All crossings of storm sewers and other utilities must be accurately depicted on profiles of water and sanitary sewer, with minimum clearances specified.

Q. Standard Notes

Include current Authority standard notes. These are as listed on G-4 & G-5, STANDARD NOTES of the *Standard Details*. Ensure that this figure is reproduced at a scale that will make the text readily legible.

R. Standard Details

Include all applicable Authority *Standard Details*. Select those that pertain to the proposed scope. Do not include figures that apply to installations that are not within the scope of the project.

3.6 Review Process

A. Pre-application Conference

No pre-application conference is required. However, engineers preparing construction plans for submission to the Authority are encouraged to seek information from staff as basis of design. Among items that can be provided are record drawings of existing facilities on, adjoining, or supporting the subject site; the nature of planned facilities that impact the site; capacity limitations that may exist; and preferences as to layout. The Authority may attend the Planning Department's pre-application meetings from time to time if deemed necessary.

B. Reviews

In response to each plan submission, the Authority will provide written comments or approval.

C. Conferences During Design

Throughout design or redesign, engineers are encouraged to confer with staff, as to the suitability of contemplated layouts or design features. This may take the form of electronic mail and telephone calls, or if needed, design meetings.

-- end of Chapter 3 --

Chapter 4: Water Distribution

4.1 Scope

A. Intent

This chapter describes the planning, layout, design and construction of water distribution systems of The Authority. The information contained in this chapter must be applied in conjunction with the latest edition of the *Waterworks Regulations* 12 VAC 5-590-10 et. seq., published by the Commonwealth of Virginia, Department of Health; standard practices of the American Water Works Association (AWWA); and with other sections of this Manual.

B. Minimums

Many criteria listed are minimums. Additional separations and clearances are to be furnished as practical to optimize each design. Attention shall be given to locating utilities so as to facilitate their re-excavation. The Authority will consider factors such as depth and magnitude of facility in determining the adequacy of each design, and may relax or increase dimensional requirements accordingly. A design is to be sought which minimizes maintenance costs.

4.2 Hydraulic Requirements

A. Flows and Pressures

1. The water distribution systems and any extensions thereof shall have adequate capacity to supply the normal (average) and peak hour demands of all customers – domestic, public, commercial and industrial – while maintaining a pressure of not less than 30 pounds per square inch (psi) at all points of delivery. The Authority further intends to provide a static service pressure of 40 psi or better to all customers. If considering an extension at higher elevations, such that lesser service pressures could result, the designer should consult with Authority staff to evaluate options for enhancing pressure.

2. Extensions shall be capable of delivering, on the day of maximum customer demand, flows required for the fire protection, while maintaining a residual pressure of not less than 20 psi. Flows required for fire protection shall be in accordance with the National Fire Protection Association Standards, and shall not be less than those listed in **Table 4.1** below.

Type of Building	Required Volume (Gallons Per Minute)
Single Family Detached or Two Family	750
Multi-Family; Apartment; or Single Family Attached with Three or More Units	1,500
School	1,500
Commercial or Industrial	1,500

Table 4.1 –Fire Flows

B. Estimating Customer Demand

1. Designs of water systems, including pumping facilities, shall be based on the *Preliminary Engineering Report - Water System Improvements Project, Clarke County, VA*, dated June 22, 2015 by Anderson & Associates, Inc. of Blacksburg, VA, and taking into consideration:

   a. the design factors established in the *Waterworks Regulations*.

   b. the estimated population to be served for a period of 30 years hence.

   c. the entire service area, built-out according to current residential, commercial, and industrial uses; and allowable land use, as established by the Clarke County Comprehensive Plan.

   d. future commercial development at a population equivalent not less than 30 people per acre.

   e. future industrial development at a population equivalent not less than 40 people per acre.

   f. any applicable Area Facility Plans and Technical Memoranda.

2. The criteria in **Table 4.2** will be used in estimating demands for water and accomplishing hydraulic design of the system.

Residential Population	N = number of dwelling units x 3.5
Residential: Average Daily Water Demand in Gallons per Day (gpd)	R = N x 100

Commercial and Industrial: Average Daily Water Demand (gpd)	C = Number of Commercial and Industrial Employees x 100 ***** *****Note: Appropriate additional water demand allowance shall be made for commercial and/or industrial establishments of types having water demands in excess of 100 gpd per employee
School: Average Daily Water Demand (gpd)	S = Number of Staff and Students x 20
Average Daily Water Demand (gpd)	A = R + C + S
Maximum Daily Water Demand (gpd)	M = A x 2
Peak Hour Demand (gpd)	P = M x 2
Peak Hour Demand in Gallons per Minute (gpm)	P / 1440

Table 4.2 – Demands

C. Sizing Transmission Mains

Public water mains of 10-inch or larger diameter are typically considered to be transmission mains. Design of transmission piping will be based on the Authority's current water utility master plan. Transmissions will be sized to ensure that velocities and corresponding head losses will not be excessive, under future conditions of high demand. Head loss in transmission mains shall be kept to less than 5 feet per 1000 feet of main.

D. Sizing Distribution Mains

Water mains of 8-inch, 6-inch, and 4-inch diameters are considered to be local distribution mains. Design of distribution mains will be based upon providing flows and service pressures in accordance with these standards from the supply design gradient (HGL) furnished by the Authority. Hydraulic design of distribution piping will be based on pipe carrying capacities consistent with head losses determined in accordance with Table 4.3.

Where a main is to be extended, it will be continued in like diameter, except where it can be shown that a lesser diameter will provide adequate pressures and flow, in accordance with these standards, to all lands and future development that might be served by that main, without the need for increased diameter downstream.

In accordance with the *Waterworks Regulations* 12-VAC5-590-1120 the minimum pipe diameter where fire protection is to be provided is 6-inch. Where system is to be extended without fire protection, 4-inch main shall be used. No fire hydrant will be supplied by a 4-inch main. Not more than one hydrant shall be located on any 6-inch dead end main and said hydrant shall not be located more than 300 feet from a looped main.

Pipe Diameter	Hazen-Williams Coefficient "C"
4 inch or 6 inch	100
8 inch or 10 inch	115
12 inch or greater	120

Table 4.3 – Friction Loss

E. System Layout

1. Redundant Supply

   a. More than one extension from the existing system is typically required to serve a planned development, subdivision, or large site. This requirement ensures the reliability of service, efficient transmission of fire flows, and may be used to reduce the water's detention time, thereby promoting water quality. Single supplies will be considered in need of reinforcement when serving more than 40 homes or 4 commercial establishments. For all commercial, medical, institutional, or industrial establishments with a heightened need for reliability of service, a redundant supply will be required.

   b. The maximum length of permanent dead-end water mains is 1000 feet. Where possible, water mains shall be looped to eliminate dead ends, thereby promoting water quality, adding reliability of service, and efficiently conveying fire flows.

F. Hydraulic Models

When requested, hydraulic models will be submitted to the Authority for review. The following are minimum requirements for all models submitted.

1. Provide a written model summary, area map, along with an electronic copy of the model for review. Identify the computer modeling software used to create the model. Submit all related database files to ensure the model will import into WaterGEMS software Version 8, or the Authority's latest software.

2. Provide a map showing pipe network. Label all pipes, nodes, road names, north arrow, scale, number of units, unit type, demands, elevation contours, and where applicable, the phasing of the project.

3. Demonstrate that the development(s) can meet the following demands: average day, maximum daily, peak hour, and maximum daily plus fire flow, throughout development.

4. Model must represent the entire development, including each planned sequence of phases. Each phase of the development must be hydraulically adequate. The model must support the desired phasing in the order that construction will occur.

5. Neighboring developments and system demands must be included in model to accurately represent system pressures.

6. Identify model assumptions, including water source and calculated demands based on the number of units and the type of units in the development. Only one water source may be used to supply the model, except where two hydraulically independent sources exist.

7. State the required fire flow demands for each unit type and call out specific nodes that require different fire flow demands, such as a development of single family homes with a school; where the school requires a higher fire flow demand, the node needs to be identified.

8. Include a node report showing elevation, demand, hydraulic grade line (HGL), and pressure. A pipe report showing diameter, flow, velocity, length, and head loss must also be included.

9. Provide a conclusion of the model results identifying the nodes with the lowest pressure during the various scenarios.

4.3 Layout of Public Water Main and Appurtenances

A. Definitions

The term "Public Water Main" and "Water Main" shall mean a water main, which is owned and controlled by the Authority.

Where the term "Pipe" is used, the design criteria and installation requirements may be considered to apply to both Public Water Mains and "Water Service Connections", as these are defined at Section 4.5.

B. Plan View

1. Public water mains of 10-inch or larger diameter are typically considered to be transmission mains. Such mains are to be located in easements on private property, and are to be routed exterior to streets and pavements, crossing streets only where necessary. Service connections to theses mains are prohibited, except in accordance with Sections 4.5 B.8 and 4.5 B.9 of this chapter.

2. Public water mains of 8-inch and 6-inch diameters are considered to be local distribution mains, to which service connections may be made. These mains are typically routed within streets and pavements, but may also be located in easement on private property.

3. 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.

4. Encumbrance of preexisting pipes for future access and/or re-excavation will not be permitted. Any necessary relocation of existing water facilities due to development is the responsibility of the Applicant, and will be replacement in kind, in the form of a new, parallel facility. Where grading is to occur, see Section 4.3 C.3 for limitations.

5. The maximum curvature by joint deflection for water mains equal to or less than 12-inch diameter is a 300-foot radius arc (3.5 degrees/joint with 18-foot pipe sections). For mains larger than 12 inches, the maximum curvature by deflection is a 500-foot radius arc. Where a restrained joint piping system is specified, consult manufacture's recommendation for maximum joint deflection.

6. Fittings and blockings should not be placed atop other utilities to avoid placement in disturbed ground.

7. Separations

   a. Provide a minimum 10 foot horizontal separation (outside to outside) with sanitary sewers, including manholes.

   b. Reduced separation with sanitary sewer will be considered in unusual situations, subject to the limitations established in the Waterworks Regulations 12 VAC 5-590-1150 B.2.

   c. Provide a minimum 6 foot horizontal separation (outside to outside) with storm drains and drainage structures, duct banks, communications or electrical vaults, and with other underground utilities or structures.

   d. For water main with 5 feet of cover or less, provide a minimum 10-foot horizontal separation to a building or other above-ground structure. For deeper water main, provide a minimum of 15 feet of separation.

   Where water main passes adjacent to a building, the design will ensure that water main can be excavated for repair or replacement, without undermining the building's foundation. Provide sectional views of the building's loading plane. For proposed buildings, provide clear specification on the site plan, stating the highest elevation at which the foundation will bear.

8. Street Design

   a. In public right of way, placement must be in accordance with current requirements of the Virginia Department of Transportation.

   b. Where future roadway improvements have been designed, or future limits can be reasonably anticipated, locate water main outside the ultimate right of way.

   c. Along median divided roads, water mains will generally be located exterior to right of way, in easement on private property.

   d. Along undivided roads, water mains will be installed under the pavement, a minimum 5 feet from the outside edge of pavement or gutter pan (7 feet from the face of standard curb and gutter). Where the pavement width is 24 feet or less, 3-foot horizontal separation from the gutter pan is permitted, if needed to attain separation from sanitary sewer. Generally centerline of water main should be located 8 feet off the centerline of subdivision streets, with sewer on the opposite side of street, resulting in the required 10 foot separation (outside to outside).

e. Where located with sanitary sewer in curved streets, locate water on the outside of prominent turns. Such is intended to foster separation with sewer while minimizing the number of sanitary sewer manholes, and to provide undisturbed ground for the blocking of water bends.

f. Keep the water main on one side of the street as much as practical, crossing only where necessary to provide needed branches or where imperative for attaining separations with other utilities.

g. Where water main is within the right of way, it is to be under a travel way or lane of the road. Placement in median, shoulder, pedestrian trail, or other green space is strictly prohibited. This is due to the maintenance concerns that arise from encumbrance of such spaces by other utilities.

h. In easements on private properties, water main may be located under pedestrian trails with asphalt surface. Placement under concrete sidewalk is typically prohibited.

9. Surface Water Crossing

Where water main is to cross a natural stream or large engineered drainage channel, the water main is to be designed so as to ensure its integrity during flooding. A restrained joint piping system may be employed. Use of steel casing may be considered as a protection measure. Provide valves to allow for the segment to be isolated, and a hydrant (preferably low in segment) to enable the segment to be flushed and tested. These appurtenances are to be beyond limits of 100-year floodwaters.

Concrete encasement of water main crossing a watercourse or drainage channel is not typically employed, since such treatment of main obstructs repair or replacement.

Above grade crossing of a watercourse by means of piers or bridge attachment is prohibited. However, should the Authority determine, at its sole discretion, to employ an above grade crossing, the design will provide the water main with protection from freezing, pursuant to the Waterworks Regulations 12-VAC5-590-1180. A.2.

10. Future Extensions of Main

a. Where deemed appropriate by the Authority, to allow for the extension of the public system to other properties, or for the future installation of planned facilities, easement for future main must be conveyed, extending to the site or subdivision boundary. Associated temporary construction easement may also be needed, as dictated by the anticipated scope of the future installation.

b. No appurtenances will be provided for anticipated future mains, unless in the sole discretion of the Authority, sufficient basis of design exists. Where sufficient certainty does not exist, pipe is to be left without appurtenances, for subsequent tapping.

c. Where the Authority determines that a future extension is practical, desirable, and likely, a spur of main will be installed. This spur is to be constructed to the limits of the area being developed, and shall be terminated in a location from which it can readily be extended in the future. This will be beyond the limits of proposed pavements, past

adjacent buildings, and beyond crossing storm drains, ducts, or other utilities that would otherwise be undermined during subsequent water installation. Provide a spur, terminating in a valve, line anchor, and temporary blow-off.

d. In cases where the future continuation of the distribution system will complete a loop, necessary to support the subject project, continue the water main to the site or subdivision boundary with current construction.

11. Future Service Connections

No appurtenances will be provided for anticipated future service connections, unless in the sole discretion of the Authority, sufficient basis of design exists. Such basis must establish with certainty the size of service, and exact horizontal and vertical location of the service line and meter, so that they will correspond correctly to the future development condition.

12. Hydrants

See Section 4.4 of this chapter for guidelines on hydrant placements.

13. Valves

Valves shall be installed at appropriate points in all public water mains to permit interruption of flow to segments of the system, as needed to facilitate operation, maintenance, and repair. Where two mains intersect at a tee, provide a minimum of two valves. At a cross, provide a minimum of three valves. Provide additional mainline valves as necessary to accomplish the segmenting criteria listed below.

a. Valves shall be arranged to isolate no more than 15 connections of single-family detached units, or 25 connections of townhouses.

b. Valves shall be provided so that no more than two commercial or multifamily buildings are served from the segment. Where the reliability of a service is of particularly high importance, a full cluster of valves may be specified at the water service connection.

c. Within subdivisions, provide valves to allow segments across private lots to be isolated.

d. Provide a valve on each side of a surface water crossing.

e. Provide valves in all mains to establish maximum 1500-foot segments.

f. Locate valves within paved area where possible. Locate valves with other appurtenances and/or with fittings to the greatest practical degree. Valves must be placed where they are practical for maintenance staff to access and operate, and where not subject to obstruction by parked vehicles. Do not locate valves within pedestrian paths.

g. Where extension from existing water main is proposed, show on construction plans the locations of existing valves and hydrants requiring operation.

h. Where determined by the Authority that it is necessary to avoid service outage to customers, specify that an insert valve be installed while the water main remains in service.

14. Air Release/Vacuum Breaker Valves

a. Major high points of mains shall be provided with automatic air release/vacuum breaker valves, to allow for the release of accumulated air. On transmission mains, a hydrant will also be specified.

b. Hydrants are to be specified at or near minor high points of mains.

15. Temporary Blow-off Assemblies

a. Blow-off assemblies are to be used only as a temporary terminus of main, where such has been determined appropriate in accordance with Section 4.3 B. 10 above. No other purpose for this device is acceptable.

b. Where a spur of main with temporary blow-off exists within a development area, it is to be extended so as to accomplish permanent termination by means of a hydrant assembly.

c. Where a blow-off assembly is to be used, specify a corresponding mainline valve, located immediately upstream of the assembly. This is needed to enable the subsequent extension to be isolated for disinfection and testing. Where a fittings cluster upstream of the blow-off contains a valve to control flow to the blow-off, this valve may be considered sufficient, if it is within some 100 feet of the blow-off, and provided that there is no intermediate service connection or appurtenance.

d. In determining the location of a blow-off assembly, consider the spatial requirements of the line anchor within the blow-off assembly.

e. In accordance with the Waterworks Regulations 12-VAC5-590-1130C and 12-VAC5-590-1160B, no flushing device shall be directly connected to any sanitary or storm sewer.

16. Provisions for Sampling of New Main

The Waterworks Regulations require that new mains undergo bacteriologic testing in segments not to exceed 1200 feet. Samples can be collected from a hydrant, temporary blow-off, or air release. Each design must make provisions accordingly. Designers will consider this requirement in selecting hydrant locations.

17. Steel Casings

Casing will be specified where trenchless installation of water pipe is to be made. Casings will also be required where, in the opinion of the Authority, such is needed to accomplish the following:

a. protect the water pipe from freezing, superimposed loads, or impact. Examples are at surface water crossings or large culvert crossings.

b. protect the public in the event of a water main break.

c. enable future access to the water pipe, where re-excavation would not be practicable.

d. to facilitate a future installation of water pipe.

Where conditions necessitate a trenchless installation by tunnel, make method and material specifications, using bolted liner plate in place of casing.

18. Miscellaneous

a. Water mains not in public right of way or pavement way shall be installed with markers according to G-16 MARKER POSTS AND TRACER PEDESTALS of the *Standard Details*.

b. Landscape features including trees, shrubs, walls and monuments are not permitted within the Authority's easements.

C. Profile

1. Where other utilities are proposed in proximity to an existing water main, test pits may be required by the Authority as basis of design, to ensure adequate clearances, and viability of the design.

2. Where water main is proposed in the proximity of existing utilities, test pits may be required as basis of design. At the Authority's discretion, these test pits may be deferred to after the approval of the design, provided that test reports are submitted to the Authority for review in advance of the Construction Permit being issued. If test pit results render an approved design invalid, a revision will be submitted for review and approval, prior to issuance of the Construction Permit.

3. Where changes to finished grade are proposed above an existing pipe, a profile of the line shall be provided. Resulting cover on the water main will be considered excessive if more than 6 feet. Limited segments with resulting cover up to 8 feet may be approved, if no service connections are within the segment. Covers of more than 8 feet are not acceptable.

4. Where pipes are to be located within paved areas, specify a minimum cover of 3.5 feet. Specify a minimum cover of 4 feet for all mains to be located outside of pavements. Provide additional cover where pipe passes below rip rap or is susceptible to extraordinary loadings.

5. Where passing below rip rap, water main must have 2.5 feet of clearance below bottom of rip rap mat.

6. On water profile, show all crossing utilities. Specify required minimum clearances from all pipes and ducts. Crossings shown in profile must account for thickness of pipe walls and be based on the computed design clearances.

7. Where a hydrant comes off the main, provide at least 4 feet of cover on main. This is necessary to allow a minimum 5-foot hydrant to be set.

8. Where an air release is specified, the profile of the main must provide at least 5 feet of cover. This is necessary to accomplish the stack-out of the structure, in accordance with W-4, AIR RELEASE of the *Standard Details*. If the device is to occur within a pavement, such that a flat top manhole cannot be used, provide additional cover. The associated tee and tapped plug in main should be called out on the profile.

9. Water pipes crossing sewers (including building sewers) shall have a separation of at least 18 inches between the bottom of the water and the top of the sewer. Water should cross above sewer wherever possible.

10. Where local conditions prevent a vertical water/sewer separation described above and water pipe passes under sewer, the following protection shall be provided subject to approval by the Authority.

    a. Provide vertical separation of at least 18 inches (outside to outside) between the bottom of the sewer and the top of the water.

    b. Provide adequate structural support for the sewer to prevent excessive deflection of the joints and settling over the water.

    c. A full section of the water pipe shall be centered at the point of the crossing so that joints shall be equidistant from the sewer.

    d. Sewer must be made of PVC pipe conforming to AWWA C900/905, pressure tested in place, and exhibiting no leakage.

11. Label clearances with all utilities.

12. Provide a minimum vertical clearance of 1.5 feet with other utilities. If water is atop other utilities, this requirement may be relaxed to as little as 0.5 foot, if such is critical to maintaining water's position on top. If absolutely necessary, reduced cover on water main will be considered, but in no case will this result in a cover of less than 2 feet.

13. Do not route water main below concrete encased duct bank. Design duct systems with sufficient cover to allow water to pass above duct.

14. If the water main will cross under a storm drain 48 inches or larger in diameter, investigate routing around the drain. Crossing below such storm sewers is discouraged. Where no viable alternative for rerouting exists, install water main in steel casing.

15. Specify controlled fill wherever the water pipe will be above the existing grade.

16. Vertical alignment (curvature) of proposed water main shall be designed to be attainable, within the allowable joint deflection of the pipe.

    Where vertical bends are required, specify these bends on profile, with the limits of restrained joint piping in accordance with G-11, RESTRAINT OF VERTICAL OFFSET of the *Standard Details*, and with **Figure 4.1** and **Table 4.4** below. Stations at which restrained joints are to begin and end are to be called out on water main's profile. For mains 16-inch and larger, locking gaskets are not an acceptable means of restraint. For these larger mains, the applicable specification is "restrained joint piping system per the Loudoun Water *Approved Materials List*.

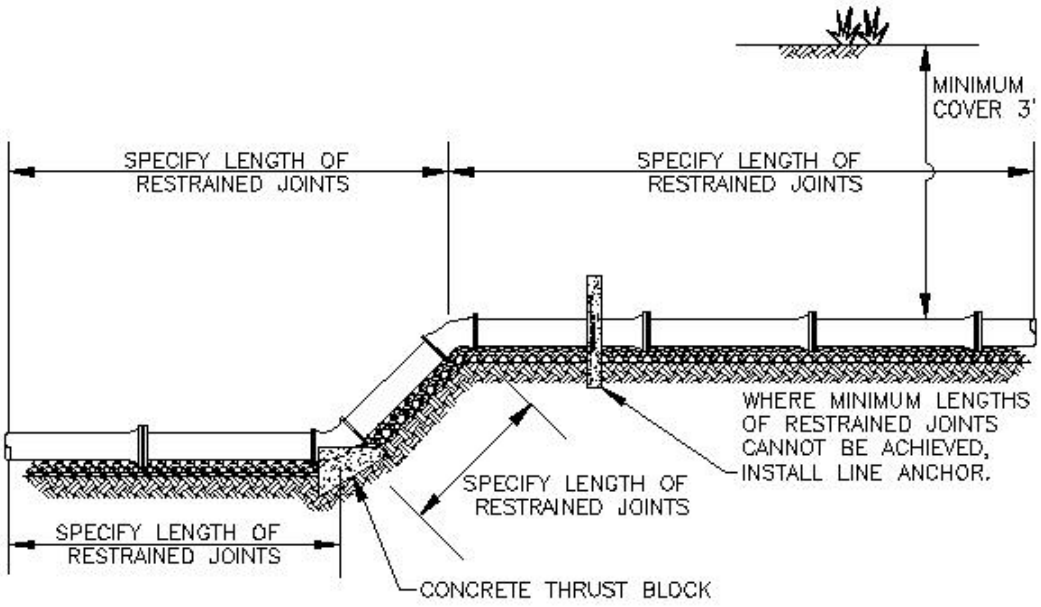


Figure 4.1 – Restraint of Vertical Offset

Ductile Iron Pipe – No Polyethylene Encasement				
Vertical Bend	Diameter of Water Main (Inches)			
	6	8	10	12
upper 11 1/4°	3	4	5	6
lower 11 1/4°	1	2	2	2
upper 22 1/2°	6	8	9	11
lower 22 1/2°	2	3	3	4
upper 45°	12	16	19	22
lower 45°	4	5	6	7
Ductile Iron Pipe – With Polyethylene Encasement				
Vertical Bend	Diameter of Water Main (Inches)			
	6	8	10	12
upper 11 1/4°	9	11	13	15
lower 11 1/4°	2	2	2	3
upper 22 1/2°	17	22	26	30
lower 22 1/2°	3	4	4	5
upper 45°	34	45	53	63
lower 45°	6	7	9	10

Table is based on bedding conditions per G-6, PIPE BEDDING AND ENCASEMENT of the *Standard Details*, a minimum cover of three feet on upper bends, a minimum cover of four feet on lower bends, a test pressure of 150 psi, and a safety factor of 1.5.

Table 4.4 – Minimum Restrained Lengths (Feet)

Should the design involve conditions beyond those used as basis of **Table 4.4**, the designer must calculate distances of restraint. Refer to *Thrust Restraint Design for Ductile Iron Pipe* published by the Ductile Iron Pipe Research Association (DIPRA) for a full discussion.

17. Where water main is located within steel casing, specify a restrained joint piping system, as listed in the Loudoun Water *Approved Materials List*.

18. The Authority requires that all pressurized pipelines be restrained with concrete reaction blocking at ends and changes in direction. Design will locate bends and termini in undisturbed soil if possible. Where conditions are such that reaction blocking would be too large or otherwise infeasible, design may allow for thrust forces to be counteracted over a wider soil area, through the use of joint restraint. Joint restraint specifications may also be made to ensure that pipe does not separate due to settlement of deep fills, in backfills, at creek crossings, in slopes of 20% or more, or where subject to surrounding soil being compromised during future excavation. Where main is being adjusted by parallel replacement, restrained joints may be specified to facilitate pressure testing, and expediency of tie-in work.

D. Easements

1. For public water mains, provide easements with widths no less than those listed in **Table 4.5** below.

Location	Minimum Width (feet)
within a private street, travel way, or other pavement	10
traversing common area of a subdivision or open area of a site plan	15
traversing an undeveloped property or area	20
along the boundary of a lot in a subdivision	20
where passing between or adjacent to buildings	20*

* Where more than ten feet of separation from a structure is required, pursuant to Section 4.3 B. 8. d. or Section 4.3 B. 8. e., provide easement to the limit of the required separation.

Table 4.5 – Easement Widths

2. Where water main runs along the lot line within a subdivision, locate water main a minimum of 3 feet off of the parcel boundary. Where main parallels such a lot line, the water easement will typically straddle the parcel boundary, so as to enable The Authority to work using both lots. The water main must be placed at least 10 feet interior to the easement, but need not be centered in its easement.

3. Provide 10-foot wide easement on each hydrant branch.

4. Service line and meter shall be placed within an easement of at least 5 feet in width.

5. No easement shall be placed on a fire service line.

6. Where proposed construction is across land of others, temporary construction easements will be established in sufficient widths to accommodate the work area.

7. Provide access easement with adequate grading to allow vehicular access. Where proposed water main is to pass out of street and between or behind homes or buildings, ensure sufficient access to enable operation, repair, or replacement of water main. Where development is to occur on land occupied by a preexisting water main, ensure that access to the water easement is maintained, and not cut off by proposed grading or improvements.

8. Easement plats and instruments shall be reviewed and executed according to the procedures found in Appendix C of this Manual.

9. Should water main, water service connection, or meter be installed outside the boundaries of the recorded easement, a Deed of Easement and Vacation with accompanying plat shall be prepared, approved, and recorded, so as to establish easement at the as-built locations.

E. Corrosion Control

1. Proposed water mains shall be evaluated to determine the need for corrosion control measures. Requirements and guidelines for this evaluation, as well as the design, installation, and acceptance testing of corrosion controls may be found in Appendix E of this Manual. Design will incorporate applicable selections from Loudoun Water's current *Standard Details* and the *Approved Materials List*.

2. Evaluation to determine the need for control measures will be based on these factors.

   a. corrosiveness of soil

   b. consequences of failure, including impact to maintaining service and relative difficulty of repair

   c. susceptibility to stray currents

3. Where water main is within 100 feet of a steel gas main or other electrically continuous metallic pipeline with impressed current, or upon which impressed current may be later added, design will specify measures to prevent corrosion of the water main. PVC DR14 (AWWA C900 or C905) pipe may be selected by the Authority. Alternately, the water main may be ductile iron with full passive cathodic protection system.

4. Where water main crosses or is adjacent to high voltage power transmission lines, proposed water main must be evaluated for the potential for induced alternating current.

5. Corrosion control may be required for steel casings.

F. Miscellaneous

1. Ensure complete and accurate pipe stationing in plan and profile views. Call out all appurtenances by station on the profile.

2. Water sampling stations shall be located as directed and shall be constructed in accordance with W-22, SAMPLING STATION of the *Standard Details*. In new subdivisions and developments, provide one sampling station for every 400 service connections. Station should be located upstream of the customers' connections that it serves. Place stations where readily accessible for flushing and collecting samples, and where flushing water will readily drain into the storm water collection system. Sampling stations are to be located where not subject to damage by vehicles. Provide easement of same dimensions as for water service with meter.

3. Where water pipes are to be abandoned, specify that pipes be removed and associated easements vacated. Where specifically approved by the Authority, abandoned pipes may be left in place. Such abandonment in place will be considered based on field conditions. Re-excavation may be determined impractical, due to such factors as depth relative to surrounding buildings, roadways, or utilities. However, preference will be for full removal, so as to release the Authority from the permanent obligation to locate and mark its abandoned facilities. Where water main is to be abandoned in place, the end shall be covered with an MJ cap. All appurtenances such as hydrants, valve boxes, air releases, and meter boxes or vaults will be removed.

4.4 Hydrants

A. Plan View

1. Hydrants along the main shall be designed and installed according to W-10, FIRE HYDRANT ALONG STREET, or W-11, FIRE HYDRANT BEHIND DITCH of the *Standard Details*. The associated tee and auxiliary branch valve must be shown in plan view and called out in profile. No service connection or branch of main shall come off between the hydrant and its auxiliary valve.

2. Each permanent termination of water main must be by means of a fire hydrant. Such dead end assemblies are to be designed and installed according to W-12, DEAD END HYDRANT of the *Standard Details*. No service connection or branch of main shall come off between the hydrant and its auxiliary valve.

3. Hydrants are to come off the main by means of a tee and branch valve, or as a dead end assembly. Hydrants shall not come off the main at a cross.

4. In one- or two-family residential areas, hydrants shall be installed such that there will be at least one hydrant within 300 feet of the nearest corner of any building.

5. In commercial, industrial, multi-family residential and townhouse areas, hydrants shall be placed such that a maximum of 300 feet of hose is required to reach any point on the exterior of all buildings.

6. A hydrant is required within 100 feet of the siamese connection, also known as fire department connection (FDC), of a building's fire suppression system.

7. Locate hydrants a minimum of 50 feet from building being protected.

8. When locating dead end fire hydrants ensure adequate space is provided for appurtenances upstream of hydrant. See **Figure 4.2** below for dimensional requirements.

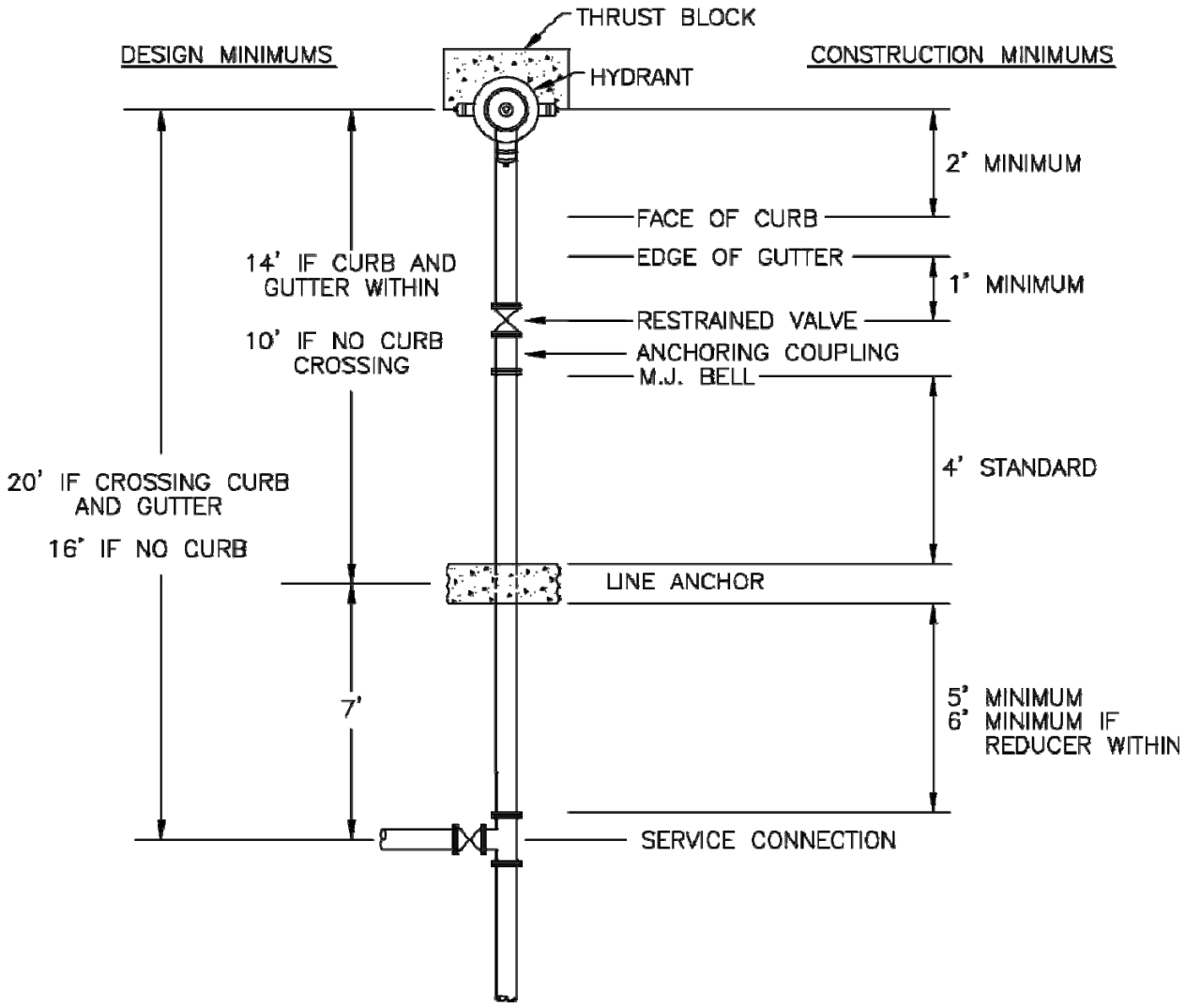


Figure 4.2 – Dead End Hydrant Assembly

9. Where spatial constraints preclude the dead-end assembly with line anchor, and where the main can be deflected by 90°, an anchoring tee and M.J. plug may be specified, occurring immediately upstream of the auxiliary valve. In conjunction, specify the use of restrained joint pipe or push-on pipe with locking gaskets, for 60 feet upstream of the anchoring tee.

10. No more than one hydrant is permitted on a dead-end 6-inch water main.

11. At stream crossing, place one hydrant to enable draining, sampling and flushing of the segment between required isolation valves. Position hydrant as low in segment as practical, while keeping away from bed and banks of the natural water course.

12. Along mains, provide hydrants at intervals not exceeding 1500 feet.

13. Along ditch and shoulder roadways, where water main is near the edge of pavement, fire hydrants are typically placed on the opposite side of road from the water main. This enables the auxiliary valve to occur in pavement, as it must not occur in the shoulder.

14. Locate hydrants a minimum of 2 feet behind the face of curb and in straight segments of curb as much as practical. The distance behind the face of curb may be increased at the Authority's discretion where roadway design speed is 45 miles per hour and greater.

15. Provide a minimum separation of 5 feet between a hydrant and any driveway. Additional separation is desired.

16. Hydrants shall not be placed in area of concrete pavement.

17. Specify bollards where hydrants are unprotected by curb and gutter, placed in open space or at the rear of commercial/industrial buildings.

18. Where an existing hydrant must be relocated, specify that a new hydrant be provided at the new location. Where tee may remain to serve hydrant at new location, the auxiliary valve must be replaced, if the existing valve does not hold test pressure. Reinstallation of existing materials is not permitted.

19. Hydrants will be painted red. The Authority will repaint caps using color indicating the available volume of flow at the installed location.

B. Profile

1. In establishing the elevation of main, and placement of hydrants, consideration must be given to the profile of branching hydrants. Ensure adequate cover on hydrant branch. Avoid taking hydrants from deep main. Where another utility crosses a hydrant branch, provide profile of hydrant branch and specify clearance.

2. To facilitate release of air, fire hydrants are to be placed at high points of mains. See Section 4.3 B. 14 concerning air release/vacuum breaker valves, which will be used in conjunction with hydrants at major high points.

3. To enable the draining and flushing of all mains, specify fire hydrants at significant low points.

4. Ensure that hydrants leave the main where depth of main will enable a proper hydrant setting, in accordance with the following limitations on hydrant barrels.

   Acceptable hydrant heights are 5 feet, 6 feet and 7 feet (measured from the invert of the hydrant's inlet to the finished grade). Use of 4-foot hydrants is typically prohibited.

Therefore, where a hydrant comes off the main, provide at least 4 feet of cover on main. This is necessary to allow a minimum 5-foot hydrant to be set.

Maximum height of a fire hydrant is 7 feet. Wherever practical, select a hydrant placement that will allow for installation of a 7 foot hydrant or shorter. For deeper mains, a vertical offset in the hydrant's lead is to be specified in accordance with G-11, RESTRAINT OF VERTICAL OFFSET of the *Standard Details*. Such offsets should be designed to allow placement of a standard 5-foot hydrant. Provide profile of any hydrant lead with an offset.

Use of barrel extensions is discouraged, and where site-specific permission is granted, will be limited to a maximum of one extension.

C. Miscellaneous

1. Landscaping, trees, signs and light poles are not permitted within 5 feet of a hydrant.

4.5 Water Service Connections and Meters

A. Definitions

The term "Water Service Connection" includes the corporation stop or fittings at the main, by which the water service is joined to the Public Water Main; the service from the Public Water Main to the meter; and the meter with its box or vault.

The term "Building Service Pipe" shall mean the extension from the end of the Water Service Connection to the inner face of the building wall.

Design criteria and installation requirements that refer to "Pipes" may be considered to apply to Water Service Connections, as well as to Public Water Mains.

B. Water Service Connection

1. A separate water service connection to the public water main is required for each premises, as the term "premises" is defined in the *Rules and Regulations*. However, the Authority may, at its sole discretion, allow a group of premises to be served through a common water service connection. In this case, there must be a management entity that will be responsible for the account and for maintenance of the associated building service pipe and indoor distribution system.

2. Each building, for which a service connection is made, must have adequate hydrant coverage, as defined in these Standards.

3. The main, to which a building's service connection is to be made, must be on the same parcel of land as the building, or be in a right of way or easement directly adjoining that parcel. Where such is not the case, the applicant for service will be required to extend the public main to the parcel to be served.

4. No two-service connections may serve the same plumbing distribution, unless the second service is separated from that distribution by an air gap.

5. Where a building contains both residential and nonresidential uses, separate service connections, building service pipes, and distribution systems within the building are required for the respective uses.

6. Where more than one water service connection, building service pipe, and distribution pipe is to be within a building; each such distribution must drain to a corresponding, independent system of drain, waste and vent; building sewer; and sewer service connection.

7. At multi-family structures, where the building service pipe serves more than one dwelling unit, that service pipe shall enter through a mechanical room. Where the associated meter is 1.5-inch or larger, a backflow prevention device is to be housed in this mechanical room, to accomplish the required service protection.

8. Service connections shall not come off mains with reduced cover, or off deep mains.

9. Service connections on commercial, industrial and institutional sites must be profiled to the meter. Where meter is to be indoors, the entire building service pipe must be profiled.

10. Vertical curvature of 1.5-inch and 2-inch water service connections must be moderate, due to the fairly rigid nature of large tubing.

11. Provide a minimum 6-foot horizontal separation with sanitary laterals.

12. Provide a minimum 5-foot separation with driveways.

13. Provide a minimum 5-foot separation between water service connections along the main.

14. Services of 1-inch diameter are typically connected to the main with a corporation stop. Where 1.5-inch and larger services leave the main, the connection shall be by means of a mainline anchoring tee, minimum 6-inch branch valve, and a tapped MJ plug. On nonresidential sites, 1-inch services may connect by means of such a tee and branch valve, to reduce the chances of service outages on the site, and to make provision, in the event that a larger service is desired in future.

C. Metering and Meter Placement

1. The Authority employs the Badger Recordall line of water meters. The operating characteristics of these meters can be found at the Badger website: BadgerMeter.com. **Table 4.6** below lists the available sizes, types, locations, and respective service line sizes.

2. All meters are to be located outdoors in underground box. The location of outdoor water meters shall be shown on the plans. Call out meter size and model number, as listed in **Table 4.6**.

3. All single-family homes and townhomes are served with a ¾ x 5/8 inch meter. For all other applications, the size and name of meter must be clearly specified on the site plan.

4. For proper placement and requirements of the meter box, see the standard detail applicable to the selected meter.

5. The meter box is to be located immediately behind the curb and as close as possible to the main. For meters of 1-inch and smaller sizes, grass area must be at least 2 feet wide. For meters 1.5-inch and 2-inch, the grass area shall be a minimum of 3 feet wide.

6. Placement of meter boxes in the sidewalk or driveway is to be avoided, and will be approved only as a last resort. Where no adequate unpaved space is available, such that meter box must be installed in a pavement or sidewalk, and meter is 1-inch or smaller, specify a frame and cover for "special applications", as established in the Loudoun Water *Approved Materials List*. This type of frame is made for embedment in concrete or bituminous pavement. For meters 1.5-inch and larger, the standard frame and cover may be embedded if necessary. Installations in concrete are to be made according to W-25, WATER METER IN SIDEWALK OR SLAB of the *Standard Details*.

7. If water meter must be placed over storm sewer, there must be a minimum 5-foot cover on the storm sewer.

8. For services requiring instantaneous delivery of 140 GPM or more, a turbine or compound meter will be employed. Such a meter must be installed in flanged iron pipe with straight section before and after the meter. These meters shall be located in an outdoor vault. Plans must specify the meter's location and provide appropriate detail. Should an indoor setting is allowed by the Authority, the service shall be an independent, privately owned branch from the Authority's main, constructed of ductile iron with a restrained branch valve (minimum 6 inches in diameter) at the main.

9. For all services with meters 1.5-inches and larger, provide an approved backflow prevention device to accomplish the required service line protection. There devices are to be located in the building's mechanical room, within the service entrance. This requirement shall be noted on the site plan.

10. Landscaping is not permitted within 5 feet of the meter box.

D. Sizing Meters

All single-family homes and townhomes are served with a ¾ x 5/8 inch meter. For all other applications, provide documentation supporting the size of each water service connection and water meter. Supply a letter from the mechanical engineer stating the design flows or supporting calculations using fixture supply units (Appendix E of the current *International Plumbing Code*), or other appropriate method of estimating demand. Identify irrigation demands and other flows not returning to sanitary sewer.

Best available estimates of demands, initial and future, are critical as basis of design for the service(s) and meter(s). It is advisable to discuss the available options for service and meter sizing, location, and configuration with the Authority's Engineer. Various

configurations for metering are possible. Metering may also be specified to measure flows that do not return to the sanitary sewer, so as to avoid unnecessary sewer service charges.

The Authority will determine the appropriate size and type of meter, in consultation with the owner and owner's mechanical engineer. **Table 4.6** below lists the available sizes and types. Where the demand could be accommodated by various meters, the characteristics of the demand will be taken into consideration, and the Authority will select the appropriate type of meter to best capture the usage over the range of flow rates. Where they offer adequate capacity, disc meters will typically be used. In special application requiring particularly large or prolonged high flows, turbine meters will be used. A compound meter will be considered where lower rates of flow need to be recorded, but flows in excess of 140 gallons per minute must be delivered. The operating characteristics of these meters can be found at the Badger website: BadgerMeter.com.

Meter Size (inches)	Model	Type	Maximum Flow (gallons/ minute)*	Water Service Connection (inches)**	Standard Detail
5/8	M25	disc	20	3/4	W-23
3/4	M35	disc	30	3/4	W-23
1	M70	disc	50	1	W-23
1-1/2	M120	disc	100	1-1/2 or 2	W-27
2	M170	disc	140	2	W-27

* Intermittent flows moderately in excess of this maximum may be accommodated. See technical briefs from Badger for head losses.

** Downstream of meter setting, service size may be maintained, increased, or decreased, in accordance with the plumbing's design.

Table 4.6 – Meter Types, Capacities, and Service Connections

E. Fire Service

1. The service to a fire suppression system must branch off the public water main independently of other service demands. Where it leaves the main, the fire service shall include a valve of a minimum 6 inches in branch diameter. This valve shall be restrained to the tee.

2. A separate fire service connection is required for each premises, as premises is defined in the *Rules and Regulations*.

3. Fire service connections shall be downstream of domestic service connections where located on dead end main.

4. Fire services are not metered, and are to be installed according to W-20, FIRE LINE, of the *Standard Details*. A backflow prevention device is to be provided in the building's fire service entrance.

5. Provide profile of fire service from main to building.

6. Where a limited fire suppression system is to be supplied by a branch of the domestic water service, a backflow prevention device is to be installed, as required by the International Residential Code. This device must be testable. Dual cartridge checks do not meet this requirement. A double check-valve assembly or reduced pressure principle device is required.

F. Cross Connection and Backflow Prevention

1. An approved backflow prevention device is required at the service entrance of all buildings in multifamily residential, commercial, industrial, or institutional use. The back flow prevention device must be certified by ASSE or CSA. Installation and testing shall be in accordance with the *International Plumbing Code* (currently including Sections 312.9.2, 608.2, 608.3), the *Virginia Waterworks Regulations* Section 12VAC5 590-590, and the Authority's *Cross Connection/Backflow Prevention Program*.

2. Where water is supplied to fixtures or systems deemed high hazard, the device providing service line protection is typically required to be one using the reduced pressure zone principle. High hazard fixtures and systems are associated with the following facilities, among others:

   a. multi-use commercial, office, or warehouse facilities

   b. high rise buildings (four or more stories)

   c. lawn sprinkler systems and irrigation systems

   d. fire suppression systems with chemical additives

   e. hospitals, mortuaries, clinics, veterinary establishments, nursing homes, and medical buildings

   f. laboratories, and schools or colleges with laboratory facilities

   g. sewage treatment plants, sewage pumping stations or water pumping stations

   h. food and beverage processing plants

   i. health clubs with swimming pools, therapeutic baths, hot tubs or saunas

j. metal plating industries

k. petroleum or natural gas processing or storage plants

l. car washes and laundries

m. pesticide or exterminating companies, and associated vehicles with storage or mixing tanks

n. farms where water is used for purposes other than typical household use

o. commercial greenhouses and nurseries

3. As required by the *Virginia Waterworks Regulations* Section 12VAC5 590-590, The Authority will inspect new buildings that will receive our water service, and those of customers receiving continuing service, to ensure the adequacy of backflow prevention devices within the building's plumbing system. Branches serving certain fixtures must be fitted with the appropriate device for the application, as established by the *International Plumbing Code*. All backflow prevention devices that incorporate testing ports are to undergo initial and annual testing by a technician, certified to conduct such testing. Where the device is found to be less than fully effective, it shall be repaired or replaced at once. Test reports must be filed with the Authority, as a condition of the initial building occupancy, and annually thereafter.

4. Where a building's plumbing or industrial process piping is supplied with potable water by The Authority, and also incorporates an auxiliary supply, an air gap shall be provided between the building service pipe, and the subject plumbing or process piping. This will be the case where a well, cistern, or reclaimed water supply is used.

5. Where potable water is stored in a basin, tank, or reservoir that is open to the atmosphere, an air gap must be provided between the incoming potable supply and the storage vessel.

4.6 Installation Requirements

All water pipe and appurtenances shall be installed in accordance with best practice, with materials and workmanship of full quality. Materials and installation shall be in accordance with all applicable sections of American Water Works Association Standards. Installation shall conform to *AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances*, or *AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings*; with all manufacturers' instructions and recommendations; and the provisions of these Standards. The installing contractor shall be solely responsible for ensuring that appropriate and acceptable construction materials, means and methods are used. Reuse of previously installed materials is prohibited, except where specifically approved by the Authority.

A. Excavation, Bedding and Backfill

1. Prior to any clearing or excavation, all required sedimentation and erosion control measures shall be in place, as required by Clarke County and in accordance with the approved plans. As the work progresses, these control measures shall be properly maintained, and subsequent control measures shall be taken, all as required by Clarke County and in accordance with the approved plans.

2. The site of an excavation shall first be cleared of all lumber, stumps, trees, brush and rubbish, which shall be removed or disposed of in a satisfactory manner.

3. During excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not suitable and/or required for backfill shall be removed and disposed of in an approved manner. Such grading shall be done as may be necessary to prevent water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by approved methods. All excavations shall be made by open cut unless otherwise specified.

4. The width of the trench above the top of the pipe may be as wide as necessary for sheeting, bracing, and the proper performance of the work. All trenches in soil shall be undercut 6 inches below pipe invert. All trenches in rock shall be undercut 10 inches below the pipe invert. Minimum clearance between the side of the trench and the pipe shall be in accordance with G-6, PIPE BEDDING AND ENCASEMENT, of the *Standard Details*. Excavations at valve vaults and similar structures shall be sufficient to leave at least 12 inches clear between their outer surface and the embankment or sheeting. The trench shall be excavated to a uniform sub-grade as required for installation of pipe bedding material.

5. All trenches and excavations shall be properly sheeted and braced for the safety of personnel and protection of the work, to maintain the maximum trench widths permitted, and to prevent the disturbance or settlement of adjacent foundations or structures. When so required by the Authority, sheeting shall be left in place by cutting off no higher than 12 inches below the finished surface grade and no lower than 12 inches above the top of the pipe. The requirement of sheeting and/or bracing left in place shall not obligate The Authority in any manner.

6. Pipe to be installed in an embankment at elevations above the existing ground level shall be installed in trenches excavated after the embankment has been constructed to an elevation that is within 12 inches of finished grade. Embankment supporting the Authority's facility will be a controlled fill of suitable material or select material, as these are defined in the Virginia Department of Transportation's *Road and Bridge Specifications*. Fill shall be placed at a moisture content that is within 2 percentage points of optimum moisture, and compacted to a density of at least 95 percent of the maximum dry density, as determined by the Standard Proctor (AASHTO T99).

7. Where the soil at the trench sub-grade elevation is soft, unstable, or saturated with water, such unsuitable material will be removed and the trench sub-grade stabilized with appropriate material. The depth of stabilization shall be as required to construct a firm sub-grade for pipe bedding material. Maximum size of material shall be 6 inches in

longest dimension to within 6 inches of pipe invert, at which point specified bedding material shall be used.

8. Pipe shall be bedded from the trench sub-grade according to G-6, PIPE BEDDING AND ENCASEMENT, of the *Standard Details*.

9. All bends and elbows of 4-inch diameter or larger shall be installed with suitable concrete thrust blocks poured in place with the concrete deposited against firm, undisturbed earth, as indicated on G-7, CONCRETE THRUST BLOCK, of the *Standard Details*.

10. Backfill

    a. Backfill shall be placed promptly after inspection by The Authority.

    b. Backfill shall be placed in 6-inch layers from top of pipe bedding to a point at least 12 inches above the top of pipe. Above this point, backfill shall be deposited in lift thickness that permits compaction to a density as specified hereinafter.

    c. Roadway Areas:

        i) Within existing public rights of way, select backfill (VDOT 21A or 21B) may be required in place for suitable material. This requirement may be a condition of the Land Use Permit issued by the Virginia Department of Transportation. All requirements and specifications of this permit will govern the work.

        ii) Within private roadways, including the areas of future roads, suitable or select material per the VDOT *Road and Bridge Specifications* may be used. Where native material is not suitable, or cannot be placed within three percentage points of its optimum moisture, backfill must be imported.

        iii) Under all pavements and future pavements, the backfill shall be compacted to a density of at least 95 percent of the maximum dry density as determined by the Standard Proctor (AASHTO T99). Pavements shall not be restored over trenches until the backfill material has been tested and determined as satisfactory according to the tests.

    d. Open Areas:

        i) Beyond pavements and where structural backfills are not required, all material used for backfilling of trenches shall be free of excessive amounts of deleterious materials such as all organic matter, frozen clods, and masses of clay, which are difficult to properly compact. Any rock materials used for backfill shall be no longer than 4 inches in greatest dimension, and shall not be placed within 12 inches of the installed pipe in any direction.

        ii) The layers of material shall be compacted to a density of at least 90 percent of the maximum density, as determined by the Standard Proctor (AASHTO T99) wherever pipe is installed in open fields or areas which will not carry vehicular traffic. Where seed or sod is to be placed, the upper layer of backfill shall be composed of topsoil at least 6 inches in depth.

B. Acceptance Tests

1. Not more than 4,000 feet of public water main shall be installed without testing and sterilizing. The contractor shall not proceed with further installation until the preceding section has been approved by the Authority. Hydrostatic testing shall be conducted on segments not exceeding 2000 feet in length.

2. Hydrostatic testing shall be conducted according to the procedures established in AWWA C600.

   a. Test Requirements and Limitations

   Test pressure (as measured on the test gauge) shall not be less than 1.25 times the working pressure at the highest point along the test section, and not less than 1.5 times the working pressure at the location of the gauge. Minimum test pressure is 150 psi, corresponding to a working pressure of 100 psi. For mains that will operate at pressures in excess of 100 psi, The Authority will specify the working pressure.

   Fire service lines will be tested independently of associated public main. Test pressure shall be introduced through a tapped blind flange at the downstream end of the fire service, and test shall be against the branch valve at the public main. In accordance with the requirements of NFPA, test pressure is 200 psi. Contact the Fire Marshall for witness and approval of fire service installations and testing.

   The test pressure shall not exceed the pipe or thrust-restraint design pressures, or the rated pressure of any valves that are being used to isolate the segment under test.

   The hydrostatic test shall be of at least 2 hours in duration.

   Test pressure shall not vary by more than ±5 psi for the duration of the leakage test.

   Test setup shall include a provision for reducing the line pressure, without operating valves within the water main. Gauges shall be in good working order, and graduated in increments of 1 psi or less.

   b. Filling and Air Removal

   After the pipe has been laid and backfill completed, the segment to be tested shall be slowly filled with water. All hydrants, blow-off valves, and air release valves within the segment will be open during filling, and will be closed only once they deliver a solid stream of water. Once all hydrants and air release valves are closed, allow segment to stabilize at the pressure available from the water source, and bleed accumulated air from high points as necessary. Disconnect or close off water source, and leave off through hydrostatic testing. Where hydrants are within the test segment, the test shall be made against the main valve in the hydrant.

   c. Testing

   Apply test pressure using a pump and clean, chlorinated water. Allow pressure to stabilize, prior to beginning leakage test. Any exposed pipe, fittings, valves, hydrants

and joints shall be examined during the test. Any visible leakage will be considered unsatisfactory must be repaired, prior to continuing the testing.

The test result will be pass/fail, based upon allowable leakage. Should the segment under test be found to lose more than the allowable volume, repairs and/or replacement shall be made, and the work will undergo further testing until it attains passing results.

d. Allowable Leakage

Leakage is defined as the quantity of water that must be supplied into the section under test, to maintain a pressure within 5 psi of the specified test pressure. Leakage shall not be estimated from the pressure drop, but rather by measuring the quantity of water pumped into the pipe to reestablish the test pressure. No pipe installation will be accepted if the leakage is greater than that determined using this formula:

$$L = SD\sqrt{P}/148{,}000$$

Where: L = allowable leakage in gallons per hour

S = length of pipe being tested in feet

D = nominal diameter of pipe in inches

P = average pressure during the test in psi

This formula is based on an allowable leakage of 10.486 gallons/day/mile/inch of diameter at 150 psi.

3. New water mains will be disinfected in accordance with *AWWA C651 Disinfecting Water Mains*. Granulated chlorine or tablets are typically employed. On occasion, the Authority may approve the continuous feed or slug method of disinfection. All lines shall be thoroughly flushed through the blow-offs and/or hydrants provided in accordance with *AWWA C600* and *AWWA C651*. Water used will be estimated by the Authority and its cost charged to the developer.

4. The Authority will sample for cleanliness and sterilization of the water main before permitting connection for service. Prior to sampling, all mains shall be flushed, with all valves and hydrants being operated during flushing. Best practice is to discharge between 2 and 3 pipe volumes. Two consecutive, satisfactory bacteriological samples are required, taken at intervals not to exceed 1200 feet. Each dead end of main and each branch of 20 feet or more in length must be sampled. The typical interval between the two samples on a segment is 24 hours, and will be no less than 16 hours.

5. Continuity of tracer wires will be tested.

6. Cathodic protection systems will be tested by a NACE Certified Engineer, and reports submitted in accordance with Appendix E of these Standards.

C. Joining to the Active Water System

1. The contractor shall join the proposed water mains and make all water service connections to existing water mains as shown on the approved construction drawings.

2. Where system shutdown is necessary, the contractor shall give the Authority's staff sufficient notice before these operations are to be performed so that advanced notice may be given to any affected customers. Where interruption of flow would result in an unacceptable interruption of service, specialized methods may be required for maintaining flow. This may include the use of insert valves and/or temporary bypass piping.

3. Authority staff will operate valves in making shutdown and in restoring pressure to the existing pipe and initiating pressures in the new installation. In order that the duration of the shutdown may be as short as possible, connections to water pipes shall be made by the contractor only after complete preparation (including sub-assembly of fittings) for such work has been made.

4. Where existing pipes are provided with fittings for the purpose of connecting to the new pipes, the contractor shall remove the plugs or bulkheads, clean the ends, prepare them for connection to the pipe, and make the new joint.

5. The water released by cutting or opening existing pipes shall be removed and the excavations kept dry until all necessary work within the excavation has been completed.

-- end of Chapter 4 --

Chapter 5: Wastewater Collection

5.1 Scope

A. Intent

This chapter describes typical practices to be followed in the planning, layout, design, and construction of sewerage collection systems of the Authority. The information contained in this chapter must be applied in conjunction with the latest edition of the *Sewage Collection and Treatment (SCAT) Regulations* 9 VAC 25-790, as published by the Commonwealth of Virginia, Department of Environmental Quality; and with other sections of these Standards.

B. Minimums

Many criteria listed are minimums. Additional separations and clearances are to be furnished as practical to optimize each design. Attention shall be given to locating utilities so as to facilitate their re-excavation. The Authority will consider factors such as depth and magnitude of facility in determining the adequacy of each design, and may relax or increase dimensional requirements accordingly. A design is to be sought which minimizes maintenance costs.

5.2 Hydraulic Requirements

Tributary population and projected volume of flow shall be calculated as basis of design for all sewers. Data shall be provided with a map of the tributary area, with topographic contours, showing where loadings have been assigned. Capacity evaluation of proposed facilities and demonstration of their hydraulic adequacy shall be tabulated on the form included in Appendix B of these Standards. Applicants for service may be required to demonstrate the capacity and hydraulic adequacy of existing downstream local collection mains, to the nearest trunk main or interceptor.

A. Tributary Population

1. Designs of sewer systems, including pumping facilities, shall be based on any applicable wastewater facility plan or technical memorandum that the Authority may have on file, and taking into consideration:

   a. the general design factors noted in the Commonwealth of *Virginia Sewage Collection and Treatment (SCAT) Regulations.*

   b. the estimated tributary population for a period of 50 years hence.

   c. the entire watershed, built-out according to current residential, commercial, and industrial uses; and where land is vacant, according to allowable land use, as established by current zonings and by the Clarke County Comprehensive Plan. Where land is vacant, and uses allowed under the Comprehensive Plan differ from current zoning, the more intensive use will be used as basis of design. Where redevelopment of land to more intensive levels than current use is anticipated, the design will make allowance for the redevelopment.

2. For land planned for residential use pursuant to the Clarke County Comprehensive Plan, sewers shall be designed to accommodate the maximum number of resultant dwellings per acre. Where a current use, zoning or special use permit allows for a more intensive use, the more intensive use will be used as basis of design.

3. For land subject to future commercial development, a population equivalent of not less than 30 people per acre shall be used.

4. For land subject to future industrial development, a population equivalent of not less than 40 people per acre shall be used.

B. Flow Projections and Capacities

1. In determining the required capacities of sanitary sewers, these factors shall be considered:

   a. peak quantity of domestic sewage.

   b. additional maximum sewage or waste from commercial and industrial facilities.

2. New sewer systems shall be designed on the basis of an average per capita flow of sewage from the equivalent population served of not less than 100 gallons per day (gpd). On this basis, the following unit factors shall be used in flow calculations:

Single Family Detached Unit	200 gpd
Single Family Attached Unit	200 gpd
Multi-Family Dwelling Unit	180 gpd
Retail Space	The greater of 0.093 gpd/sq. ft. OR 30 persons per acre
Commercial/Office Space	The greater of 0.160 gpd/sq. ft. OR 30 persons per acre
Industrial Space	The greater of 0.160 gpd/sq. ft. OR 40 persons per acre

Table 5.1 – Wastewater Loadings

3. Sewers shall be designed to support peak flows (Q_{PEAK}) when running full, in accordance with the following equations:

   $PF = 3.81(Q_{AVG})^{-0.187}$

   $Q_{PEAK} = PF(Q_{AVG})$

   Where PF is the peak factor and Q_{AVG} is the average daily flow in millions of gallons per day (mgd). Where engineer and the Authority determine that an alternative peak factor to that determined above is suitable, the case specific peak factor may be used, but in no case shall the peak factor be less than the minimum listed in **Table 5.2** below.

Category	Size	Minimum Factor
building sewers	all	4.0
local collection mains	8-inch through 12-inch	4.0

Table 5.2 – Minimum Peak Factors

4. Unless evidence is presented to demonstrate a different flow from industry at ultimate development, the minimum allowance for industrial flow shall be determined by providing a population equivalent of 40 persons per acre, or 1 person per employee, whichever is greater, in the industrial area. "Area" shall include entire area planned for industry, except public road, street and highway rights-of-way; flood plains on which construction is prohibited; and buffers or green zones at least 100 feet in width, separating the industry from other uses.

5. The minimum allowance for flows from commercial areas shall be determined by providing a population equivalent of 30 persons per acre, or 1/2 person per employee, whichever is the greater, in the commercial area. Area shall include entire area zoned for commercial development, including off-street parking areas and landscaped areas, but excluding the rights-of-way of public roads, streets and highways; flood plains of streams on which construction is prohibited; and buffers or green zones at least 100 feet in width, separating commercial from other uses.

6. In cases where the above criteria are not applicable, an alternate design procedure may be submitted to the Authority for approval. A description of the procedure and justification for the modifications as basis of design shall be included with the analyses submitted for review and approval.

7. Minimum size of public sewer is 8-inch diameter, of manhole to manhole construction.

C. Hydraulic Design Criteria

The hydraulic design and determination of sewer sizes will be based on the following criteria.

1. Sewers shall have a uniform slope and straight alignment between manholes. Horizontally curved sewers shall not be used unless specifically approved by the Authority.

2. The diameter of local collection and trunk mains shall be continually increasing, with increase in tributary flow. Isolated segments shall not be oversized to take advantage of lower minimum slopes, in an attempt to compensate for a lack of natural topographic slope along the route.

3. At all junctions where a smaller diameter sewer discharges into a larger one, and at all locations where sewer increases in size, the invert of the larger sewer shall be lowered so that the energy gradients of the sewers at the junction are at the same level. Generally, this condition will be met by placing the crowns of the two sewers at the same elevation.

4. Sewers shall be designed to be free flowing with hydraulic grade below the crown of pipe, and with slopes sufficient to provide an average velocity when running full of not less than 2.25 feet per second. Computations of flow will be based on the Manning's coefficient of friction: n=0.012.

5. The maximum permissible velocity at average daily flow is 15 feet per second.

6. **Table 5.3** below lists the minimum slopes to be provided.

Sewer Size	Minimum Slope
8-inch	0.50
10-inch	0.37
12-inch	0.29

Table 5.3 – Minimum Slopes (Feet per 100 Feet)

7. The terminal upstream section (manhole to manhole) of a local collection main, a section discharging into a lift station or treatment plant, or a section discharging effluent into a stream, requires a minimum slope of double that indicated in **Table 5.3**.

8. Where liquid depth to pipe diameter ratio (D/d) at average daily flow is more than one third (1/3), slopes less than those listed in **Table 5.3** may be approved. For public sewers larger than 42-inch, slopes will be determined on a project specific basis. In all cases, the requirements of the *Sewage Collection and Treatment (SCAT) Regulations* must be met.

9. Maximum slope on all gravity sewers is 10 percent.

5.3 Public Sewer Layout

A. Definitions

"Public Sewer" shall mean a sewer which is owned and controlled by the Authority.

B. Plan View

1. Public sewers of 16-inch or larger diameter are typically considered to be trunk mains or interceptors, such that service connections are not permitted directly to these pipes. Service connections may be made at manholes. Interceptors and trunk mains are to be located in easements on private property, and are to be routed exterior to streets and pavements, crossing streets only where necessary.

2. Public sewers of 12-inch, 10-inch, and 8-inch diameters are considered to be local collection mains, to which service connections may be made along the pipe. These mains may be routed within streets and pavements, or be located in easements on private property.

3. Routes for sewers shall be selected so as to provide the required separations from buildings and other utilities, while minimizing the use of manholes, and minimizing the number of crossings with curbing and sidewalks.

4. Sewer routes and manhole placements are to be selected so that manholes will be accessible for maintenance operations. Where sewer is in easement and beyond the street, the Authority will determine the extent of vehicular access needed to accomplish maintenance operations. Where determined necessary, provide vehicular access to easement from street. Drop curb may be required. For easements where vehicular traverse is required, grade easement to allow traverse, with slopes not to exceed 8 percent. Road shall be at least 10 feet wide. Use of pavement or gravel surface is typically limited to facilities that require maintenance visits on a daily, weekly, or monthly basis. Pavement or stone and gravel stabilization may also be required where slopes or drainage would otherwise result in difficulty of traverse in wet conditions. Requirements may be reduced in environmentally sensitive areas.

5. Encumbrance of preexisting sewers for future access and/or re-excavation will not be permitted. Any necessary relocation of existing sewer facilities due to development is the responsibility of the applicant, and will be replacement in kind, in the form of a new, parallel facility. Where grading is to occur, resulting cover on existing sewer must remain above design minimum and may be considered excessive if resulting in total cover in excess of 20 feet.

6. If parallel to a public street, which is divided by a median, locate sewer outside of the ultimate right of way. However, where a median is being placed in a local subdivision street for aesthetic purposes, sewer may be located within the driving lanes of the street. Along undivided roads, sewer is allowed under pavement.

7. At manholes, the minimum angle between influent and effluent lines is 90-degrees.

8. Separations

   a. Provide a minimum 10 foot horizontal separation (outside to outside) with water main, including at sanitary manholes, in accordance with the *Waterworks Regulations* (12 VAC 5-590-1150).

   Provide minimum 6 foot horizontal separation (outside to outside) with storm drains and drainage structures, duct banks, communications or electrical vaults, and with other underground utilities or structures. This separation is to be provided at sanitary manholes. Under no circumstances may any sewer cross beneath a storm drainage structure, or beneath any other above ground or underground structure.

   b. Provide minimum 15-foot horizontal separation with a building or any other above ground structure. This requirement may be increased for deep and/or large diameter sewers, as determined by the Authority.

   c. Where sewer passes adjacent to a building, the design will ensure that the sewer can be excavated for repair or replacement, without undermining the building's foundation. Provide sectional views of the building's loading plane. For proposed buildings, provide clear specification on the site plan, stating the highest elevation at which the foundation will bear.

d. Show all existing and proposed wells within 100 feet of sanitary sewer easements, to include potable wells and those non-potable wells, as are used in agricultural, industrial and geothermal applications. Provide a minimum 50-foot horizontal separation between sewer and all potable wells. However, in accordance with Clarke County Ordinance, this separation may be reduced to as little as 35 feet. Where such reduced separation is to be employed, the sewer is constructed shall be of pressure pipe, tested in place.

9. Street Design

   a. Manhole location in pavement is preferred. Locate manholes at crown of pavement if possible. Where separation requirements preclude manholes on crown or centerline, manholes should be placed in the center of the travel lane.

   b. In public roads containing both water mains and public sewers, there will typically not be sufficient width to accommodate waterline with sewer on centerline. In this case, center manhole 5 feet from the centerline of the roadway. In such cases, waterline is typically located 8 feet from centerline, on opposite side of street, resulting in the required 10-foot separation (outside to outside).

10. Locate manholes beyond spread of gutter's flow.

11. Future Extensions of Public Sewer or Future Service Connection

    Identify places where future extension of public sewer or future sewer service connection appears practical to allow service to other properties or buildings. Sewer is to be constructed to the limits of the area being developed, so as to terminate in a location from which it can readily be extended in the future. This will be beyond proposed pavements, past adjacent buildings, and beyond adjacent or crossing waterlines or storm drains ducts, or other utilities that would otherwise be undermined during subsequent sewer installation. Temporary terminations of public sewer will be at a manhole. Easement for the future line must be conveyed, extending to the site or subdivision boundary. Associated temporary construction easement may also be needed, as dictated by the scope of the future installation.

12. Sewers parallel to or crossing streams shall be designed as follows:

    a. Sewers and their appurtenances located along streams shall be protected against the 100-year flood. Sewers located along streams shall be located outside of the streambed wherever possible and be sufficiently separated to provide for possible future channel widening. Reasons for requesting sewer lines to be located within streambeds shall be given in the application.

    b. Depending on cover and magnitude of stream, sewers crossing streams may require concrete encasement according to G-6, PIPE BEDDING AND ENCASEMENT, of the *Standard Details*. Where encasement is determined necessary by The Authority, encasement shall extend minimum 15 feet beyond bank on each side of the stream. The pipe and joints shall be tested in place, must exhibit zero infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical stresses; longitudinal, vertical and horizontal loads; and erosion.

c. Sewers parallel to streams shall be of sufficient depth so that tributary extensions can be made under the streams while maintaining adequate cover. See Section 5.3.C of this Chapter for cover requirements. Anticipated future extensions must be shown in plan view, and corresponding actual surveyed stream depths will be required for plan review. When requested by the Authority, the designer will provide profiles for these future extensions, proving adequate depth of the sewer.

d. Sewers placed on piers across ravines or streams shall be allowed only when it can be demonstrated that no practical alternative exists. Such sewers on piers shall be constructed in accordance with the requirements for sewers entering or crossing under streams. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade.

C. Profile

1. Maintain a minimum cover of 6.0 feet. Cover may be reduced to 4.0 feet in isolated instances at the upper reaches of the system, and where the public sewer is located outside pavement. Where approved to be at less than four feet of cover, sewers may be required to be protected from superimposed loads by means of concrete encasement.

2. Minimum cover at a stream crossing is 1 foot if in rock or 3 feet if in soil or alluvium. Concrete encasement shall be provided where cover is less than 4 feet, and may be specified wherever needed to ensure that the sewer is not compromised during flooding. Specify concrete encasement of existing or proposed sewer where below rip rap.

3. Maintain minimum vertical separation of 1.5 feet below crossing water main, 2.0 feet if sewer is below drain or utility duct, and 1.5 feet if sewer is above another utility.

4. Show all crossing utilities and specify required clearances for all pipes. Crossings shown in profile must account for pipe wall thicknesses and be labeled with designed clearances, not required clearances.

5. Include the following note, prominently displayed on each profile view: "THE CONTRACTOR SHALL ENSURE THAT SANITARY SEWER IS CONSTRUCTED TO THE APPROVED SLOPES. IF DURING THE ASBUILT SURVEY, THE SLOPE OF ANY SEWER IS FOUND TO BE INADEQUATE TO CONVEY THE DESIGN FLOW, OR LESS THAN THE MINIMUM PER VIRGINIA REGULATIONS, SEWER WILL BE REINSTALLED TO CORRECT SLOPES AT THE EXPENSE OF THE CONTRACTOR OR OWNER."

6. Sewers installed above existing grade shall be placed in controlled fill.

7. Locate out of areas supporting foundations of structures. Where sewers are deep and in close proximity to structures, the Authority may request a loading plane diagram showing that the sewer may be excavated through conventional means without disturbance to the surrounding structure(s). Adequate easement must be provided so that future excavation and maintenance is feasible.

8. Specify type of pipe for each run. Typical pipe material is PVC DR25 conforming to AWWA C900/905. Where cover is less than 6 feet, or where cover exceeds 20 feet, gravity sewers shall be constructed of PVC DR18. For additional strength, PVC DR 14

may be specified, but must not be used where there are fittings in the run, due to the difference in inside diameter between PVC DR 14 pipe and AWWA C907 fittings.

Pipe material and dimension ratio shall remain constant between manholes.

D. Easement

1. For public sewer mains, provide easements with widths no less than those listed in **Table 5.4** below.

Location	Minimum Width (feet)
within a private street or travel way	10
traversing common area of a subdivision or open area of a site plan	15
traversing an undeveloped property or area	20
along the boundary of a lot in a subdivision	20
where passing between or adjacent to buildings	30*

* Sewer must be located a minimum of 15 feet from structures per Section 5.3 B. 9. b. Easement must extend to the limit of this required separation.

Table 5.4 – Easement Widths for Sewer

1. Where public sewer runs along a lot line within a subdivision, locate the sewer a minimum of 3 feet off of the parcel boundary. Where public sewer parallels such a lot line, the sewer easement will straddle the parcel boundary, so as to enable future work using both lots. The public sewer must be placed at least 10 feet interior to the easement, but need not be centered in easement. Additional width of easement may be required where sewer is not centered in its easement.

2. The Authority does not take easement on the building sewer, between the public sewer and the premises served. However, where a short length of building sewer is approved to be run on land of others, between the parcel served and the public right of way or easement, the Authority will consider taking easement across the land of others. Such occurs in planned developments, where common ground is traversed. Alternately, private easement, with rights running to the property served, may be used for this purpose. In considering which type of easement to apply, the Authority will consider the length and setting, and whether taking easement as public might foster a future mainline extension.

3. Where proposed construction is across land of others, temporary construction easements will be established in sufficient widths to accommodate the work area.

4. Provide access easement with adequate grading to allow vehicular access. Where proposed sewer is to pass out of street and between or behind homes or buildings,

ensure sufficient access to enable operation, repair, or replacement of sewer. Where development is to occur on land occupied by a preexisting sewer, ensure that access to the sewer easement is maintained, and not cut off by proposed grading or improvements.

5. Easement plats and instruments shall be reviewed and executed according to the procedures found in Appendix C of this Manual.

6. Should public sewer be installed outside the boundaries of the recorded easement, a Deed of Easement and Vacation with accompanying plat shall be prepared, approved, and recorded, so as to establish easement at the as-built locations.

E. Miscellaneous

1. Show sanitary sewer crossings on all applicable profiles of other utilities.

2. Facilities being decommissioned shall be abandoned and associated easements vacated. Manholes, structures, and appurtenances are to be removed to the depth specified by The Authority. Removal of pipe will be required in all places where deemed practical by the Authority. This is intended to minimize the need to perpetually mark abandoned lines in response to requests for location services. Under circumstances where re-excavation is deemed impractical, such as below existing roadways, the Authority may approve abandonment of segments of pipe by means of grouting in place.

5.4 Manholes

A. Plan View

1. Provide a manhole at:

   a. all junctions, changes in horizontal alignment, changes in gradient, and temporary or permanent terminus of public sewer;

   b. every 400 feet of developed length (8-inch through 16-inch diameter) and every 500 feet of developed length (greater than 16-inch diameter);

   c. changes in pipe diameter;

   d. lateral connections for laterals 8-inch diameter and larger.

2. Separation

   a. Provide a minimum horizontal separation of 10 feet between exterior of manhole and all water pipes.

   b. Provide minimum 6 foot horizontal separation (outside to outside) with storm structures, drainage piping, duct banks, vaults, and other structures.

   c. Do not locate a manhole in a parking space, or where continuous access would otherwise be obstructed.

3. Maximum number of connecting pipes per manhole is four, (one out; three in), with a pipe entering by a drop connection counting as one.

4. Inside diameter of manholes shall be 4.0 feet for public sewers less than or equal to 24-inch diameter. Manhole diameter requirements for sewers larger than 24-inch diameter will be specified on a project-specific basis.

5. Provide a minimum of 6 inches between openings (cores). Sample calculations are provided in Appendix B of these Standards.

6. Existing manholes to receive proposed pipe shall be core bored.

7. A manhole is required at each temporary termination of the public sewer. In isolated instances, when stubbing out of commercially zoned land, which is not fully planned or engineered, plugged stubs of 8-inch diameter may be used. Minimum slope for such a stub is 1.00 percent.

8. A 25-foot advance blast shall be specified in all alignments that might be utilized for future extensions or connections.

9. For all sewers receiving pumped sewage, downstream manholes shall have protective lining, to such point as the proportion of pumped sewage to gravity collected sewage is equal (50 percent dilution). Lining shall be in accordance with SEWER, SECTION 3 of the Loudoun Water *Approved Materials List*. New manholes shall be specified as having HDPE cast-in lining system. Such lining systems typically preclude the use of cone sections, so such manholes cannot be located in public streets, and should typically not be located in pavements. If downstream manholes must be within a pavement, or they pre-exist, then one of the approved coatings for field application may be specified.

B. Profile

1. Minimum depth of manhole in pavement is 6 feet. Minimum depth of manhole in grass is 4 feet.

2. Sewers are to be routed so that depth at manholes is limited to a maximum of 20 feet. Where greater cover on sewer would result, investigate alternate route to better mirror the topography. Sewer involving manholes in excess of 20 feet will only be considered where, in the Authority's judgment, an alternate route is not viable.

3. Provide a maximum of 0.50 feet and a minimum 0.10 feet between invert elevations of pipes of like diameter. When influent pipe is of smaller diameter than effluent pipe, its minimum invert elevation is that which results in matched elevations between crowns of influent and effluent pipes. Additional drop across manholes may be required to insure that a positive hydraulic grade is maintained across the manhole so that flows do not surcharge one or more of the influent pipes.

4. Use of drop connections will be limited to instances where, in The Authority's discretion, excessive slope or depth of sewer would otherwise result. Drop connections will be considered where slope of main would otherwise exceed 10 percent, or to avoid conflict with other utilities that cannot be readily relocated. Slope of sewer upstream of a drop connection shall be 2 percent. Outside drop connections in accordance with S-4,

OUTSIDE DROP CONNECTION, of the *Standard Details* shall be utilized in new manhole construction. Inside drop connections in accordance with S-5, INSIDE DROP CONNECTION, of the *Standard Details* will be considered where connecting to sewers that have been in service for more than one year, and where manhole re-excavation for the installation of an outside drop connection or lateral with riser is determined by The Authority to be impractical.

5. "Doghouse" manholes are not permitted. Any manhole installed on an existing sewer must be installed by cut-in.

6. Specify heavy-duty cover in proposed or future pavement.

7. Specify watertight cover if less than 1 foot above the 100-year water surface elevation.

8. Provide ventilation where continuous watertight sections greater than 1,000 feet would otherwise occur.

9. Specify elevation of the vent's opening, establishing between 3 and 5 feet above surrounding grade. If the opening is to be below 100-year water surface, then specify a float valve in the vent.

10. When top is not in developed lawn or pavement, specify elevation 1 foot above surrounding grade.

11. Provide positive drainage for sanitary manholes located outside of pavement.

12. Where future grading can be anticipated, manholes are to be installed to ultimate top elevations, wherever practical. However, where doing so would result in tops that are more than 4 feet above the interim grade, manhole tops are to be set to the interim condition.

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

5.5 Sewer Service Connections and Building Sewers

A. Definitions

The term "Sewer Service Connection" shall mean the fittings through which the building sewer is joined to the Public Sewer, and constitutes the point of service by the Authority.

The term "Building Sewer" shall mean the extension from the Sewer Service Connection to the Building Drain.

The term "Building Drain" shall mean that part of the lowest horizontal piping of a drainage system, which receives discharges from the drain, waste, and vent system within the building. The Building Drain extends to five feet exterior to the building, where it is joined to the Building Sewer.

Within these Standards, the term "Lateral" will be used to describe the initial stub-out of Building Sewer, that is installed with the site work, and from which a subsequent extension of Building Sewer is made.

B. Plan View

1. A separate sewer service connection to the public sewer is required for each premises. However, the Authority may, at its sole discretion, allow a group of premises to be served through a common sewer service connection. In this case, there must be a single water service connection serving this same group, and a management entity that will be responsible for the account and for maintenance of the associated building sewer and drain, waste and vent system.

2. Where a building contains both residential and nonresidential uses, separate sewer service connections, building sewers, and drain, waste and vent systems within the building are required for the respective uses.

3. The public sewer to which a building's sewer service connection is to be made, must be on the parcel of land served, or in right of way or easement, which directly adjoins that parcel. Where such is not the case, extension of the public sewer is required. Short, incidental length of building sewer across lands of others may occasionally be approved, with corresponding easement.

4. Sewer service connections and building sewers for single-family homes shall be 4-inch minimum. Service connections and building sewers for multi-family, commercial, and industrial buildings shall be 6-inch minimum, except where the building and upstream plumbing are known to be so small as to never warrant 6-inch building sewer.

5. Direct connection of 4-inch and 6-inch services is permitted on 12-inch or smaller public sewer that is being simultaneously installed. Service connections to larger public sewers, and to all sewers already conveying flow, should be made at manholes. Where a sewer service connection must be made to a main conveying flow, and no manhole can be accessed, connection by saddle tap may be permitted.

6. Building sewers of 8-inch diameter or larger must connect to the public sewer at a manhole. Pursuant to the International Plumbing Code, manholes are required in lieu of clean-outs at all changes in horizontal alignment and vertical grade on building sewers of 8-inch diameter and larger. The clean-out at the junction of building sewer and building drain may be omitted, provided that a manhole occurs within 200 feet of this location.

7. It is preferred that service connections of single-family dwelling units (attached or detached) be made along the pipe of the public main, rather than at a manhole. Service connections of multi-family residential, commercial, and industrial premises are preferred at a manhole.

8. Where the Authority determines that a practical layout can be attained, a building sewer draining a grease interceptor or oil/water separator shall connect to the main at a manhole, and shall be routed to the main independently of other drain, waste and vent systems.

9. All building sewers from customers classified as a Significant Industrial User (SIU) must connect to the public sewer at a manhole. The Authority may require that the building sewers of such customers be of 8-inch minimum diameter, with provisions for sample collection.

10. No drains subject to receiving storm water may be tributary to the sanitary sewer.

11. Discharge of storm water, ground water, or other unpolluted water to the public sewer is prohibited with accordance to County Code 180-34.25.

12. When connecting to the public sewer just outside of a manhole, a minimum distance of 5.0 feet is required between outside wall of manhole and service connection. On a standard 4.0-foot diameter manhole, this corresponds to 7.5 feet between service connection and center of manhole.

13. Minimize length of laterals, with initial stub-out to be less than 100 feet wherever possible. Clean outs are not permitted within the initial stub-out.

14. Provide minimum horizontal separation of 5.0 feet (center to center) between sewer service connections along the public sewer.

15. Where the sewer service connection is made to the pubic sewer along the pipe, and not at a manhole, the lateral shall extend at 90 degrees to the main.

16. When connecting at a manhole, a lateral must be separated by at least 90 degrees with the effluent public sewer.

17. Bends in laterals are prohibited within public right of way.

18. Laterals shall be located so as to minimize the number of bends in the subsequent extension of building sewer, taking into account all known architectural constraints or proposed homes.

19. Laterals in residential subdivisions shall be extended a minimum of 1 foot beyond the Utility Easement (gas, electric, and communications), or 16 feet inside lot, whichever is greater.

20. Laterals must be terminated at least 5.0 feet short of the anticipated house site. Additional distance between the end of the lateral and the structure is desirable, particularly if a vertical offset (1:1 riser) is likely to occur with the extension of the building sewer.

21. At town homes, service from the rear of lots is discouraged, due to the typical encumbrance of pipes for maintenance. If considering such a layout, investigate alternatives and consult Authority staff at basis of design.

22. For multi-family residential, commercial, and industrial site plans, laterals should be proposed as complete building sewers, extending to the respective buildings.

23. Where feasible, provide minimum horizontal separation of 6.0 feet between lateral and driveway apron.

24. Provide minimum horizontal separation of 6.0 feet between lateral and water service.

25. Provide minimum 35-foot horizontal separation between building sewer and any water well, and construct in accordance with Clarke County Ordinance.

C. Profile

1. All sewer service connections must be stationed on the profile of the public main.

2. Tabulation and/or profile must be provided for each lateral. Any non-residential or multifamily lateral crossing another utility shall be profiled.

3. Show crossing laterals on profiles of storm drains and water pipes if vertical clearance (outside to outside) is less than 3.0 feet.

4. Maintain minimum vertical separation of 2.0 feet where building sewer is below another utility, and 1.5 feet if building sewer is above another utility. Where conditions preclude these minimum recommended clearances, reduced clearance to as little as 0.5 feet may be approved.

5. The PVC fittings employed at the sewer service connection result in a difference between invert elevation of the public sewer and invert elevation of the lateral of 1.25 feet for 4-inch diameter service connections, and 1.50 feet for 6-inch diameter service connections, where the connection is to a public sewer of 8-inch diameter. For larger public sewers, the additional diameter of the main should be added to this elevation difference. Laterals shall be constructed in accordance with S-10, LATERAL of the *Standard Details*.

6. Sewer service connections made at a manhole may match crown elevations with the highest influent sewer, or be higher. However, the invert elevation of the service connection shall not exceed the crown of the highest influent sewer.

7. Building sewers serving single-family homes (detached or attached) must have a minimum slope of 2.08% (¼ inch : 1 foot).

8. Laterals are to be at sufficient depth to sewer the lowest portion of a structure, including basement. Recommended calculation provides a minimum slope of 2.08 percent to a point 2 feet below the lowest floor elevation, at the most remote portion of the building.

   Where adequate depth of lateral cannot otherwise be achieved, designer should confer with The Authority's Staff to arrive at an acceptable design. Initially, the designer should investigate raising the elevation of the building.

Hung sewers are discouraged. Where gravity service cannot be attained, such that a hung sewer is to exit a home, provide prominent label to this effect on the plan view at that home's footprint.

9. Where depth of public sewer would result in excess depth of lateral, the slope of the lateral may be increased from 2.08 percent (¼ inch : 1 foot) to 4.17 percent (½ inch : 1 foot). If further reduction of cover is warranted, specify a vertical offset (1:1 riser) in accordance with S-11, LATERAL WITH VERTICAL BENDS of the *Standard Details*. Such vertical offsets must be 3.0 vertical feet or more, and must be exterior to right of way, easement, and traffic court.

10. Building sewers serving multifamily residential, commercial and industrial uses must have a minimum slope of 1.04% (1/8 inch : 1 foot), and be of minimum 6-inch diameter. These building sewers may be run at higher slopes, typically not to exceed 8.32 percent (1 inch : 1 foot). Where surplus gradient exists, one or more vertical offsets (1:1 risers) may be employed. Vertical offsets shall be located a minimum of 5.0 feet off of the public sewer, or outside edge of manhole.

11. Specify a clean-out where developed length reaches 100 feet. Where nearby bend occurs, position clean-out immediately upstream of bend.

12. Specify a clean-out within 5.0 feet of the building's exterior wall. This serves as the clean-out at junction of building sewer and building drain, required by the International Plumbing Code.

13. Clean-outs must be shown in plan and profile of all multifamily residential, commercial, and industrial laterals.

D. Metering As Basis of Continuing Sewer Service Charges

1. Where customer is not served by the Authority's water system, specify an appropriately sized meter to be installed in the private water supply, in accordance with S-13, WATER METER SETTING–SEWER ONLY ACCOUNTS of the *Standard Details*. This meter will allow the billing for continuing sewer service to be based upon actual consumption. The meter will be supplied and maintained by The Authority. The meter and its setting will be installed by the customer's contractor.

2. Where an evaporative cooling system or industrial process discharges to the sanitary sewer, in an amount that is significantly different from the water supplied to the process through the Authority's metered supply, metering may be installed at the point of discharge into the drain, waste and vent system. By having the Authority's meter at this location, billing for continuing sewer service can reflect the actual sewerage discharged. Magnetic meters are used for this purpose.

   Confer with the Authority staff for arrangements. Approved installation details are required for each such meter. Design details are to be submitted to The Authority for review and approval prior to plumbing installation. Requirements include the following:

   a. The wastewater discharge shall be of a quality that will not damage the meter. Parameters such as suspended solids and temperature will be considered.

b. The plumbing shall be installed in a manner that will keep the meter below a column of water at all times. Where possible, locate meter upstream of the valve that actuates the discharge. Where this is not possible, such that discharge is conveyed to metering location by gravity, a riser of at least four feet in height must be installed downstream of the meter, to supply the required column of water. A sight-glass or clear pipe shall be provided to allow the column to be monitored. At least 1.5 psi of backpressure must be provided at the meter.

c. Accommodations must be made to prevent separation of the water column (air entrapment). This can be accomplished with an air-gap at the discharge point and venting of the upstream gravity piping and hydraulic riser, to produce a solid flow through the meter.

d. Minimum straight pipe lengths shall be provided upstream and downstream of the meter in accordance with the meter's installation instructions. Provide a ball valve upstream and downstream of the meter. For 1-inch magnetic meter, use approved iron yoke and meter valves.

e. A bypass for maintenance may be included within the plumbing of the meter. This bypass shall include a valve; normally closed.

f. A sample tap shall be provided at the meter setting.

5.6 Pretreatment

The Authority defines pretreatment as any process, which removes a substance from the wastewater stream before it enters the public sanitary sewer. The Authority separates pretreatment processes into the following categories: Grease, Oil, Sand, Carwash Reclamation Systems, and Significant Industrial Users.

In addition to the requirements herein, all building sewers and pretreatment systems shall be constructed and maintained in accordance with Clarke County Ordinance; the *International Plumbing Code*; the *Standard Details*, and the Loudoun Water *Approved Materials List*.

A. Definitions

Grease – Fat, oil, or grease (liquid or solid) from an animal, vegetable, or mineral source; as identified by EPA Method 1664, Revision A. The Authority's action level is >100 mg/L.

Grease Trap – A device installed inside a facility, designed to separate grease from the kitchen wastewater. Grease traps are typically smaller than grease interceptors and are usually installed in the kitchen under the floor or next to a sink.

Grease Interceptor – A device installed outside of a building, designed to separate grease from the kitchen wastewater. The structure shall only receive wastewater from kitchen drains (no sanitary wastewater).

Oil – Any greasy, combustible substance obtained from an animal, vegetable, or mineral source. Oils are liquid at ordinary temperatures and soluble in certain organic solvents, but

not in water. The Authority usually refers to oil more specifically as petroleum products, detected by EPA Method 8015. The Authority's action level is >100 mg/L.

Oil/Water Separator – A device designed to separate oil from wastewater, through the use of baffled compartments and corrugated plates (coalescing plates).

Sand Interceptor (Grit Interceptor) – A device, installed outside of the building, designed to separate sand, grit, or other inorganic particles from wastewater, prior to discharging to The Authority's sanitary sewer.

Carwash Water Reclamation System – Any system, which treats the water, used in a carwash, in order to reuse the water in the carwash.

B. Guidelines and Review Process for Interceptors and Reclamation Systems

All commercial kitchens are required to be fitted with a suitable grease interceptor. All automotive facilities (except for completely dry shops) require an oil-water separator, outside of the building. The location of establishments requiring a pretreatment device shall be identified prior to construction, preferably during the construction plan review. Additionally, The Authority may identify existing establishments that need new or improved pretreatment devices.

The applicant, owner, and their consultant are responsible for proper design, installation, and maintenance of any pretreatment system.

Applicants shall provide sizing calculations certified by a Professional Engineer licensed by the Commonwealth of Virginia. The Authority's Engineer will review the selection to verify that the sizing, cover, and other site constraints are suitable for application of the selected device.

For devices not listed by the Loudoun Water *Approved Materials List*, (including carwash water reclamation systems) the device manufacturer shall provide a product submittal. The Authority's Engineer will review the device, for compliance with these guidelines and applicable requirements of the Loudoun Water *Approved Materials List*. Discrepancies and inadequacies identified must be addressed in order for the device to be approved for installation.

The Authority requires the sizing calculations and device selection or product submittal receive approval before the Authority will execute the construction permit. These items may be submitted to the Authority any time before construction permitting. The Authority recommends initiating this process as soon as possible, because review and approval is not immediate.

C. Design Requirements

1. All pretreatment devices shall have a sampling port on the effluent plumbing, at a point prior to combining with other untreated flows.

2. Grease interceptors shall be designed to meet the limit of 100 mg/L maximum oil and grease content at all times of discharge. The following minimum features must be incorporated:

a. The grease mat shall be less than 25 percent of the liquid depth and solids accumulation shall be less than 10 percent of the liquid depth.

b. The design will not require owner maintenance more frequently than once per month, to meet the above discharge limit.

c. Unless an alternate method of sizing is approved, the volume of the grease interceptor shall be based on a detention time of at least 30 minutes at peak flow. However, the volume should not be excessive, so as to avoid septic conditions. Additional detention time may be required for large dishwashing machines. Peak flow shall be calculated as follows:

i) Use the International Plumbing Code (currently Section 709) to calculate the total number of drainage fixture units (DFU), which drain to the grease interceptor.

ii) Calculate the peak flow, based on 1 DFU = 2.5 gpm at peak flow. For commercial dishwashing machines, use the manufacturer's specified drainage rate.

d. The Authority will consider alternative sizing methodology, and recommendations from the grease interceptor manufacturer. Where third party testing of hydraulically engineered units has demonstrated the effectiveness and efficiency of the unit, the corresponding flow rating may be used as basis of unit sizing and selection.

3. Oil/water separators shall be designed and proven to produce effluent with less than 15 parts per million (ppm) free oil; with influents containing oils of 0.90 or lighter specific gravity, up to 20 percent (200,000 ppm) oil content in the water at temperatures of 40° to 140° F.

4. Carwash water reclamation system submittals shall include a system flow chart, a statement as to percentage water that is reused from each wash, description of any treatment process, and tank or structure details. Also, provide a completed Wastewater Pretreatment Questionnaire, as discussed in Section 5.6.D below.

5. Solids removed from the carwash reclamation systems may not be discharged into the sanitary sewer.

6. Carwash reclamation systems shall be designed so that any water discharged to the sanitary sewer shall contain less than 15 ppm free oil; with influents containing oils of 0.90 or lighter specific gravity, up to 20 percent (200,000 ppm) oil content in the water at temperatures of 40° to 140° F. If this cannot be achieved within the reclamation system, an independent oil/water separator will be provided between the reclamation system and the sanitary sewer.

7. The drain in an elevator pit may be routed to the building's drain, waste and vent system, provided that it is fitted with industry standard detection and alarm for detection of oil in the discharge.

D. Significant Industrial Users

The Authority's Industrial Pretreatment Program utilizes Chapter 180 of the Clarke County Codified Ordinance. The ordinance covers pre-treatment; to remove materials determined by the EPA and/or the Authority to have harmful effects on the wastewater collection

system, wastewater treatment operations, the receiving stream, or residual solids. Typical substances controlled by this program include toxic organic compounds, metals, extreme pH, and cyanide. Industries identified, through this program, as Significant Industrial Users (SIUs) are issued a wastewater discharge permit, which contains monitoring requirements. This program does not address sewer blockages caused by grease buildup.

Wastewater Pretreatment Questionnaire – This questionnaire is used to identify and track industries that may warrant specialized pretreatment devices, and/or be SIUs. The Authority requires that the questionnaire be completed by the industry in question, prior to construction or installation of the facilities. The Authority's pretreatment coordinator will review the completed form and determine if the industry is an SIU. Additionally, the Authority may identify an existing business or industry that might be a SIU. These customers will also be required to complete the questionnaire.

5.7 Low Pressure Collection and Grinder Pumps

A. Definitions and Conditions of Service

Resident User – A Resident User is defined as the person(s) or company registered as a sewer customer of the Authority and responsible for payment of invoices rendered for service.

Grinder System – A Grinder System is defined as a wastewater collection system that serves two or more properties discharging through a common low-pressure pipe. The Authority shall be responsible for emergency and scheduled maintenance of Grinder Systems.

Grinder Pump Service Connection – A Grinder Pump Service Connection includes the grinder pump, the control panel, and the downstream piping. Where multiple premises on a single property are to be served, each premises must have a separate grinder pump (or gravity lateral where possible), that delivers sewage to the Grinder System.

Individual Grinder – A private Individual Grinder is defined as serving one property, discharging to a gravity lateral or gravity collection system, and includes the pump, lateral, and appurtenances. Resident Users are responsible to secure VDOT permits for any private low-pressure laterals crossing the VDOT right of way. Such permit shall state that the User will own and maintain the pressure lateral within the right of way. Maintenance of private Individual Grinders shall be the responsibility of the Resident User.

B. Installations to Meet the Authority Intent and Policy

1. Proposed sewer systems must adhere to the Authority's current, applicable area facility plan. Gravity collection in combination with regional pumping stations identified in such facility plan must be used where feasible.

2. As compared to collection by gravity, Grinder Systems are less reliable, pose greater risks to health, and require substantially more emergency and scheduled maintenance. The intent and policy is to reinforce the objective of using Grinder Systems only where gravity collectors and/or a centralized pumping station is not feasible, in The Authority's sole discretion.

3. Except in response to a resolution by the Clarke County Board of Supervisors, The Authority shall not accept ownership, maintenance or operation of any Grinder System, which does not meet the provisions herein.

4. Grinder Systems shall not be used to avoid placing collectors at appropriate depths to serve upstream areas within the sanitary sewer shed or sub-shed.

5. In occasional, isolated instances the Authority, may determine that the installation of gravity collectors or conventional pumping is not feasible. In such cases, Individual Grinders or Grinder Systems may be permitted.

6. Sewage ejectors serving a basement will not be considered as part of, or compatible with, a Grinder System and shall be the full responsibility of the Resident User. As such, operation and maintenance of ejectors shall be the sole responsibility of the Resident User.

C. Design Approval Required

1. Before agreeing to allow any Grinder System or Individual Grinders, The Authority shall review and approve the construction design and details applicable to that system. The Authority review and approval shall be in addition to any review, approval or standards, which may be adopted and enforced by county, state and federal regulatory authorities.

2. The Authority's design standards shall require Grinder Systems and Grinder Pump Service Connections to be of a standard configuration, capable of being compatible when connected to The Authority sewerage system.

3. The design of any Grinder System shall make acceptable provision for necessary easements and maintenance access to all portions of the Grinder System, the Grinder Pump Service Connection, and any planned extensions. The Grinder System shall be conveyed, along with all necessary easements and manufacturers' warranties, by general deed with title satisfactory to the Authority

D. Financial Considerations

1. Grinder Systems, Grinder Pump Service Connections, and Individual Grinders shall be constructed at no cost to the Authority and in accordance with construction and design criteria approved by the Authority and appropriate regulatory agencies.

2. Grinder Systems with Grinder Pump Service Connections represent a unique circumstance for sewer service. As such, the project's agreement shall include the following paragraph:

Grinder Systems. This development may contain a Grinder System in lieu of gravity collectors. Lots { list of lots } may be served by a Grinder System. The availability fee associated with service to each of the listed lots will include an additional fee of { current price } to address pump replacement, maintenance, and repairs for each Grinder Pump Service Connection. Fee shall be paid prior to issuance of the Connection Permit.

E. Notice on Record Plat

1. For lots associated with Grinder Systems, the Applicant shall cause to be recorded on the official record plat for the subdivision or development, the following notice:

   The property receives sanitary sewer service by means of a grinder pump. Extraneous flows, such as from sump pumps, are prohibited. Residents may not flush unauthorized products or materials deleterious to the grinder system. Contact the Clarke County Sanitary Authority for further information.

F. Laterals

1. Grinder System and Grinder Pump Service Connection shall be designed and built according to the *Standard Details* (LPC-1 through LPC-8), and specifications in applicable sections of the Loudoun Water *Approved Materials List*.

2. Pressurized laterals shall be designed for minimum velocity of 2.0 feet per second and a maximum velocity of 8.0 feet per second.

3. Pressurized laterals shall be no less than 1.25-inch diameter.

4. Pressurized laterals shall enter the gravity sewer system via a section of gravity sewer in accordance with S-10, LATERAL, of the *Standard Details*. Design of the pressurized lateral termination structure shall ensure a smooth flow transition to the gravity flow section to prevent turbulence and release of gases.

5. All pressurized laterals shall be tested at a pressure of at least 150 percent of the design operating pressure for at least 30 minutes. Leakage shall not exceed the amount specified in AWWA Standard C-600.

5.8 Installation Requirements

All sewer pipe and appurtenances shall be installed in accordance with best practice, with materials and workmanship of full quality. Materials and installation shall be in accordance with all applicable sections of American Water Works Association Standards. Installation shall conform to *AWWA C605, Standard for Underground Installation of PVC and PVCO Pressure Pipe and Fittings*; with all manufacturers' instructions and recommendations; and

the provisions of these Standards. The installing contractor shall be solely responsible for ensuring that appropriate and acceptable construction materials, means and methods are used. Reuse of previously installed materials is prohibited, except where specifically approved by The Authority.

A. Excavation, Bedding and Backfill

1. Prior to any clearing or excavation, all required sedimentation and erosion control measures shall be in place as required by Clarke County and in accordance with the approved plans. As the work progresses, these control measures shall be properly maintained and subsequent control measures taken, all as required by Clarke County and in accordance with approved plans.

2. The site of all excavation shall be first cleared of all lumber, stumps, trees, brush and rubbish which shall be removed or disposed of in a satisfactory manner.

3. During excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not suitable and/or required for backfill shall be removed and disposed or in an approved manner. Such grading shall be done as may be necessary to prevent water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by approved methods. All excavation shall be made by open cut unless otherwise specified.

4. The trench shall not be opened for a distance exceeding 300 feet at any time, when located along streets or highways. The width of the trench above the top of the pipe may be as wide as necessary for sheeting and bracing and the proper performance of the work. All trenches in soil shall be undercut 6 inches below the pipe invert. All trenches in rock shall be undercut 10 inches below the pipe invert. Minimum clearance between side of trench and pipe shall be in accordance with G-6, PIPE BEDDING AND ENCASEMENT, of the *Standard Details*. Excavation at manholes, vaults and similar structures shall be sufficient to leave at least 12 inches clear between their outer surface and the embankment or sheeting. The trench shall be excavated to a uniform subgrade as required for installation of pipe bedding material.

5. All trenches and excavations shall be properly sheeted and braced for the safety of personnel and/or protection of the work; and/or to maintain the maximum trench widths permitted; and/or to prevent the disturbance or settlement of adjacent foundations or structures. Where so required by the Authority, sheeting shall be left in place by cutting off no higher than 1.0 foot below finished surface grade and no lower than 1.0 foot above the top of the pipe. The requirement of sheeting and/or bracing left in place shall not obligate the Authority in any manner.

6. Pipe to be located at elevations above the existing ground level shall be installed in trenches excavated after embankment has been constructed to a minimum elevation of 6 feet above the pipe. Embankment supporting The Authority's facility will be a controlled fill of suitable material or select material, as these are defined in the Virginia Department of Transportation's *Road and Bridge Specifications*. Fill shall be placed at a moisture content that is within 2 percentage points of optimum moisture, and

compacted to a density of at least 95 percent of the maximum dry density, as determined by the Standard Proctor (AASHTO T99).

7. The pipe shall be bedded from the trench subgrade to a point 4 inches above the crown of pipe in bedding material, in accordance with G-6, PIPE BEDDING AND ENCASEMENT, of the *Standard Details*.

8. Wherever the soil at the trench subgrade elevation is soft, unstable, or saturated with water, such unsuitable material will be removed and the trench subgrade stabilized with a granular stabilization material. Maximum size of granular material shall be 6 inches in its longest dimension to within 6 inches of pipe invert, at which point specified bedding material shall be used. Depth of stabilization shall be as required to construct a firm subgrade for pipe bedding material. Lean concrete may be used as a stabilization mat. Concrete encasement shall be provided where necessary to bridge highly unstable soils. Where encasement is required, it shall be installed in accordance with G-6, PIPE BEDDING AND ENCASEMENT of the *Standard Details*.

9. Backfill

   a. Backfill shall be placed promptly after inspection by the Authority.

   b. Backfill shall be placed in 12-inch layers from top of pipe bedding to a point at least 24 inches above the top of pipe. Above this point, backfill shall be deposited in layers of a thickness, which will permit compaction to a density as specified hereinafter.

   c. Roadway Areas:

      i) Within existing public rights of way, select backfill (VDOT 21A or 21B) may be required in place for suitable material. This requirement may be a condition of the Land Use Permit issued by the Virginia Department of Transportation. All requirements and specifications of this permit will govern the work.

      ii) Within private roadways, including the areas of future roads, suitable or select material per the VDOT *Road and Bridge Specifications* may be used. Where native material is not suitable, or cannot be placed within three percentage points of its optimum moisture, backfill must be imported.

      iii) Under all pavements and future pavements, the backfill shall be compacted to a density of at least 95 percent of the maximum dry density as determined by the Standard Proctor (AASHTO T99). Pavements shall not be restored over trenches until the backfill material has been tested and determined as satisfactory according to the tests.

   d. Open Areas:

      i) All material used for backfilling of trenches in open fields or areas which will carry no vehicular traffic shall be free of excessive amounts of deleterious materials such as all organic matter, frozen clods and masses of fat clay which are difficult to properly compact. Backfill shall not contain earth clods or rock material greater than 12 inches in greatest dimension.

      ii) The layers of material shall be compacted to a density of at least 90 percent of the maximum density as determined by the Standard Proctor (AASHTO T99). Where

seed or sod is to be placed, the upper layer of backfill shall be composed of topsoil at least 6 inches in depth.

B. Bypass Pumping

Where an existing public sewer is subject to being rerouted, or a manhole or fittings must be cut into a public sewer, bypass pumping may be required to transmit flow during the work. Pumping will be required, unless the flow is sufficiently small as to make detention within the system, or pump and haul practical for the entire duration of the work, including the time needed for testing. Use of newly installed pipe to convey flow is prohibited, until such time as that pipe has successfully undergone acceptance testing and inspection.

Where bypass pumping is determined to be necessary, the following features must be incorporated into the pump-around system.

1. one standby pump, in addition to the pump or pumps sized to convey the flow
2. engine(s) or generator(s) to run the pumps
3. sufficient above ground piping to reliably convey flow to the receiving manhole
4. float system to control the pumps and provide an alarm in the event of system failure
5. auto dialer to transmit warning of alarm condition by telephone
6. an emergency response plan

For each pump-around, the installation contractor will submit a bypass pumping plan to The Authority for review and approval.

C. Acceptance Tests

1. Sewers will be checked by the Authority to determine whether any displacement of pipe has occurred, through use of closed circuit television inspection, prior to Beneficial Use, and during Final Inspection. Contractor shall clean sewers prior to each television inspection. If interior of pipe shows poor alignment, incorrect joining, displaced pipe, leakage, or any other defect, the defect shall be remedied before acceptance.

2. Completed sewers will be tested for leakage by a hydrostatic exfiltration test. For hydrostatic test, all outlets or inlets shall be plugged and secured in a manner to resist the internal pressure of the test without leakage or failure. The test section shall be filled with water to an elevation up to the top of the manhole at the upstream end, providing an internal pressure head. This level of water shall be maintained as long as necessary to determine acceptability of sewer being tested, but not less than 2 hours. Measurements shall be made of the rate of leakage (exfiltration) from the sewer by determining the amount of water required to maintain the initial level at the upstream manhole. Contractor shall provide all water used in testing from an approved source. Leakage shall not exceed 100 gallons per inch of diameter of sewer per mile per day. Sewers crossing streams shall exhibit zero exfiltration.

3. In limited cases where in the Authority's determination, groundwater conditions or installation logistics warrant the air testing of pipes will serve as an alternate acceptance test. Air test is to be conducted in accordance with ASTM F1417.

4. All completed manholes shall be tested for leakage. Manholes may be tested with associated pipe. Where entire depth has not been included in the testing of pipe, the manholes shall be used to plug all lines into and out of the manhole being tested. The manhole shall be plugged independently and filled with water to the top. Manholes must exhibit no appreciable leakage during a two hour period.

5. Vacuum testing of manholes will be considered in certain conditions, such as connections during parallel replacement work. Vacuum testing should be done only prior to backfill. Damage to manhole joints and pipe connectors may occur, if test is done after backfill and in the presence of groundwater. Vacuum test is to be done according to ASTM C 1244.

6. Contractors may low-pressure air test sewer pipe for their verification purposes, at their own risk, prior to hydrostatic acceptance testing. Contractors who wish to vacuum test manholes prior to acceptance testing may do so only prior to placing backfill.

5.9 Building Sewer Construction

The Clarke County Building Official's Office must inspect and approve the entire building sewer, for all sewer service connections made to one of the Authority's collection systems. This inspection will include all piping from the main, or where such has been installed with the main, from the end of the service spur.

1. Where a spur has already been provided from the sewer service connection, it will have been constructed in accordance with S-10, LATERAL or S-11, LATERAL WITH VERTICAL BENDS of the *Standard Details*. Pipe material (typically PVC) will have cast iron outside diameter. A transition coupling may used to adapt to IPS outside dimensions. A SCH40 PVC test tee is typically employed, with bushing in upstream bell to adapt to outside dimensions of PVC SDR 35.

2. Vertical offsets, where necessary, will be by means of two 45-degree vertical bends. Vertical stacks are prohibited.

-- end of Chapter 5 --

Chapter 6: Water Treatment

6.1 Scope

A. Intent

This Chapter establishes requirements and standards for water treatment facilities designed and constructed on behalf of the Authority. These standards are not intended to be all-inclusive. The Authority will consider alternative means and methods to accomplish its objectives, based upon good engineering practice and demonstrated technical effectiveness, reliability, and cost-effectiveness.

B. Standards

The standards presented herein shall supplement the latest edition of the *Waterworks Regulations* 12 VAC 5-590-10 et seq., as published by the Commonwealth of Virginia, Department of Health (VDH). The *Waterworks Regulations* represent the minimum design requirements set forth by VDH. All requirements of the *Waterworks Regulations* shall be adhered to. As the owner, the Authority may identify and determine the need for standards and requirements that are more stringent than those contained in the *Waterworks Regulations*.

The headings and sub-headings of this chapter are based on the *Waterworks Regulations*. In instances where no additional requirements are specified, *Waterworks Regulations* shall apply as written.

C. Interpretation

Waterworks infrastructure shall meet all applicable requirements of these Standards. The Authority will grant no exceptions to the requirements of these water system standards except where doing so provides a direct benefit to the Authority.

6.2 Requirements Supplemental to Virginia Waterworks Regulations

A. Definitions

To 12 VAC 5-590-10, add the following:

"Applicant" means developer or property owner seeking approval of the facility.

"The Authority Design Standards" means the Authority - approved procedures, methods and materials as promulgated in these Standards.

"Community Water System" means any freestanding system to be owned and/or operated by the Authority. Freestanding systems are not connected to the Authority's central water system.

"Major Process Equipment" means mechanically or electrically actuated process equipment requiring routine maintenance and specified in Divisions 11 through 16 of contract specifications formatted in accordance with the Construction Specifications Institute. Major process equipment includes pumping and treatment unit processes and associated electrical controllers.

"SCADA System" means The Authority's system control and data acquisition system for instrumentation, whereby equipment and processes are remotely monitored.

"Water Budget" means a quantitative accounting of volumes that are to be used in the community to be served, and the patterns of this usage, to include irrigation, if such is to be permitted.

"Waterworks Regulations" means the latest edition of the *Waterworks Regulations* 12 VAC 5-590, as published by the Commonwealth of Virginia, Department of Health.

B. Administration of Regulations

To 12 VAC 5-590-40, add the following:

The Authority, which shall become the owner and operator of the facility that is to be designed and constructed, is responsible for definition and specification of standards, including equipment, and materials and design criteria.

C. Reserved Section

To 12 VAC 5-590-90, add the following:

1. The service area of any Community Water System shall be as reviewed by The Authority and approved by the Clarke County Board of Supervisors. The Applicant shall provide a certificate from the Clarke County Zoning Administrator, establishing that the area to be served by the proposed water system has been zoned for the particular land use or uses described in the application.

2. If, in the future determination of The Authority, the system may be connected to another water system, The Authority may do so at its discretion, but in accordance with the requirements of Clarke County.

3. The Community Water System shall be approved by The Authority. The Authority will only consider for approval, groundwater systems not influenced by surface water. As owner and operator, the Authority represents the future customers who will depend on a reliable and durable facility. As such, The Authority reserves the right of approval. Before agreeing to accept any Community Water System, The Authority shall review and approve all design documents applicable to that system, including the Basis of Design, Preliminary Engineering Report, and Plans and Specifications. Said review and approval shall be in accordance with these standards and shall be in addition to, and take precedence over, required approvals by county, state, and federal authorities. The Authority's procedure is shown by the chart "DESIGN REVIEW PROCESS" in Appendix D of these Standards. This procedure shall govern all review and approvals. The procedure requires that The Authority approve a "Basis of Design" prior to the Preliminary Engineering Conference required by the VDH. It also requires approval of a

"Preliminary Engineering Report" prior to submitting the official Engineer's Report to VDH.

4. Community Water Systems shall be constructed at no cost to The Authority. In order to ensure standardization, reasonable equipment inventories, and compatibility with efficient maintenance procedures, the design and construction shall be in accordance with all applicable sections of these Standards, and the *Waterworks Regulations*.

5. Each Community Water System shall be financially self-sustaining. The Authority has adopted a single rate structure for all applicant initiated Community Systems. A "Cost of Service Review", consisting of a rate study, shall be provided to The Authority for review no later than the final submission of the plans and specifications. The review shall determine annual costs for a five-year basis, replacement costs for 40 years, and determine how anticipated costs and revenues compare. If the cost of service over a 40 year like-cycle exceeds the anticipated revenue then the Applicant must submit a Revenue Equalization Fee payable in installments, once the system is operational. As such, operating, maintenance, repair and replacement, and upgrade costs shall be borne by the owners of all properties within the service area for said system and a notice to this effect shall be recorded in each homeowner's covenant. In the interest of economy-of-scale, a mandatory connection provision may be required by The Authority Board for inclusion within the homeowner's covenant.

6. Adequate construction and maintenance easements or access rights-of-way for all Community Water Systems shall be provided for future extensions as well as new infrastructure. Perpetual easements in lieu of fee simple property for pumping stations and treatment facilities shall not be provided unless specifically approved by The Authority.

7. Community Water Systems shall require an Agreement (Water Agreement) between the Authority and the Applicant. The Water Agreement shall require the Applicant to subsidize the operation and maintenance of the waterworks until such time that 90 percent of the units within the development are sold and connected to the system. The Applicant shall agree to perform all construction in accordance with the plans and specifications approved by The Authority and in accordance with Authority standards. Applicant shall agree to transfer to The Authority all property and facilities free of debts, liens and/or other legal encumbrances, for ownership, operation and maintenance. The Water Agreement shall be completed prior to issuance of the Construction Permit by The Authority.

8. The design of the Community Water System shall incorporate such features as are determined by The Authority to be warranted, to facilitate system expansion or upgrade of treatment processes in the future. This may include branches of pipe, valves, vaults, and reserved spaces for the future addition of Major Process Equipment.

9. As the applicant identifies well sites, the proposed well locations must be submitted to The Authority for informational purposes. The Authority must be given notification and access, so that drilling and well development can be monitored. Where conditions warrant, The Authority may require special steps in commissioning the well, to assure and verify its performance. Failure to make the well available for The Authority's

inspection during its drilling and development may result in the well being ineligible for acceptance as a water source for the project.

10. Wells must be developed in conformance with the Clarke County ordinance, including its requirements for investigation of the site's hydrogeology, with corresponding reporting and testing. The Authority will be furnished with these reports and test results by the Applicant.

11. Once the system is operational, The Authority will operate the system under a contract with the Applicant for at least one year, prior to the system being accepted for The Authority's ownership.

D. Variances

To 12 VAC 5-590-140, add the following:

The applicant may apply to The Authority for variances to these Community Water Standards provided the variance requests are made in writing to the Authority.

E. Construction Permits

To 12 VAC 5-590-200, add the following:

1. Refer to Chapter 3 of these Standards for complete permitting and bonding procedures. General requirements for permits are as described below.

2. The Authority must review and approve the construction drawings, plans and specifications for a project prior to issuing The Authority's Construction Permit. This construction permit references the executed Community Water System Agreement between The Authority and the applicant, and summarizes terms and conditions between the parties. A Waterworks Permit is required from the Virginia Department of Health, executed by a Virginia licensed Professional Engineer.

   Upon approval, The Authority will send notice and a Construction Permit for execution by the project's applicant. The following items must be in place prior to execution of Construction Permit by The Authority:

   a. Performance Bond and Labor and Materials Payment Bond

   b. Certificate of Insurance, naming The Authority as additional insured

   c. payment of balance (if any) of Plan Review Fee

   d. payment of Inspection Fee

   e. digital data reflecting the approved construction plans

   f. executed Agreement

   g. conveyance and recordation of supporting easements

Once all necessary items are in place, The Authority will fully execute the permit, send approved plans, and permit to the Inspections Department for pre-construction meeting.

3. Prior to commencement of construction, a mandatory pre-construction conference shall be held and a list of major process equipment shop drawings to be reviewed by The Authority shall be established. The applicant shall submit its proposed agenda to The Authority for approval at least 7 days prior to the conference.

F. Formal Requirements for the Submission of Engineering Data

To 12 VAC 5-590-210, add the following:

1. In accordance with Appendix D of these Standards, provide a Basis of Design Report, which shall include:

   a. Proposed Service Area including a detailed vicinity map showing individual lots within the proposed subdivision layout; and the required system capacity (based on number of proposed lots and The Authority-required flow rates) and number of wells.

   b. Treatment Technology to include applicable (and The Authority acceptable) treatment technologies; provide a process flow diagram for each unit process.

   c. If necessary, like-cycle cost comparisons among competing technologies considering initial and replacement costs, maintenance costs, operational costs and reliability.

   d. For selected treatment technology, provide design criteria, catalog cut sheets of major process equipment, and a detailed process flow diagram showing number of units and capacities of the major process equipment components. Design criteria must meet the more stringent of the *Waterworks Regulations* or Authority standards. Calculations shall include hydraulics, process chemistry, anti-flotation calculations, and water hammer analyses. Water hammer analyses may be waived by The Authority for booster pumping station capacities less than 500 gallons per minute, or station pressures less than 50-feet total dynamic head. Systems where column separation can occur shall have water hammer analyses conducted.

2. Before The Authority will review the applicant's plans and specifications, the Applicant must pay applicable engineering review fees as described in the *Rules and Regulations*. Plan review will not commence until all plans, including architectural, site/civil, and electrical/mechanical are submitted to make a complete package.

G. Issuance of the Operation Permit

To 12 VAC 5-590-260, add the following:

1. The Applicant shall complete and submit the "Statement of Completion of Construction" to the VDH upon its satisfaction that the Treatment Works meets the requirements of the approved plans and specifications and only when a final inspection by the VDH is warranted. The Authority shall approve the "Statement of Completion of Construction" prior to the Applicant submitting it to the VDH.

2. The Applicant shall maintain record drawings of as-built conditions that vary from the work as originally shown on the contract drawings. The Applicant shall submit electronic files of the record drawings within 30 days after completion of construction and prior to acceptance of the facility by The Authority. Provide coordinates for field location of valves, manholes, and other buried facilities. For required electronic format, see Chapter 3 of these Standards.

3. Draft and Final Operation and Maintenance Manuals must be approved by the Authority before substantial completion and prior to submittal to the VDH for approval.

H. Inspection and Correction

To 12 VAC 5-590-270, add the following:

1. The Authority will accept or reject shop drawings for major process equipment and provide inspection of the Community Water Systems in accordance with the Community Water System Agreement. All shop drawing submittals shall bear the stamp of approval of the Applicant as evidence that the Applicant has checked the shop drawings. Submittals without this stamp of approval will not be reviewed and will be returned to the Applicant for resubmission. The Applicant shall cite in the letter of the transmittal all shop drawing variances from the requirements of the contract Documents and the design modifications proposed to accommodate the variances. If variances are not cited, the Applicant will not be relieved of the responsibility for executing the work in full conformance with the Contract Documents even though such submittals have been accepted by The Authority.

2. Pumps and other major process equipment shall be certified by the manufacturer. Certifications shall be provided to The Authority prior to shipping to the site.

I. General

To 12 VAC5-590-640, add the following:

Plans shall be submitted in accordance with the requirements of Chapter 3 of these Standards.

J. Capacity of Waterworks

To 12 VAC 5-590-690, add the following:

1. The applicant for the proposed system will prepare a Water Budget for the community, to establish the quantity and patterns of usage that may be anticipated. Irrigation (if any) must be considered in this accounting. Unless otherwise determined by The Authority upon review of the Water Budget, the system will be designed to meet a maximum daily demand of 900 gallons per equivalent residential connection.

2. Treatment process units shall be sized to match the well pumping capacity.

3. It is strongly recommended that where underground irrigation systems are to be allowed within the community, that a separate water system with a separate source of water be constructed to serve irrigation. Under this arrangement, the irrigation supply

and potable water system are to be designed as hydraulically independent of one another.

4. Minimum acceptable effective storage for domestic purposes shall be not less than 450 gallons per equivalent residential connection while maintaining minimum working pressures. Storage for fire suppression shall be in addition to that demanded by service connections.

5. Minimum working pressure at service connections shall be 50 psi at peak hourly flow rates under build-out conditions, and with system equalization storage at either low levels or pressures.

6. All groundwater systems shall provide the number of wells that are anticipated to be capable of continuously pumping no less than 1.2 gpm per connection for 60 consecutive days.

7. Groundwater systems having more than fifty connections shall have the number of wells indicated below; each determined to be independent of one another in hydrogeology. All well yield combinations stated below refer to the minimum pumping test rates to be used during a 72 hour groundwater testing program, as described in Section P Groundwater Sources (12 VAC 5-590-840) of this chapter.

8. Provide 3 wells, with each producing a minimum of 0.6 gpm per connection. Two wells shall be in service; the third well shall be identified, developed, and reserved as a backup well with the required easements. Once the development reaches 60% of build-out, The Authority will assess whether the raw water line and the reserve well must be placed in service.

9. Four or more wells, the two smallest of which shall produce a combined minimum of 0.6 gpm per connection and with the smallest well producing at least 0.12 gpm per connection. A standby well shall undergo initial hydro geological testing and be reserved as a backup well with the required easements. Once the development reaches 60% of build-out, The Authority will assess whether the raw water line and backup well must be developed by the applicant and placed in service. Wells in service shall produce a minimum of 1.2 gpm per connection.

10. Groundwater systems serving 26 to 50 connections shall have at least 2 wells producing a combined total of 1.8 gpm per connection, the smallest of which must produce a minimum of 0.6 gpm per connection.

11. Groundwater systems serving 25 or fewer connections shall have at least 2 wells producing a combined total of 2.4 gpm per connection, the smallest of which must produce a minimum of 0.6 gpm per connection.

12. For areas of karst topography, the potential for well failure is greater. Therefore, all such groundwater systems shall have in addition to what is stated above at least one additional standby well developed and capable of producing at least 0.3 gpm per connection.

13. Unless otherwise approved by Clarke County, Community Water Systems shall have fire flow capability. System design will be based on the following criteria, but not less than that established by Clarke County Ordinance, Chapter 1042.03:

    a. Less than 100 homes – 250 gpm for 2 hours plus maximum daily demand at 20 psi minimum

    b. 100 to 199 homes – 500 gpm for 2 hours plus maximum day demand at 20 psi minimum

    c. More than 200 homes – 750 gpm for 2 hours plus maximum day demand at 20 psi minimum

    d. Distribution mains conveying water for fire suppression shall be of a minimum 6-inch diameter.

K. Site Layout

To 12 VAC 5-590-710, add the following:

1. Provide exterior lighting around all major process equipment and controls with luminance ranging from 10 to 20 foot-candles.

2. Facilities shall be enclosed by steel security fence. Fence shall provide adequate clearance for maintenance, snow removal and other required activities. Fencing shall be black, PVC-coated (ASTM F668 Class 2b) chain link (8 feet fabric height) with 6 barbed wire strands (3 facing in, 3 facing out) on top. Gateposts shall be 4 inches in diameter and corner posts shall be 2.625 inches in diameter. Provide pad lock per The Authority standard with a shank size of ¼-inch in diameter.

3. Provide facility address sign at facility entrance in accordance with County standards.

4. Building sites shall have access by roadways a minimum of 12 feet wide, with maximum 8% slope, and minimum 50-foot radius of horizontal curvature. Surfaces of roadways and parking areas are to be bituminous concrete equal to a minimum of 3 inches of intermediate mix (IM1-A) on 6 inches of 21A subbase. A minimum of 3 parking spaces shall be provided. A turnaround area shall be provided for large trucks, turning at a 50-foot radius. Roadways to treatment and pumping facilities shall be gated. The gates shall have reflectors. In cases where the treatment plan and/or pumping facility are fenced, the gate shall be a fenced gate with pad lock per the Authority standard with a shank size of ¼-inch in diameter. Where the treatment plant and/or pumping facility is not fenced, the gate shall be constructed in accordance with the Authority's standards.

5. Provide antenna needed by the Authority's SCADA, in accordance with the current standards for that system.

6. Provide antenna, data collector, and communications service needed by the Authority's automated meter reading system, whereby meters within the associated distribution system will be monitored. This may be located at the site of a well, treatment, or water storage.

L. Building Layout

To 12 VAC 5-590-720, add the following:

1. Provide suitable architectural treatment. Brick/block shall be provided. Provide quality interior block filler and paint. Split-faced CMU with foam insulation may also be used. Slope roofs and provide aluminum gutters with leaf guards and downspouts. Use standing seam metal roof with Kynar finish for high visibility areas. Soffit and fascia shall be of low maintenance vinyl materials. Provide insulated, moisture-resistant, painted drywall finish on interior walls and ceilings in laboratory office and hypochlorite storage areas in accordance with Clarke County code for residential occupancy.

2. A minimum laboratory space of 400 square feet shall be provided, unless The Authority determines that another of The Authority's laboratories can serve this purpose. Note that sufficient workspace and equipment must be provided in the building for daily operational tests.

3. Floor slabs within all building shall be steel reinforced and shall be sloped 1/8-inch per foot to a floor drain. Floor to have power-trowel finish and waterproofing sealer applied. Provide Dri-deck in potential spill areas. Provide industrial grade vinyl tile, or equal, for office and laboratory areas. Floor drains shall be provided in laboratory and lavatory. Well blow-off line and floor drain shall have separate discharge piping to grade (if possible) with a screened or capped discharge end.

4. Provide minimum 3 feet separation between all equipment and walls or other equipment.

5. Provide standard the Authority building inventory to include maintenance equipment, safety equipment, supplies, shelving, desk and chair, and file cabinet for on-site record storage.

6. Provide lightning arrestor/protection for each well house and treatment plant.

7. Provide running time meters for all pumps.

8. Doors shall have a closer and wall mounted hook doorstop, and replaceable cores with keys matched to The Authority standard.

9. Intake and exhaust louvers shall have stainless steel insect screens. Provide gravity dampers with PVC seal strips.

10. Electrical equipment shall meet the following the Authority's standards:

    a. Breakers are to be made by Square D or Cutler-Hammer.

    b. Provide automatic reset and startup for all electrical relays.

    c. Provide GFI protected electrical receptacles on all interior walls, a maximum of 12 feet apart.

d. Exterior control panels shall be stainless steel NEMA 4X. Interior control panels shall be fiberglass NEMA 4X.

e. Do not mount equipment and electrical panels on tanks or wet wells.

f. Provide lights over all exterior doors.

g. Provide GFI protected electrical outlets all four exterior sides or every 40 (horizontal) feet.

h. Conduct arc flash study and make corresponding provisions to ensure operator safety. Design system to Class 2 or lower rating for arc flash.

11. Process equipment shall be fitted for monitoring the flow of raw and finished waters, using flow indicators, totalizers and digital recorders. Flow meters 1.5-inch and larger will be electromagnetic type, fitted with appropriate options. Acceptable flow meters are Badger M3000 Series or Invensys FOXBORO 9100 Series.

12. Instrumentation shall be integrated with The Authority's SCADA, in accordance with the current standards for that system. Should it be determined that the community is too remote to receive a signal from this system, then provisions will be made for possible future integration.

13. Provide heat and air conditioning in laboratory and sodium hypochlorite storage rooms.

14. Where emergency generator is to be indoors, it shall be in a room dedicated to this purpose.

15. At The Authority's discretion, a lavatory (toilet, sink, and shower with a 30-gallon water heater) may be required to serve operators of the community system.

M. Maintenance and Servicing of Equipment

To 12 VAC 5-590-740, add the following:

1. Specifications for major process equipment shall include provisions for start-up, testing and training of The Authority personnel in operation and maintenance of the equipment. Minimum training provided shall include 2 separate days of on-site instruction to allow attendance by different shifts of The Authority personnel. Instructors shall be certified by the equipment manufacturers as competent to provide the required training.

2. At the option of the Authority, the applicant shall provide a lump sum payment to The Authority equal to 3 percent of the construction costs of major process equipment in lieu of manufacturer-recommended spare parts. Under this option, The Authority will order and store spare parts.

N. Wall Castings

To 12 VAC 5-590-780, add the following:

Pipe through floor or wall shall have Omni Sleeve by Sigma or The Authority approved equal.

O. Disinfection

To 12 VAC 5-590-800, add the following:

Use of liquid chlorine (to be used as a gas) is prohibited.

P. Groundwater Sources

To 12 VAC 5-590-840, add the following:

1. Hydrogeological study is required per Clarke County requirements, and shall be approved by Clarke County Health Department and a copy provided to The Authority for review and comment. All wells shall be Class I construction.

2. A 100-foot radial or a square, 200 feet by 200 feet, well lot will be required as a minimum for each well.

3. Wells shall not be located within any major 100-year flood plain (per Clarke County codified ordinance).

4. A 72-hour yield test followed by recovery test must be performed. If more than one well is proposed, the yield and recovery tests must be sufficiently overlapping for all the wells so as to confirm that wells do not influence each other during pumping. Wells located in karst geology will be subject to additional testing requirements to assure their suitability. Note that The Authority requires minimum of 1.2 gpm production for each residential connection to the system. Well yield and drawdown information will be subject to disapproval if the information is older than 5 years, is not performed simultaneously with other nearby proposed wells, or negatively impacts nearby preexisting wells.

5. A total of 20 water samples for total coliform analysis using MPN method must be collected from each well. Samples must be collected in accordance with an approved plan starting 8 hours after the yield test has begun. This groundwater-sampling plan will be submitted to The Authority as indicated below. If concentration of total coliform in any sample is greater than 3, the sample must further be analyzed for presence of fecal coliform.

6. Water samples for complete chemical, physical and radiological analyses must be collected towards the end of the yield test, e.g., 70th hour for 72-hour test. List of the parameters to be analyzed must comply with the most recent edition of these *Waterworks Regulations* and any upcoming federal regulations.

7. A daily log of weather conditions during the pumping test program must be kept by the driller. The log must include rain events and their magnitude.

8. Results of all sample analyses shall be submitted to The Authority and to the Virginia Department of Health if required, as part of the overall hydrogeology report.

9. A written schedule of events shall be submitted to The Authority 2 weeks prior to start of the above evaluation. The Authority normally will provide comments within five days after receipt.

10. Any negative impact to surrounding wells is unacceptable and must be addressed by the applicant to the satisfaction of the respective owners of the wells.

11. Well head protection measures shall be employed in accordance with the *Handbook for Developing a Public Water Supply Well*, published by the Virginia Department of Health.

Q. General

To 12 VAC 5-590-850, add the following:

1. Treatment systems shall be based on conventional technology and be supported by references, as required by The Authority, from 5 similar systems each with at least 3 years of successful operation at build-out capacity. Examples of conventional technology are manganese greensand filters for iron, manganese, and radium removal; membrane filtration; chlorination for disinfection; ultraviolet (UV) disinfection; sequestration for low levels of iron and manganese; and the addition of VDH-approved chemicals for corrosion control.

R. Chemical Application

To 12 VAC 5-590-860, add the following:

1. Chemical systems utilizing sodium hypochlorite shall utilize 15%-50% solutions per AWWA B300 standard, depending on the feed rate and storage time.

2. Chemical feed systems shall use liquid solutions or, if approved by The Authority, liquid solutions prepared from dry chemicals. A spare chemical feed pump shall be provided for each system. Adequate facility room and climate control shall be provided for bulk chemical storage and solution day tanks, as The Authority deems necessary.

3. The applicant shall provide secondary containment for day solution tanks and raw chemical drums, adequate raw chemical transfer equipment, and calibration tubes for all chemical feeders. Size chemical feeders to operate near middle of capacity range. Provide separate chemical storage room and ventilation for highly corrosive chemicals.

4. Chemical feed systems shall have:

   a. peristaltic type feed pumps with an anti-siphon valve and backpressure valve at the discharge.

   b. Dry tanks and transfer pumps where required to make up 15% feed solutions.

   c. chemical feed tubing as specified in **Table 7.1** of this Chapter. Support tubing with lengths of Schedule 40 PVC pipe, with chamfer cut ends.

   d. translucent solution tank with liquid level scale and weight scale.

e. vacuum breaker on makeup water spigot when hoses are used.

f. room temperature control for hypochlorite storage.

g. protective equipment (rubber apron, rubber gloves, combination face shield/head gear, safety shower and eyewash station).

S. Disinfection

To 12 VAC 5-590-1000, add the following:

1. Where groundwater source is in karst topography, the risk of contaminants in the groundwater is higher. Therefore, in addition to the chlorination system, the Authority may require UV disinfection.

2. In karst topographies where there are insufficient soil strata to act as a filter for groundwater recharge, the Authority may further require filtration by membranes. Parameters to be considered in the determination to use membrane filtration are presence/absence of E-coli, Microscopic Particle Analysis result in excess of 15, and/or Total Coliform count greater than 100.

T. Groundwater Facilities

To 12 VAC 5-590-1030, add the following:

1. Well meter shall have counter that has readout suitable for RTU service.

2. Drawdown gauges and airlines are prohibited. Provide The Authority approved level transducer, with data logger, installed inside protective HDPE conduit.

3. Electric power cables shall be attached to the pump riser with approved plastic fasteners. Adhesive tapes are prohibited.

4. Well pumping controls shall be based on storage tank level, shall have remote LCD tank level indicators, and shall include provisions for future wells.

5. Alarms are to be transmitted by telephone auto dialer. Instrumentation shall also be integrated with The Authority's SCADA, in accordance with the current standards for that system. Should it be determined that the community is too remote to receive a signal from this system, then provisions will be made for possible future integration.

6. Dry, normally open contacts will be provided for all status and alarm circuits. This will include pump run/fail, generator run/fail, AC power status, generator starting system loss of charge, and pump overload. Both audible and visual alarms will be provided at the pumping station. A press-to-test circuit will be installed for all of the control and alarm panel indicator lights. Generator fail and power fail alarms shall function upon complete loss of power. All alarms shall clear after events and return to normal (no latching alarms to SCADA). An antenna pole or tower will be installed at the station near the control building for the SCADA antenna. The location of the antenna pole will be shown on the project plans.

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

    a. Pump On (each pump)

    b. Pump Fail (each pump)

    c. Flow Rate/Total

    d. Tank Level with High Water Alarm and Low Water Alarm

    e. Loss of Primary Power

    f. Generator Standby/Secondary Power On/Generator Failure

    g. Generator Fuel Low

    h. Building/Hatch Intrusion Alarm

    i. UPS Run/Fail

    j. Building Temperature Alarm

8. Standby generator (or at The Authority's discretions, a NEMA 4X capped receptacle, 4P5W design of adequate rating for portable generator) shall be provided with the capability to power the closest water supply well, and any booster pumps, to meet the peak demand. Fuel storage will be adequate for 36 hours of operation. Generator shall be by Cummins Onan.

9. Well house piping shall utilize:

    a. separate blow-off lines and floor drains. Provide blow-off lines downstream of the meter and check valve.

    b. concrete headwalls and rip rap for termination of drain lines. Cover flanged discharge opening with #4 mesh stainless steel screen and bolted flange.

    c. Omni Sleeve by Sigma or other The Authority approved system for all pipes passing through slabs or walls.

    d. Dresser couplings.

    e. straight pipe at least 5 times the pipe diameter prior to meters.

    f. 12 inches of vertical clearance between floors and flanges.

    g. ¾-inch brass ball valves for sample taps.

10. Wells in remote locations shall be housed and fenced.

U. Pump Stations

To 12 VAC 5-590-1040, add the following:

1. Pumping stations shall be protected against lightning.

2. Pump motors 7.5 horsepower and larger shall be 480 volt and shall be equipped with reduced-voltage starters. Ramp up and ramp down time shall each be limited to 3 seconds.

3. Standby generator (or at The Authority's discretions, a NEMA 4X capped receptacle, 4P5W design of adequate rating for portable generator) shall be provided with the capability to power the closest water supply well, any booster pumps, and any air compressors, so as to meet the peak demand. Fuel storage will be adequate for 36 hours of operation. Generator shall be by Cummins Onan.

4. Telemetry and instrumentation shall be provided as described above for groundwater pumping facilities.

V. General

To 12 VAC 5-590-1080, add the following:

1. Storage tanks for community systems shall be glass-lined bolted tanks conforming to AWWA D103. Glass-lined tanks shall have:

   a. copolymer caps on all interior and exterior nuts and bolts.

   b. fall prevention system and 2 climbing harnesses. Provide fold back on ladder to prevent unauthorized entry.

   c. curbed, sleeved and sealed float tube entrance through the roof.

   d. drain tank sump within the concrete foundation.

   e. ductile iron pipe, in accordance with **Table 6.1** of this Chapter.

   f. independently valved tank drain.

   g. adequate roof vent area for draining (vacuum) and filling.

   h. lightning protection.

   i. 2 lockable access hatches on opposite ends of tank shell bottom.

   j. standard cobalt-blue exterior finish unless otherwise approved.

   k. brackets on tank roof for future attachment of 2 communications antennae.

   l. a foundation design with adequate capacity to increase tank volume by 25 percent.

   m. provision for disinfecting and filling of the tank by the contractor.

2. Provide a valved connection between the well supply and the gravity storage tank suitable for a portable truck hook-up in case the gravity tank is taken off-line for maintenance or repair.

W. Distribution Storage

To 12 VAC 5-590-1100, add the following:

1. Gravity storage (elevated tank, reservoir or standpipe) facilities shall be used where possible. If one or more hydro pneumatic tanks are required, at least 2 booster pumps shall be provided for each tank. The maximum-hour domestic demand flow shall be met with the largest pump offline.

2. Elevated tanks and standpipes shall be provided with ladders incorporating the Miller VI-GO™ fall prevention system. For standpipes, provide separate inlet and outlet lines with weep hole near bottom of internal inlet. Floats and electrodes are prohibited within tanks. Provide ultrasonic level transmitter.

3. Hydropneumatic tank systems shall be provided with lead/lag air compressors.

4. Telemetry and instrumentation shall be provided as described above for groundwater pumping facilities.

X. Materials

To 12 VAC 5-590-1110, add the following:

1. Piping materials shall be provided in accordance with The Loudoun Water *Approved Materials List* and **Table 6.1** below.

Application	Size	Specification
Raw water lines	4-inch and larger	Ductile iron pipe AWWA C151, Class 52 or better, with AWWA C153 MJ fittings
	3-inch and smaller	HDPE AWWA C901, 160 psi rated, IPS size, ASTM F2620 with fittings to ASTM D3261
Process piping (above grade)	4-inch and larger	Ductile iron pipe AWWA C151, Class 52 or better, with flanged fittings to AWWA C110
	3-inch and smaller	PVC ASTM D1785 Schedule 80 with Schedule 80 fittings
Yard piping (below grade)	4-inch and larger	Ductile iron pipe AWWA C151, Class 52 or better, with AWWA C153 MJ fittings

	3-inch and smaller	PVC ASTM D2241 SDR 21
Chemical feed tubing	All diameters	Suction: high density polyethylene (HDPE) Shore A Durometer = 65 Tensile strength = 3900 psi, FDA Grade, translucent Discharge: low density polyethylene (LDPE) Shore A Durometer =94 Tensile strength = 2800 psi, color coded, FDA Grade Fittings: compression type with 316 stainless steel reinforcing sleeves

See the Loudoun Water *Approved Materials List* for items not listed, and for approved manufacturers.

Table 6.1 – Piping Materials

Y. System Design

To 12 VAC 5-590-1130, add the following:

1. A computerized hydraulic analysis of the distribution system shall be submitted to The Authority for review and approval. See Chapter 4 of these Standards for requirements.

2. Water distribution system design shall comply with Chapter 4 these Standards.

-- end of Chapter 6 --

Chapter 7: Wastewater Treatment

7.1 Scope

A. Intent

This Chapter provides requirements and standards for wastewater treatment systems designed and constructed on behalf of the Authority. These standards are not intended to be all-inclusive. The Authority will consider alternative means and methods to accomplish its objectives based upon good engineering practices and demonstrated technical effectiveness, reliability and cost effectiveness.

B. Standards

The community wastewater system standards presented herein shall supplement the latest edition of the *Sewage Collection and Treatment (SCAT) Regulations* 9 VAC 25-790, as published by the Commonwealth of Virginia, Department of Environmental Quality (DEQ). The *SCAT Regulations* represent the minimum design requirements. All requirements of the *SCAT Regulations* shall be adhered to. As the owner, The Authority may identify and determine the need for standards and requirements that are more stringent than those contained in Part III of the *SCAT Regulations*.

The headings and sub-headings of this chapter are based on the *SCAT Regulations*. In instances where no additional requirements are specified, the *SCAT Regulations* shall apply as written.

If the proposed system uses a soil-based effluent discharge, wastewater infrastructure shall meet the requirements of the latest edition of the *Sewage Handling and Disposal Regulations* 12 VAC 5-610, as published by the Commonwealth of Virginia, Department of Environmental Quality.

If reuse of reclaimed wastewater is to be practiced at locations other than the wastewater treatment plant site, the project shall adhere to the *Water Reclamation and Reuse Regulation* 9 VAC 25-740-10 et seq.

C. Interpretation

Wastewater infrastructure shall meet the applicable requirements of these Standards. The Authority will grant no exceptions to the requirements of these standards, except where doing so provides a direct benefit to the Authority.

7.2 Requirements Supplemental to SCAT Regulations

A. Definitions

To 9 VAC 25-790-10, add the following:

> **"Applicant"** means the developer or property owner seeking approval of the Community Wastewater System.

"The Authority Design Standards" means The Authority-approved procedures, methods, and materials as promulgated in these Standards.

"Community Wastewater System" means any free-standing system to be owned and/or operated by the Authority. Freestanding systems are not connected to The Authority's central wastewater system.

"Major Process Equipment" means mechanically or electrically actuated process equipment requiring routine maintenance and specified in Divisions 11 through 16 of contract specifications formatted in accordance with the Construction Specifications Institute. Major process equipment includes, but is not limited to, pumping and treatment unit processes and associated electrical controllers, motor control center, SCADA equipment, and standby generator/transfer switch.

"SCADA System" means The Authority's system control and data acquisition system for instrumentation, whereby equipment and processes are remotely monitored.

B. Extent

To 9 VAC 25-790-30, add the following:

1. The service area of any Community Wastewater System shall be as reviewed by The Authority and approved by the Clarke County Board of Supervisors. A copy of the site plan permit also is required of the applicant. If, in the future determination of The Authority, the system may be connected to another water system, The Authority may do so at its discretion.

2. The Community Wastewater System shall be approved by The Authority. As owner and operator, The Authority represents the future customers who will depend on a reliable and durable facility. As such, The Authority reserves the right of approval. Before agreeing to accept any Community Wastewater System, The Authority shall review and approve all design documents applicable to that system, including the Basis of Design, Preliminary Engineering Report, and Plans and Specifications. Said review and approval shall be in accordance with these standards and shall be in addition to, and take precedence over, required approvals by County, State, and Federal authorities. The Authority's procedure is shown by the chart "DESIGN REVIEW PROCESS" in Appendix D of these Standards. This procedure shall govern all reviews and approvals. The process allows the Design Engineer to apply for a VPDES or VPA permit directly to the Department of Environmental Quality (DEQ), but thereafter requires that The Authority approve a Basis of Design prior to the Preliminary Engineering Conference. It also requires approval of a Preliminary Engineering Report prior to submitting the official Preliminary Engineering Proposal to DEQ. Applications to DEQ shall be made with the knowledge and approval of The Authority who, acting as owner and operator, shall become the permit holder.

3. Community Wastewater Systems shall be constructed at no cost to The Authority. In order to ensure standardization, reasonable equipment inventories and compatibility with efficient maintenance procedures, the design and construction shall be in accordance with these Standards, as well as the latest editions of the *Sewage Collection and Treatment Regulations*; the *Biosolids Use Regulations* 12 VAC 5-585, the *Sewage*

Handling and Disposal Regulations 12 VAC 5-610, and the applicable Chapters of these Standards.

4. Each Community Wastewater System shall be financially self-sustaining. As such, operation, maintenance, repair and replacement, and upgrade costs shall be borne by the owners of all properties within the service area for said system, and a notice to this effect shall be recorded in each property's covenants. In the interest of economy-of-scale, a mandatory connection provision may be required by the Authority Board for inclusion within the property covenants.

5. Adequate construction and maintenance easements or access rights-of-way for all Community Wastewater Systems shall be provided. Said easement access shall be provided for planned extensions as well as new infrastructure. Perpetual easements in lieu of fee simple property for pumping stations and treatment facilities shall not be accepted unless specifically approved by The Authority.

6. Community Wastewater Systems must be built under an Agreement between The Authority and the Applicant. The Agreement shall provide for the Applicant to subsidize the operation and maintenance of the plant until such time as 90 percent of the units within the development are sold and connected to the system. The Applicant shall agree to perform all construction in accordance with plans and specifications approved by The Authority and in accordance with The Authority standards. The Applicant shall agree to transfer to The Authority all property and facilities free of debts, liens, and/or other legal encumbrances, for ownership, operation and maintenance. The Agreement shall be completed prior to acceptance of the Plans and Specifications by The Authority.

7. "Cost of Service Review", consisting of a rate study, shall be provided to The Authority for review no later than the final submission of the plans and specifications. The review shall determine annual costs for a 5 year period, replacement costs for 40 years, and determine how anticipated costs and revenues compare.

8. The design of the Community Wastewater System shall incorporate any such features as are determined by The Authority to be warranted, to facilitate system expansion or upgrade of treatment processes in the future. This may include branches of pipe, valves, vaults, and reserved spaces for the future addition of Major Process Equipment.

C. Variances

To 9 VAC 25-790-40, add the following:

The Applicant may apply to The Authority for variances to these Community Wastewater Standards provided the variance requests are made in writing to the Authority.

D. Reliability Classification

To 9 VAC 25-790-70, add the following:

Community Wastewater Systems shall be classified as Reliability Class I.

E. Certificate to Construct Application

To 9 VAC 25-790-90, add the following:

1. The Applicant shall provide a certificate from the Clarke County Zoning Administrator that the area to be served by the proposed treatment facility has been officially zoned for the particular type, or types, of land use described in the application. A copy of the Site Plan Permit is also required of the applicant.

2. Provide a basis of design report that shall include:

   a. Proposed Service Area

      - Detailed vicinity map showing layout of lots within the proposed community.
      - Required system capacity based on number of proposed lots and The Authority required flow rates.

   b. Discharge/Land Application Determination

      - Description of discharge location.
      - Required permit.
      - Required treatment limits.

   c. Treatment Technology

      - Describe proposed treatment technologies and provide sizing calculations and a process flow diagram for each.
      - Perform, if necessary, like-cycle cost comparisons among competing technologies considering initial and replacement costs, maintenance costs, operational costs and reliability. Labor and power cost estimates will be provided by the Authority.
      - For the selected treatment technology, provide design criteria, catalog cut sheets of major process equipment, and a detailed process flow diagram showing number of units and capacities of the major equipment components. Design criteria must meet the more stringent of *SCAT Regulations* or the Authority's standards.

   d. Land Application of Treated Effluent

      - Spray Application – preliminary phase site evaluation (per *SCAT Regulations*). The Authority promotes land application for reuse purposes. However, if spray application is proposed for disposal purposes only, this method of disposal is discouraged, and the Applicant must request a variance

from The Authority during the Basis of Design. The Authority will only consider spray irrigation for effluent disposal if the Applicant can show that subsurface disposal is not possible on the Applicant's property.

- Subsurface Disposal - provide the same applicable information as for spray application.

e. Other Requirements:

- Sludge Management Plan (the Authority will provide upon request)
- Facility location & site plan
- Architectural Issues – provide brief description of proposed buildings

F. Preliminary Engineering Conference

To 9 VAC 25-790-100, add the following:

The Applicant will coordinate the meeting with DEQ and the Authority after approval of the Basis of Design.

G. Preliminary Engineering Report

To 9 VAC 25-790-110, add the following:

The applicant will coordinate the meeting with DEQ and the Authority after approval of the Preliminary Engineering Report. The Preliminary Engineering Report shall also include the following:

- Process and instrumentation diagram
- Equipment selection
- Materials of construction
- Soil investigation reports
- Community Wastewater System Agreement modification requests

H. Specifications

To 12 VAC 25-790-130, add the following:

The Applicant initially will submit the specifications to The Authority for review. The Applicant may send subsequent submissions to the Authority and DEQ for parallel review.

I. Operation and Maintenance Manuals

To 9 VAC 25-790-140, add the following:

1. Draft and final Operation and Maintenance Manuals must be approved by the Authority prior to submittal to DEQ for approval.

2. At the option of the Authority, the applicant shall provide a lump sum payment to The Authority equal to 3 percent of the construction costs of major process equipment in lieu of manufacturer-recommended spare parts. Under this option the Authority will order and store spare parts.

3. Specifications for major process equipment shall include provisions for start-up testing and training of the Authority personnel in operation and maintenance of the equipment. Minimum training provided shall include 2 separate days of onsite instruction to allow attendance by different shifts of the Authority personnel. Instructors shall be certified by the equipment manufacturers as competent to provide the required training.

J. Sludge Management Plans

To 9 VAC 25-790-150, add the following:

A Sludge Management Plan is available from the Authority.

K. Formal Requirements for Submission of Engineering Data

To 9 VAC 25-790-160, add the following:

1. Surveying shall meet State grid coordinate specifications. Provide four northern Virginia grid coordinates for plan views and two horizontal and vertical control benchmarks per site. All drawings shall be 24 x 36 inches in size. Pipeline profiles shall have a horizontal scale of 1 inches = 50 feet or less. Vertical control shall be based on NAVD 88.

2. Geotechnical evaluation, including adequate borings, shall be provided as part of the formal submission of plans and specifications.

3. VDH written approval of active and reserve drain field sites shall be required. All soils investigation reports completed for the applicant shall be provided to the Authority during the Preliminary Engineering Report phase.

4. Calculations shall be submitted for review, and will include hydraulics, process kinetics, anti-flotation calculations, generator sizing, and pressure surge analyses for force mains. Surge analyses may be waived by the Authority for pump station capacities less than 500 gallons per minute and pump discharge pressures less than 50 feet total dynamic head. Systems where water column separation can occur (with significant high or low points) shall have surge pressure analyses conducted, also where force main length is less than 20 times the total dynamic head (TDH) or velocity is greater than 3.5 fps.

5. A clean water testing and start-up plan shall be provided for review and approval by the Authority.

6. Before the Authority will review the Applicant's plans and specifications, the Applicant must pay applicable engineering review fees as described in the Community Wastewater

System Agreement. A plan review will not begin until a complete set of construction plans, including architectural, civil/site, mechanical and electrical, is submitted.

L. Processing of Plans

To 9 VAC 25-790-170, add the following:

The applicant initially will submit the construction documents to the Authority for review. The Applicant may send subsequent submissions to the Authority and DEQ for parallel review.

M. Certificate To Construct

To 9 VAC 25-790-180, add the following:

1. The Authority must review and approve the construction drawings, plans and specifications for a project prior to construction permitting, and will submit the same to the Virginia Department of Environmental Quality or Virginia Department of Health (as required) for a Certificate to Construct. The construction permit references the executed Community Wastewater System Agreement between The Authority and the owner/applicant, summarizes the terms, and conditions between the parties. Complete execution of this agreement is required before the project receives approval by the Authority. A construction permit must be issued and executed by an engineer licensed in the Commonwealth of Virginia as a Professional Engineer.

2. Upon approval, The Authority will send notice and a construction permit for execution by the project's applicant. The following items must be in place prior to execution of construction permit by the Authority:

   a. Performance Bond and Labor and Materials Payment Bond

   b. Certificate of Insurance, naming The Authority as additional insured

   c. payment of balance (if any) of Plan Review Fee

   d. payment of Inspection Fee

   e. digital data reflecting the approved construction plans

   f. executed Agreement

   g. conveyance and recordation of supporting easements

   Once all necessary items are in place, the Authority will fully execute the permit, send approved plans and permit to the Authority's staff for pre-construction meeting.

   The Applicant shall also submit a proposed list of major process equipment shop drawings to be reviewed by the Authority.

3. The Authority will accept or reject shop drawings for major process equipment and provide inspection of the Community Wastewater Systems in accordance with the

Community Wastewater System Agreement. All shop drawing submittals shall bear the stamp of approval of the Applicant's Engineer as evidence that the Applicant has checked the shop drawings. Submittals without this stamp of approval will not be reviewed and will be returned to the Applicant for resubmission. The Applicant shall cite in the letter of transmittal all shop drawing variances from the requirements of the Contract Documents and the design modifications proposed to accommodate the variances. If variances are not cited, the Applicant will not be relieved of the responsibility for executing the work in full conformance with the Contract Documents even though such submittals have been accepted by the Authority.

4. Pumps and other major process equipment shall be certified by the manufacturer. Certifications shall be provided to the Authority prior to shipping to the site.

   Completion of Construction

5. The Applicant's Engineer shall complete and submit the "Statement of Completion of Construction" to DEQ or VDH (as required) upon The Authority's satisfaction that the Community System meets the requirements of the approved plans and specifications and only when a final inspection by the DEQ or VDH is warranted. The Authority shall approve the "Statement of Completion of Construction" prior to the Applicant submitting to DEQ or VDH.

6. The Applicant shall maintain record drawings of as-built conditions that vary from the work as originally shown on the contract drawings. Prior to acceptance of the facility by the Authority, the Applicant shall submit electronic PDF files of the record drawings to the Authority.

N. Non-conventional Methods, Processes or Equipment

To 9 VAC 25-790-210, add the following:

1. Land application processes shall be based on proven, conventional technology. Land application processes not specifically defined within the SCAT Regulations shall be treated by The Authority and the DEQ or VDH (as required) as non-conventional and subject to the Commonwealth's Provisional Operation Permit for a period of 18-months. The Authority shall first review any request for non-conventional methods prior to the Applicant's submission to DEQ or VDH. The applicant must provide pilot data and operational experience in similar situations and conditions demonstrating that the non-conventional system will operate as designed. An operating and maintenance bond for non-conventional systems, equal to 50% of the construction cost of the treatment facilities, will be provided to the Authority for an operating period of five years.

2. Filtration and disinfection units shall be required for non-conventional land application systems, except that post aeration, chlorine contact tanks and dechlorination shall not be necessary. Gas facilities for chlorination and dechlorination shall not be utilized.

3. If the Applicant intends to construct a non-discharging treatment works, a soil profile report must be submitted to the Authority, which includes soil classifications and depth to bedrock, utilizing one boring per 1,000 square feet of absorption field.

4. Due to nutrient offset and BNR requirements, water reclamation or non-point source treatment works are the preferred treatment options.

O. Local Review for Sewerage Systems

To 9 VAC 25-790-220, add the following:

The Authority has local review authority for wastewater collection systems up to 12-inch diameter.

P. Manuals

To 9 VAC 25-790-290, add the following:

Draft and Final "Operating and Maintenance Manuals" must be approved by The Authority prior to Substantial Completion before submittal to DEQ for approval. The operating manual shall be specifically written for the facility and not simply refer to the vendor's O&M manuals.

Q. Reliability

To 9 VAC 25-790-300, add the following:

Operability

For treatment facilities larger than 0.40 mgd, dual process units shall be required. For treatment facilities 0.20–0.40 mgd, this requirement will be evaluated on case-by-case basis depending on treatment technology and disposal method.

R. Collection and Conveyance Sewers

Comply with the *SCAT Regulations* (9 VAC 25-790-310 thru 9 VAC 25-790-370) and Chapter 5 of these Standards.

S. Sewage Pumping Stations

Comply with the *SCAT Regulations* (9 VAC 25-790-380 thru 9 VAC 25-790-440) and Chapter 9 of these Standards.

T. Standards

To 9 VAC 25-790-460, add the following:

For wastewater flows of less than 0.02 mgd, the required treatment system is septic tanks/recirculating sand filters (RSF) with subsurface land disposal. For flows from 0.02 – 0.04 mgd, RSF and subsurface disposal shall be compared on a cost-of-service basis to other technologies. For flows greater than 0.04 mgd, the most cost effective technology shall be provided.

U. Treatment Works

To 9 VAC 25-790-470, add the following:

Instrumentation

1. All influent and effluent flow meters shall be provided with indicating, totalizing and digital recording equipment. Flow meters 1.5-inch and larger will be electromagnetic type, fitted with appropriate options. Acceptable flow meters are Badger M3000 Series or Invensys FOXBORO 9100 Series.

2. Process equipment will have instrumentation to provide alarm upon malfunction or failure. Alarms are to be transmitted by telephone auto dialer.

3. Telemetry and instrumentation shall be integrated with the Authority's SCADA, in accordance with the current standards for that system. Should it be determined that the community is too remote to receive a signal from this system, then provisions will be made for possible future integration.

4. Dry, normally open contacts will be provided for all status and 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. Both audible and visual alarms will be provided at the treatment works. 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). An antenna pole or tower will be installed at the station near the control building for the SCADA antenna. The location of the antenna pole will be shown on the project plans.

5. At a minimum, the following telemetry shall be provided at each treatment facility:

    a. Pump On (each pump)

    b. Pump Fail (each pump)

    c. Flow Rate/Total

    d. Wet Well High Water Alarm and Low Water Alarm

    e. Loss of Primary Power

    f. Generator Standby/Secondary Power On/Generator Failure

    g. Building/Hatch Intrusion Alarm

    h. Grinder/Comminutor Failure

    i. Generator Fuel Low

    j. UPS Run/Fail

    k. Building Temperature Alarm

6. If customer's service is to be metered, provide antenna, data collector, and communications service for The Authority's automated meter reading system. This will be accomplished by the community's water system, if any.

   Essential Facilities

7. The Authority owns and operates a regional laboratory and as such, the minimum laboratory space of 400 square feet shall not be required unless specifically required by the Authority in the Basis of Design. Note that sufficient workspace must still be provided for daily operational tests.

   Odor Control

8. Odor control provisions shall be required.

   Standard Equipment

9. Treatment facilities shall provide the following standard equipment:

   a. Safety equipment and signs, including appropriate arc flash protective equipment

   b. Maintenance equipment

   c. Laboratory equipment and supplies

   d. Confined entry equipment

   e. Doors shall have closers and wall mounted hook doorstops. Keys shall have replaceable cores and be matched using the Authority standard.

   f. Potable water system for wash down facilities, lavatory and laboratory

   g. Wash down facilities for each major unit process. Major unit processes will be identified as such by the Authority during the review of the "Basis of Design". Each major unit process shall have a hose bib with 50 feet of 1-inch diameter hose capable of producing at least 20 gpm at 60 psi.

   h. Lavatory (toilet, sink, and shower) with a 30-gallon hot water heater

   i. Heating and air conditioning in the laboratory and sodium hypochlorite storage rooms

   j. Facility address sign at facility entrance in accordance with County standards

   k. Emergency showers and eyewashes per OSHA requirements

   l. Gas monitors per OSHA and The Authority requirements

10. Systems utilizing drain field applications shall be provided with adequate provisions to protect the fields from heavy equipment and recreational usage detrimental to the drain

field soils and piping. Drain field piping materials and construction shall be designed for AASHTO H20 wheel loading.

11. Building sites shall have access by roadways a minimum of 12 feet wide, with maximum 8% slope, and minimum 50-foot radius of horizontal curvature. Surfaces of roadways and parking areas are to be bituminous concrete equal to a minimum of 3 inches of intermediate mix (IM1-A) on 6 inches of 21A subbase. A minimum of 3 parking spaces shall be provided. A turnaround area shall be provided for large trucks, turning at a 50-foot radius. Roadways to treatment and pumping facilities shall be gated. The gates shall have reflectors. In cases where the treatment plant and/or pumping facility are fenced then the gate shall be a fenced gate with pad lock per The Authority standard with a shank size of ¼-inch in diameter. Where the treatment plant and/or pumping facility is not fenced, the gate shall be constructed in accordance with The Authority's standards.

12. Provide a minimum of 3 feet clearance around all equipment.

13. In cases where future additional unit processes may be required in the opinion of The Authority, adequate physical space and hydraulic grade line shall be provided.

14. Where emergency generator is to be indoors, it shall be in a room dedicated to this purpose.

15. Buried steel tanks shall not be allowed without the specific approval of The Authority. In all such cases, cathodic protection and monitoring systems shall be provided.

16. Painting systems for steel tanks shall be according to **Table 7.1** below.

Exposure	Surface Preparation	Prime Coat	Dry Film Thickness (mils)	Inter- mediate Coat	Dry Film Thickness (mils)	Finish Coat	Dry Film Thickness (mils)	Total Dry Film Thickness (mils)
Exposed Exterior	SSSP-SP10	Epoxy	2.5-3.5	Epoxy	2.0-3.0	Polyurethane	2.0-5.0	6.5-11.5
Immersion	SSSP-SP10	Zinc-rich epoxy	2.5-3.5	Coal tar epoxy	4.0-6.0	Epoxy	4.0-6.0	10.5-15.5

Table 7.1 -- Painting Systems for Steel Tanks

17. Provide suitable architectural treatment. Brick/block shall be provided. Provide insulated, quality interior block filler and paint. Split-faced CMU with foam insulation may also be used. Roofs must be sloped and have aluminum gutters with leaf guards and downspouts. Use standing seam metal roof with Kynar finish for high visibility areas. Soffit and fascia shall be of low maintenance vinyl or aluminum materials. Provide moisture-resistant painted drywall finish on interior walls and ceiling in office and laboratory areas in accordance with Clarke County code for residential occupancy.

18. Floor slabs within all buildings shall be steel reinforced and shall slope 1/8-inch per foot to a floor drain. Floor to have power-trowel finish and waterproofing sealer applied. Provide Dri-deck in potential spill areas. Provide industrial grade vinyl tile, or equal, for office and laboratory areas. Floor drains shall be provided in laboratory and lavatory.

19. Provide standard building inventory to include suitable shelving, desk and chair for operators, as well as file cabinet for on-site records.

Chemical Application

20. Chemical systems utilizing sodium hypochlorite shall utilize 15% solutions per AWWA B300 standard.

21. Chemical feed systems shall use liquid solutions or, if approved by the Authority, liquid solutions prepared from dry chemicals. A spare chemical feed pump shall be provided for each system. Adequate facility room and climate control shall be provided for bulk chemical storage and solution day tanks, as The Authority deems necessary. Do not locate process or chemical feed equipment in laboratory or office areas.

22. The Applicant shall provide secondary containment for day solution tanks and raw chemical drums, adequate raw chemical transfer equipment, and calibration tubes for all chemical feeders; size chemical feeders to operate near middle of capacity range; and provide separate chemical storage room and ventilation for highly corrosive chemicals.

23. Chemical feed systems shall have the following:

    a. Peristaltic type feed pumps with antisiphon valve

    b. Chemical tubing shall be provided as specified in **Table 7.2**. Support tubing with lengths of Schedule 40 PVC pipe, with chamfer cut ends.

    c. Translucent solution tank with liquid level scale and weight scale

    d. Vacuum breaker on makeup water spigot when hoses are used

    e. Room temperature control for hypochlorite storage

    f. Protective equipment (rubber apron, rubber gloves, combination face shield/head gear, safety shower and eyewash station)

Electrical

24. Electrical equipment shall meet the following the Authority standards:

    a. Breakers shall be Square D or Cutler-Hammer.

    b. Provide automatic reset and startup for all electrical relays.

    c. Provide GFI electrical receptacles on all walls, a maximum of 12 feet apart.

    d. Exterior control panels shall be stainless steel NEMA 4X. Interior control panels shall be fiberglass NEMA 4X.

    e. Equipment and electrical panels shall not be mounted on tanks or wet wells.

    f. Provide lights over all exterior doors.

g. Provide exterior, GFI protected, electrical outlets on front, sides and back of each building.

h. Provided additional GFI protected electrical outlets every 40 (horizontal) feet in each building.

i. Provide exterior lights around all major process equipment and controls with luminance ranging from 10 to 20 foot-candles.

25. Standby generator (or at The Authority's discretions, a NEMA 4X capped receptacle, 4P5W design of adequate rating for portable generator) shall be provided with the capability to power critical process equipment. Fuel storage will be adequate for 36 hours of operation. Generator shall be by Cummins Onan.

26. Conduct arc flash study and make corresponding provisions to ensure operator safety. Design system to Class 2 or lower rating for arc flash.

Miscellaneous

27. Miscellaneous standards are as follows:

a. Pipe through floors and wall shall have sleeves with link-seal or equivalent.

b. Air control valves shall be stainless steel ball valves.

c. Below grade and submerged reinforced and pre-cast concrete shall have bituminous coating. Below grade rooms or vaults containing mechanical or electrical equipment shall have exterior coating of bituminous waterproofing or equivalent.

d. Minimum steel thickness shall be ¼ - inch plate.

e. Parshall flume ultrasonic flow meters shall be American Sigma Model 980.

f. Provide stainless steel insect screens for all intake and exhaust louvers. Provide gravity dampers with PVC seal strips.

g. Valve stems, wheel and chains shall be readily accessible.

h. Provide sufficient diesel fuel storage to allow all generation equipment to operate 36 hours at full load.

V. Treatment Works Outfalls

To 9 VAC 25-790-480, add the following:

Accessibility – Provide parallel access road 12 feet wide along outfall easement.

Application	Size	Specification
Aeration	1-inch and larger	Galvanized steel pipe ASTM A53 Schedule 40
Process piping above grade	3-inch and larger	Ductile iron pipe AWWA C151 with AWWA C110 flanged fittings
	2 ½-inch and smaller	PVC ASTM D1785 Schedule 80 with Schedule 80 fittings
Process piping below grade/yard piping	3-inch and larger	Ductile iron pipe AWWA C151, Class 52 or better with AWWA C110 or C153 MJ Fittings
	2 ½-inch & smaller	PVC ASTM D2241, SDR 21 (200psi)
Low pressure sewers and drain field manifold downstream of check valves	All diameters	PVC ASTM D2241, SDR 21 (200psi)
Drain field lateral force mains under roads and streams and raw water lines	3-inch and smaller	Polyethylene tubing AWWA C901
	4-inch and larger	Polyethylene AWWA C906
Chemical feed	All diameters	Discharge: FDA grade, low density PE Shore A Durometer = 94, Tensile strength 2000 psi, with color coded fittings using 316 stainless steel reinforcing sleeves Suction: same as above except HDPE (no color) Shore A = 65, Tensile = 3900 psi

See the Loudoun Water *Approved Materials List* for items not listed, and for approved manufacturers.

Table 7.2 -- Piping Materials

W. Aerobic Sludge Digestion

To 9 VAC 25-790-560, add the following:

1. Sludge holding for a period of 30 days shall be required; thickening to accomplish this holding volume may be provided.

2. Aerobic digesters shall use forced air and coarse bubble diffusers for mixing.

3. Supernatant piping in aerobic digesters will not be required. Provide 3, 1/2 HP submersible, supernatant sump pumps with 20 feet of 1 1/4 –inch diameter corrugated hose.

X. Attached Growth Processes

To 9 VAC 25-790-670, add the following:

Except as noted above, attached growth processes are prohibited, except for deep bed denitrification filters, or where specifically approved by the Authority.

Y. Rotating Biological Contactors

To 9 VAC 25-790-680, add the following:

Rotating Biological Contactors are prohibited.

Z. Suspended Growth (Activated Sludge) Process

To 9 VAC 25-790-690, add the following:

Design

1. Subsurface disposal wastewater treatment facilities shall be designed for a year-round Total Nitrogen effluent concentration based on plant capacity and effluent requirements and should utilize either an SBR with tertiary filter or another The Authority-approved process. Process kinetics for all biological treatment processes shall be designed using a minimum wastewater temperature of 12 degrees centigrade.

   Fine bubble diffused aeration shall be utilized for all suspended growth activated sludge processes with a grid of EPDM membrane tube diffusers and an oxygen transfer efficiency (SOTE) of 25 percent (25 degrees centigrade shall be used for the maximum wastewater temperature when calculating maximum diffused air requirements). Drop pipes and diffuser shall be removable, with swing joints and winch for larger plants. For systems using return activated sludge (RAS) piping, such piping from geyser airlift pumps shall be hard-piped to discharge into a calibrated weir box for flow measurement. Common blowers shall not be used for aeration and sludge holding tanks; provide separate blowers or the ability to isolate blowers and maintain adequate airflow to the biological reactors. Blowers shall be low decibel models with inlet filters, residential-type inlet and outlet silencers and shall be housed in a separate sound-insulated room within the treatment plant enclosure. Lobe, helical screw, turbo and

centrifugal blowers shall be considered based on air volume requirements, reliability, and efficiency. If the treatment plant is not enclosed, provide sound insulated housings made by West Chester Manufacturing of Avondale, Pennsylvania or approved equal.

Alkalinity addition shall be provided using magnesium hydroxide to maintain a minimum secondary effluent alkalinity of at least 50 mg/l (as $CaCO_3$). Alkalinity shall be fed using multiple feed points in the aeration basins. Lime shall not be used for alkalinity addition.

All package plant systems shall minimally have 5 installations treating 100 percent domestic wastewater of similar design size of the proposed system. One of these installations must be operating in Virginia for at least 3 years from the date of initiating the Basis of Design Report. Provide references for all regional and Virginia installations. Provide operating data as requested by The Authority.

AA. Sequencing Batch Reactors (SBR)

To 9 VAC 25-790-710, add the following:

Provide retrievable diffuser assemblies. Each diffuser assembly shall be retrievable (at least 4 feet above the high water level) with an electric winch.

BB. Chlorination

To 9 VAC 25-790-750, add the following:

Chemical

1. Use of gaseous chlorine is prohibited.

Design

2. Subsurface wastewater disposal systems and wastewater disposal systems incorporating holding ponds shall use calcium hypochlorite.

CC. Ultraviolet Light Irradiation (UV)

To 9 VAC 25-790-770, add the following:

Surface discharge treatment facilities utilizing filtration shall utilize UV disinfection.

DD. Postaeration

To 9 VAC 25-790-820, add the following:

Cascade Type

Cascade type aerators shall be concrete steps.

EE. Flow Equalization

To 9 VAC 25-790-830, add the following:

Usage

Provide a separate in-line equalization basin, minimum 8-hour HRT based upon design average daily flow, for the wastewater treatment facility

FF. Filtration

To 9 VAC 25-790-860, add the following:

General Design

Tertiary filtration is required by VDH when effluent TSS permit limits are less than or equal to 15 mg/l TSS.

GG. Land Treatment

To 9 VAC 25-790-880, add the following:

Land Treatment Methods

1. Land application systems shall be low intensity spray application adhering to reuse standards or dispersal by a low-pressure distribution mass drain field system or drip system. Buffer zones shall, at a minimum, meet regulations of Virginia, but may be increased if there are environmental or community considerations.

Field Area Design

2. Not less than 3 monitoring wells (1 up-gradient and 2 down-gradient) shall be constructed for land application systems at least one year prior to completion of construction of the treatment facility. Background ground water quality monitoring shall be conducted quarterly for at least one year. Provide official laboratory results to The Authority within 60 days after sampling.

Low Intensity Design

3. The Authority is considering establishing specific minimum design criteria for spray application area design. Before any Applicant begins design of a spray field, The Authority should be contacted, asking whether the criteria have been established.

4. Unless specifically waived by the Authority, the Applicant must complete a prevailing wind study for the proposed application sites. The study must statistically determine typical wind speeds and directions. This information must be taken into consideration during design of the system so as to prevent off-site migration of aerosols while assuring all effluent can be irrigated in a given year.

5. Low intensity spray systems shall include automatic operational controls that cease spray operations if sustained wind speed or precipitation exceeds certain programmable levels.

-- end of Chapter 7 --

Chapter 8: Sewage Pumping Stations

8.1 Scope

A. Intent

These sewage pumping station (SPS) design standards are intended to assist design engineers in the development of plans and specifications for Authority projects. The materials, configurations, and features described here represent the minimum acceptable level of quality expected in pumping station design and reflect the goal of standardizing the Authority's equipment. These standards should not be construed as being a complete description of the necessary features for a particular pumping station design. Deviations from these standards must be approved by the Authority during the Basis of Design phase of the project. The Authority has the final authority regarding the acceptability of any particular pumping station design.

B. Limitations

The sewage pumping station standards presented herein shall supplement the latest edition of the *Sewage Collection and Treatment (SCAT) Regulations 9* VAC 25-790, as published by the Commonwealth of Virginia, Virginia Department of Environmental Quality (DEQ). The *SCAT Regulations* represent the minimum design requirements set forth by the DEQ. All aspects of the *SCAT Regulations* shall be adhered to. As the owner, The Authority may identify and determine the need for standards and requirements that are more stringent than those contained in Part III of the *SCAT Regulations*.

8.2 Reference Standards

The design engineer will comply with all relevant industry standards and federal, state and local regulations, including the following standards:

Virginia Sewage Collection and Treatment Regulations

Virginia Building Code

Virginia Water Control Board: *Dulles Area Watershed Policy*

Virginia Water Control Board: *Occoquan Policy*

Virginia Department of Transportation (VDOT): *Road and Bridge Specifications*

National Fire Protection Association (NFPA): *820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities*

Regulations of the Occupational Safety and Health Administration (OSHA)

Clarke County Sanitary Authority: *Spare Parts Checklist*

Clarke County Sanitary Authority: *SCADA and Control System Standards*

Loudoun Water Engineering Design Manual: *Approved Materials List*

8.3 Suggested References

Additional standards and regulations to be considered, incorporated herein by reference are as follows:

Hydraulic Standards Institute

American Concrete Institute (ACI) 308-01, Guide to Curing Concrete

American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete

American Concrete Institute (ACI) 530-02, Building Code Requirements for Masonry Structures and Specifications for Masonry Structures

American Concrete Institute (ACI) 350, Code Requirements for Environmental Engineering Concrete Structures

National Electric Code (NEC)

National Electric Manufacturers Association (NEMA)

National Fire Protection Association (NFPA)

Standard Rules of American Institute of Electrical Engineers

Environmental Protection Agency (EPA)

International Building Code

American National Standards Institute (ANSI)

American Institute for Steel Construction (AISC)

National Association of Corrosion Engineers (NACE)

8.4 Required Meetings

During the course of the pumping station design, meetings shall take place at the following project milestones:

Initial Planning/Kickoff Meeting

Immediately after Basis of Design Report submittal

Preliminary Engineering Report

90% Design Submittal (when requested)

The Authority has established a procedure for the review of pumping station plans. The design engineer shall meet with the Authority prior to start of design to discuss The Authority's procedures and requirements.

8.5 General Requirements

Sewage pumping stations will be designed in conformance with the Commonwealth of Virginia *SCAT Regulations*. The sewage pumping station will not be accepted by the Authority until the following items have been provided:

a Certificate to Construct (CTC) from Virginia DEQ. This is a condition of the Authority's approval of design.

a Certificate to Operate (CTO) the pumping station from the Virginia DEQ. This is a condition of the Authority granting Substantial Completion.

five copies of Operations and Maintenance Manual, and one digital copy on CD, approved by The Authority and Virginia DEQ

certified pump curves and actual pump curve at startup

a certificate of substantial completion issued by the Authority

A. Types of Stations

The 3 types of sewage pumping stations used by the Authority are:

1. **Temporary Pumping Station -- A** temporary sewage pumping station will be used to serve a single subdivision or commercial site. The location of the station does not conform to The Authority's master plan and the station will be abandoned when gravity sewers reach the station or the permanent facility is constructed.

2. **Interim Sewage Pumping Station -- An** interim sewage pumping station shall be designed to serve the portion of the sewer shed upstream of the permanent station's site. The station is in conformance with the Authority's master sewer plan except that, due to financial considerations, it is not located at the ultimate location of the permanent facility or is not constructed to serve the entire shed. The station will be abandoned when the permanent sewage pumping station and associated interceptor sewers are constructed.

3. **Permanent Pumping Station --** Permanent sewage pumping stations shall be designed and sited to serve the entire sewer shed service area and are identified as part of the applicable area facility plan and/or preliminary engineering report as may have been approved by the Authority. A permanent station may not be initially constructed with capacity for the entire sewer shed, but the major structures in the facility will be designed and constructed to accommodate the ultimate capacity of the station.

B. Site

1. Sewage pumping stations will be located so as to prevent flooding during large storms. Finished floor of the control building, the tops of all below ground structures, and all outdoor tanks and equipment will be above 100-year flood elevation.

2. The fee simple ownership of the pumping station's parcel will be transferred to The Authority. A The Authority easement may be substituted in place of a parcel with The Authority's approval.

C. Design Flow

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

2. Provisions for future expansion include the possible selection of pumps with higher than required motor horsepower to allow the future installation of larger diameter impellers, capable of pumping increased flows. Other possible features to consider include sizing of the force main, wet well dimensions, incorporating variable frequency drives, generator selection, electrical service, and other components, so as to allow for the increase in capacity, without causing problems during initial operation. Life-cycle costs will be considered.

3. All sewage pumping stations will have at least 2 pumps. For stations with 2 pumps, each pump must be able to pump the design peak flow with the other pump out of service.

4. For sewage pumping stations with more than 2 pumps, with the largest pump out of service, the remaining pumps must be able to pump the design peak flow.

8.6 Pumping Station Selection Criteria

The selection of which style of pumping station to use will depend on several factors including capacity, depth, location, and life-cycle costs. The following four basic styles of pumping stations that are used in the Authority's system:

Suction Lift:	Wet well depths to 20 ft.; maximum 20 HP pumps
Submersible:	Wet well depths greater than 15 ft.; maximum 20 HP pumps; capacities under 1 mgd
Package:	Wet well depths to 25 ft.; capacities under 1 mgd
Conventional:	Wet well depths greater than 25 ft. or capacities of 1 mgd or more

There are situations where more than one type of station may be appropriate. A conceptual or schematic design along with important design criteria submitted as the Basis of Design shall be approved by the Authority before proceeding with the development of the Preliminary Engineering Report and contract plans and specifications.

A. Design Limitations

The following design limitations should be observed for each style of station.

1. Suction Lift Pumping Stations

   a. **Definition -- Suction** Lift stations are defined here, as those stations where the pumps are located above the water level in the wet well and hence must employ some means of lifting the sewage to the pumps in order for the pumps to be primed. The pumps shall be of the self-priming, flooded box type.

   b. **Configuration --** Suction Lift pumping stations shall be designed with the pumps mounted directly above the wet well and shall have suction pipes that are straight. Suction Lift stations shall satisfy the pump's NPSH requirements. The outside wall of the pumping station building shall be located above the wet well with the pumps and piping located inside the building and the wet well entrance hatch located outside. A roll-up type door shall be provided for access to the pumps. A swinging jib crane or rolling floor crane shall be provided to facilitate pump removal. See **Figures 8.1** and **8.2.**

2. Submersible Pumping Stations

   a. **Definition -- Submersible** stations are defined here as those where the pumps are "submerged" in the wet well. Because the pumps operate under water in the wet well, there is no need for a separate pump room. The pumps can be raised and lowered out of the wet well by means of a jib crane located at the top of the wet well. Guide rails enable the pump to be raised and lowered into place without requiring entry by personnel under normal circumstances.

   b. **Configuration -- Submersible** pumping stations shall be designed with an aluminum hatch at the top for pump removal, mounting base for portable or fixed jib crane, and stainless steel guide rails. A building shall be constructed adjacent to the wet well housing electrical equipment, controls, and emergency generator. See **Figures 8.3** and **8.4**.

   c. A valve vault will be provided for the pump discharge shut-off and check valves.

3. Package Pumping Stations

   a. **Definition -- Package** pumping stations are defined here as wet well/dry well pumping stations in which the pumps, suction and discharge piping, pump dry well, electrical equipment and connections are pre-assembled by a single manufacturer and then erected on-site by the Contractor. Package pumping stations with metal well chambers shall not be acceptable. Only pre-cast concrete well chambers shall be acceptable.

b. **Configuration -- Package** pumping stations shall be of a wet well/dry well configuration. Electrical equipment shall be located above grade in a building erected above the dry well chamber. Access hatches for the dry well shall be located in the floor of the electrical building. Pumps shall be of the dry-pit submersible type with media-cooled motors. Equipment hatches and monorail hoist will be provided for pump removal. See **Figures 8.5** and **8.6**.

4. Conventional Pumping Stations

a. **Definition -- Conventional** pumping stations are defined here as pumping stations in which the wet well and dry well structures are formed and poured onsite. All of the piping and valves are assembled by the Contractor.

b. **Configuration -- Wet** wells shall be divided into 2 chambers connected by a sluice gate in the divider wall, with operating stem extended up to grade level, so as to enable one of the chambers to be taken out of service for maintenance without taking the station off-line. Influent sewage should flow into an influent channel with sluice gates or slide gates to enable sewage to flow to one or both of the chambers. Influent channel will have a hydraulically driven Comminutor for grinding debris. Also, provide a bypass channel and trash rack. Wet wells shall have a walkway spanning the length of the wet well. Grab bars shall be provided from grade level to the walkway and from the walkway down into each chamber. Grab bars shall be equipped with safety extension poles. See **Figures 8.7** and **8.8**.

c. Electrical equipment shall be located above grade in a room above the dry well. Access to the pumps for removal shall be located in the floor and directly above the pumps. A monorail shall be provided to facilitate removal of the pumps. Pumps shall be of the dry-pit submersible type with liquid-cooled motors. Dry well shall be designed with at least one unused space for a future pump to accommodate future upgrades. Electrical/control room should be designed with extra space to accommodate future upgrades. Pump suction piping shall be connected to the dry pit sump to enable one of the pumps to be used for dewatering of the dry pit. The valve for opening this dry-pit suction connection as well as the pump suction isolation valve shall have extended operator stems up to the control room. A surge relief valve shall be placed on the discharge force main before the piping leaves the station. Surge relief valves and piping shall discharge to the wet well.

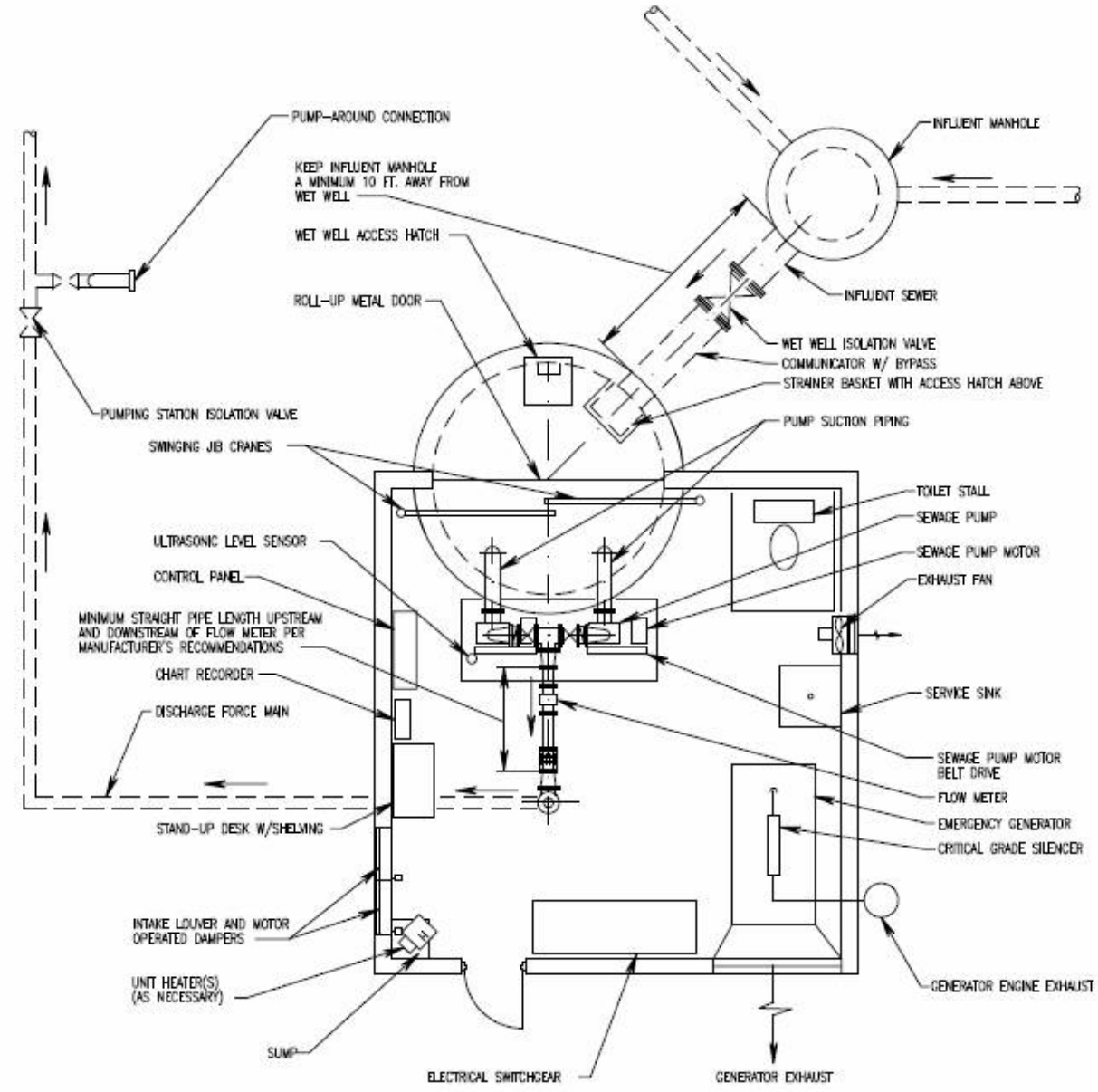


Figure 8.1 -- Typical Suction Lift (Station Layout)

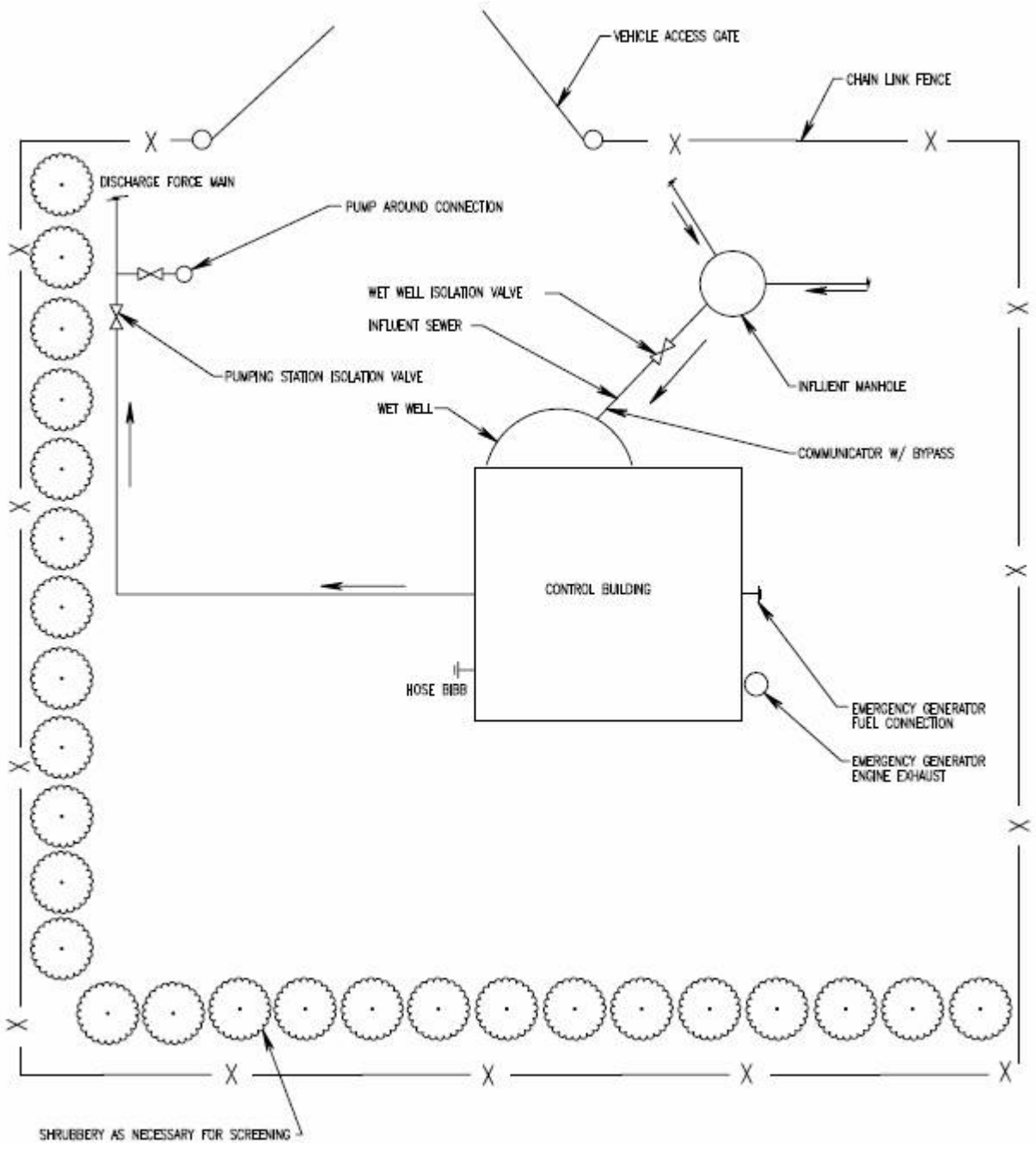


Figure 8.2 -- Typical Suction Lift (Site Layout)

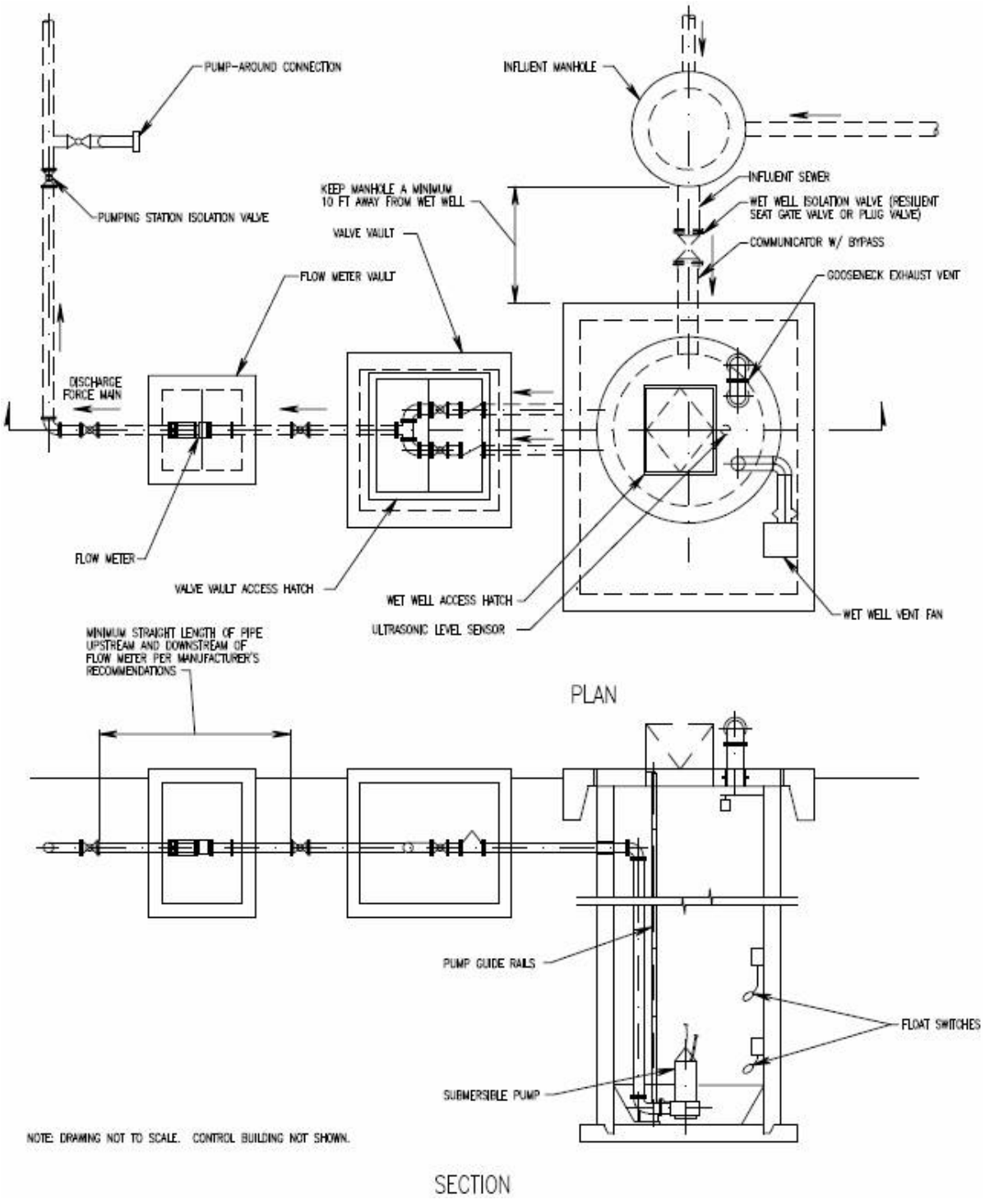


Figure 8.3 -- Typical Submersible (Station Layout)

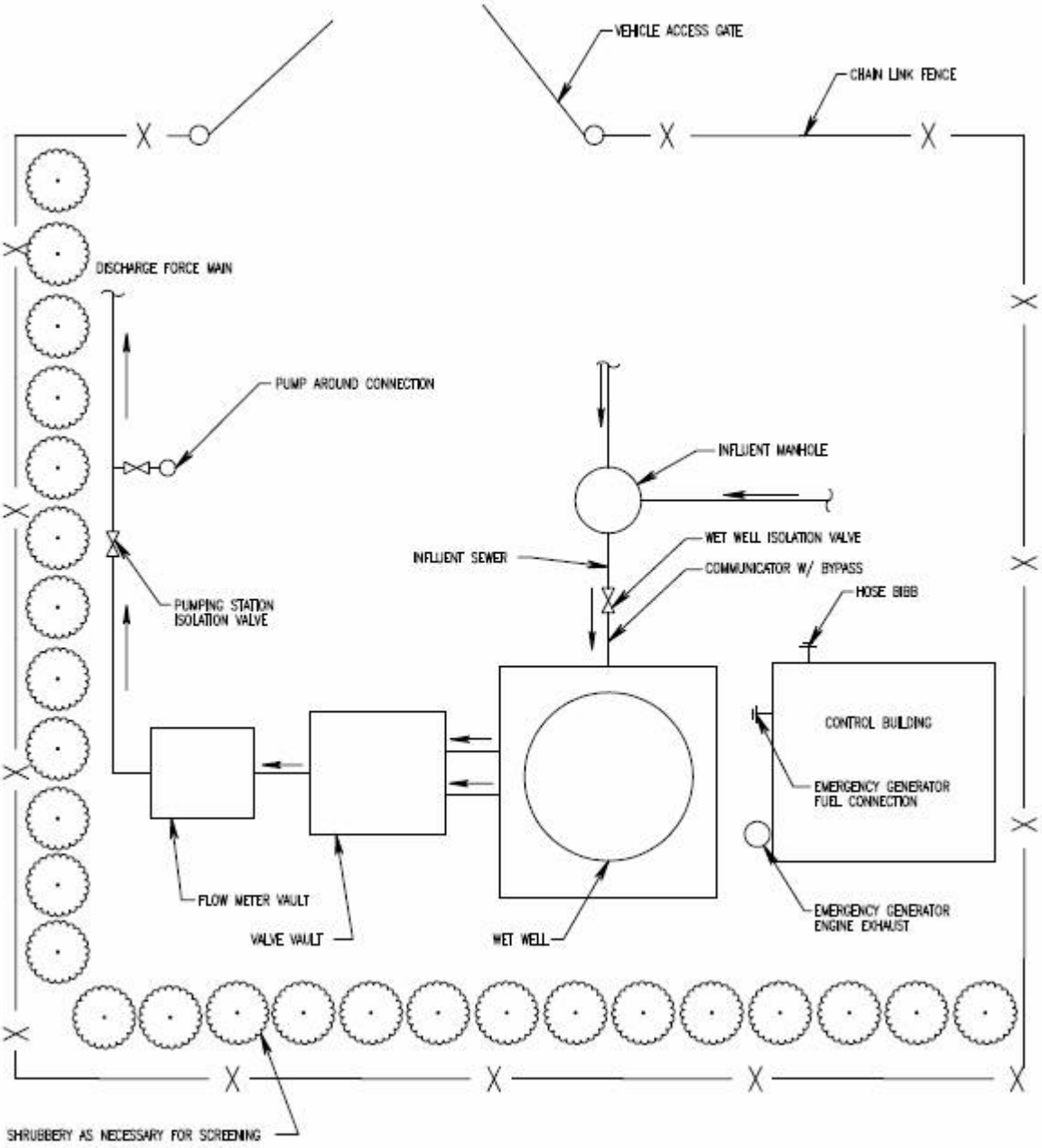


Figure 8.4 -- Typical Submersible (Site Layout)

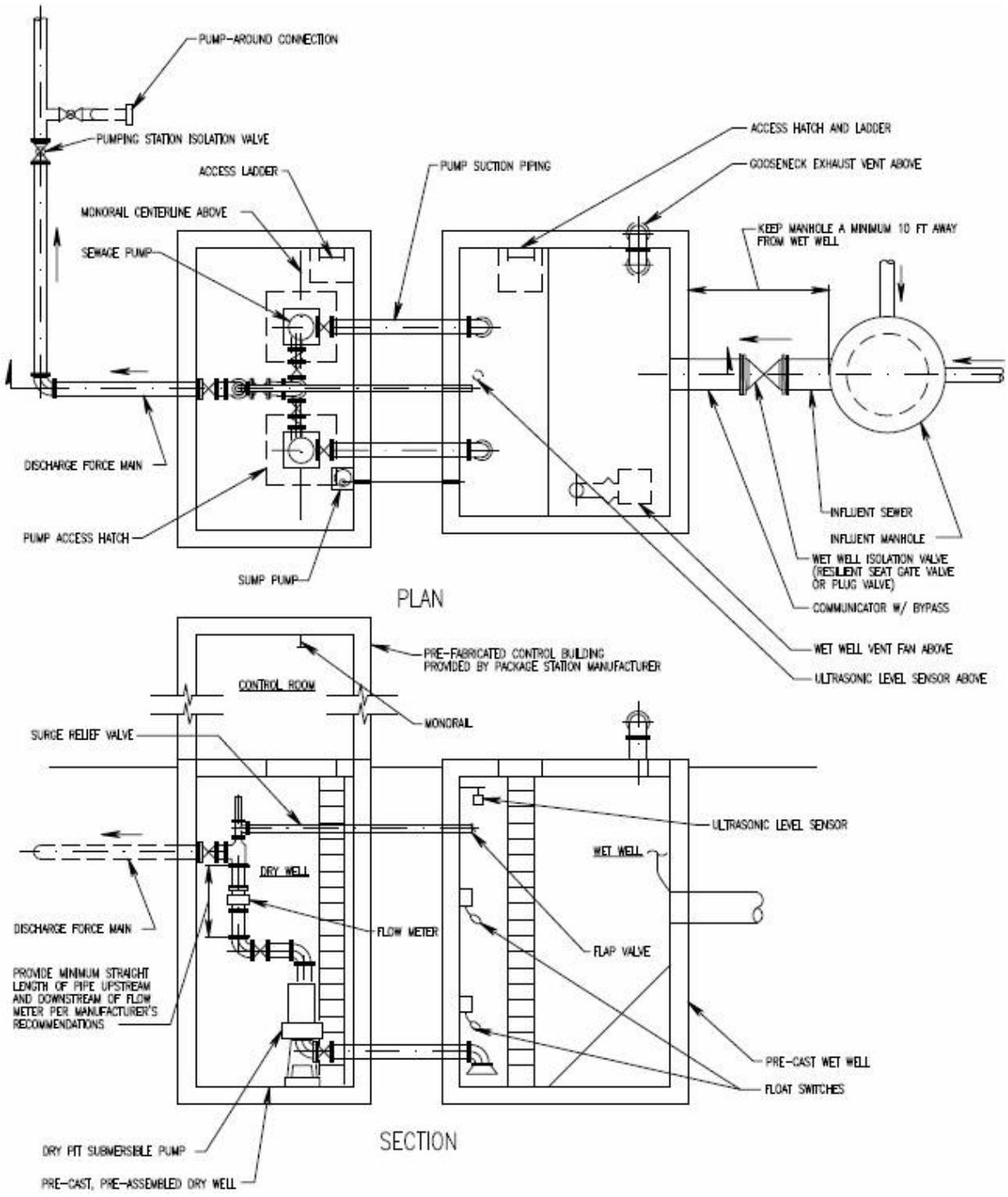


Figure 8.5 -- Typical Package (Station Layout)

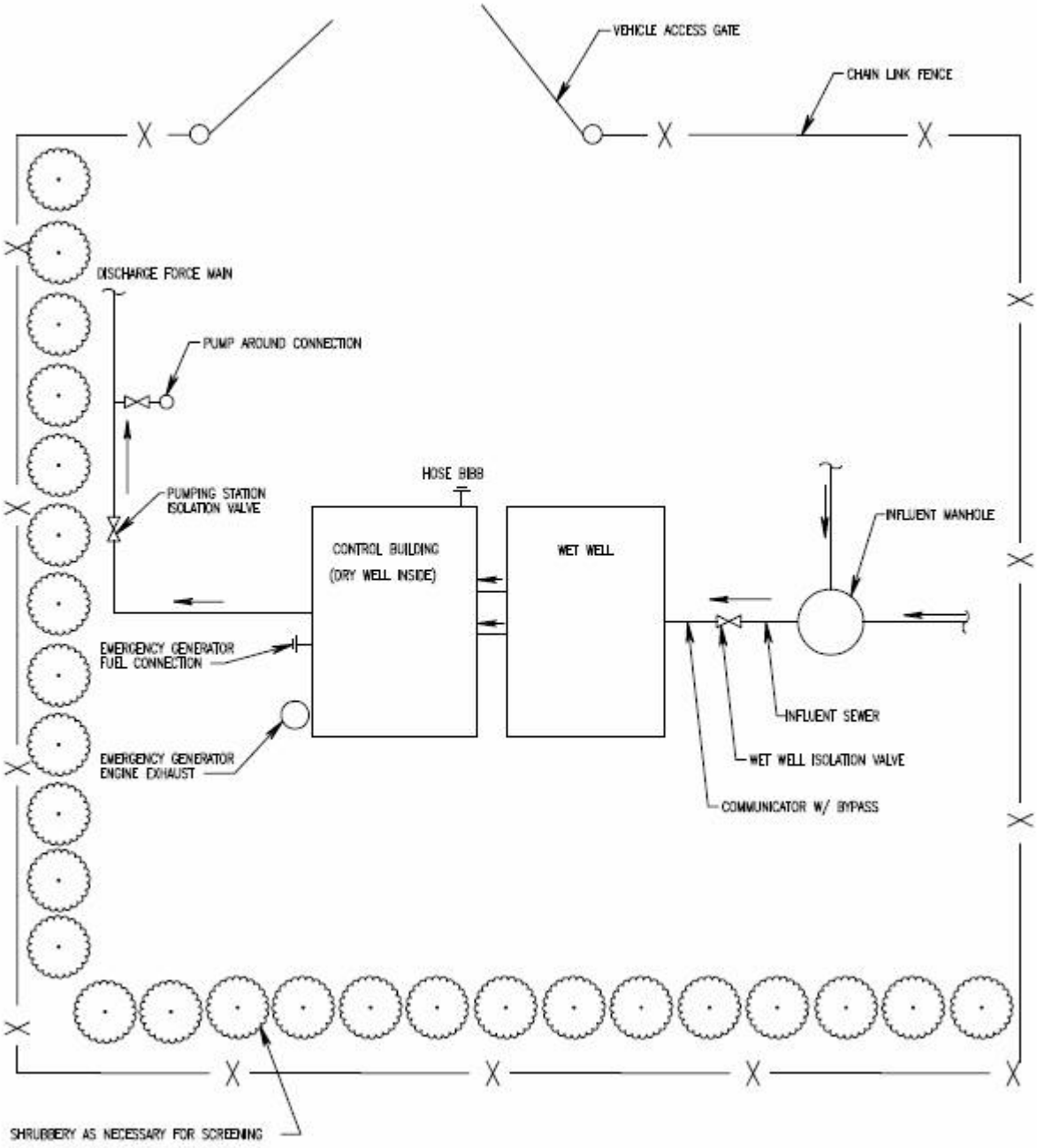


Figure 8.6 -- Typical Package (Site Layout)

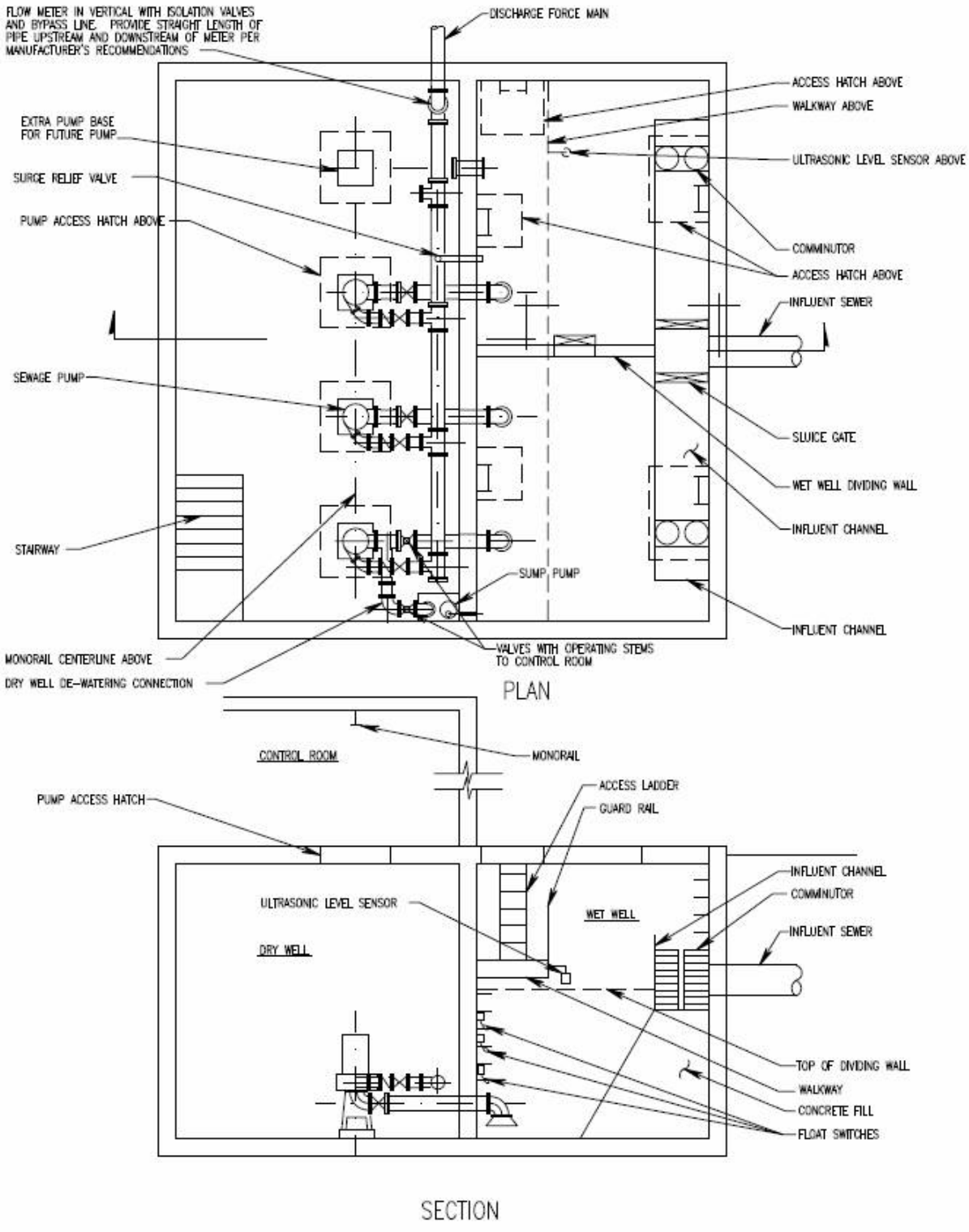


Figure 8.7 -- Typical Conventional (Station Layout)

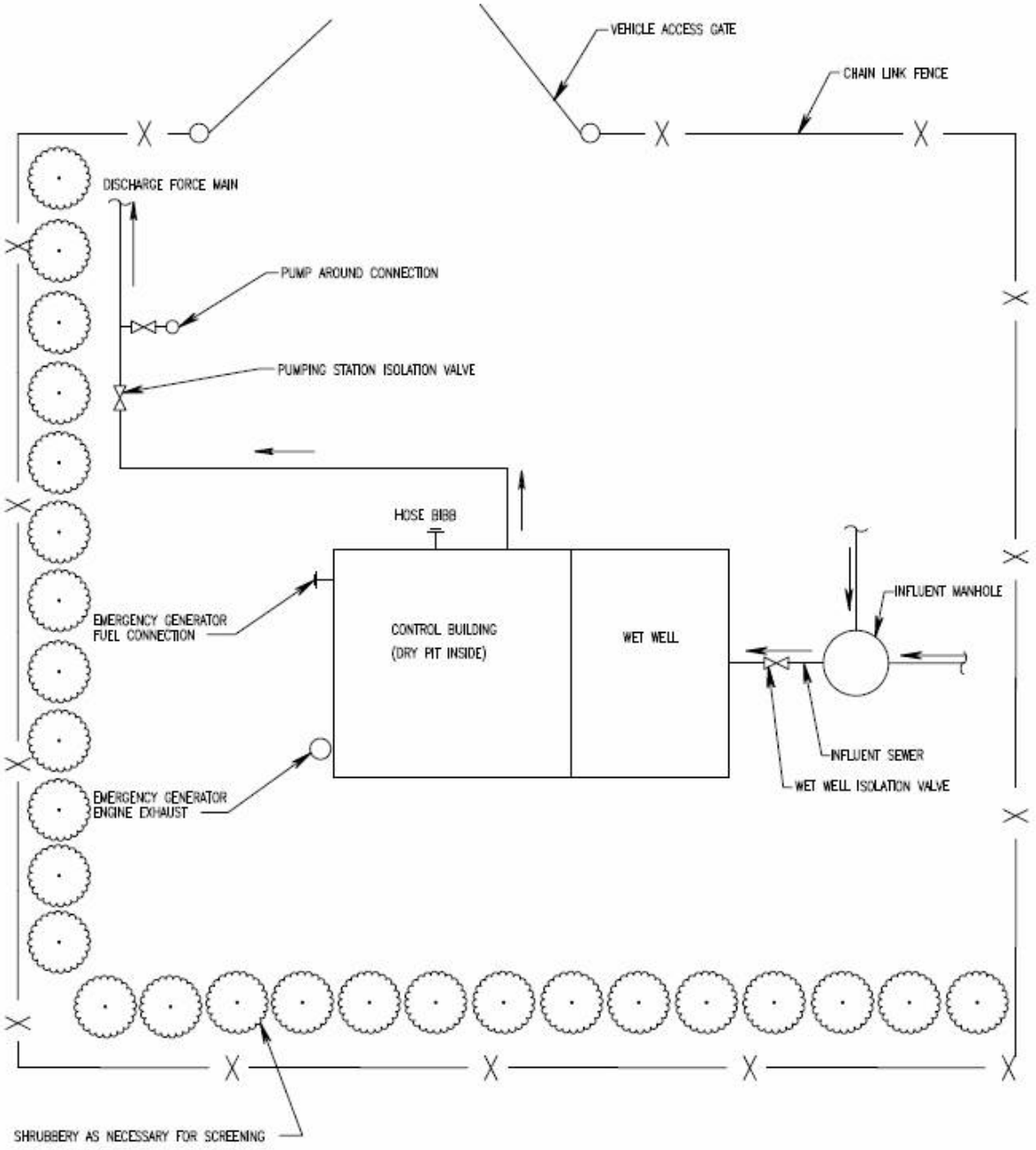


Figure 8.8 -- Typical Conventional (Site Layout)

8.7 Design Criteria for Pumping Stations

All sewage pumping stations will be designed in accordance with the following criteria. Additional requirements of *SCAT Regulations* shall also apply.

A. Pump Selection

1. 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 period must start at time of final acceptance of the station by The Authority, and shall be non-prorated. All pumps using a center shaft shall be equipped with oversized bearings (Class B).

2. All pump openings and passages shall be large enough to permit the passage of a sphere 3-inch in diameter and any trash that can pass through a 4-inch house collection system. All pumps will have cleanout ports on the volute.

3. For new pumping stations, prepare Total Dynamic Head (TDH) calculations based on the pipe C factor anticipated after the force main has been in service for ten years. When expanding the capacity of an existing pumping station, which has been in service for many years, the actual C factor of the force main should be determined by field measurements.

4. Typically, the TDH calculations are based on the entire length of force main pipe from the pumping discharge to the discharge manhole of the gravity system. However, when pumping from one valley over a hill to a gravity sewer on the other side of the hill, it is important to consider whether or not there is free fall in the downhill segment of the force main such that the downhill length of pipe does not need to be considered in the TDH calculations. If the static head from the force main's high point to the discharge point exceeds the full flow head loss in the downhill segment of force main, sewage should flow by gravity through the force main similar to a gravity sewer instead of as a full pipe under pressure.

5. Consideration must be given during design to include a small submersible jockey pump in the wet well, which will operate almost continuously through the day at a lower flow rate. This lower flow rate will significantly reduce the friction loss and energy requirements while providing reliable service. The larger pumps should only operate a few times a day, (during peak flow periods in the morning and evening) which is sufficient to scour the force main.

B. Protection Against Clogging

1. All pumping stations shall have a Comminutor vault at the influent portion of the station. The Comminutor will be sized for the estimated peak hourly flow into the station.

2. The Comminutor will be designed to be easily removed from the flow channel without disturbing any piping connections. The Comminutor channel shall be designed to settle

out grit upstream of the screening area. On larger stations, a separate grit chamber may be required.

3. Comminutor shall be designed for continuous operation and will automatically restart after power failures. The vault shall also be equipped with an aluminum bar screen (inline or as a bypass), so that the Comminutor can be taken out of service for repair and maintenance.

4. The clear openings on the bar screen will not exceed 2.5 inches in any dimension. In the event the Comminutor must be taken out of service, slide gates are provided to direct Comminutor vault influent flow to a bypass bar screen. Also, in the event flow backs up upstream of the Comminutor the influent channel wall shall have an overflow notch just upstream of the bar screen. The bar screen shall be constructed of stainless steel bars for manual cleaning with a rake.

5. The Comminutor vault may be a precast concrete manhole with high-density polyethylene (HDPE) liner per the Loudoun Water *Approved Materials List*. Aluminum alternating tread stairs shall be used for access to the bottom of the vault.

6. All lighting and electrical equipment shall be explosion proof inside the vault.

7. A ventilation fan shall be provided on top of the Comminutor vault.

8. An emergency stop button shall be provided in the Comminutor vault for the Comminutor

C. Wet Well

1. Wet wells shall be designed for a minimum pump cycle time of 10 minutes as defined by the following formula:

   $T = 4V/Q$ where,

   T = Pump Cycle Time (time between pump starts)

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

   Q = Design Flow rate of the pumping station, in gallons per minute

2. The wet wells at stations 3 million gallons per day or larger shall be divided into two interconnected sections to facilitate repairs and cleaning. The effective capacity of the wet well shall be such that one pump will run continuously at least 5 minutes of every 30-minute period at the minimum flow. The wet well fillets shall be sloped at 1:1 to the hopper bottom. The hopper bottom shall be no larger than necessary for the proper installation and function of the inlet. To prevent corrosion, all wet wells shall be of hydraulic content concrete with an approved lining system or of an approved circular polymer concrete. The wet well size and control settings shall be designed to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention times. A visual gauge of the wet well level shall be provided.

3. Wet wells shall be designed to have not less than 1 foot between alarm points and set points. See Sections L. Controls and M. SCADA System of this Chapter. Wet wells shall be designed with an additional 2 feet of depth above the highest alarm as a safety factor to accommodate unexpected increases in station capacity.

4. Wet wells shall be approved polymer concrete or be lined with approved HDPE protective liner. Bottom of wet well shall be grouted to a minimum slope of 45 degrees toward the pump suction inlet.

5. A wet well mixer may be required

D. Emergency Storage

Underground storage structures for wastewater will be provided at all lift stations. The structure(s) will be sized to hold at least the estimated 2-hour peak flow volume.

E. Influent Manhole

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 yard valve. Yard valve shall be a buried resilient wedge valve with valve box to grade.

F. Auxiliary Force Main Connection

Pumping stations shall be provided with a bypass pumping connection downstream of the station. In conjunction with the influent manhole described above, this connection riser enables the station to be taken off-line for periodic maintenance or repairs. Slope auxiliary force main piping so that it can be drained to the wet well.

G. Surge Analysis

1. When pumps cycle off or there is a power failure, transient surge pressures can damage piping. Reduced voltage solid state starters may be required to reduce surge pressures. As backup protection, a surge relief valve may be required at the pumping station, to provide for events of power failure, or a failure of the soft start/stop equipment. Design Engineer shall perform a surge analysis of the discharge force main when the velocity exceeds 3.5 fps and/or the total dynamic head (TDH) of the system's design exceeds 150 feet.

2. On package, submersible and conventional stations, surge relief valves or accumulators shall be provided, where the following conditions will exist.

   a. Force main contains substantial high points in its profile, or contains a steep gradient.

   b. Length of force main is less than 20 times the total dynamic head.

   c. Velocity in force main will be above 4 feet/second.

d. There can be slowdown and reversal of flow in less than t_c.

e. There is check valve closure in less than t_c.

f. There can be damage to pump and motor if allowed to run backward.

g. Pump can stop or speed be reduced to the point that the shut-off head is less than static head, before the discharge valve is fully closed.

H. Backup Power

1. All pumping stations shall be provided with either a standby generator or a secondary power feed with automatic transfer switches to achieve Class I reliability as described in the *SCAT Regulations*. Pumps shall be capable of automatic restart after power failures. Generator shall be rated for primary service, and have permanent magnet excitation.

2. Standby generators shall be diesel driven with fuel storage on the underside of the generator in a belly tank or outside the building in an above ground, double walled storage tank.

3. Tank size shall be suitable for 48 hours of generator operation at full load. Skid mounted tanks shall be double-walled for leak containment and shall meet all DEQ and EPA regulations. A fuel storage level indicator will be provided in the generator and control building. Fuel tank shall be refilled after all startup and testing is complete.

4. The generator will be equipped with an alarm indicator and output contacts to display the cause of a generator failure, both locally and remotely. The means for starting an emergency generator shall be completely independent of the normal electric power source. The starting system shall be sufficient to start the generator a minimum of 3 times without recharging. The starting system shall be alarmed and instrumented to indicate a loss of readiness.

5. It is preferred that emergency generators shall be located in a separate room inside the pumping station building, mounted on vibration isolators, with a fuel tank fill connection to the outside. A spill containment area around the generator shall be provided. This spill containment area shall consist of a 4-inch curb surrounding the generator. Generator engine exhaust shall be provided with a critical grade silencer and piped to the outside of the building. Generator exhaust shall face away from nearby neighbors. If this is not possible, a baffle wall shall be constructed in front of the generator exhaust. A plenum shall be provided for generation intake exhaust. Generator installations of 100 kW or less will have gravity dampers on the air supply and exhaust louvers. Installations larger than 100 kW shall have motorized dampers. Acoustic baffles shall be installed on exhaust louvers for units larger than 250 kW.

6. The generator switch gear shall be provided by the same manufacturer as the generator. All electrical distribution equipment shall be protected by a solid-state advanced control phase monitor. The generator shall be equipped with a battery charger and block heater. The transfer switch shall include a plant exerciser, adjustable time delays between all functions and transitions. The switch shall also be capable of holding in the "neutral" position for an adjustable time period between all transitions. All electrical

switch gear and controls will be located in a building. Any equipment remotely located from the distribution panel shall have a lockable service disconnect on the line side.

I. Valves and Piping

1. 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 may be located either inside the pumping station building or in a separate valve vault. Pump isolation or check valves shall not be located in the wet well. Isolation valves for pumps in wet well/dry well stations shall be plug valves, installed in the horizontal position, so that the plug is in the top when open.

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

3. The velocity in the suction line will not exceed 4 fps. The velocity in the discharge line will not exceed 6 fps. Pressure gauges with isolation valves will be installed on the discharge side of the check valve. Gauge taps with valves will be installed on the suction side of each pump.

4. Flexible, watertight connections shall be provided for all below grade pipe connections to concrete structures. Gravity sewers entering structures shall have boots. Pressure pipe will penetrate walls by means of an Omni-Sleeve by Sigma, or approved equal. Link seal will not be permitted.

5. 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.

J. Lighting

Adequate lighting will be provided throughout the station. All lighting fixtures shall be rated for the environment in which they are installed. Where applicable fluorescent fixtures shall be installed in accordance with the manufacturer's recommendations to provide adequate heat dissipation, and maximize the life expectancy of the fixture. Fluorescent fixtures shall have a 0°F start ballast and have a plastic lens to protect the lamps. Fluorescent fixtures shall use F40 lamps and shall be constructed so as to allow the entrance of conduits to the ends of the fixture. A skylight will be installed in the generator and control building to provide natural light. All lighting located in a wet well shall be serviceable from the catwalk. All lighting located in a dry well shall be vapor proof, corrosion resistant, and shall be mounted with stainless steel hardware. All exterior-photoelectric switches shall be intrinsic. All lighting shall have an HOA switch.

K. Flow Metering

1. All pumping stations shall be provided with a magnetic type flow meter, equipped for wastewater service, with a bypass line and valves to enable pumping station to operate when meter is being serviced. Acceptable flow meters are Badger M3000 Series or Invensys FOXBORO 9100 Series.

2. Range of flow meter shall be twice the normal pump output.

3. All flow meters shall have an adequate length of straight pipe both upstream and downstream of the meter in accordance with manufacturer's recommendations.

4. Provide a totalizer and indicator/transmitter in units of gpm. Flow metering equipment except for the sensor will be located in the control building.

L. Controls

1. The pumps shall be controlled by means of a pressure transducer. The pressure transducer shall be programmed to turn the pumps on or off at various levels in the wet well.

2. The transmitter sensor shall be mounted near the top of the wet well and be removable without entering the wet well. The transmitter shall also report the level in the wet well on an indicator located inside the station.

3. The pumping station shall also have a back-up pressure transducer control system with transducers for turning the individual pumps on and off if the primary pressure transducer malfunctions. Back-up transducers shall be wired to individual pump motor starters. Enough pumps shall have back-up transducers to maintain the "safe pumping capacity" (i.e. largest pump out of service) of the station.

4. Where variable speed pumps are specified, an Allen-Bradley 7000 Series controller shall be used in addition to the pump controller specified above.

5. Check valve limit switch circuitry shall be used for pump failure logic.

6. An elapsed run time indicator will be provided for each pump.

7. A press-to-test circuit will be provided for the control panel indicator lights.

8. 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.

9. All motor controls shall be equipped with a motor overload indicator light for each motor equipped with a thermal overload protection device.

10. Provide an uninterruptible power supply (UPS) with 2-hour battery for the control system.

M. SCADA System

1. The Authority shall specify the method of communications and the specific brands of hardware and software to be used. See The Authority's Supervisory Control and Data Acquisition (SCADA) and Control System Standards for details. The Authority may require additional telemetry and SCADA communications at a particular station.

2. A radio path study is required during the design of the pump station in order to size the antenna needed to transmit data.

3. Pumping stations will be monitored by The Authority's SCADA system. Dry, normally open contacts will be provided for all status and 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. Both audible and visual alarms will be provided at the pumping station. 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). An antenna pole or tower will be installed at the station near the control building for the SCADA antenna. The location of the antenna pole will be shown on the project plans.

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

   a. Pump On (each pump)

   b. Pump Fail (each pump)

   c. High Wet Well Water Level Alarm

   d. Low Wet Well Water Level Alarm

   e. Loss of Primary Power

   f. Generator/Secondary Power On/Fail

   g. Building/Hatch Intrusion Alarm

   h. Grinder Failure

   i. Generator Failure

   j. Bioxide Tank Empty

   k. Comminutor Fail

   l. Generator Fuel Low

   m. UPS Run/Fail

   n. Flow Rate/Total

   o. Wet Well Level

   p. Building Temperature Alarm

N. Ventilation

1. Ventilation shall be by means of wall mounted exhaust fans with backdraft dampers operated by thermostats, freezestats and intake louvers with motor operated dampers, where required. Pumping station wet wells shall be ventilated in accordance with the

SCAT Regulations. Dry wells in package and conventional stations shall also be ventilated per the *SCAT Regulations*.

2. Ventilation shall be provided for pumping stations during all periods when the station is occupied. Where the pumps are below ground, mechanical ventilation is required and shall be arranged so as to independently ventilate all of the wells and/or vaults at the station. Dry well supply and exhaust louvers shall have insect screens. Exhaust air shall be drawn from the lowest floor or area of the structure. Supply air will enter at the top floor or area. No damper shall be used on the exhaust or fresh air ducts, and the screens will be ¼-inch stainless steel. The switches for the operation of the ventilation equipment shall be well marked and located above grade near the entrance doors or hatches. The lighting and ventilation switches on all wet wells shall be interlocking. If 3-phase service is available, the exhaust fan motors shall be 3-phase motors. Time clock switches will be provided to allow a programmed run time of the exhaust fans. There will be no interconnection between the ventilation systems in the wet well and dry well. Dry well entrances shall not be in close proximity to the wet well or generator exhausts.

3. Wet wells ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour. Wet well ventilation fans and ducts shall be constructed of either stainless steel or fiberglass.

4. Dry well ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 6 complete air changes per hour; if intermittent, at least 30 complete air changes per hour.

5. Ventilation openings shall be protected with aluminum louvers with bird-screens.

O. Water Supply

1. Wherever possible, public water will be extended to the pumping station for wash down and cleanup operations. The water service into the station will be a 1-inch, type "K" copper. A fire hydrant shall be provided on site. The meter will be set as shown in the details of these Standards. If public water is not available, a potable well will be provided at the site.

2. Appropriate cross connection measures shall be used to ensure that no physical connection exists between any potable water supply and a sewage pumping station that under any conditions might cause a contamination of the potable water supply. A non freeze yard hydrant will be installed at the station. A 50-foot long, 1-inch diameter hose and a hose rack will be provided at the control building. When required, restroom facilities will be provided at pumping stations. Where building is fitted with water distribution plumbing, there will be a strainer installed immediately upstream of the backflow prevention device that constitutes the service line protection.

P. Vaults

1. Access hatches will be located in the vault so as to facilitate the removal of the pump's, motor and other equipment in the station without disrupting the operation of the facility.

2. All hatches will be aluminum with stainless steel hardware. All hatches will have locking hasps and automatic hold-open arms with safety grates.

3. A fixed or portable hoist suitable for removing the Comminutor, pumps and other equipment will be provided at the vault. If a portable hoist is provided, surface mount sockets will be installed at the Comminutor vault and pump well. Sockets shall be above grade, painted yellow, and located such that the hatch can be open while operating the hoist.

4. The valve vault and flow meter vault will have floor drains. The floor drain will have a "P" trap and will discharge into the wet well. The floor drain shall be installed with a check valve or flapper valve on the end to prevent sewage from entering the structures if the wet well floods.

Q. Odor Control

1. Odor control measures must be designed and installed as part of the station. The odor control measures to be used will be determined by The Authority during plan review.

2. All pumping stations shall be provided with an odor control system designed to mitigate odors from the wet well and influent manhole. Different acceptable methods include but are not limited to carbon adsorption (air scrubbing), and chemical addition at the wet well or influent manhole.

3. Pumping stations should be designed to minimize the possible formation of odors by limiting wet well retention times and avoiding high drops for influent sewers, which cause odors to be released.

4. The pumping station design shall include a pad mounted chemical storage tank and automatic chemical feed equipment to control odors at the force main discharge. The chemical shall be pumped directly into the force main.

R. Control Building

1. The Control building shall be of brick and block design with pitched roof and wooden roof trusses, to house the generator, electrical, and control equipment. The use of pre-cast or pre-fabricated buildings must be approved by The Authority.

2. Ensure positive drainage away from building at a minimum 4 percent slope. Provide foundation drain.

3. There shall be no exposed woodwork on the outside of the building. The control building exteriors include stone-faced block walls or other features to match the surrounding architecture. All exterior woodwork shall have vinyl or aluminum siding.

4. Building finished floor, vault hatches, and all electrical equipment shall be located at least 1 foot above the 100-year flood elevation.

5. Pump room floor shall be sloped to a sump. A sanitary lateral with piping leading to the wet well shall be provided. Building shall be furnished with a service sink with both hot

and cold water, outside non-freeze hose bib and toilet stall with waste piped to influent manhole or wet well.

6. A thermostatically controlled heater and exhaust fan sized for the building will be provided in the control building. The exhaust fans shall be adequately sized to cool the heat generating equipment located in the building. The thermostats controlling all HVAC equipment shall be located in an easily accessible area. Heaters shall not be located near exhaust louvers.

7. Floors shall be epoxy coated.

8. All heated areas shall include R-13 wall insulation and R-30 ceiling insulation.

9. Pumping station doors shall be bullet proof steel with locks keyed as specified by The Authority. Building shall be provided with entry alarm connected to the station telemetry.

10. Building shall include small desk with chair.

11. Security measures at all pump stations shall be as determined by the Authority. Security measures can include, but are not limited to fencing, keypad gate entry, security cameras, intrusion alarms and barbwire atop fence.

S. Safety Measures

1. Ensure that effective safety measures are incorporated into the design and specifications, so as to enable operation and maintenance to be conducted in accordance with current requirements of the Occupational Safety and Health Administration. This will include fall protection and retrieval measures as applicable, an eyewash station, and yellow nosing on stair treads.

T. Electrical Design

1. All pumping stations will be reliability Class I. Electric power shall be provided to the station by distribution lines and by a standby generator. Both power sources shall be sufficient to operate all pumps, critical lighting and ventilation systems during peak flow conditions.

2. 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. 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 these manually.

3. The station's power supply shall be protected from lightning.

4. 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 shall be provided for each power source.

5. 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.

6. 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.

7. All lighting transformers shall be pad mounted. The load distribution panel shall not be an internal part of the transformer.

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

9. All equipment shall be installed in accordance with the manufacturer's recommendations. When laying out the location of the equipment in the control and generator building, the engineer will 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. Also, provide housekeeping pads to keep equipment off of the floor.

10. Provide arc flash study and rating for the facility, with design of corresponding safety features. Design system to Class 2 or lower rating for arc flash. Arc flash study shall be performed on the design, and again at the substantial completion of the station.

U. Electrical Equipment

1. The electrical equipment in the generator and control building, wet well, dry well and the valve vault, will comply with the appropriate requirements of the National Electrical Code. No aluminum bus bars, wire connectors or lugs shall be allowed.

2. Housing of electrical equipment within the pump room is to be minimized.

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

4. 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.

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

6. Indoor motors shall be of splash resistant design.

7. All wires installed in underground conduits will have moisture resistant insulation as identified in the National Electric Code. All wiring installed in raceways shall be THHN stranded wire. 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.

8. Electrical power devices or equipment used to convert single-phase power to three-phase power will be dedicated to a single specific motor.

9. All surface mounted electrical device boxes and small junction boxes subject to moisture shall be constructed of non-corrosive materials. All boxes shall have mounting lugs. Drilling mounting holes in the back of the box is unacceptable. Gasketed covers with stainless steel screws will be provided for all boxes. The covers will be from the same manufacturer as the boxes. All boxes will be mounted with stainless steel hardware. Moisture proof bell boxes are not acceptable.

10. Any cable subjected to stress or strain shall be equipped with a 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, pinching, crushing and abrasion.

11. All electrical enclosures located outdoors shall be NEMA 4X, 304 Stainless Steel. Electrical enclosures located in the wet well shall be explosion proof and corrosion resistant. All pulling devices and junction boxes in the wet well shall be 304 Stainless Steel. All conduit termination points shall be potted with duct seal or equivalent to reduce the potential of migrating gases.

12. Wiring conduit shall be galvanized rigid conduit no smaller than 0.75-inch diameter except for conduits located in the wet well. Conduits located in the wet well shall be PVC coated or aluminum rigid conduit, no smaller than 0.75-inch diameter. Conduits shall be sized to facilitate wiring for the ultimate design conditions. The rigid conduit will be recoated with PVC at all locations where the coating was removed during the installation of the conduit. All conduit straps used in the wet well will be PVC coated. All other conduit straps shall be corrosion resistant. Fasteners used outdoors, below grade, or in wet well shall be 304 Stainless Steel. Channels used to mount electrical equipment or conduit shall be aluminum or other material approved by The Authority.

13. All foreign sources of electrical power entering a control cabinet or motor control cabinet shall be identified and a means of disconnecting power shall be provided.

V. Site Design

1. Pumping station site shall have a paved access road with enough room to allow access to the wet well with a vacuum truck, and to accommodate deliveries by a chemical tanker.

2. The need for and quantity of exterior lighting shall be determined on a case-by-case basis. The site shall be landscaped so as to require a minimum of maintenance. Wherever possible, pumping station shall be hidden from view of nearby neighbors and roads. If necessary, pumping station shall be hidden through the use of tree plantings. Quantity and type of tree must be approved by The Authority. Required buffers shall comply with Clarke County Zoning Ordinance.

3. The sewage pumping station's lot will be fenced and screened/landscaped per Clarke County requirements.

4. A 12-foot wide, paved access road with gravel shoulders will be provided to the station. The minimum road section will consist of a compacted sub-grade, 8 inches of VDOT 21A stone and 2 inches of compacted VDOT SM9.5 bituminous concrete. The gradient of the

roadway centerline will not exceed 8 percent. Unrestricted ingress and egress will be granted to The Authority from a public right of way to the pumping station. On all access roads, a locking gate will be provided at the entrance to the access road from the public right of way.

5. An unrestricted, all weather access road to the station will be maintained by the contractor/applicant until the permanent access road is complete and accepted by The Authority. The Authority must have access to the station at all times.

6. An 8-foot high, black or green chain link security fence topped with angle arms pointing out and 3 strands of barbed wire shall be provided around the pumping station lot. The total height of this assembly is 10 feet. The fence shall be equipped with a top rail and a bottom tension wire. Access into the station will be through a minimum 12-foot wide, lockable gate. All door locks and padlocks in the station will be keyed to The Authority's standard keys.

7. Adequate provisions will be made for parking and turning large vehicles around at the station.

8. The project specifications will specify a paint or other protective coating for all corrodible materials not otherwise protected. The type, color and thickness of the paint or other protective coating are subject to the approval of the Authority.

9. Where a dewatering well has been placed adjacent to the station's wet well, dewatering may be left in place for future use. Casing will be securely capped above grade.

W. Startup

1. Five Day Reliability Test

a. The purpose of the 5-day reliability test is to operate the pumping station in an operational mode for 5 continuous days (24 hours per day). The intent is to test all the major pieces of equipment, the control systems, the SCADA system, other pumping station components, and alarm modes (including confirmed call-outs to the SCADA system or external phone lines) under conditions as close as possible to normal operating conditions.

b. Following completion of the equipment start-up and performance testing, the Contractor shall schedule a 5-day reliability test for the sewage pumping station.

i) The test shall be scheduled after the major equipment has been installed, tested, and individually started up.

ii) The 5-day reliability test shall not be scheduled to take place during any of the manufacturer training events.

iii) A successful 5-day reliability test shall be performed by the Contractor, certified by the Engineer, and accepted by the Owner prior to Substantial Completion of the project.

c. Major pieces of equipment shall include Comminutor, pumps, flow meter, surge tank, check valves, generator, automatic transfer switch, control system, and SCADA system.

d. The Owner operated wastewater pump-and-haul operation shall remain in operation for the duration of the 5-day reliability testing.

e. The Owner's representatives shall witness the 5-day reliability test. The Contractor shall schedule the 5-day reliability test with the Owner and the Owner's representative.

f. Submit a detailed plan for the 5-day reliability test. Obtain approval of the detailed plan prior to scheduling the 5-day reliability test.

g. The cost for the 5-day reliability test shall be included in the Contractor's services, including, but not limited to equipment, personnel, piping, valves, storage tank, test water, and disposal.

h. A successful 5-day reliability test shall be a requirement for substantial completion.

2. Successful test shall include confirmation that:

a. all the major equipment worked, as specified, for the duration of the 5-day reliability test.

b. the control systems worked, as specified, for the duration of the 5-day reliability test.

c. the SCADA systems worked, as specified, for the duration of the 5-day reliability test.

d. Adjustments of control settings within the normal operating parameters are allowed as long as the pumping station remains operational and no unplanned alarm signals are generated.

3. Substantial Completion

a. All successful 5-day reliability tests shall be performed by the Contractor, certified by the Engineer, and accepted by the Owner prior to the Certificate of Substantial Completion.

b. The Authority shall be provided with sufficient spare parts for all major equipment. See The Authority's Spare Parts Checklist. Special tools may also be required for a given station that uses special (non-standard) equipment. Special tools shall be specified during the review of the pumping station plans by The Authority.

c. Five copies of the approved Operations and Maintenance Manual and one digital copy on CD will be supplied to The Authority prior to completion of the station. The Operations and Maintenance Manual will be reviewed and approved by the Virginia DEQ and the Authority. The Operations and Maintenance Manual will contain a reduced set of the pumping station plans, including as-built electrical and control schematics, equipment model and serial numbers, installation instructions,

maintenance schedules, names and telephone numbers for local representative for each item of equipment.

d. Applicant may have to make arrangements for temporary pump and haul until sufficient wastewater flows to the pumping station, so that pumps and force mains operate properly.

8.8 Force Mains

A. Design

1. Force main materials shall conform to the Loudoun Water *Approved Materials List*.

2. Force mains shall be located in publicly owned right of way parallel to the centerline, if practical, or in a minimum 15-foot wide sanitary sewer easement.

3. To the greatest degree possible, force mains shall be designed and laid on a continuously ascending gradient. Avoid vertical offsets.

4. Except for small grinder and effluent pump installations, piping for force mains should not be less than 4 inches in diameter. No 90-degree bends will be used. Such changes in direction are to be accomplished using a sweep consisting of two 45-degree bends, with a section of pipe between.

5. At pumping capacity, a minimum self-scouring velocity of 2 fps should be maintained unless flushing facilities are provided. Velocity should not exceed 6 fps. Optimum velocities for reducing maintenance costs and preventing accumulation of solids range between 2.5 and 3.5 fps.

6. Valves shall be located as directed by the Authority. Valves may be required at tees, pig launching stations, or to isolate segments of force main that cross environmentally sensitive areas.

7. The minimum depth of cover shall be 48 inches. Future grading shall be taken into consideration.

8. Force mains discharging into gravity sewer shall be laid horizontal for at least ten feet before discharging into a manhole. The receiving manhole requires an approved polyethylene lining for protection against deterioration, due to hydrogen sulfide. Also, downstream facilities may warrant protection. Where the manhole(s) pre-exists the project in question, an interior coating may be approved for this purpose in lieu of the polyethylene. See the Loudoun Water *Approved Materials List* for manhole linings and interior coatings.

9. Sewage force mains discharging into a gravity sewer should enter the receiving manhole so that the force main's invert elevation is at the centerline of the downstream gravity sewer. A channel shall be constructed to transition the flow from the force main invert down to the gravity sewer's invert. Special attention shall be paid to the design of the termination in order to prevent turbulence at this point. Downstream gravity sewer must be at least one pipe size larger than that of the force main.

10. If determined necessary by the Authority, a blow-off or pigging station may be installed at substantial low points of force main, to enable removal of grit or draining of sewage during maintenance operations.

11. An air relief valve shall be placed at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves. Air relief and air/vacuum valves should be designed with cleanout or flushing attachments to facilitate maintenance. These valves should be protected from freezing and from damage by heavy equipment.

12. Friction losses through force mains shall be based on the Hazen and Williams Formula or other acceptable methods. When the Hazen and Williams formula is used, the value for "C" shall be 120 for smooth, pipe materials such as PVC, polyethylene, lined ductile iron, etc. When initially installed, force mains will have significantly higher "C" factor. The effect of the higher "C" factor should be considered in calculating maximum power requirements and duty cycle time to prevent damage to the motor.

13. Where force main is to be of ductile iron pipe, provide corrosion control measures pursuant to current standards of the Authority.

14. Provisions for launching and retrieving cleaning pigs should be considered in the design of a force main. Provisions should be made for attaching gauges to monitor pressure.

B. Installation

1. Force main installation shall be in accordance with the applicable portions of Chapter 4, Section 4.6.

2. All force mains shall be tested for leakage as determined by the following formula:

$$L = SD(P)^{1/2}/148{,}000$$

Where: L = allowable leakage in gallons per hour

S = length of pipe being tested in feet

D = nominal diameter of pipe in inches

P = average pressure during the test in psi

This formula is based on an allowable leakage at 150 psi of 10.486 gallons/day/mile/inch of diameter.

The hydrostatic test pressure shall be maintained for at least 30 minutes at 100 PSI or 1.5 times the working pressure, whichever is greater, based on the elevation of the lowest point in the line under test, and shall be corrected to the elevation of the test gauge. The tester shall ascertain the specific working pressure of the force main from the design engineer. Visible leaks shall be satisfactorily repaired regardless of the amount of allowable leakage.

8.9 Materials

The design engineer shall follow the Authority's SCADA and control system standards and the Loudoun Water *Approved Materials List* when specifying materials and equipment with the following additions and exceptions:

Suction Lift Pumping Station: Gorman-Rupp Co.

Submersible, Package or Conventional Pump: Flygt

Comminutor: Channel Monster type by JWC Environmental

Isolation Valves in Wet Well/Dry Well Station: DeZurik or Val-Matic Plug Valves

Chemical Injection Equipment: Siemens, Bioxide Odor Control with NBox Controller

Magnetic Flow Meter: Badger M3000 Series or Foxboro 9100 Series

Pressure Transducer: Foxboro IGP Series

Swing Check Valve: American Flow Control, VAG USA, LLC (formerly GA Industries), or APCO

Engine/Generator Set: Cummins/Onan (includes transfer switch)

Submersible Level Transducer: Endress and Hauser Water Pilot

Wet Well Lining System: Agru Sure Grip HDPE Concrete Protective Liner

Automatic Air Release: ARI D-020,

Plug Valve: DeZurik or Val-Matic

Wet Well Mixer: Flygt Flush Valves for submersibles; Flygt 4620 Submersible Mixer for package or conventional station

Access Cover: Flygt Safe Hatch, Bilco or Halliday

Programmable Logic Controller (PLC): Allen Bradley Rockwell Automation Compact Logix

Sump Pump: Zoeller 98-0006, Model M98-B

Electrical Transfer Switch (plug-in stations only): Eaton or Cutler Hammer

Auto Dialer: Racco Verbatim

Variable Frequency Pump Drive: Allen-Bradley

Power Monitor: Allen Bradley Power Monitor 5000

8.10 Miscellaneous Supplies

These miscellaneous supplies are to be furnished with the station:

brooms (1 push, 1 regular) and dustpan

squeegees (2)

mop and mop bucket with wringer

50 feet of 5/8-inch heavy duty hose with fire hose type nozzle (2), with hose reel (outside near hose bib) and hose hanger (inside near hose bib)

step ladder (sized to reach interior light fixtures)

extension ladder (sized to access wet well with 3 feet of ladder above top of slab, stored on wall hangers on outside of building – mounted out of view of the general public

industrial grade storage cabinet (general purpose, 48 inches wide x 78 inches high x 24 inches deep or equivalent)

fire proof cabinet (30 gallon or equivalent)

single pedestal desk with chair; 2-drawer file cabinet; cordless phone with answering machine; bulletin board (combo: ½ dri-erase, ½ cork)

55-gallon trash can with lid and dolly

50 feet of 12 gauge electrical extension cord

paper towel dispenser and soap dispenser (near sink)

streamlight lightbox (color: yellow, Model SQ-FL-45109)

4-gas portable, rechargeable gas monitor (pHDPlus or equivalent with calibration kit)

brass combination locks (4 number): 2-1/4-inch shank for gate (Model 175LH), and 1 for each hatch (Model 177)

DBI Sala Safety Harness (fall protection) (DBI Sala Model No. 1107800, Size: Large, Quantity: 2)

face shields (ratchet headgear with crown extension and clear polycarbonate lens)

fire extinguishers (suitable for electrical fires in control panels; include minimum of 1 extinguisher per floor level)

First Aid Kit, OSHA approved (1 per floor level)

earmuff hearing protectors (2 per generator room with storage cabinet mounted outside generator room door)

MSDS binder with applicable information (i.e. Bioxide, fuel, oil, etc.)

elbow length, acid resistant gloves (2 pair)

any applicable specialty tools required for SPS maintenance/repair

Lockout/Tagout Station/Center (center should include minimum of the following – Equipped with 6 locks, 25+ lockout tags and fasteners, 2-1.5-inch multi-lockout device, 2-single pole breaker lockouts, 1 small plug lockout, 1 large plug lockout, 2 wall switch lockouts)

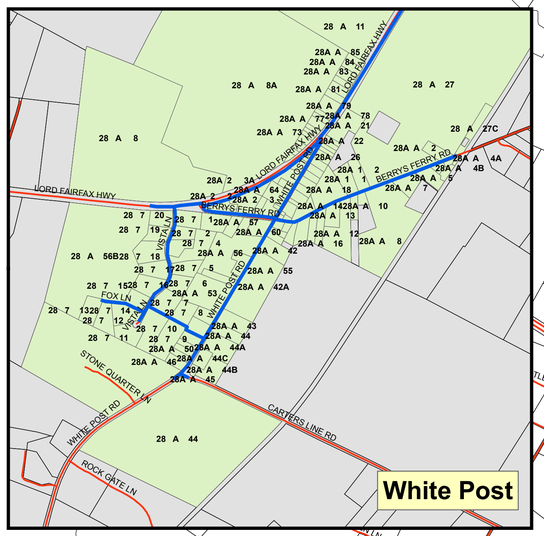
-- end of Chapter 8 --

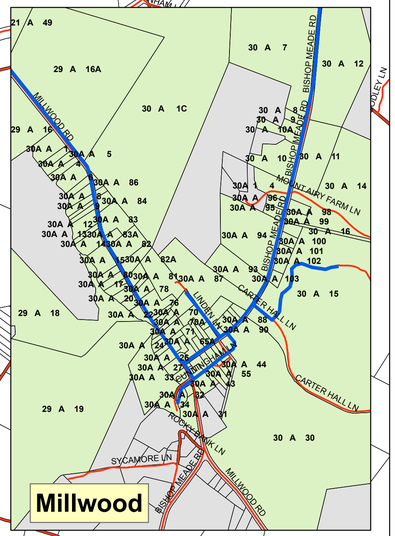
Appendix A: Current Systems

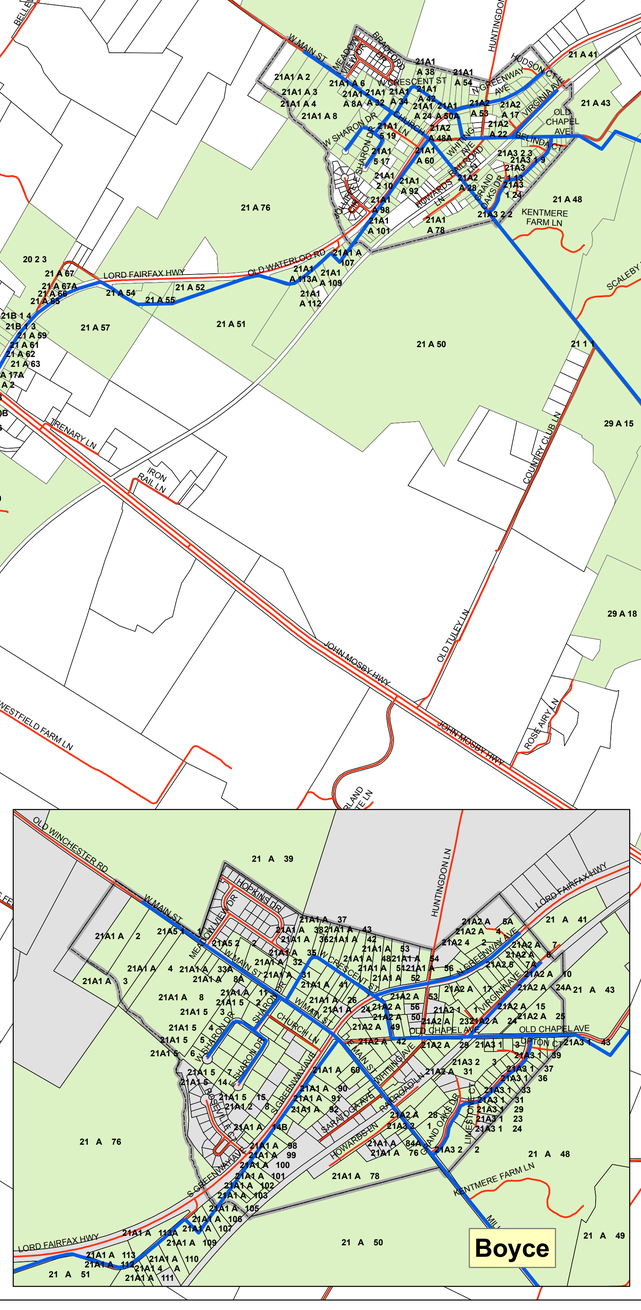
Water System Map

Sewer System Map

Resolution – Mandatory Connection to Public Water System

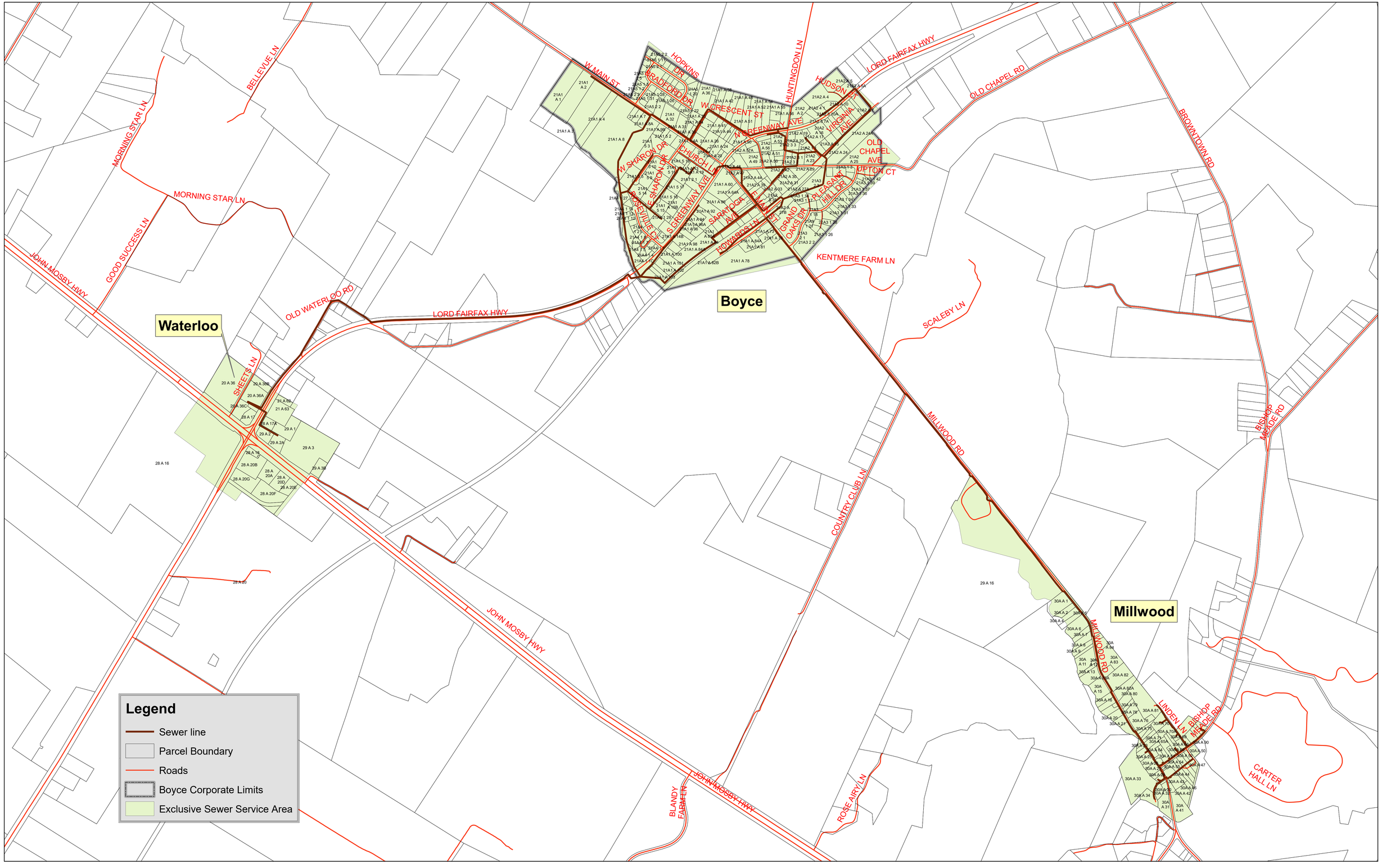






Legend

- Waterline
- Roads
- Boyce Corporate Limits
- Parcels adjacent to waterline
- Parcel Boundary


Boyce
Waterloo
Millwood
W MAIN ST
HOPKINS LN
BRADFORD DR
W CRESCENT ST
HUNTINGDON LN
HUDSON ST
LORD FAIRFAX HWY
OLD CHAPEL RD
BROWNTOWN RD
VIRGINIA AVE
OLD CHAPEL AVE
UPTON CT
W GREENWAY AVE
W SHARON DR
SHARON DR
CHURCH LN
S GREENWAY AVE
SCRIVENER CT
SARATOGA AVE
HOWARD LN
GRAND OAKS DR
PLEASANT HILL DR
KENTMERE FARM LN
SCALEBY LN
MILLWOOD RD
BISHOP MEADE RD
LINDEN LN
CARTER HALL LN
BELLEVUE LN
MORNING STAR LN
GOOD SUCCESS LN
JOHN MOSBY HWY
OLD WATERLOO RD
SHEETS LN
COUNTRY CLUB LN
ROSE AIRY LN
BLANDY FARRIER
Legend
Sewer line
Parcel Boundary
Roads
Boyce Corporate Limits
Exclusive Sewer Service Area

COPY

RESOLUTION

WHEREAS, the Clarke County Sanitary Authority has a water system and water mains by which it provides water service; and

WHEREAS, the Authority determines that it is advisable to require properties adjacent to its water mains and lines to connect to such water mains and lines, as authorized by §15.2-5137, Code of Virginia.

NOW, THEREFORE, be it RESOLVED as follows:

1. The owner, tenant, or occupant of each lot or parcel of land (1) which abuts a street or other public right of way which contains, or is adjacent to an easement containing, a water main of the Authority, and (2) upon which a building has been constructed for residential, commercial, or industrial use, shall connect the building with the water main, and shall not use any other source of water supply for domestic use; provided that the Authority may waive the requirement to connect upon finding that (1) the parcel is in the AOC or FOC zoning district, (2) the building is to be used for residential purposes, and (3) the distance from the water main to the building is so great, or the physical features (streams, rock, etc.) between the water main and the building is so difficult, that a requirement to connect to the main would create an unreasonable hardship.

2. The foregoing provisions requiring connection to the water main shall not apply to any building which is served by a private well, or other source of water supply, on the effective date of this resolution, for so long as such other source of water supply continuously serves the building.

3. This resolution shall be effective on the date on which the Clarke County Board of Supervisors takes action to concur with this resolution.

I certify that the members of the Board of Supervisors voted as follows in concurrence with this resolution on this 20th day of December 2005.

John R. Staelin, Chair	-	Aye
J. Michael Hobert, Vice Chair	-	Aye
Barbara J. Byrd	-	Aye
A.R. Dunning, Jr.	-	Aye
David S. Weiss	-	Aye

ATTEST:

David L. Ash
Clerk to the Board of Supervisors

Appendix B: Construction Detail

Utility Extension Request

Table of Minimum Separations

Sanitary Sewer – Design Computation Table

Angles for Minimum Core Separations in Sanitary Manhole

Clarke
COUNTY • VIRGINIA

Utility Extention Request (UER)

Include this UER form with all submissions along with 1 set of plans. Submit a separate UER form for each proposed project phase. All review fees will be billed after completed.

Check applicable:
- ☐ Submit Approved Application
- ☐ 1st Submission (Submit CAD data)
- ☐ Re-submission (Submit comment response letter)
- ☐ Revisions to Approved Plan (Submit change narrative)

Date: _____
Project ID: _____

Project Name:
Description of Proposed Work:

Project Location:

Parcel Identification Number:

Proposed Gross Floor Area
Commercial: _____
Office: _____
Industrial: _____
Retail: _____
Other (*specify*): _____

Proposed Dwellings:
Single-family Detached: _____
Townhouses: _____
Multi-family Units: _____

Owner/Developer (*enter the party who will execute Agreement with Authority*)
Company:
Contact Person (*name & title*)
Telephone: _____ Fax: _____ Email: _____
Mailing Address:
City, State, ZIP:
Additional Contact Person (*name & email*):

Engineer
Company: _____ Contact: _____
Telephone: _____ Fax: _____ Email: _____
Mailing Address:
City, State, ZIP:

Plan Review Fees: *All fees can be found in the Clarke County Sanitary Authority Rules & Regulations for Water & Sewer Service*

Engineering & Inspection Service	Actual cost to Authority, plus 10% of that cost

By signing below, applicant aggress to pay invoiced amount when received of actual review and/or inspection costs plus 10%.

Signature _____ **Date:** _____

Water

Type of Pipe	Diameter of Pipe	Minimum Horizontal Separation			Minimum Soil Cover	Minimum Vertical Separation	
		to Sanitary Sewer Main, Manhole, or Other Sewer Structure	to Building or Other Above Ground Structure	to Storm Drain or Other Underground Utility		to Sanitary Sewer	to Other Utillity**
Main	12-inch and Larger	10 feet	15 feet*	6 feet	3.5 feet	1.5 feet	1.5 feet
Main	6-inch to 10-inch	10 feet	15 feet*	6 feet	3 feet	1.5 feet	1.5 feet
Service	all sizes	6 feet from a sanitary lateral	5 feet from building, structure, or driveway	5 feet	3 feet	1.5 feet	1.5 feet

All clearances are as measured outside to outside.

Minimum separation between water service connections along the main is 5 feet.

* For water mains 12-inch and smaller with no more than 5 feet of cover, separation may be reduced to as little as 10 feet with case specific approval from Loudoun Water.

** Where water is above other utility, clearance may be reduced to as little as 0.5 foot, with case specific approval from CCSA. Minimum soil cover on water can be no less than 2 feet. Additional clearance and/or casing may be required where water passes below a large drain or duct. Reduced separation is not permitted where water preexists and other utility is being installed subsequently.

Sanitary Sewer

Type of Pipe	Diameter of Pipe	Minimum Horizontal Separation				Minimum Vertical Separation		Minimum Soil Cover	Maximum Cover
		to Water Main	to Building or Other Above Ground Structure	to Storm Drain or Other Underground Utility	Well	Sewer is Below Utililty	Sewer is Above Utillity		
Trunk Main or Interceptor	16-inch and larger	10 feet	15 feet	6 feet	35 feet	2 feet	1.5 feet	6 feet **	20 feet ***
Local Collection Main	8-inch to 12-inch	10 feet	15 feet	6 feet	35 feet	2 feet	1.5 feet	6 feet **	20 feet ***
Lateral or Bulding Sewer	4-inch and larger	6 feet from a water service	6 feet	6 feet	35 feet	2 feet	1.5 feet	2 feet	--
Manhole	All	10 ft	15 feet	6 feet	35 feet				

All clearances are as measured outside to outside.

Minimum separation between sewer service connections along the main is 5 feet.

** May be reduced to as little as 3 feet in isolated instances, with case specific approval from CCSA. See Chapter 5 for parameters. At least 4 vertical feet are needed to accomodate a manhole.

*** Deeper sewers are discouraged, but are occasionally necessary, based on available routes and topography. Successful designs will be those that follow the natural topography. See Chapter 5 for design parameters. Consult the Authroity's staff where considering a design requiring sewer deeper than 20 vertical feet.

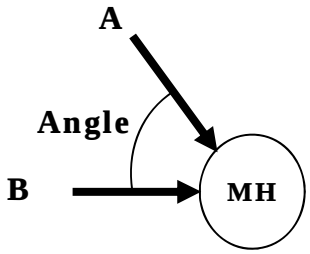
Sanitary Sewer Design Computation Table - Revised 12/2014

Pipe Characteristics					Flow Characteristics										Total Flow				Capacity Information				
Upstream MH	Downstream MH	Diameter (inches)	Slope %	Length (ft)	# of SFD Units	Average flow for units (350 gpd / unit)	# of SFA or MF Units	Average flow for units (280 gpd / unit)	SF of Retail Space	Average Flow for retail (0.093 gpd/SF)	SF of Industrial / Commercial Space	Average Flow for com. Ind. (0.16 gpd/SF)	Additional Known Peak Flow (MGD)	KnownCumulative Peak Flow (MGD)	Total Incremental flow (gpd)	Total Cumulative Flow (gpd)	Peak Flow Factor	Peak Hour Flow (MGD)	Full Capacity of Pipe (MGD)	% full	Velocity in pipe (fps)	velocity OK?	NOTES
TRIBUTARY 1:																							
TRIBUTARY 2:																							
TRUNK MAIN:																							
n = 0.012																							

Design and Construction Standards, Appendix B
Sanitary Sewer - Design Computation Table
September 2019

Sanitary Sewer Minimum Core Separation Angles

Minimum Core Separation (in.)	6.00
4-foot Diameter Manhole Circumference (in.)	150.80
5-foot Diameter Manhole Circumference (in.)	188.50



Pipe A Diameter (in.)	Pipe B Diameter (in.)	Core A Diameter (in.)	Core B Diameter (in.)	Minimum Angle for 4-foot Diameter Manhole (Deg)	Minimum Angle for 5-foot Diameter Manhole (Deg)
4	4	7.00	7.00	31	25
4	6	7.00	10.15	35	28
4	8	7.00	12.13	37	30
4	10	7.00	16.07	42	33
4	12	7.00	16.07	42	33
4	16	7.00	22.13	49	39
6	6	10.15	10.15	39	31
6	8	10.15	12.13	41	33
6	10	10.15	16.07	46	36
6	12	10.15	16.07	46	36
6	16	10.15	22.13	53	42
8	8	12.13	12.13	43	35
8	10	12.13	16.07	48	38
8	12	12.13	16.07	48	38
8	16	12.13	22.13	55	44
10	10	16.07	16.07	53	42
10	12	16.07	16.07	53	42
10	16	16.07	22.13	60	48
12	12	16.07	16.07	53	42
12	16	16.07	22.13	60	48
16	16	22.13	22.13	67	54

Appendix C: Estimating Construction Cost

Estimate of Construction Cost

Clarke COUNTY • VIRGINIA

Under the Developer Agreement with Clarke County Sanitary Authority, each project must be built under a performance bond to assurance completion of the public improvements, a payment bond to ensure that contractors and suppliers are paid, and a maintenance bond to serve as a warranty on the work. This form may be used to establish the amount of the performance and payment bonds. Listed below are unit costs for many of the items that are installed on a typical project. Where the scope of work is not reflected, or not fully reflected by the listed items and prices, the developer or engineer will furnish an estimate of cost using other sources, such as a formal engineer's estimate or a contract for the work.

The listed items may be considered to include the labor, materials, and equipment needed to make a complete, typical installation. Components included are clearing; siltation and erosion control; excavation and trench de-watering; pipe and fittings; blocking and thrust restraint; bedding; native backfill; acceptance testing; and restoration. Add estimate for items that are site specific, to include, among others: blasting in open trench, rock excavation by hoe-ram, imported backfill, offsite dispoal, installation of sewer to a depth greater than 20 feet, and landscape replacement.

Project Name: _____

Project ID #: **Date Prepared:**

Item	Quantity	Unit	Unit Price	Total Price
WATER MAIN				
4" ductle iron pipe and fittings		LF	$ 50	$ -
6" ductile iron pipe and fittings		LF	$ 65	$ -
8" ductile iron pipe and fittings		LF	$ 80	$ -
10" ductile iron pipe and fittings		LF	$ 90	$ -
12" ductile iron pipe and fittings		LF	$ 100	$ -
16" ductile iron pipe and fittings		LF	$ 130	$ -
20" ductile iron pipe and fittings		LF	$ 135	$ -
24" ductile iron pipe and fittings		LF	$ 180	$ -
30" ductile iron pipe and fittings		LF	$ 220	$ -
VALVE				
4" or 6" valve		Each	$ 900	$ -
8", 10" or 12" valve		Each	$ 2,200	$ -
16" or 20" valve		Each	$ 4,500	$ -
24" or 30" valve		Each	$ 7,500	$ -
FIRE HYDRANT				
hydrant assembly including auxilary valve		Each	$ 4,500	$ -
AIR RELEASE				
air release assembly with manhole		Each	$ 5,000	$ -
EXTENSION FROM EXISTING BLOW-OFF				
4" thru 12" main		Each	$ 1,500	$ -
16" thru 30" main		Each	$ 3,000	$ -
CUT-IN ON EXISTING MAIN				
6" thru 12" existing main - not including valve(s)		Each	$ 4,000	$ -
16" thru 30" existing main - not including valve(s)		Each	$ 6,000	$ -
WET TAP OF EXISTING MAIN				
6" thru 12" existing main including tapping sleeve and valve		Each	$ 8,000	$ -
16" thru 24" existing main including tapping sleeve and valve		Each	$ 15,000	$ -

Item	Quantity	Unit	Unit Price	Total Price
SERVICE CONNECTION				
1" service with meter setting		Each	$ 1,500	$ -
1 1/2" or 2" service with meter setting, including 6" auxiliary valve		Each	$ 3,000	$ -
3" or larger service with underground meter, including 6" valve		Each	$ 17,000	$ -
fire or domestic connection with indoor meter, including 6" valve		Each	$ 1,500	$ -
TEMPORARY BLOW-OFF				
temporary blow-off with line anchor on 4" thru 12" main		Each	$ 2,500	$ -
temporary blow-off with line anchor on 16" thru 30" main		Each	$ 3,500	$ -
TRENCHLESS CROSSING				
bore pit and retrieval pit		Each	$ 5,000	$ -
jack and bore with 16" or 20" casing		LF	$ 800	$ -
jack and bore with 24" or 30" casing		LF	$ 1,300	$ -
jack and bore with 36" or 42" casing		LF	$ 1,700	$ -
jack and bore or tunnel with 48" thru 60" casing or liner		LF	$ 2,000	$ -
WATER MISCELLANEOUS				
polyethylene encasement, bonded joints and anode beds		LF	$ 22	$ -
anode bed and test station		Each	$ 4,000	$ -
				$ -
				$ -
				$ -
				$ -
WATER SUBTOTAL:				**$ -**

Item	Quantity	Unit	Unit Price	Total Price
8" SANITARY SEWER				
depths to 10' of cover		LF	$ 65	$ -
cover more than 10'		LF	$ 125	$ -
10" SANITARY SEWER				
depths to 10' of cover		LF	$ 75	$ -
cover more than 10'		LF	$ 135	$ -
12" SANITARY SEWER				
depths to 10' of cover		LF	$ 85	$ -
cover more than 10'		LF	$ 145	$ -
16" SANITARY SEWER				
depths to 10' of cover		LF	$ 100	$ -
cover more than 10'		LF	$ 175	$ -
20" SANITARY SEWER				
depths to 10' of cover		LF	$ 115	$ -
cover more than 10'		LF	$ 185	$ -
24" SANITARY SEWER				
depths to 10' of cover		LF	$ 125	$ -
cover more than 10'		LF	$ 200	$ -
30" SANITARY SEWER				
depths to 10' of cover		LF	$ 145	$ -
cover more than 10'		LF	$ 235	$ -

Item	Quantity	Unit	Unit Price	Total Price
36" SANITARY SEWER				
depths to 10' of cover		LF	$ 175	$ -
cover more than 10'		LF	$ 250	$ -
MANHOLE				
4' inside diameter, 6' depth		Each	$ 5,000	$ -
4' inside diameter, depth below 6'		VF	$ 350	$ -
5' inside diameter, 6' depth		Each	$ 6,500	$ -
5' inside diameter, depth below 6'		VF	$ 500	$ -
connect to existing manhole by core and boot		Each	$ 2,000	$ -
TRENCHLESS CROSSING				
bore pit and retrieval pit		Each	$ 5,000	$ -
jack and bore through 24" or smaller casing		LF	$ 700	$ -
jack and bore with 30" thru 42" casing		LF	$ 1,300	$ -
jack and bore or tunnel with 48" thru 60" casing or liner		LF	$ 2,200	$ -
SEWER MISCELLANEOUS				
sewer service connection and lateral		Each	$ 1,800	$ -
concrete encasement		LF	$ 150	$ -
bypass pumping-one segment for one week		Each	$ 3,500	$ -
				$ -
				$ -
				$ -
				$ -
SEWER SUBTOTAL:				**$ -**
MISCELLANEOUS FOR WATER OR SEWER				
16" or 20" casing installed by direct bury		LF	$ 140	$ -
24" or 30" casing installed by direct bury		LF	$ 175	$ -
36" or 42" casing installed by direct bury		LF	$ 250	$ -
pavement restoration, 4" deep patch		SY	$ 60	$ -
mill pavement and overlay		SY	$ 25	$ -
traffic control		Day	$ 2,000	$ -
imported backfill		CY	$ 30	$ -
rock excavation by hoe-ram		CY	$ 120	$ -
12' gravel access road for dedication		LF	$ 5	$ -
				$ -
				$ -
MISCELLANEOUS SUBTOTAL:				**$ -**

Water Subtotal + Sewer Subtotal + Miscellaneous Subtotal	$ -
Mobilization	$ -
10% Construction Contingency	$ -
Inflation During the Project at 4% for 3 years	$ -
ESTIMATED COST OF CONSTRUCTION:	**$ -**

Appendix D: Hydraulic Analysis of Water Distribution System

PRELIMINARY ENGINEERING REPORT
WATER SYSTEM IMPROVEMENTS PROJECT
CLARKE COUNTY, VIRGINIA

JUNE 22, 2015

Prepared for:

Michael Legge – Purchasing Manager

Sanitary Authority:

Ian Williams – Chairman
Dan Mackay-Smith – Vice-Chairman
Harry Jones – Treasurer
A. R. "Pete" Dunning, Jr. – Board of Supervisors
Joseph Myer

QA/QC_____

Anderson & Associates, Inc.
Professional Design Services
Blacksburg, Virginia
JN 31168

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EXECUTIVE SUMMARY

This report is part of an ongoing effort by the Clarke County Sanitary Authority to continue improving the infrastructure and operation of the water distribution system. As part of this report, the County's existing hydraulic model has been revised using updated water distribution system mapping. The recommended improvements listed below will increase available fire flows in the distribution system.

Recommended improvements to the Clarke County water distribution system are as follows:

1. Virginia Avenue

   Replace approximately 1,150 linear feet of existing 4 inch waterline with a proposed 6 inch water line and reconnect existing customers.

2. South Greenway Avenue

   Replace approximately 2,300 linear feet of existing 6 inch waterline with a proposed 8 inch water line and reconnect existing customers.

The total estimated cost for the recommended improvements is approximately $294,675, which includes estimated construction and related costs.

I. INTRODUCTION

The purpose of this report is to evaluate the existing water distribution system that serves the Boyce, Millwood, and White Post communities of Clarke County and to recommend changes needed to improve the water distribution system. The improvements recommended in this report meet or exceed the state and federal guidelines that regulate the type of work being proposed.

As an integral part of this report the water distribution system mapping within the County has been updated. The updated system mapping was then used to update the hydraulic model in order to analyze the existing water distribution system. The hydraulic analysis of the existing water distribution system examined residual pressures, available fire flows, and water age throughout the existing system.

The County's effective storage capacity was also analyzed as part of this report. The analysis shows the number of future connections that can be added to the County's system while maintaining the required amount of storage as determined by Virginia Department of Health regulations.

II. PROJECT PLANNING AREA

A. Location

The water distribution system serving the Boyce, Millwood, and White Post communities is located in the southwestern portion of Clarke County, Virginia. The water distribution system extends generally along U.S. Route 340 and State Route 723, intersecting in the Town of Boyce. The topography of the area is generally described as relatively flat to gently rolling terrain. Elevations of service areas range from approximately 490 feet to 640 feet (see Appendix A – Vicinity Map).

B. Growth Areas and Population

The Clarke County water distribution system has approximately 446 connections serving a population of approximately 1,100 people. The US Census Bureau data indicates that population within Clarke County has grown at a rate of 2.3% between April 2010 and July 2013 (See Appendix B – US Census Bureau Data).

III. EXISTING FACILITIES

A. System Layout

The public water supply for the Boyce, Millwood, and White Post communities is the Prospect Hill Spring. The spring was permitted by VDH in 1977. The permitted capacity of the Prospect Hill Spring is 0.22 MGD. The spring water is treated by a chlorine injection process. Treated water is then pumped from the spring's clearwell / contact tank to the County's water storage facilities. Included in Appendix C – Existing System Mapping of this report is an overall exhibit of the existing water system.

The County currently maintains three water storage facilities in three separate pressure zones. Water produced at the WTP is pumped into the Boyce pressure zone. The Boyce Elevated Tank has an approximate capacity of 150,000 gallons and operates at a maximum hydraulic grade of 713'.

The Millwood pressure zone is fed from the Boyce Tank through a pressure reducing valve located in the vicinity of the Powhatan School. The Millwood Elevated Tank has an approximate capacity of 75,000 gallons and operates at a maximum hydraulic grade of 686'. The Boyce and Millwood pressure zones are isolated by a closed gate valve located near the intersection of Bishop Meade and Browntown Roads.

The White Post pressure zone is fed from a booster pump station pulling from the Boyce Tank. The White Post Elevated Tank has an approximate capacity of 50,000 gallons and operates at a maximum hydraulic grade of 765'. The White Post pump station also includes a set of higher capacity pumps and generator to provide adequate fire protection to the White Post pressure zone. The White Post pump station also includes a pressure reducing valve to feed back into the Boyce pressure zone in an emergency condition.

A new Millwood Elevated Tank is currently under construction in the vicinity of the existing tank. The new Millwood Tank is designed to operate at the same hydraulic grade as the Boyce Tank combining the Boyce and Millwood pressure zones and removing the pressure reducing and isolation valves from operation. The new Millwood Elevated Tank will have an approximate capacity of 100,000 gallons and a maximum hydraulic grade of 712'. The existing system scenarios analyzed in this report will assume construction of the new Millwood Tank is completed.

B. Condition of Facilities

Clarke County's water distribution system is currently in compliance with all state and federal guidelines pertaining to the treatment and distribution of potable water. The County has provided historical documentation indicating that unaccounted water totals 30% of the overall production for the water distribution system. The American Water Works Association's *Water Distribution Principles and Practices of Water Supply Operations* considers 15% unaccounted water as acceptable for large water utilities. As part of the work to be completed under this PER, areas of concern with respect to low pressure and low available fire flows will be evaluated.

IV. EXISTING SYSTEM – HYDRAULIC ANALYSIS

A. Effective Storage Calculations

1. Existing System

The following data is based on Run #1 of the Hydraulic Model (see Appendix E), and the effective storage calculations found in Appendix G. The effective storage available in the Boyce Tank is 110,540 gallons, which equates to 73% of the total volume. The effective storage available in the Millwood Tank is 110,540 gallons, which equates to 100% of the total volume. The combined effective storage capacity in the low pressure zone is 221,080 gallons. Based on the Virginia Department of Health requirement for effective storage of half an average days storage, the required amount of effective storage in the low pressure zone is 30,553 gallons. The combined effective storage capacity of the Boyce and Millwood Tanks satisfies the effective storage requirement outlined by the Virginia Department of Health for the low pressure zone. Under existing conditions the County has 190,526 gallons of effective storage for future development.

The effective storage available in the high pressure zone's White Post Tank is 54,024 gallons, which equates to 100% of the total volume. Based on the Virginia Department of Health requirement for effective storage of half an average days storage, the required amount of effective storage in the high pressure zone is 12,571 gallons. The effective storage capacity of the White Post Tank satisfies the effective storage requirement outlined by the Virginia Department of Health for the high pressure zone. Under existing conditions the County has 41,453 gallons of effective storage for future development.

2. Future Demands

Included in Appendix E – Hydraulic Model of this report are future demand projections to the year 2035. These future demands are a linear projection based upon previous records. Run #5 of the hydraulic analysis evaluates effective storage in the proposed system under these future demand projections. The amount of effective storage in the system remains unchanged at 221,080 gallons in the low pressure zone and 54,024 gallons in the high pressure zone. The required effective storage increases with the demand growth and is projected to equal 62,219 gallons in the low pressure zone and 25,592 gallons in the high pressure zone. The amount of effective storage available is projected to equal 158,861 gallons in the low pressure zone and 28,432 gallons in the high pressure zone.

B. Residual Pressure

1. Existing System

Included in Appendix E – Hydraulic Model of this report is an exhibit titled, “Run #1 – Pressure Exhibit.” This exhibit shows low pressures throughout the existing system with tanks emptied and the Water Treatment Plant off. Aside from low pressures in the vicinity of tanks, the lowest pressure occurs in the northeastern portion of the system in the vicinity of Browntown Road, with approximately 33 psi at the end of the 2 inch water line. However this low pressure area exceeds the minimum pressure requirements and does not have an adverse effect on the available storage capacity.

C. Available Fire Flow

1. Existing System

Included in Appendix E – Hydraulic Model of this report is an exhibit titled, “Run #2 – Available Fire Flow Exhibit.” This exhibit shows the maximum fire flow that can be withdrawn from each hydrant while maintaining 20 psi for all users in the existing system under normal conditions with the Water Treatment Plant off. All hydrants in the system, with the exception of FH-1, have an available fire flow of at least 500 gpm. The available fire flow at hydrant FH-1 is 367 gpm. The water line serving hydrant FH-1 along Virginia Avenue is reportedly 4 inch.

V. PROPOSED IMPROVEMENTS

A. Virginia Avenue

1. Proposed Changes

The proposed improvement to the water distribution system along Virginia Avenue is in an effort to increase available fire flows. The proposed improvement consist of replacing approximately 1,150 linear feet of existing 4" water line with 6" water line along Virginia Avenue from hydrant FH-2 to hydrant FH-1 (see Appendix D - Proposed Improvements).

2. Hydraulics

The improvement outlined for Virginia Avenue is supported by Run #7 of the hydraulic analysis. The available fire flow report indicates that after the proposed improvement the available fire flows at hydrant FH-1 will increase to 938 gpm, over their existing flows of 367 gpm. Included in Appendix E is an exhibit showing the available fire flow at all hydrants in the proposed system titled, "Run #7 – Available Fire Flow Exhibit." Comparing this exhibit to another in Appendix E for the existing system titled, "Run #3 – Available Fire Flow Exhibit," it is evident that the proposed improvement increases the available fire flow to the hydrant at the end of Virginia Avenue.

3. Storage

The improvement outlined for Virginia Avenue has no impact on the effective storage in the water system.

4. Cost

The construction cost associated with this improvement is $59,150 (see Appendix H – Cost Estimates).

B. South Greenway Avenue

1. Proposed Changes

The proposed improvement to the water distribution system along South Greenway Avenue is in an effort to improve the suction side flow path of the White Post pump station thereby increasing available fire flows. The proposed improvement consist of replacing approximately 2,300 linear feet of existing 6" water line with 8" water line along South Greenway Avenue from Church Lane to where the existing water line transitions to 8" along Old Waterloo Road (see Appendix D - Proposed Improvements).

2. Hydraulics

The improvement outlined for South Greenway Avenue is supported by Run #8 of the hydraulic analysis. The available fire flow report indicates that after the proposed improvement the available fire flows at hydrant FH-14, located near the pump station discharge, will increase to 1515 gpm, over their existing flows of 423 gpm. Included in Appendix E is an exhibit showing the available fire flow at all hydrants in the proposed system titled, "Run #8 – Available Fire Flow Exhibit." Comparing this exhibit to another in Appendix E for the existing system titled, "Run #4 – Available Fire Flow Exhibit," it is evident that the proposed improvement increases the available fire flow to all hydrants in the vicinity.

3. Storage

The improvement outlined for South Greenway Avenue has no impact on the effective storage in the water system.

4. Cost

The construction cost associated with this improvement is $121,025 (see Appendix H – Cost Estimates).

VII. CONCLUSIONS AND RECOMMENDATIONS

A. General

Based on our evaluation of the existing problem areas identified, recommended improvements to the water system have been listed below.

B. Summary of Recommended Improvements

1. Virginia Avenue

   Replace approximately 1,150 linear feet of existing 4 inch waterline with a proposed 6 inch water line and reconnect existing customers.

2. South Greenway Avenue

   Replace approximately 2,300 linear feet of existing 6 inch waterline with a proposed 8 inch water line and reconnect existing customers.

C. Funding

The total estimated cost for the recommended improvements is approximately $294,675, which includes estimated construction and related costs. If the Clarke County Sanitary Authority plans to pursue a feasible funding package through Rural Development, the Virginia Department of Health, or other sources, Anderson and Associates, Inc. will assist the Clarke County Sanitary Authority with funding applications upon request.

APPENDIX A

Vicinity Map

CLARKE COUNTY SANITARY AUTHORITY

6000 3000 0 6000 12000 18000
SCALE IN FEET

ANDERSON AND ASSOCIATES, Inc.

VICINITY MAP
JUNE 22, 2015

APPENDIX B

US Census Bureau Data

State & County QuickFacts

Clarke County, Virginia

People QuickFacts	Clarke County	Virginia
Population, 2013 estimate	14,348	8,260,405
Population, 2010 (April 1) estimates base	14,023	8,001,031
Population, percent change, April 1, 2010 to July 1, 2013	2.3%	3.2%
Population, 2010	14,034	8,001,024
Persons under 5 years, percent, 2013	5.1%	6.2%
Persons under 18 years, percent, 2013	21.4%	22.6%
Persons 65 years and over, percent, 2013	17.7%	13.4%
Female persons, percent, 2013	50.2%	50.8%
White alone, percent, 2013 (a)	90.8%	70.8%
Black or African American alone, percent, 2013 (a)	5.2%	19.7%
American Indian and Alaska Native alone, percent, 2013 (a)	0.4%	0.5%
Asian alone, percent, 2013 (a)	1.1%	6.1%
Native Hawaiian and Other Pacific Islander alone, percent, 2013 (a)	0.1%	0.1%
Two or More Races, percent, 2013	2.4%	2.7%
Hispanic or Latino, percent, 2013 (b)	3.9%	8.6%
White alone, not Hispanic or Latino, percent, 2013	87.5%	63.6%
Living in same house 1 year & over, percent, 2008-2012	91.5%	84.7%
Foreign born persons, percent, 2008-2012	3.7%	11.1%
Language other than English spoken at home, pct age 5+, 2008-2012	6.3%	14.7%
High school graduate or higher, percent of persons age 25+, 2008-2012	89.3%	86.9%
Bachelor's degree or higher, percent of persons age 25+, 2008-2012	31.2%	34.7%
Veterans, 2008-2012	1,662	734,151
Mean travel time to work (minutes), workers age 16+, 2008-2012	36.9	27.5
Housing units, 2013	6,247	3,412,460
Homeownership rate, 2008-2012	78.6%	67.8%
Housing units in multi-unit structures, percent, 2008-2012	6.1%	21.5%
Median value of owner-occupied housing units, 2008-2012	$348,000	$249,700
Households, 2008-2012	5,580	3,006,219
Persons per household, 2008-2012	2.48	2.59
Per capita money income in past 12 months (2012 dollars), 2008-2012	$38,121	$33,326
Median household income, 2008-2012	$80,186	$63,636
Persons below poverty level, percent, 2008-2012	7.9%	11.1%

Business QuickFacts	Clarke County	Virginia
Private nonfarm establishments, 2012	356	192,730[1]
Private nonfarm employment, 2012	2,920	3,089,241[1]
Private nonfarm employment, percent change, 2011-2012	-6.3%	2.0%[1]
Nonemployer establishments, 2012	1,286	529,636
Total number of firms, 2007	1,276	638,643
Black-owned firms, percent, 2007	F	9.9%
American Indian- and Alaska Native-owned firms, percent, 2007	F	0.5%
Asian-owned firms, percent, 2007	F	7.0%

Native Hawaiian and Other Pacific Islander-owned firms, percent, 2007	F	0.1%
Hispanic-owned firms, percent, 2007	F	4.5%
Women-owned firms, percent, 2007	31.3%	30.1%
Manufacturers shipments, 2007 ($1000)	228,253	92,417,797
Merchant wholesaler sales, 2007 ($1000)	D	60,513,396
Retail sales, 2007 ($1000)	91,615	105,663,299
Retail sales per capita, 2007	$6,381	$13,687
Accommodation and food services sales, 2007 ($1000)	8,980	15,340,483
Building permits, 2012	20	27,278

Geography QuickFacts	Clarke County	Virginia
Land area in square miles, 2010	176.18	39,490.09
Persons per square mile, 2010	79.7	202.6
FIPS Code	043	51
Metropolitan or Micropolitan Statistical Area	Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area	

1: Includes data not distributed by county.

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

D: Suppressed to avoid disclosure of confidential information
F: Fewer than 25 firms
FN: Footnote on this item for this area in place of data
NA: Not available
S: Suppressed; does not meet publication standards
X: Not applicable
Z: Value greater than zero but less than half unit of measure shown

Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits
Last Revised: Tuesday, 08-Jul-2014 06:46:28 EDT

APPENDIX C

Existing System Mapping

CLARKE COUNTY SANITARY AUTHORITY

BOYCE ELEVATED TANK
150,000 GALLONS
OVERFLOW = 713'
L.W.L. = 680'
BASE = 610'
DIAMETER = 28'

PS/PRV

WTP

MILLWOOD
ELEVATED TANK
75,000 GALLONS
OVERFLOW = 686'
L.W.L. = 653'
BASE = 585'
DIAMETER = 20'

PRV

UNDER CONSTRUCTION
NEW MILLWOOD
ELEVATED TANK
100,000 GALLONS
OVERFLOW = 712'
L.W.L. = 688'
BASE = 581'
DIAMETER = 28'

WHITE POST ELEVATED TANK
50,000 GALLONS
OVERFLOW = 765'
L.W.L. = 746'
BASE = 625'
DIAMETER = 22'

N

LEGEND

- EXISTING 2" WATER LINE
- EXISTING 4" WATER LINE
- EXISTING 6" WATER LINE
- EXISTING 8" WATER LINE
- EXISTING 12" WATER LINE
- EXISTING STORAGE TANK
- EXISTING PUMP STATION
- EXISTING PRESSURE REDUCING VALVE
- EXISTING FIRE HYDRANT
- EXISTING CLOSED GATE VALVE

1000 500 0 1000 2000 3000
SCALE IN FEET

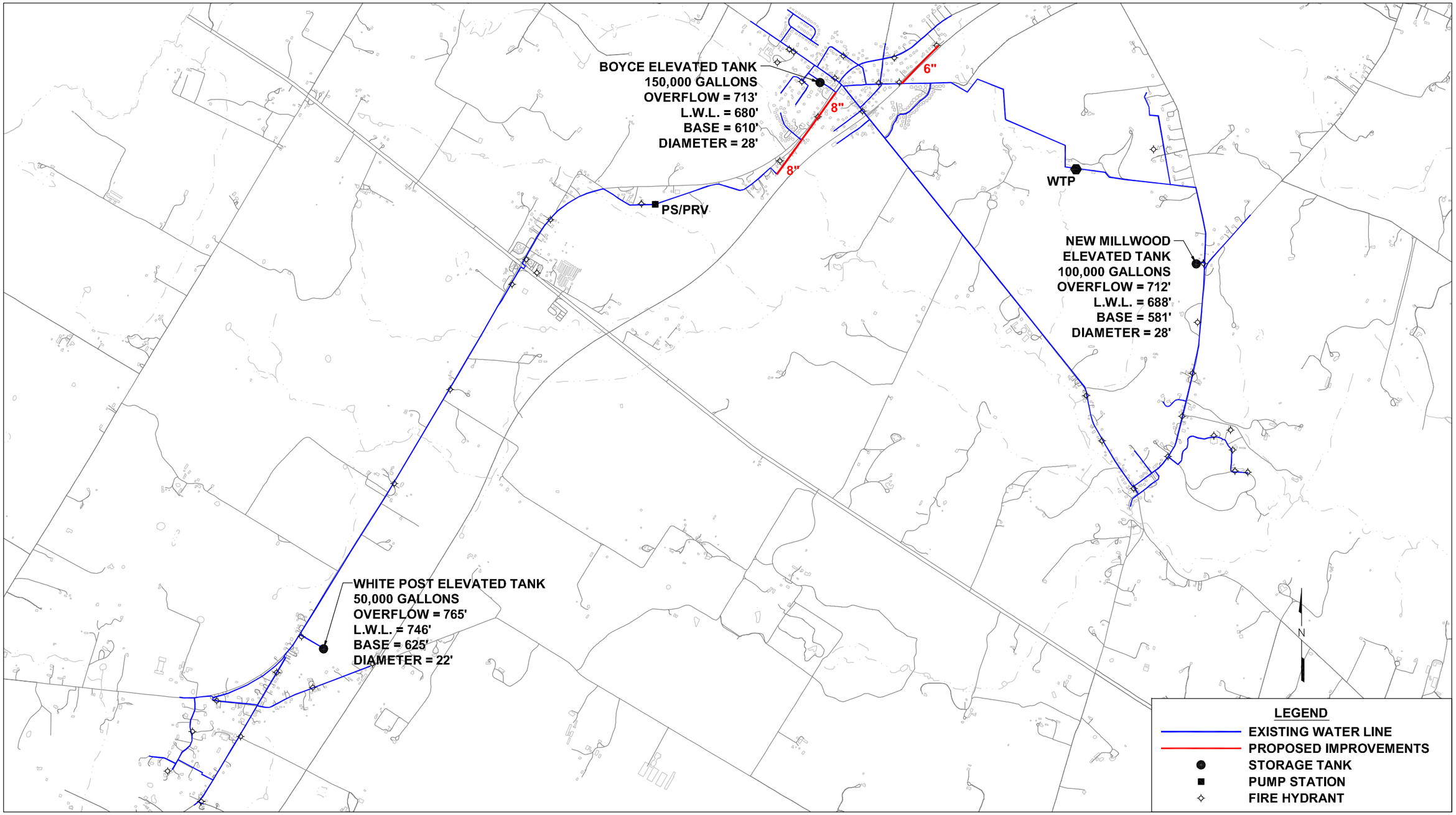
ANDERSON AND ASSOCIATES, Inc.

EXISTING WATER SYSTEM
JUNE 22, 2015

APPENDIX D

Proposed Improvements

CLARKE COUNTY SANITARY AUTHORITY



1000 500 0 1000 2000 3000
SCALE IN FEET

ANDERSON AND ASSOCIATES, Inc.

PROPOSED WATER SYSTEM IMPROVEMENTS
JUNE 22, 2015

APPENDIX E

Hydraulic Model

Clarke County Water System Hydraulic Analysis
June 22, 2015
Narrative

The Clarke County water systems serving the Boyce, Millwood, and White Post communities was modeled using WaterGEMS v8i series 4. An AutoCAD drawing of the water system was prepared using the WaterGEMS interface and is included in this report. A summary of the runs completed is presented below while detailed printouts of each model run follow this narrative.

The twice average daily demand used in this analysis was calculated using past records provided by the County from July 2013 to February 2014, a summary is included in this report. The average daily demand of the County is 191 gpd/conn including leakage, unbilled, and peak commercial use. Projected future demands were calculated based upon recent growth and are equal to approximately 175,622 gpd projected for year 2035. The applicable fire flow policy adopted by the County requires a minimum fire flow of 500 gpm for a duration of 2 hours.

Run #1 – Steady state analysis of twice average daily demand. Initial conditions are as follow: Existing Water System, Boyce Tank – Absolute Low, Millwood Tank – Absolute Low, White Post Tank – Absolute Low, Water Treatment Plant – Off, & White Post Pump Station – Off.
Purpose – To determine the minimum tank level in the existing water system necessary to maintain 20 psi for all users under twice average daily conditions.
Result – The White Post Tank serving the high pressure zone can empty and still maintain 20 psi for all users in the system. The minimum hydraulic grade in the Boyce and Millwood Tanks serving the low pressure zone is 688' which corresponds to 8.00' of water in the Boyce Tank and the Millwood Tank empty.

Run #2 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow: Existing Water System, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – Off, & White Post Pump Station – Off.
Purpose – To identify critical hydrants in the existing system and report their available fire flows while maintaining 20 psi for all users in the system.
Result – All hydrants exceed 500 gpm available fire flow with the exception of FH-1. See the fire flow report for details.

Run #3 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow: Existing Water System, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – On, & White Post Pump Station – Off.
Purpose – To identify critical hydrants in the existing system and report their available fire flows while maintaining 20 psi for all users in the system.
Result – All hydrants exceed 500 gpm available fire flow with the exception of FH-1. See the fire flow report for details.

Run #4 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow: Existing Water System, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – On, & White Post Pump Station – Fire Pump On.
Purpose – To identify critical hydrants in the existing system and report their available fire flows while maintaining 20 psi for all users in the system.
Result – As flow through the White Post pump station increases, a critical junction along the pump station's suction line falls below the required 20 psi minimum pressure, limiting available fire flows in the White Post pressure zone. See the fire flow report for details.

Run #5 – Steady state analysis of twice average daily demand. Initial conditions are as follow: Proposed Water System Improvements – Constructed, Boyce Tank – Absolute Low, Millwood Tank – Absolute Low, White Post Tank – Absolute Low, Water Treatment Plant – Off, & White Post Pump Station – Off.
Purpose – To determine the minimum tank level in the proposed water system necessary to maintain 20 psi for all users under twice average daily conditions.
Result – The White Post Tank serving the high pressure zone can empty and still maintain 20 psi for all users in the system. The minimum hydraulic grade in the Boyce and Millwood Tanks serving the low pressure zone is 688' which corresponds to 8.00' of water in the Boyce Tank and the Millwood Tank empty.

Run #6 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow: Proposed Water System Improvements – Constructed, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – Off, & White Post Pump Station – Off.
Purpose – To identify critical hydrants in the proposed system and report their available fire flows while maintaining 20 psi for all users in the system.
Result – All hydrants in the proposed water system exceed 500 gpm available fire flow. See the fire flow report for details.

Run #7 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow: Proposed Water System Improvements – Constructed, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – On, & White Post Pump Station – Off.
Purpose – To identify critical hydrants in the proposed system and report their available fire flows while maintaining 20 psi for all users in the system.
Result – All hydrants in the proposed water system exceed 500 gpm available fire flow. See the fire flow report for details.

Run #8 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow: Proposed Water System Improvements – Constructed, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – On, & White Post Pump Station – Fire Pump On.
Purpose – To identify critical hydrants in the proposed system and report their available fire flows while maintaining 20 psi for all users in the system.
Result – All hydrants in the proposed water system's high pressure zone exceed 500 gpm available fire flow. See the fire flow report for details.

Run #9 – Extended period analysis of twice average daily demand plus 500 gpm 2 hour fire flow event at hydrant FH-38. Initial conditions are as follow: Proposed Water System Improvements – Constructed, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – On, & White Post Pump Station – On.
Purpose – To identify if the proposed water system is capable of supporting the described fire flow event while maintaining 20 psi for all users in the system.
Result – The minimum required pressure of 20 psi is maintained for all users in the system for the duration of the fire flow event. Hydrants FH-39 and FH-40 fail to maintain 20 psi throughout the system for the entire fire flow duration when analyzed under a similar fire flow event.

Run #10 – Extended period analysis of twice average daily demand plus 750 gpm 2 hour fire flow event at hydrant FH-27. Initial conditions are as follow: Proposed Water System Improvements – Constructed, Boyce Tank – Normal Low, Millwood Tank – Normal Low, White Post Tank – Normal Low, Water Treatment Plant – On, & White Post Pump Station – Fire Pump On.
Purpose – To identify if the proposed water system is capable of supporting the described fire flow event while maintaining 20 psi for all users in the system.
Result – The minimum required pressure of 20 psi is maintained for all users in the system for the duration of the fire flow event.

Demand Calculations for the Clarke County Water System
October 16, 2014

*Daily Average of	Water Produced	**85,357**	gpd
	Water Bought from Localities	**0**	gpd
	Water Sold to Localities	**0**	gpd
	Metered Water Billed	**59,208**	gpd
	Metered Water Unbilled	**0**	gpd
	Total Water Unaccounted	**26,149**	gpd
	Water Sold to Residential and Commercial Users	**59,208**	gpd
	Number of Users	**446**	users

Top Users:

Name	Water Bought (gpd)	Equivalent Residential Connections (ERC's)
Waterloo Handymart	1,973	18
Sheetz	1,907	17
Project Hope	1,578	14
McDonalds	1,216	11
Boyce Elementary School	1,216	11
Powhatan School	1,184	11
Total	**9,074**	**82**

Water Sold to Remaining Residential and Commercial Users	**50,134**	gpd
Number of Users minus the Top 10	**440**	users
Average Water Use of Residential and Commercial Users	**114**	gpd/erc
	0.079	gpm/erc
Water Use per Connection to be used in the Model	**0.08**	**gpm/erc**
Water Use Top Users	**9,074**	**gpd**
	6.30	**gpm**
	82	**erc**
Water Unaccounted For/Leaked	**26,149**	**gpd**
	18.16	**gpm**
	227	**erc**
Total Number of Nodes in the Hydraulic Model	**109**	**nodes**
Water Leaked per Node	**2.08**	**erc**
Total Number ERC's in the Model from Calculations	**749**	**erc**
Total Number of ERC's in the Model from Water Use Records	**741**	**erc**
Average Water Use per User including Leaks, Unbilled Usage & Peak Commercial Usage	**191**	**gpd**
	0.13	**gpm**

*Based on Water Use Information obtained from the County from 7/13 to 2/14

Run #1 – Steady state analysis of twice average daily demand. Initial conditions are as follow:

Existing Water System

Boyce Tank – Absolute Low

Millwood Tank – Absolute Low

White Post Tank – Absolute Low

Water Treatment Plant – Off

White Post Pump Station – Off.

Purpose – To determine the minimum tank level in the existing water system necessary to maintain 20 psi for all users under twice average daily conditions.

Result – The White Post Tank serving the high pressure zone can empty and still maintain 20 psi for all users in the system. The minimum hydraulic grade in the Boyce and Millwood Tanks serving the low pressure zone is 688’ which corresponds to 8.00’ of water in the Boyce Tank and the Millwood Tank empty.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 1 - Twice Average Daily Demand.
Existing Water System.
All Tanks at Absolute Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-111	610.64	Boyce/Millwood	1.06	687.87	33.41
J-2	610.00	Boyce/Millwood	0.70	688.01	33.75
J-91	606.86	Boyce/Millwood	0.70	687.97	35.09
FH-5	605.84	Boyce/Millwood	2.14	687.97	35.53
J-39	602.18	Boyce/Millwood	0.45	688.00	37.13
J-58	600.56	Boyce/Millwood	1.66	687.97	37.82
J-11	599.91	Boyce/Millwood	1.06	687.98	38.10
FH-32	599.76	Boyce/Millwood	0.45	687.97	38.17
FH-6	599.69	Boyce/Millwood	0.82	687.98	38.20
J-50	598.85	Boyce/Millwood	0.82	687.97	38.56
J-37	598.00	Boyce/Millwood	0.70	687.97	38.92
FH-12	596.84	Boyce/Millwood	1.78	687.98	39.43
J-12	596.72	Boyce/Millwood	0.82	687.98	39.48
J-36	595.30	Boyce/Millwood	1.66	687.97	40.09
J-54	594.28	Boyce/Millwood	0.70	687.97	40.53
J-38	594.22	Boyce/Millwood	1.06	687.99	40.57
J-29	594.00	Boyce/Millwood	1.54	687.97	40.66
J-30	593.67	Boyce/Millwood	0.57	687.97	40.80
J-13	593.62	Boyce/Millwood	0.57	687.98	40.82
J-6	592.70	Boyce/Millwood	0.57	687.98	41.22
J-5	592.37	Boyce/Millwood	0.82	687.97	41.36
J-88	591.09	Boyce/Millwood	1.18	687.96	41.91
FH-10	590.96	Boyce/Millwood	0.94	688.00	41.98
J-48	590.22	Boyce/Millwood	1.54	687.97	42.29
J-110	590.21	Boyce/Millwood	1.30	687.99	42.30
J-34	590.00	Boyce/Millwood	0.57	688.00	42.40
J-119	589.09	Boyce/Millwood	0.00	688.01	42.80
FH-30	589.03	Boyce/Millwood	0.94	688.01	42.82
FH-3	588.55	Boyce/Millwood	0.70	687.96	43.01
J-93	588.18	Boyce/Millwood	0.94	687.92	43.15
J-14	588.00	Boyce/Millwood	0.57	687.97	43.25
J-45	587.66	Boyce/Millwood	0.94	687.97	43.40
FH-35	587.32	Boyce/Millwood	0.94	687.92	43.52
J-70	587.31	Boyce/Millwood	3.23	687.95	43.54
J-3	586.89	Boyce/Millwood	1.18	687.96	43.73
J-7	586.03	Boyce/Millwood	0.33	687.97	44.11
J-18	585.30	Boyce/Millwood	0.94	687.97	44.42
FH-7	584.92	Boyce/Millwood	0.45	687.97	44.59
J-17	584.61	Boyce/Millwood	0.57	687.97	44.72
FH-9	584.24	Boyce/Millwood	2.05	687.97	44.88
FH-8	583.74	Boyce/Millwood	0.45	687.97	45.09
J-81	582.80	Boyce/Millwood	2.51	687.98	45.51
J-118	582.00	Boyce/Millwood	0.00	687.98	45.85
FH-4	581.71	Boyce/Millwood	0.94	687.96	45.97
FH-33	581.47	Boyce/Millwood	1.06	687.95	46.07
J-71	581.24	Boyce/Millwood	1.18	688.00	46.19
J-10	580.50	Boyce/Millwood	1.90	687.96	46.49
FH-11	580.00	Boyce/Millwood	1.06	687.96	46.71
J-75	637.43	White_Post	0.57	745.97	46.96
J-52	636.38	White_Post	0.45	745.97	47.42
J-72	577.84	Boyce/Millwood	1.06	688.00	47.66
J-43	576.17	Boyce/Millwood	1.06	687.96	48.37
J-87	575.25	Boyce/Millwood	2.14	687.98	48.77
J-117	575.00	Boyce/Millwood	0.00	687.98	48.88
J-56	572.76	Boyce/Millwood	0.70	687.93	49.83
FH-2	572.00	Boyce/Millwood	1.30	687.96	50.17
FH-26	630.00	White_Post	1.90	745.97	50.18
J-53	630.00	White_Post	0.82	745.97	50.18
J-19	630.00	White_Post	0.57	745.97	50.18
FH-22	630.00	White_Post	1.06	745.98	50.18
FH-23	629.31	White_Post	0.82	745.97	50.48
J-83	571.29	Boyce/Millwood	2.39	687.96	50.48
J-61	629.12	White_Post	1.18	745.98	50.56
J-57	569.25	Boyce/Millwood	1.06	687.96	51.36
FH-20	626.39	White_Post	1.06	745.95	51.73
FH-21	625.02	White_Post	1.06	745.98	52.34
FH-34	566.63	Boyce/Millwood	0.94	687.93	52.48
J-89	623.98	White_Post	2.02	745.97	52.78
FH-25	623.87	White_Post	0.57	745.97	52.83
FH-24	623.56	White_Post	1.18	745.97	52.96
J-16	565.12	Boyce/Millwood	0.94	687.91	53.13
FH-28	622.96	White_Post	0.94	745.97	53.22
J-22	620.68	White_Post	0.57	745.97	54.21
J-21	620.00	White_Post	0.57	745.97	54.50
FH-27	619.66	White_Post	1.18	745.97	54.65
J-73	619.54	White_Post	1.18	745.97	54.70
J-64	561.35	Boyce/Millwood	0.70	687.91	54.76
FH-39	560.00	Boyce/Millwood	0.57	687.91	55.34
J-109	560.00	Boyce/Millwood	1.06	688.00	55.38
FH-13	558.71	Boyce/Millwood	2.02	687.98	55.93
J-15	558.57	Boyce/Millwood	1.30	687.91	55.96
FH-36	558.14	Boyce/Millwood	1.61	687.91	56.15
J-86	558.00	Boyce/Millwood	0.94	687.91	56.20
J-113	557.64	Boyce/Millwood	0.33	687.94	56.37
J-26	615.16	White_Post	0.57	745.97	56.60
FH-1	556.00	Boyce/Millwood	1.18	687.96	57.09
FH-40	554.08	Boyce/Millwood	1.61	687.91	57.90
J-107	611.32	White_Post	0.33	745.97	58.26
FH-29	611.02	White_Post	0.82	745.97	58.39

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-25	610.52	White_Post	0.45	745.97	58.60
FH-19	609.26	White_Post	0.70	745.93	59.13
J-69	548.01	Boyce/Millwood	0.70	687.93	60.54
J-112	547.12	Boyce/Millwood	0.33	687.98	60.94
J-79	542.18	Boyce/Millwood	0.94	687.91	63.05
J-94	540.00	Boyce/Millwood	0.33	687.96	64.02
J-97	594.87	White_Post	0.45	745.94	65.36
J-103	594.00	White_Post	0.45	745.92	65.73
FH-18	593.08	White_Post	3.41	745.91	66.12
FH-16	592.75	White_Post	3.25	745.90	66.26
FH-38	534.15	Boyce/Millwood	0.57	687.91	66.52
J-32	592.00	White_Post	0.57	745.90	66.59
FH-15	588.89	White_Post	1.42	745.90	67.93
FH-17	588.00	White_Post	2.05	745.90	68.32
J-77	528.14	Boyce/Millwood	0.82	687.93	69.14
J-95	584.95	White_Post	1.54	745.90	69.64
FH-41	522.12	Boyce/Millwood	2.02	687.91	71.73
J-78	522.03	Boyce/Millwood	2.05	687.93	71.78
FH-43	519.63	Boyce/Millwood	1.54	687.92	72.81
J-116	575.00	White_Post	0.00	745.90	73.94
FH-42	515.59	Boyce/Millwood	2.02	687.92	74.56
FH-14	572.83	White_Post	1.18	745.90	74.88
J-42	512.17	Boyce/Millwood	0.94	687.91	76.04
J-51	492.81	Boyce/Millwood	0.70	687.91	84.41

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 1 - Twice Average Daily Demand.
Existing Water System.
All Tanks at Absolute Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-2.05	687.97	687.97	0.00	0.00
P-2	311.00	6.00	120.00	Open	2.05	745.90	745.90	0.00	0.00
P-3	22.00	8.00	120.00	Open	61.86	688.01	688.01	0.00	0.00
P-4	867.00	2.00	120.00	Open	-0.94	687.92	687.96	0.04	0.00
P-5	327.00	4.00	120.00	Open	0.70	687.97	687.97	0.00	0.00
P-6	198.00	8.00	120.00	Open	0.70	687.97	687.97	0.00	0.00
P-7	150.00	8.00	120.00	Open	0.57	687.97	687.97	0.00	0.00
P-8	324.00	8.00	120.00	Open	-2.46	687.97	687.97	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.34	687.97	687.97	0.00	0.00
P-10	498.00	8.00	120.00	Open	2.01	687.97	687.97	0.00	0.00
P-11	391.00	8.00	120.00	Open	6.01	687.97	687.97	0.00	0.00
P-12	758.00	8.00	120.00	Open	2.14	687.98	687.98	0.00	0.00
P-13	596.00	8.00	120.00	Open	34.92	746.01	745.98	0.03	0.00
P-14	505.00	6.00	120.00	Open	-2.76	687.91	687.91	0.00	0.00
P-15	532.00	6.00	120.00	Open	-2.19	687.91	687.91	0.00	0.00
P-16	290.00	6.00	120.00	Open	-1.61	687.91	687.91	0.00	0.00
P-17	598.00	4.00	120.00	Open	-0.70	687.93	687.93	0.00	0.00
P-18	541.00	4.00	120.00	Open	-1.34	687.96	687.97	0.00	0.00
P-19	696.00	6.00	120.00	Open	-0.94	687.91	687.91	0.00	0.00
P-20	560.00	6.00	120.00	Open	7.20	687.98	687.97	0.01	0.00
P-21	492.00	6.00	120.00	Open	-7.54	687.97	687.97	0.01	0.00
P-22	680.00	2.00	120.00	Open	-0.31	687.96	687.96	0.00	0.00
P-23	746.00	4.00	120.00	Open	-1.18	687.96	687.96	0.00	0.00
P-24	399.00	8.00	120.00	Open	33.20	688.01	687.99	0.02	0.00
P-25	320.00	8.00	120.00	Open	-27.97	688.00	688.01	0.01	0.00
P-26	185.00	12.00	120.00	Open	23.01	688.01	688.01	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	0.57	745.97	745.97	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.45	745.97	745.97	0.00	0.00
P-29	561.00	8.00	120.00	Open	1.84	745.97	745.97	0.00	0.00
P-30	601.00	8.00	120.00	Open	0.57	745.97	745.97	0.00	0.00
P-31	146.00	8.00	120.00	Open	0.57	745.97	745.97	0.00	0.00
P-32	98.00	8.00	120.00	Open	1.72	745.97	745.97	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.45	745.97	745.97	0.00	0.00
P-34	698.00	8.00	120.00	Open	2.34	745.97	745.97	0.00	0.00
P-35	743.00	8.00	120.00	Open	3.52	745.97	745.97	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.04	745.97	745.97	0.00	0.00
P-37	417.00	8.00	120.00	Open	-4.79	745.97	745.97	0.00	0.00
P-38	1087.00	8.00	120.00	Open	2.98	745.97	745.97	0.00	0.00
P-39	758.00	8.00	120.00	Open	3.92	745.97	745.97	0.00	0.00
P-40	1294.00	8.00	120.00	Open	1.18	745.97	745.97	0.00	0.00
P-41	1283.00	8.00	120.00	Open	3.08	745.97	745.97	0.00	0.00
P-42	396.00	8.00	120.00	Open	-9.31	745.98	745.98	0.00	0.00
P-43	803.00	8.00	120.00	Open	-8.25	745.97	745.98	0.00	0.00
P-44	866.00	8.00	120.00	Open	0.77	745.97	745.97	0.00	0.00
P-45	150.00	8.00	120.00	Open	1.58	745.97	745.97	0.00	0.00
P-46	1764.00	8.00	120.00	Open	6.94	745.98	745.97	0.00	0.00
P-47	573.00	8.00	120.00	Open	17.43	745.98	745.98	0.01	0.00
P-48	1343.00	8.00	120.00	Open	-16.43	745.97	745.98	0.01	0.00
P-49	2431.00	8.00	120.00	Open	-16.09	745.95	745.97	0.02	0.00
P-50	978.00	8.00	120.00	Open	-15.04	745.94	745.95	0.01	0.00
P-51	1346.00	8.00	120.00	Open	-14.58	745.93	745.94	0.01	0.00
P-52	1207.00	8.00	120.00	Open	-13.89	745.92	745.93	0.01	0.00
P-53	1377.00	8.00	120.00	Open	-13.43	745.91	745.92	0.01	0.00
P-54	556.00	8.00	120.00	Open	-10.02	745.90	745.91	0.00	0.00
P-55	198.00	8.00	120.00	Open	-7.39	745.90	745.90	0.00	0.00
P-56	996.00	8.00	120.00	Open	-4.14	745.90	745.90	0.00	0.00
P-57	959.00	8.00	120.00	Open	-2.72	745.90	745.90	0.00	0.00
P-58	1275.00	8.00	120.00	Open	-1.18	745.90	745.90	0.00	0.00
P-59A	268.00	8.00	120.00	Open	0.00	745.90	745.90	0.00	0.00
P-59B	25.00	8.00	120.00	Open	0.00	745.90	745.90	0.00	0.00
P-59C	25.00	8.00	120.00	Open	0.00	687.98	687.98	0.00	0.00
P-59D	1211.00	8.00	120.00	Open	0.00	687.98	687.98	0.00	0.00
P-59E	32.00	8.00	120.00	Open	0.00	745.90	745.90	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	687.98	687.98	0.00	0.00
P-60	1927.00	8.00	120.00	Open	0.00	687.98	687.98	0.00	0.00
P-61	623.00	6.00	120.00	Open	2.02	687.98	687.98	0.00	0.00
P-61A	623.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62	605.00	6.00	120.00	Open	6.67	687.98	687.98	0.00	0.00
P-62A	605.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63	647.00	6.00	120.00	Open	8.45	687.99	687.98	0.01	0.00
P-63A	647.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-64	198.00	6.00	120.00	Open	-23.68	687.98	687.99	0.02	0.00
P-65	657.00	4.00	120.00	Open	-1.06	688.00	688.00	0.00	0.00
P-66	660.00	4.00	120.00	Open	1.18	688.00	688.00	0.00	0.00
P-67	206.00	6.00	120.00	Open	3.17	688.00	688.00	0.00	0.00
P-68	211.00	6.00	120.00	Open	-24.35	687.98	688.00	0.02	0.00
P-69	778.00	6.00	120.00	Open	0.70	687.97	687.97	0.00	0.00
P-70	85.00	6.00	120.00	Open	7.64	687.97	687.97	0.00	0.00
P-71	157.00	8.00	120.00	Open	8.22	687.97	687.97	0.00	0.00
P-72	105.00	8.00	120.00	Open	8.67	687.97	687.97	0.00	0.00
P-73	48.00	8.00	120.00	Open	9.12	687.97	687.97	0.00	0.00
P-74	79.00	8.00	120.00	Open	11.51	687.97	687.97	0.00	0.00
P-75	398.00	6.00	120.00	Open	12.08	687.98	687.97	0.01	0.00
P-76	70.00	6.00	120.00	Open	-11.45	687.98	687.98	0.00	0.00
P-77	542.00	6.00	120.00	Open	-6.60	687.97	687.97	0.00	0.00
P-78	270.00	6.00	120.00	Open	-3.63	687.96	687.97	0.00	0.00
P-79	347.00	4.00	120.00	Open	-2.69	687.96	687.96	0.00	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-1.63	687.91	687.96	0.05	0.00
P-81	1620.00	8.00	120.00	Open	7.33	687.96	687.95	0.00	0.00
P-82	3361.00	8.00	120.00	Open	-9.94	687.94	687.95	0.01	0.00
P-83	2159.00	8.00	120.00	Open	-9.60	687.93	687.94	0.01	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-7.55	687.93	687.93	0.00	0.00
P-85	615.00	6.00	120.00	Open	-5.10	687.96	687.96	0.00	0.00
P-86	441.00	6.00	120.00	Open	-5.48	687.98	687.98	0.00	0.00
P-87	129.00	6.00	120.00	Open	-4.66	687.98	687.98	0.00	0.00
P-88	71.00	6.00	120.00	Open	3.11	687.98	687.98	0.00	0.00
P-89	41.00	6.00	120.00	Open	-20.00	687.97	687.98	0.00	0.00
P-90	583.00	6.00	120.00	Open	-11.65	687.96	687.97	0.01	0.00
P-91	63.00	6.00	120.00	Open	-10.06	687.96	687.96	0.00	0.00
P-92	258.00	6.00	120.00	Open	-7.83	687.96	687.96	0.00	0.00
P-93	516.00	6.00	120.00	Open	-5.83	687.95	687.96	0.00	0.00
P-94	860.00	6.00	120.00	Open	-4.91	687.97	687.98	0.00	0.00
P-95	375.00	4.00	120.00	Open	-2.77	687.97	687.97	0.00	0.00
P-96	467.00	4.00	120.00	Open	-1.70	687.97	687.97	0.00	0.00
P-97	300.00	6.00	120.00	Open	-8.43	687.96	687.97	0.00	0.00
P-98	33.00	6.00	120.00	Open	-9.07	687.96	687.96	0.00	0.00
P-99	422.00	6.00	120.00	Open	-7.58	687.96	687.96	0.00	0.00
P-100	1029.00	4.00	120.00	Open	1.18	687.96	687.96	0.00	0.00
P-100A	1029.00	6.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-101	1478.00	6.00	120.00	Open	4.38	687.92	687.91	0.01	0.00
P-102	608.00	6.00	120.00	Open	-11.30	687.93	687.95	0.01	0.00
P-103	334.00	6.00	120.00	Open	-9.91	687.93	687.93	0.01	0.00
P-104	913.00	6.00	120.00	Open	-8.97	687.92	687.93	0.01	0.00
P-105	415.00	6.00	120.00	Open	-3.66	687.91	687.92	0.00	0.00
P-106	82.00	6.00	120.00	Open	-1.98	687.91	687.91	0.00	0.00
P-107	482.00	6.00	120.00	Open	0.26	687.91	687.91	0.00	0.00
P-108	1167.00	6.00	120.00	Open	3.17	687.92	687.91	0.00	0.00
P-109	1019.00	6.00	120.00	Open	5.19	687.92	687.92	0.01	0.00
P-110	832.00	6.00	120.00	Open	6.74	687.93	687.92	0.01	0.00
P-111	2178.00	2.00	120.00	Open	1.06	687.99	687.87	0.12	0.00
P-112	2060.00	6.00	120.00	Open	5.28	687.99	687.98	0.01	0.00
P-113	1535.00	4.00	120.00	Open	1.06	688.00	688.00	0.00	0.00
P-114	1091.00	6.00	120.00	Open	12.35	687.97	687.95	0.03	0.00
P-115	1112.00	6.00	120.00	Open	12.81	688.00	687.97	0.03	0.00
P-116	161.00	6.00	120.00	Open	14.44	688.01	688.00	0.01	0.00
P-117A	2061.00	6.00	120.00	Open	-7.64	687.99	688.01	0.02	0.00
P-117B	100.00	6.00	120.00	Open	-7.64	688.01	688.01	0.00	0.00
P-118	1082.00	6.00	120.00	Open	4.62	687.96	687.96	0.00	0.00
P-119	3401.00	6.00	120.00	Open	4.95	687.98	687.96	0.02	0.00
P-120	211.00	6.00	120.00	Open	0.89	687.91	687.91	0.00	0.00
P-121	335.00	6.00	120.00	Open	0.70	687.91	687.91	0.00	0.00
P-122	740.00	6.00	120.00	Open	0.74	687.91	687.91	0.00	0.00
P-123	605.00	6.00	120.00	Open	0.94	687.91	687.91	0.00	0.00
P-124	1.00	2.00	120.00	Open	0.00	540.00	540.00	0.00	0.00
P-125	80.00	2.00	120.00	Open	0.00	687.98	687.98	0.00	0.00

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 1 - Twice Average Daily Demand.
Existing Water System.
All Tanks at Absolute Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	688.01	713.00	28.00	-61.86	688.01
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	688.01	712.00	28.00	-23.01	688.01
White_Post_Tank	625.00	746.00	746.01	765.00	22.00	-34.92	746.01
R-WTP	--	--	--	--	--	0.00	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	Off	540.00	687.98	0.00	0.00
PMP-White_Post	575.00	Off	687.98	745.90	0.00	0.00

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	745.90	687.98	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY SANITARY AUTHORITY

EXISTING WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT ABSOLUTE LOW LEVEL,
WHITE POST PS OFF, WTP OFF

PRESSURE

- 30 - 40 PSI
- 40 - 50 PSI
- 50 - 60 PSI
- 60 - 70 PSI
- 70 - 80 PSI
- 80 - 90 PSI

BOYCE ELEVATED TANK
150,000 GALLONS
OVERFLOW = 713'
L.W.L. = 680'
BASE = 610'
DIAMETER = 28'

PS/PRV

WTP

NEW MILLWOOD
ELEVATED TANK
100,000 GALLONS
OVERFLOW = 712'
L.W.L. = 688'
BASE = 581'
DIAMETER = 28'

WHITE POST ELEVATED TANK
50,000 GALLONS
OVERFLOW = 765'
L.W.L. = 746'
BASE = 625'
DIAMETER = 22'

N

LEGEND

- EXISTING 2" WATER LINE
- EXISTING 4" WATER LINE
- EXISTING 6" WATER LINE
- EXISTING 8" WATER LINE
- EXISTING 12" WATER LINE
- EXISTING STORAGE TANK
- EXISTING PUMP STATION
- EXISTING FIRE HYDRANT

1000 500 0 1000 2000 3000
SCALE IN FEET

RUN #1 - PRESSURE EXHIBIT
JUNE 22, 2015

ANDERSON AND ASSOCIATES, Inc.

Run #2 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow:

Existing Water System

Boyce Tank – Normal Low

Millwood Tank – Normal Low

White Post Tank – Normal Low

Water Treatment Plant – Off

White Post Pump Station – Off.

Purpose – To identify critical hydrants in the existing system and report their available fire flows while maintaining 20 psi for all users in the system.

Result – All hydrants exceed 500 gpm available fire flow with the exception of FH-1. See the fire flow report for details.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 2 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-111	610.64	Boyce/Millwood	1.06	706.87	41.63
J-2	610.00	Boyce/Millwood	0.70	707.01	41.97
J-91	606.86	Boyce/Millwood	0.70	706.97	43.31
FH-5	605.84	Boyce/Millwood	2.14	706.97	43.75
J-39	602.18	Boyce/Millwood	0.45	707.00	45.35
J-58	600.56	Boyce/Millwood	1.66	706.97	46.04
J-11	599.91	Boyce/Millwood	1.06	706.98	46.32
FH-32	599.76	Boyce/Millwood	0.45	706.97	46.39
FH-6	599.69	Boyce/Millwood	0.82	706.98	46.42
J-50	598.85	Boyce/Millwood	0.82	706.97	46.78
J-37	598.00	Boyce/Millwood	0.70	706.97	47.14
FH-12	596.84	Boyce/Millwood	1.78	706.98	47.65
J-12	596.72	Boyce/Millwood	0.82	706.98	47.70
J-36	595.30	Boyce/Millwood	1.66	706.97	48.31
J-54	594.28	Boyce/Millwood	0.70	706.97	48.75
J-38	594.22	Boyce/Millwood	1.06	706.99	48.79
J-29	594.00	Boyce/Millwood	1.54	706.97	48.88
J-30	593.67	Boyce/Millwood	0.57	706.97	49.02
J-13	593.62	Boyce/Millwood	0.57	706.98	49.04
J-6	592.70	Boyce/Millwood	0.57	706.98	49.44
J-5	592.37	Boyce/Millwood	0.82	706.97	49.58
J-88	591.09	Boyce/Millwood	1.18	706.96	50.13
FH-10	590.96	Boyce/Millwood	0.94	707.00	50.21
J-48	590.22	Boyce/Millwood	1.54	706.97	50.51
J-110	590.21	Boyce/Millwood	1.30	706.99	50.52
J-34	590.00	Boyce/Millwood	0.57	707.00	50.62
J-119	589.09	Boyce/Millwood	0.00	707.01	51.02
FH-30	589.03	Boyce/Millwood	0.94	707.01	51.04
FH-3	588.55	Boyce/Millwood	0.70	706.96	51.23
J-93	588.18	Boyce/Millwood	0.94	706.92	51.37
J-14	588.00	Boyce/Millwood	0.57	706.97	51.47
J-45	587.66	Boyce/Millwood	0.94	706.97	51.62
FH-35	587.32	Boyce/Millwood	0.94	706.92	51.74
J-70	587.31	Boyce/Millwood	3.23	706.95	51.76
J-3	586.89	Boyce/Millwood	1.18	706.96	51.95
J-7	586.03	Boyce/Millwood	0.33	706.97	52.33
J-18	585.30	Boyce/Millwood	0.94	706.97	52.64
FH-7	584.92	Boyce/Millwood	0.45	706.97	52.81
J-17	584.61	Boyce/Millwood	0.57	706.97	52.94
FH-9	584.24	Boyce/Millwood	2.05	706.97	53.10
FH-8	583.74	Boyce/Millwood	0.45	706.97	53.32
J-75	637.43	White_Post	0.57	760.97	53.45
J-81	582.80	Boyce/Millwood	2.51	706.98	53.73
J-52	636.38	White_Post	0.45	760.97	53.90
J-118	582.00	Boyce/Millwood	0.00	706.98	54.07
FH-4	581.71	Boyce/Millwood	0.94	706.96	54.19
FH-33	581.47	Boyce/Millwood	1.06	706.95	54.29
J-71	581.24	Boyce/Millwood	1.18	707.00	54.41
J-10	580.50	Boyce/Millwood	1.90	706.96	54.71
FH-11	580.00	Boyce/Millwood	1.06	706.96	54.93
J-72	577.84	Boyce/Millwood	1.06	707.00	55.88
J-43	576.17	Boyce/Millwood	1.06	706.96	56.59
FH-26	630.00	White_Post	1.90	760.97	56.67
J-53	630.00	White_Post	0.82	760.97	56.67
J-19	630.00	White_Post	0.57	760.97	56.67
FH-22	630.00	White_Post	1.06	760.98	56.67
FH-23	629.31	White_Post	0.82	760.97	56.97
J-87	575.25	Boyce/Millwood	2.14	706.98	56.99
J-61	629.12	White_Post	1.18	760.98	57.05
J-117	575.00	Boyce/Millwood	0.00	706.98	57.10
J-56	572.76	Boyce/Millwood	0.70	706.93	58.05
FH-20	626.39	White_Post	1.06	760.95	58.22
FH-2	572.00	Boyce/Millwood	1.30	706.96	58.39
J-83	571.29	Boyce/Millwood	2.39	706.96	58.70
FH-21	625.02	White_Post	1.06	760.98	58.83
J-89	623.98	White_Post	2.02	760.97	59.27
FH-25	623.87	White_Post	0.57	760.97	59.32
FH-24	623.56	White_Post	1.18	760.97	59.45
J-57	569.25	Boyce/Millwood	1.06	706.96	59.58
FH-28	622.96	White_Post	0.94	760.97	59.71
J-22	620.68	White_Post	0.57	760.97	60.70
FH-34	566.63	Boyce/Millwood	0.94	706.93	60.70
J-21	620.00	White_Post	0.57	760.97	60.99
FH-27	619.66	White_Post	1.18	760.97	61.14
J-73	619.54	White_Post	1.18	760.97	61.19
J-16	565.12	Boyce/Millwood	0.94	706.91	61.35
J-64	561.35	Boyce/Millwood	0.70	706.91	62.98
J-26	615.16	White_Post	0.57	760.97	63.09
FH-39	560.00	Boyce/Millwood	0.57	706.91	63.56
J-109	560.00	Boyce/Millwood	1.06	707.00	63.60
FH-13	558.71	Boyce/Millwood	2.02	706.98	64.15
J-15	558.57	Boyce/Millwood	1.30	706.91	64.18
FH-36	558.14	Boyce/Millwood	1.61	706.91	64.37
J-86	558.00	Boyce/Millwood	0.94	706.91	64.43
J-113	557.64	Boyce/Millwood	0.33	706.94	64.60
J-107	611.32	White_Post	0.33	760.97	64.75
FH-29	611.02	White_Post	0.82	760.97	64.88
J-25	610.52	White_Post	0.45	760.97	65.09
FH-1	556.00	Boyce/Millwood	1.18	706.96	65.31

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-19	609.26	White_Post	0.70	760.93	65.62
FH-40	554.08	Boyce/Millwood	1.61	706.91	66.12
J-69	548.01	Boyce/Millwood	0.70	706.93	68.76
J-112	547.12	Boyce/Millwood	0.33	706.98	69.16
J-79	542.18	Boyce/Millwood	0.94	706.91	71.27
J-97	594.87	White_Post	0.45	760.94	71.85
J-103	594.00	White_Post	0.45	760.92	72.22
J-94	540.00	Boyce/Millwood	0.33	706.96	72.24
FH-18	593.08	White_Post	3.41	760.91	72.61
FH-16	592.75	White_Post	3.25	760.90	72.75
J-32	592.00	White_Post	0.57	760.90	73.08
FH-15	588.89	White_Post	1.42	760.90	74.42
FH-38	534.15	Boyce/Millwood	0.57	706.91	74.74
FH-17	588.00	White_Post	2.05	760.90	74.81
J-95	584.95	White_Post	1.54	760.90	76.13
J-77	528.14	Boyce/Millwood	0.82	706.93	77.36
FH-41	522.12	Boyce/Millwood	2.02	706.91	79.95
J-78	522.03	Boyce/Millwood	2.05	706.93	80.00
J-116	575.00	White_Post	0.00	760.90	80.43
FH-43	519.63	Boyce/Millwood	1.54	706.92	81.03
FH-14	572.83	White_Post	1.18	760.90	81.37
FH-42	515.59	Boyce/Millwood	2.02	706.92	82.78
J-42	512.17	Boyce/Millwood	0.94	706.91	84.26
J-51	492.81	Boyce/Millwood	0.70	706.91	92.63

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 2 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-2.05	706.97	706.97	0.00	0.00
P-2	311.00	6.00	120.00	Open	2.05	760.90	760.90	0.00	0.00
P-3	22.00	8.00	120.00	Open	61.86	707.01	707.01	0.00	0.00
P-4	867.00	2.00	120.00	Open	-0.94	706.92	706.96	0.04	0.00
P-5	327.00	4.00	120.00	Open	0.70	706.97	706.97	0.00	0.00
P-6	198.00	8.00	120.00	Open	0.70	706.97	706.97	0.00	0.00
P-7	150.00	8.00	120.00	Open	0.57	706.97	706.97	0.00	0.00
P-8	324.00	8.00	120.00	Open	-2.46	706.97	706.97	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.34	706.97	706.97	0.00	0.00
P-10	498.00	8.00	120.00	Open	2.01	706.97	706.97	0.00	0.00
P-11	391.00	8.00	120.00	Open	6.01	706.97	706.97	0.00	0.00
P-12	758.00	8.00	120.00	Open	2.14	706.98	706.98	0.00	0.00
P-13	596.00	8.00	120.00	Open	34.91	761.01	760.98	0.03	0.00
P-14	505.00	6.00	120.00	Open	-2.76	706.91	706.91	0.00	0.00
P-15	532.00	6.00	120.00	Open	-2.19	706.91	706.91	0.00	0.00
P-16	290.00	6.00	120.00	Open	-1.61	706.91	706.91	0.00	0.00
P-17	598.00	4.00	120.00	Open	-0.70	706.93	706.93	0.00	0.00
P-18	541.00	4.00	120.00	Open	-1.34	706.96	706.97	0.00	0.00
P-19	696.00	6.00	120.00	Open	-0.94	706.91	706.91	0.00	0.00
P-20	560.00	6.00	120.00	Open	7.20	706.98	706.97	0.01	0.00
P-21	492.00	6.00	120.00	Open	-7.54	706.97	706.97	0.01	0.00
P-22	680.00	2.00	120.00	Open	-0.31	706.96	706.96	0.00	0.00
P-23	746.00	4.00	120.00	Open	-1.18	706.96	706.96	0.00	0.00
P-24	399.00	8.00	120.00	Open	33.20	707.01	706.99	0.02	0.00
P-25	320.00	8.00	120.00	Open	-27.97	707.00	707.01	0.01	0.00
P-26	185.00	12.00	120.00	Open	23.01	707.01	707.01	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	0.57	760.97	760.97	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.45	760.97	760.97	0.00	0.00
P-29	561.00	8.00	120.00	Open	1.84	760.97	760.97	0.00	0.00
P-30	601.00	8.00	120.00	Open	0.57	760.97	760.97	0.00	0.00
P-31	146.00	8.00	120.00	Open	0.57	760.97	760.97	0.00	0.00
P-32	98.00	8.00	120.00	Open	1.72	760.97	760.97	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.45	760.97	760.97	0.00	0.00
P-34	698.00	8.00	120.00	Open	2.34	760.97	760.97	0.00	0.00
P-35	743.00	8.00	120.00	Open	3.52	760.97	760.97	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.04	760.97	760.97	0.00	0.00
P-37	417.00	8.00	120.00	Open	-4.79	760.97	760.97	0.00	0.00
P-38	1087.00	8.00	120.00	Open	2.98	760.97	760.97	0.00	0.00
P-39	758.00	8.00	120.00	Open	3.92	760.97	760.97	0.00	0.00
P-40	1294.00	8.00	120.00	Open	1.18	760.97	760.97	0.00	0.00
P-41	1283.00	8.00	120.00	Open	3.08	760.97	760.97	0.00	0.00
P-42	396.00	8.00	120.00	Open	-9.31	760.98	760.98	0.00	0.00
P-43	803.00	8.00	120.00	Open	-8.25	760.97	760.98	0.00	0.00
P-44	866.00	8.00	120.00	Open	0.77	760.97	760.97	0.00	0.00
P-45	150.00	8.00	120.00	Open	1.58	760.97	760.97	0.00	0.00
P-46	1764.00	8.00	120.00	Open	6.94	760.98	760.97	0.00	0.00
P-47	573.00	8.00	120.00	Open	17.43	760.98	760.98	0.01	0.00
P-48	1343.00	8.00	120.00	Open	-16.43	760.97	760.98	0.01	0.00
P-49	2431.00	8.00	120.00	Open	-16.09	760.95	760.97	0.02	0.00
P-50	978.00	8.00	120.00	Open	-15.04	760.94	760.95	0.01	0.00
P-51	1346.00	8.00	120.00	Open	-14.58	760.93	760.94	0.01	0.00
P-52	1207.00	8.00	120.00	Open	-13.89	760.92	760.93	0.01	0.00
P-53	1377.00	8.00	120.00	Open	-13.43	760.91	760.92	0.01	0.00
P-54	556.00	8.00	120.00	Open	-10.02	760.90	760.91	0.00	0.00
P-55	198.00	8.00	120.00	Open	-7.39	760.90	760.90	0.00	0.00
P-56	996.00	8.00	120.00	Open	-4.14	760.90	760.90	0.00	0.00
P-57	959.00	8.00	120.00	Open	-2.72	760.90	760.90	0.00	0.00
P-58	1275.00	8.00	120.00	Open	-1.18	760.90	760.90	0.00	0.00
P-59A	268.00	8.00	120.00	Open	0.00	760.90	760.90	0.00	0.00
P-59B	25.00	8.00	120.00	Open	0.00	760.90	760.90	0.00	0.00
P-59C	25.00	8.00	120.00	Open	0.00	706.98	706.98	0.00	0.00
P-59D	1211.00	8.00	120.00	Open	0.00	706.98	706.98	0.00	0.00
P-59E	32.00	8.00	120.00	Open	0.00	760.90	760.90	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	706.98	706.98	0.00	0.00
P-60	1927.00	8.00	120.00	Open	0.00	706.98	706.98	0.00	0.00
P-61	623.00	6.00	120.00	Open	2.02	706.98	706.98	0.00	0.00
P-61A	623.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62	605.00	6.00	120.00	Open	6.67	706.98	706.98	0.00	0.00
P-62A	605.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63	647.00	6.00	120.00	Open	8.46	706.99	706.98	0.01	0.00
P-63A	647.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-64	198.00	6.00	120.00	Open	-23.68	706.98	706.99	0.02	0.00
P-65	657.00	4.00	120.00	Open	-1.06	707.00	707.00	0.00	0.00
P-66	660.00	4.00	120.00	Open	1.18	707.00	707.00	0.00	0.00
P-67	206.00	6.00	120.00	Open	3.17	707.00	707.00	0.00	0.00
P-68	211.00	6.00	120.00	Open	-24.35	706.98	707.00	0.02	0.00
P-69	778.00	6.00	120.00	Open	0.70	706.97	706.97	0.00	0.00
P-70	85.00	6.00	120.00	Open	7.64	706.97	706.97	0.00	0.00
P-71	157.00	8.00	120.00	Open	8.22	706.97	706.97	0.00	0.00
P-72	105.00	8.00	120.00	Open	8.67	706.97	706.97	0.00	0.00
P-73	48.00	8.00	120.00	Open	9.12	706.97	706.97	0.00	0.00
P-74	79.00	8.00	120.00	Open	11.51	706.97	706.97	0.00	0.00
P-75	398.00	6.00	120.00	Open	12.08	706.98	706.97	0.01	0.00
P-76	70.00	6.00	120.00	Open	-11.45	706.98	706.98	0.00	0.00
P-77	542.00	6.00	120.00	Open	-6.60	706.97	706.97	0.00	0.00
P-78	270.00	6.00	120.00	Open	-3.63	706.96	706.97	0.00	0.00
P-79	347.00	4.00	120.00	Open	-2.69	706.96	706.96	0.00	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-1.63	706.91	706.96	0.05	0.00
P-81	1620.00	8.00	120.00	Open	7.33	706.96	706.95	0.00	0.00
P-82	3361.00	8.00	120.00	Open	-9.94	706.94	706.95	0.01	0.00
P-83	2159.00	8.00	120.00	Open	-9.60	706.93	706.94	0.01	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-7.55	706.93	706.93	0.00	0.00
P-85	615.00	6.00	120.00	Open	-5.10	706.96	706.96	0.00	0.00
P-86	441.00	6.00	120.00	Open	-5.48	706.98	706.98	0.00	0.00
P-87	129.00	6.00	120.00	Open	-4.66	706.98	706.98	0.00	0.00
P-88	71.00	6.00	120.00	Open	3.11	706.98	706.98	0.00	0.00
P-89	41.00	6.00	120.00	Open	-20.00	706.97	706.98	0.00	0.00
P-90	583.00	6.00	120.00	Open	-11.65	706.96	706.97	0.01	0.00
P-91	63.00	6.00	120.00	Open	-10.06	706.96	706.96	0.00	0.00
P-92	258.00	6.00	120.00	Open	-7.83	706.96	706.96	0.00	0.00
P-93	516.00	6.00	120.00	Open	-5.83	706.95	706.96	0.00	0.00
P-94	860.00	6.00	120.00	Open	-4.91	706.97	706.98	0.00	0.00
P-95	375.00	4.00	120.00	Open	-2.77	706.97	706.97	0.00	0.00
P-96	467.00	4.00	120.00	Open	-1.70	706.97	706.97	0.00	0.00
P-97	300.00	6.00	120.00	Open	-8.42	706.96	706.97	0.00	0.00
P-98	33.00	6.00	120.00	Open	-9.07	706.96	706.96	0.00	0.00
P-99	422.00	6.00	120.00	Open	-7.58	706.96	706.96	0.00	0.00
P-100	1029.00	4.00	120.00	Open	1.18	706.96	706.96	0.00	0.00
P-100A	1029.00	6.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-101	1478.00	6.00	120.00	Open	4.38	706.92	706.91	0.01	0.00
P-102	608.00	6.00	120.00	Open	-11.30	706.93	706.95	0.01	0.00
P-103	334.00	6.00	120.00	Open	-9.91	706.93	706.93	0.01	0.00
P-104	913.00	6.00	120.00	Open	-8.97	706.92	706.93	0.01	0.00
P-105	415.00	6.00	120.00	Open	-3.66	706.91	706.92	0.00	0.00
P-106	82.00	6.00	120.00	Open	-1.98	706.91	706.91	0.00	0.00
P-107	482.00	6.00	120.00	Open	0.26	706.91	706.91	0.00	0.00
P-108	1167.00	6.00	120.00	Open	3.17	706.92	706.91	0.00	0.00
P-109	1019.00	6.00	120.00	Open	5.19	706.92	706.92	0.01	0.00
P-110	832.00	6.00	120.00	Open	6.74	706.93	706.92	0.01	0.00
P-111	2178.00	2.00	120.00	Open	1.06	706.99	706.87	0.12	0.00
P-112	2060.00	6.00	120.00	Open	5.28	706.99	706.98	0.01	0.00
P-113	1535.00	4.00	120.00	Open	1.06	707.00	707.00	0.00	0.00
P-114	1091.00	6.00	120.00	Open	12.35	706.97	706.95	0.03	0.00
P-115	1112.00	6.00	120.00	Open	12.81	707.00	706.97	0.03	0.00
P-116	161.00	6.00	120.00	Open	14.44	707.01	707.00	0.01	0.00
P-117A	2061.00	6.00	120.00	Open	-7.64	706.99	707.01	0.02	0.00
P-117B	100.00	6.00	120.00	Open	-7.64	707.01	707.01	0.00	0.00
P-118	1082.00	6.00	120.00	Open	4.62	706.96	706.96	0.00	0.00
P-119	3401.00	6.00	120.00	Open	4.95	706.98	706.96	0.02	0.00
P-120	211.00	6.00	120.00	Open	0.89	706.91	706.91	0.00	0.00
P-121	335.00	6.00	120.00	Open	0.70	706.91	706.91	0.00	0.00
P-122	740.00	6.00	120.00	Open	0.74	706.91	706.91	0.00	0.00
P-123	605.00	6.00	120.00	Open	0.94	706.91	706.91	0.00	0.00
P-124	1.00	2.00	120.00	Open	0.00	540.00	540.00	0.00	0.00
P-125	80.00	2.00	120.00	Open	0.00	706.98	706.98	0.00	0.00

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 2 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.01	713.00	28.00	-61.86	707.01
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.01	712.00	28.00	-23.01	707.01
White_Post_Tank	625.00	746.00	761.01	765.00	22.00	-34.91	761.01
R-WTP	--	--	--	--	--	0.00	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	Off	540.00	706.98	0.00	0.00
PMP-White_Post	575.00	Off	706.98	760.90	0.00	0.00

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	760.90	706.98	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 2 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Fire Flow Report - sorted by Available Fire Flow

Node Label	Pressure Zone	Fire Flow Constraints Satisfied	Desired Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Desired (gpm)	Total Flow Available (gpm)	Desired Residual Pressure (psi)	Calculated Residual Pressure (psi)	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node
J-111	Boyce/Millwood	FALSE	500.00	26.14	501.06	27.20	20.00	20.06	20.00	41.97	J-2	20.00	41.97	J-2
J-93	Boyce/Millwood	FALSE	500.00	53.73	500.94	54.67	20.00	20.02	20.00	41.61	J-111	20.00	41.61	J-111
J-86	Boyce/Millwood	FALSE	500.00	91.22	500.94	92.16	20.00	21.20	20.00	20.07	J-64	20.00	20.07	J-64
J-64	Boyce/Millwood	FALSE	500.00	91.30	500.70	91.99	20.00	20.00	20.00	21.45	J-86	20.00	21.45	J-86
J-109	Boyce/Millwood	FALSE	500.00	294.30	501.06	295.35	20.00	20.00	20.00	41.60	J-111	20.00	41.60	J-111
J-88	Boyce/Millwood	FALSE	500.00	346.14	501.18	347.32	20.00	20.00	20.00	41.37	J-111	20.00	41.37	J-111
FH-1	Boyce/Millwood	FALSE	500.00	365.81	501.18	366.99	20.00	20.00	20.00	41.25	J-111	20.00	41.25	J-111
J-71	Boyce/Millwood	FALSE	500.00	399.70	501.18	400.87	20.00	20.00	20.00	41.58	J-111	20.00	41.58	J-111
J-72	Boyce/Millwood	FALSE	500.00	409.93	501.06	410.99	20.00	20.00	20.00	41.58	J-111	20.00	41.58	J-111
J-69	Boyce/Millwood	FALSE	500.00	456.68	500.70	457.38	20.00	20.00	20.00	41.43	J-111	20.00	41.43	J-111
J-54	Boyce/Millwood	FALSE	500.00	491.48	500.70	492.17	20.00	20.00	20.00	41.35	J-111	20.00	41.35	J-111
FH-40	Boyce/Millwood	TRUE	500.00	513.03	501.61	514.64	20.00	20.00	20.00	20.59	FH-39	20.00	20.59	FH-39
FH-39	Boyce/Millwood	TRUE	500.00	516.90	500.57	517.47	20.00	20.00	20.00	22.56	FH-40	20.00	22.56	FH-40
J-57	Boyce/Millwood	TRUE	500.00	541.62	501.06	542.67	20.00	20.00	20.00	23.40	J-64	20.00	23.40	J-64
FH-38	Boyce/Millwood	TRUE	500.00	559.74	500.57	560.32	20.00	31.18	20.00	20.00	FH-39	20.00	20.00	FH-39
FH-36	Boyce/Millwood	TRUE	500.00	611.52	501.61	613.14	20.00	20.81	20.00	20.00	FH-39	20.00	20.00	FH-39
J-91	Boyce/Millwood	TRUE	500.00	623.10	500.70	623.79	20.00	20.00	20.00	35.91	J-37	20.00	35.91	J-37
J-116	White_Post	TRUE	500.00	666.22	500.00	666.22	20.00	20.00	20.00	22.10	FH-14	20.00	22.10	FH-14
FH-14	White_Post	TRUE	500.00	673.35	501.18	674.52	20.00	20.94	20.00	20.00	J-116	20.00	20.00	J-116
J-95	White_Post	TRUE	500.00	682.31	501.54	683.85	20.00	20.00	20.00	22.66	FH-15	20.00	22.66	FH-15
FH-15	White_Post	TRUE	500.00	701.38	501.42	702.80	20.00	20.00	20.00	21.71	J-95	20.00	21.71	J-95
FH-17	White_Post	TRUE	500.00	702.05	502.05	704.11	20.00	20.00	20.00	23.99	FH-16	20.00	23.99	FH-16
FH-16	White_Post	TRUE	500.00	725.33	503.25	728.58	20.00	20.00	20.00	21.34	J-32	20.00	21.34	J-32
J-32	White_Post	TRUE	500.00	733.19	500.57	733.76	20.00	20.32	20.00	20.00	FH-16	20.00	20.00	FH-16
J-110	Boyce/Millwood	TRUE	500.00	747.93	501.30	749.23	20.00	28.89	20.00	20.00	J-111	20.00	20.00	J-111
FH-18	White_Post	TRUE	500.00	755.61	503.41	759.02	20.00	20.00	20.00	20.14	FH-16	20.00	20.14	FH-16
FH-35	Boyce/Millwood	TRUE	500.00	765.78	500.94	766.72	20.00	20.00	20.00	31.82	FH-39	20.00	31.82	FH-39
J-16	Boyce/Millwood	TRUE	500.00	799.37	500.94	800.31	20.00	26.59	20.00	20.00	FH-35	20.00	20.00	FH-35
J-15	Boyce/Millwood	TRUE	500.00	803.21	501.30	804.51	20.00	28.48	20.00	20.00	FH-35	20.00	20.00	FH-35
J-79	Boyce/Millwood	TRUE	500.00	803.22	500.94	804.15	20.00	20.53	20.00	20.00	FH-35	20.00	20.00	FH-35
J-42	Boyce/Millwood	TRUE	500.00	810.18	500.94	811.12	20.00	46.72	20.00	20.00	FH-35	20.00	20.00	FH-35
J-51	Boyce/Millwood	TRUE	500.00	810.19	500.70	810.88	20.00	46.64	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-41	Boyce/Millwood	TRUE	500.00	816.43	502.02	818.46	20.00	43.77	20.00	20.00	FH-35	20.00	20.00	FH-35
J-103	White_Post	TRUE	500.00	821.58	500.45	822.03	20.00	20.00	20.00	20.40	FH-18	20.00	20.40	FH-18
FH-19	White_Post	TRUE	500.00	835.09	500.70	835.78	20.00	20.00	20.00	26.60	J-103	20.00	26.60	J-103
FH-34	Boyce/Millwood	TRUE	500.00	862.10	500.94	863.03	20.00	24.17	20.00	20.00	FH-35	20.00	20.00	FH-35
J-37	Boyce/Millwood	TRUE	500.00	886.26	500.70	886.95	20.00	20.00	20.00	22.00	J-91	20.00	22.00	J-91
J-56	Boyce/Millwood	TRUE	500.00	903.60	500.70	904.30	20.00	20.00	20.00	20.18	FH-35	20.00	20.18	FH-35
FH-33	Boyce/Millwood	TRUE	500.00	908.56	501.06	909.62	20.00	20.00	20.00	25.40	FH-35	20.00	25.40	FH-35
J-36	Boyce/Millwood	TRUE	500.00	913.38	501.66	915.04	20.00	21.17	20.00	20.00	J-37	20.00	20.00	J-37
FH-9	Boyce/Millwood	TRUE	500.00	917.26	502.05	919.31	20.00	20.00	20.00	25.82	J-91	20.00	25.82	J-91
J-30	Boyce/Millwood	TRUE	500.00	930.85	500.57	931.42	20.00	20.04	20.00	20.00	J-91	20.00	20.00	J-91
J-18	Boyce/Millwood	TRUE	500.00	930.89	500.94	931.83	20.00	29.33	20.00	20.00	J-91	20.00	20.00	J-91
J-48	Boyce/Millwood	TRUE	500.00	930.90	501.54	932.44	20.00	24.02	20.00	20.00	J-91	20.00	20.00	J-91
J-29	Boyce/Millwood	TRUE	500.00	930.90	501.54	932.44	20.00	21.10	20.00	20.00	J-91	20.00	20.00	J-91
FH-42	Boyce/Millwood	TRUE	500.00	935.21	502.02	937.24	20.00	38.38	20.00	20.00	FH-35	20.00	20.00	FH-35
J-112	Boyce/Millwood	TRUE	500.00	936.96	500.33	937.29	20.00	27.17	20.00	20.00	J-111	20.00	20.00	J-111
J-97	White_Post	TRUE	500.00	944.18	500.45	944.63	20.00	26.23	20.00	20.00	FH-19	20.00	20.00	FH-19
FH-20	White_Post	TRUE	500.00	956.50	501.06	957.56	20.00	20.01	20.00	27.41	FH-19	20.00	27.41	FH-19
FH-32	Boyce/Millwood	TRUE	500.00	974.00	500.45	974.45	20.00	20.00	20.00	30.97	FH-33	20.00	30.97	FH-33
J-17	Boyce/Millwood	TRUE	500.00	998.86	500.57	999.43	20.00	29.62	20.00	20.00	J-91	20.00	20.00	J-91
FH-27	White_Post	TRUE	500.00	1027.66	501.18	1028.84	20.00	20.00	20.00	28.03	FH-26	20.00	28.03	FH-26
FH-8	Boyce/Millwood	TRUE	500.00	1034.83	500.45	1035.28	20.00	30.00	20.00	20.00	J-91	20.00	20.00	J-91
FH-7	Boyce/Millwood	TRUE	500.00	1061.06	500.45	1061.51	20.00	29.49	20.00	20.00	J-91	20.00	20.00	J-91
J-7	Boyce/Millwood	TRUE	500.00	1073.71	500.33	1074.04	20.00	29.01	20.00	20.00	J-91	20.00	20.00	J-91
FH-43	Boyce/Millwood	TRUE	500.00	1084.39	501.54	1085.93	20.00	29.53	20.00	20.00	FH-35	20.00	20.00	FH-35
J-14	Boyce/Millwood	TRUE	500.00	1095.57	500.57	1096.14	20.00	28.16	20.00	20.00	J-91	20.00	20.00	J-91
FH-4	Boyce/Millwood	TRUE	500.00	1097.07	500.94	1098.00	20.00	20.00	20.00	25.39	J-57	20.00	25.39	J-57
J-75	White_Post	TRUE	500.00	1120.97	500.57	1121.55	20.00	20.00	20.00	32.68	FH-25	20.00	32.68	FH-25
FH-5	Boyce/Millwood	TRUE	500.00	1153.55	502.14	1155.69	20.00	20.00	20.00	39.35	J-91	20.00	39.35	J-91
FH-26	White_Post	TRUE	500.00	1176.31	501.90	1178.22	20.00	20.00	20.00	24.47	FH-27	20.00	24.47	FH-27
J-118	Boyce/Millwood	TRUE	500.00	1205.38	500.00	1205.38	20.00	20.00	20.00	27.57	J-117	20.00	27.57	J-117
J-87	Boyce/Millwood	TRUE	500.00	1216.97	502.14	1219.11	20.00	20.00	20.00	26.76	J-81	20.00	26.76	J-81
J-117	Boyce/Millwood	TRUE	500.00	1243.09	500.00	1243.09	20.00	20.00	20.00	21.00	J-118	20.00	20.27	J-116
J-45	Boyce/Millwood	TRUE	500.00	1263.92	500.94	1264.86	20.00	22.86	20.00	20.00	J-54	20.00	20.00	J-54
J-22	White_Post	TRUE	500.00	1269.90	500.57	1270.47	20.00	27.25	20.00	20.00	J-75	20.00	20.00	J-75
FH-25	White_Post	TRUE	500.00	1269.90	500.57	1270.47	20.00	23.78	20.00	20.00	J-75	20.00	20.00	J-75
J-77	Boyce/Millwood	TRUE	500.00	1276.02	500.82	1276.84	20.00	20.10	20.00	20.00	FH-35	20.00	20.00	FH-35
J-26	White_Post	TRUE	500.00	1291.66	500.57	1292.24	20.00	20.00	20.00	23.38	J-75	20.00	23.38	J-75
J-113	Boyce/Millwood	TRUE	500.00	1295.23	500.33	1295.57	20.00	20.00	20.00	28.73	FH-35	20.00	28.73	FH-35
J-21	White_Post	TRUE	500.00	1300.01	500.57	1300.59	20.00	27.54	20.00	20.00	J-75	20.00	20.00	J-75
J-52	White_Post	TRUE	500.00	1312.76	500.45	1313.22	20.00	20.00	20.00	26.12	J-75	20.00	26.12	J-75
J-25	White_Post	TRUE	500.00	1321.78	500.45	1322.23	20.00	20.23	20.00	20.00	J-26	20.00	20.00	J-26
FH-29	White_Post	TRUE	500.00	1321.82	500.82	1322.63	20.00	21.79	20.00	20.00	J-26	20.00	20.00	J-26
J-78	Boyce/Millwood	TRUE	500.00	1322.47	502.05	1324.52	20.00	21.72	20.00	20.00	FH-35	20.00	20.00	FH-35
J-81	Boyce/Millwood	TRUE	500.00	1346.01	502.51	1348.52	20.00	20.00	20.00	23.27	J-87	20.00	23.27	J-87
J-94	Boyce/Millwood	TRUE	500.00	1346.29	500.33	1346.62	20.00	20.00	20.00	26.64	J-111	20.00	26.64	J-111
FH-13	Boyce/Millwood	TRUE	500.00	1351.91	502.02	1353.93	20.00	22.85	20.00	20.00	J-118	20.00	20.00	J-118
J-73	White_Post	TRUE	500.00	1369.41	501.18	1370.59	20.00	24.45	20.00	20.00	J-75	20.00	20.00	J-75
FH-24	White_Post	TRUE	500.00	1371.90	501.18	1373.08	20.00	24.22	20.00	20.00	J-75	20.00	20.00	J-75
J-53	White_Post	TRUE	500.00	1429.24	500.82	1430.05	20.00	22.76	20.00	20.00	J-52	20.00	20.00	J-52
FH-28	White_Post	TRUE	500.00	1462.62	500.94	1463.56	20.00	22.30	20.00	20.00	J-75	20.00	20.00	J-75
FH-12	Boyce/Millwood	TRUE	500.00	1486.72	501.78	1488.50	20.00	20.00	20.00	31.46	J-81	20.00	31.46	J-81
J-107	White_Post	TRUE	500.00	1490.21	500.33	1490.54	20.00	26.53	20.00	20.00	FH-20	20.00	20.00	FH-20
J-19	White_Post	TRUE	500.00	1530.29	500.57	1530.87	20.00	22.51	20.00	20.00	J-52	20.00	20.00	J-52
FH-23	White_Post	TRUE	500.00	1542.39	500.82	1543.21	20.00	21.68	20.00	20.00	J-52	20.00	20.00	J-52
J-89	White_Post	TRUE	500.00	1561.35	502.02	1563.37	20.00	24.59	20.00	20.00	J-75	20.00	20.00	J-75

Node	Pressure	Fire Flow Constraints	Desired Fire Flow	Available Fire Flow	Total Flow Desired	Total Flow Available	Desired Residual Pressure	Calculated Residual Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure
J-43	Boyce/Millwood	TRUE	500.00	1578.83	501.06	1579.89	20.00	25.21	20.00	20.00	J-93	20.00	20.00	J-93
FH-11	Boyce/Millwood	TRUE	500.00	1610.92	501.06	1611.97	20.00	24.80	20.00	20.00	J-88	20.00	20.00	J-88
J-70	Boyce/Millwood	TRUE	500.00	1666.73	503.23	1669.96	20.00	20.00	20.00	28.50	J-93	20.00	28.50	J-93
J-10	Boyce/Millwood	TRUE	500.00	1670.92	501.90	1672.82	20.00	23.58	20.00	20.00	J-88	20.00	20.00	J-88
FH-22	White_Post	TRUE	500.00	1706.16	501.06	1707.22	20.00	21.21	20.00	20.00	J-75	20.00	20.00	J-75
FH-2	Boyce/Millwood	TRUE	500.00	1784.81	501.30	1786.11	20.00	20.00	20.00	26.92	FH-1	20.00	26.92	FH-1
J-58	Boyce/Millwood	TRUE	500.00	1790.80	501.66	1792.46	20.00	20.00	20.00	24.41	J-54	20.00	24.41	J-54
J-61	White_Post	TRUE	500.00	1823.16	501.18	1824.33	20.00	23.60	20.00	20.00	J-75	20.00	20.00	J-75
FH-10	Boyce/Millwood	TRUE	500.00	1838.82	500.94	1839.75	20.00	20.00	20.00	24.21	J-71	20.00	24.21	J-71
J-3	Boyce/Millwood	TRUE	500.00	1854.79	501.18	1855.97	20.00	20.00	20.00	21.06	FH-3	20.00	21.06	FH-3
J-50	Boyce/Millwood	TRUE	500.00	1855.07	500.82	1855.89	20.00	20.00	20.00	29.53	FH-3	20.00	29.53	FH-3
J-83	Boyce/Millwood	TRUE	500.00	1863.85	502.39	1866.23	20.00	20.00	20.00	23.32	J-70	20.00	23.32	J-70
FH-3	Boyce/Millwood	TRUE	500.00	1864.83	500.70	1865.52	20.00	20.00	20.00	21.22	J-3	20.00	21.22	J-3
FH-6	Boyce/Millwood	TRUE	500.00	2321.54	500.82	2322.36	20.00	20.00	20.00	29.80	FH-5	20.00	29.80	FH-5
J-12	Boyce/Millwood	TRUE	500.00	2444.05	500.82	2444.86	20.00	24.39	20.00	20.00	J-91	20.00	20.00	J-91
J-11	Boyce/Millwood	TRUE	500.00	2512.50	501.06	2513.55	20.00	20.00	20.00	20.84	FH-5	20.00	20.84	FH-5
J-34	Boyce/Millwood	TRUE	500.00	2558.72	500.57	2559.29	20.00	21.14	20.00	20.00	FH-32	20.00	20.00	FH-32
FH-21	White_Post	TRUE	500.00	2625.89	501.06	2626.95	20.00	25.38	20.00	20.00	J-75	20.00	20.00	J-75
J-5	Boyce/Millwood	TRUE	500.00	2814.03	500.82	2814.84	20.00	20.00	20.00	20.65	J-50	20.00	20.65	J-50
J-13	Boyce/Millwood	TRUE	500.00	2848.47	500.57	2849.04	20.00	20.00	20.00	20.45	FH-6	20.00	20.45	FH-6
J-2	Boyce/Millwood	TRUE	500.00	3000.00	500.70	3000.69	20.00	40.46	20.00	41.28	J-111	20.00	41.28	J-111
J-6	Boyce/Millwood	TRUE	500.00	3000.00	500.57	3000.57	20.00	22.05	20.00	21.44	J-58	20.00	21.44	J-58
FH-30	Boyce/Millwood	TRUE	500.00	3000.00	500.94	3000.94	20.00	49.33	20.00	40.22	J-111	20.00	40.22	J-111
J-38	Boyce/Millwood	TRUE	500.00	3000.00	501.06	3001.06	20.00	34.08	20.00	34.17	FH-12	20.00	34.17	FH-12
J-39	Boyce/Millwood	TRUE	500.00	3000.00	500.45	3000.45	20.00	29.57	20.00	31.05	J-91	20.00	31.05	J-91
J-119	Boyce/Millwood	TRUE	500.00	3000.00	500.00	3000.00	20.00	25.14	20.00	21.42	J-111	20.00	21.42	J-111

CLARKE COUNTY SANITARY AUTHORITY

EXISTING WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT NORMAL LOW LEVEL,
WHITE POST PS OFF, WTP OFF

AVAILABLE FIRE FLOW
- 0 - 250 GPM
- 250 - 500 GPM
- 500 - 750 GPM
- 750 - 1000 GPM
- 1000 - 1500 GPM
- 1500 - 2000 GPM
- > 2000 GPM

BOYCE ELEVATED TANK
150,000 GALLONS
OVERFLOW = 713'
L.W.L. = 680'
BASE = 610'
DIAMETER = 28'

PS/PRV

WTP

NEW MILLWOOD
ELEVATED TANK
100,000 GALLONS
OVERFLOW = 712'
L.W.L. = 688'
BASE = 581'
DIAMETER = 28'

WHITE POST ELEVATED TANK
50,000 GALLONS
OVERFLOW = 765'
L.W.L. = 746'
BASE = 625'
DIAMETER = 22'

N

LEGEND
- EXISTING 2" WATER LINE
- EXISTING 4" WATER LINE
- EXISTING 6" WATER LINE
- EXISTING 8" WATER LINE
- EXISTING 12" WATER LINE
- EXISTING STORAGE TANK
- EXISTING PUMP STATION
- EXISTING FIRE HYDRANT

1000 500 0 1000 2000 3000
SCALE IN FEET

ANDERSON AND ASSOCIATES, Inc.

RUN #2 - AVAILABLE FIRE FLOW EXHIBIT
JUNE 22, 2015

Run #3 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow:

Existing Water System
Boyce Tank – Normal Low
Millwood Tank – Normal Low
White Post Tank – Normal Low
Water Treatment Plant – On
White Post Pump Station – Off.

Purpose – To identify critical hydrants in the existing system and report their available fire flows while maintaining 20 psi for all users in the system.

Result – All hydrants exceed 500 gpm available fire flow with the exception of FH-1. See the fire flow report for details.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 3 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-2	610.00	Boyce/Millwood	0.70	707.00	41.97
J-111	610.64	Boyce/Millwood	1.06	708.82	42.48
J-91	606.86	Boyce/Millwood	0.70	706.99	43.32
FH-5	605.84	Boyce/Millwood	2.14	707.00	43.77
J-39	602.18	Boyce/Millwood	0.45	707.00	45.35
J-58	600.56	Boyce/Millwood	1.66	707.02	46.06
J-11	599.91	Boyce/Millwood	1.06	707.00	46.33
FH-32	599.76	Boyce/Millwood	0.45	707.00	46.40
FH-6	599.69	Boyce/Millwood	0.82	707.01	46.43
J-50	598.85	Boyce/Millwood	0.82	707.04	46.81
J-37	598.00	Boyce/Millwood	0.70	706.99	47.15
FH-12	596.84	Boyce/Millwood	1.78	706.99	47.66
J-12	596.72	Boyce/Millwood	0.82	707.00	47.71
J-36	595.30	Boyce/Millwood	1.66	706.99	48.32
J-54	594.28	Boyce/Millwood	0.70	707.02	48.77
J-38	594.22	Boyce/Millwood	1.06	707.00	48.80
J-29	594.00	Boyce/Millwood	1.54	706.99	48.88
J-30	593.67	Boyce/Millwood	0.57	706.99	49.03
J-13	593.62	Boyce/Millwood	0.57	707.01	49.06
J-6	592.70	Boyce/Millwood	0.57	707.02	49.46
J-5	592.37	Boyce/Millwood	0.82	707.02	49.61
J-88	591.09	Boyce/Millwood	1.18	707.05	50.17
FH-10	590.96	Boyce/Millwood	0.94	707.00	50.21
J-48	590.22	Boyce/Millwood	1.54	706.99	50.52
J-34	590.00	Boyce/Millwood	0.57	707.00	50.62
FH-30	589.03	Boyce/Millwood	0.94	707.00	51.04
J-119	589.09	Boyce/Millwood	0.00	707.09	51.06
FH-3	588.55	Boyce/Millwood	0.70	707.06	51.27
J-110	590.21	Boyce/Millwood	1.30	708.94	51.37
J-93	588.18	Boyce/Millwood	0.94	707.04	51.43
J-14	588.00	Boyce/Millwood	0.57	706.99	51.48
J-45	587.66	Boyce/Millwood	0.94	707.02	51.64
FH-35	587.32	Boyce/Millwood	0.94	706.99	51.77
J-70	587.31	Boyce/Millwood	3.23	707.12	51.83
J-3	586.89	Boyce/Millwood	1.18	707.06	51.99
J-7	586.03	Boyce/Millwood	0.33	706.99	52.34
J-18	585.30	Boyce/Millwood	0.94	706.99	52.65
FH-7	584.92	Boyce/Millwood	0.45	706.99	52.81
J-17	584.61	Boyce/Millwood	0.57	706.99	52.95
FH-9	584.24	Boyce/Millwood	2.05	706.99	53.11
FH-8	583.74	Boyce/Millwood	0.45	706.99	53.32
J-75	637.43	White_Post	0.57	760.97	53.45
J-81	582.80	Boyce/Millwood	2.51	706.99	53.73
J-52	636.38	White_Post	0.45	760.97	53.90
J-118	582.00	Boyce/Millwood	0.00	706.99	54.08
FH-4	581.71	Boyce/Millwood	0.94	707.02	54.21
FH-33	581.47	Boyce/Millwood	1.06	706.99	54.31
J-71	581.24	Boyce/Millwood	1.18	707.00	54.41
J-10	580.50	Boyce/Millwood	1.90	707.05	54.75
FH-11	580.00	Boyce/Millwood	1.06	707.06	54.97
J-72	577.84	Boyce/Millwood	1.06	707.00	55.88
J-43	576.17	Boyce/Millwood	1.06	707.08	56.64
FH-26	630.00	White_Post	1.90	760.97	56.67
J-53	630.00	White_Post	0.82	760.97	56.67
J-19	630.00	White_Post	0.57	760.97	56.67
FH-22	630.00	White_Post	1.06	760.98	56.67
FH-23	629.31	White_Post	0.82	760.97	56.97
J-87	575.25	Boyce/Millwood	2.14	706.99	57.00
J-61	629.12	White_Post	1.18	760.98	57.05
J-117	575.00	Boyce/Millwood	0.00	706.99	57.11
J-56	572.76	Boyce/Millwood	0.70	706.99	58.07
FH-20	626.39	White_Post	1.06	760.95	58.22
FH-2	572.00	Boyce/Millwood	1.30	707.12	58.46
J-83	571.29	Boyce/Millwood	2.39	707.23	58.81
FH-21	625.02	White_Post	1.06	760.98	58.83
J-89	623.98	White_Post	2.02	760.97	59.27
FH-25	623.87	White_Post	0.57	760.97	59.32
FH-24	623.56	White_Post	1.18	760.97	59.45
J-57	569.25	Boyce/Millwood	1.06	707.01	59.60
FH-28	622.96	White_Post	0.94	760.97	59.71
J-22	620.68	White_Post	0.57	760.97	60.70
FH-34	566.63	Boyce/Millwood	0.94	706.99	60.72
J-21	620.00	White_Post	0.57	760.97	60.99
FH-27	619.66	White_Post	1.18	760.97	61.14
J-73	619.54	White_Post	1.18	760.97	61.19
J-16	565.12	Boyce/Millwood	0.94	706.99	61.38
J-64	561.35	Boyce/Millwood	0.70	706.96	63.00
J-26	615.16	White_Post	0.57	760.97	63.09
FH-39	560.00	Boyce/Millwood	0.57	706.98	63.59
J-109	560.00	Boyce/Millwood	1.06	707.00	63.60
FH-13	558.71	Boyce/Millwood	2.02	706.99	64.15
J-15	558.57	Boyce/Millwood	1.30	706.99	64.21
FH-36	558.14	Boyce/Millwood	1.61	706.98	64.40
J-86	558.00	Boyce/Millwood	0.94	706.96	64.45
J-113	557.64	Boyce/Millwood	0.33	707.08	64.66
J-107	611.32	White_Post	0.33	760.97	64.75
FH-29	611.02	White_Post	0.82	760.97	64.88
J-25	610.52	White_Post	0.45	760.97	65.09
FH-1	556.00	Boyce/Millwood	1.18	707.12	65.38

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-19	609.26	White_Post	0.70	760.93	65.62
FH-40	554.08	Boyce/Millwood	1.61	706.98	66.15
J-69	548.01	Boyce/Millwood	0.70	706.99	68.78
J-112	547.12	Boyce/Millwood	0.33	710.88	70.85
J-79	542.18	Boyce/Millwood	0.94	706.99	71.30
J-97	594.87	White_Post	0.45	760.94	71.85
J-103	594.00	White_Post	0.45	760.92	72.22
FH-18	593.08	White_Post	3.41	760.91	72.61
J-94	540.00	Boyce/Millwood	0.33	708.10	72.73
FH-16	592.75	White_Post	3.25	760.90	72.75
J-32	592.00	White_Post	0.57	760.90	73.08
FH-15	588.89	White_Post	1.42	760.90	74.42
FH-38	534.15	Boyce/Millwood	0.57	706.98	74.77
FH-17	588.00	White_Post	2.05	760.90	74.81
J-95	584.95	White_Post	1.54	760.90	76.13
J-77	528.14	Boyce/Millwood	0.82	707.06	77.41
FH-41	522.12	Boyce/Millwood	2.02	706.99	79.98
J-78	522.03	Boyce/Millwood	2.05	707.06	80.05
J-116	575.00	White_Post	0.00	760.90	80.43
FH-43	519.63	Boyce/Millwood	1.54	707.03	81.08
FH-14	572.83	White_Post	1.18	760.90	81.37
FH-42	515.59	Boyce/Millwood	2.02	707.01	82.82
J-42	512.17	Boyce/Millwood	0.94	706.99	84.29
J-51	492.81	Boyce/Millwood	0.70	706.99	92.67

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 3 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-2.05	706.99	706.99	0.00	0.00
P-2	311.00	6.00	120.00	Open	2.05	760.90	760.90	0.00	0.00
P-3	22.00	8.00	120.00	Open	-7.33	707.00	707.00	0.00	0.00
P-4	867.00	2.00	120.00	Open	-0.94	707.04	707.08	0.04	0.00
P-5	327.00	4.00	120.00	Open	0.70	707.02	707.02	0.00	0.00
P-6	198.00	8.00	120.00	Open	0.70	706.99	706.99	0.00	0.00
P-7	150.00	8.00	120.00	Open	0.57	706.99	706.99	0.00	0.00
P-8	324.00	8.00	120.00	Open	-2.46	706.99	706.99	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.34	706.99	706.99	0.00	0.00
P-10	498.00	8.00	120.00	Open	2.01	706.99	706.99	0.00	0.00
P-11	391.00	8.00	120.00	Open	6.01	706.99	706.99	0.00	0.00
P-12	758.00	8.00	120.00	Open	2.14	706.99	706.99	0.00	0.00
P-13	596.00	8.00	120.00	Open	34.92	761.01	760.98	0.03	0.00
P-14	505.00	6.00	120.00	Open	-2.76	706.98	706.98	0.00	0.00
P-15	532.00	6.00	120.00	Open	-2.19	706.98	706.98	0.00	0.00
P-16	290.00	6.00	120.00	Open	-1.61	706.98	706.98	0.00	0.00
P-17	598.00	4.00	120.00	Open	-0.70	706.99	706.99	0.00	0.00
P-18	541.00	4.00	120.00	Open	7.93	707.06	707.02	0.04	0.00
P-19	696.00	6.00	120.00	Open	-0.94	706.96	706.96	0.00	0.00
P-20	560.00	6.00	120.00	Open	-2.32	707.01	707.02	0.00	0.00
P-21	492.00	6.00	120.00	Open	14.41	707.04	707.02	0.02	0.00
P-22	680.00	2.00	120.00	Open	-0.53	707.05	707.06	0.01	0.00
P-23	746.00	4.00	120.00	Open	-1.18	707.05	707.06	0.00	0.00
P-24	399.00	8.00	120.00	Open	-11.59	707.00	707.00	0.00	0.00
P-25	320.00	8.00	120.00	Open	-3.57	707.00	707.00	0.00	0.00
P-26	185.00	12.00	120.00	Open	-76.46	707.00	707.00	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	0.57	760.97	760.97	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.45	760.97	760.97	0.00	0.00
P-29	561.00	8.00	120.00	Open	1.84	760.97	760.97	0.00	0.00
P-30	601.00	8.00	120.00	Open	0.57	760.97	760.97	0.00	0.00
P-31	146.00	8.00	120.00	Open	0.57	760.97	760.97	0.00	0.00
P-32	98.00	8.00	120.00	Open	1.72	760.97	760.97	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.45	760.97	760.97	0.00	0.00
P-34	698.00	8.00	120.00	Open	2.34	760.97	760.97	0.00	0.00
P-35	743.00	8.00	120.00	Open	3.52	760.97	760.97	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.04	760.97	760.97	0.00	0.00
P-37	417.00	8.00	120.00	Open	-4.79	760.97	760.97	0.00	0.00
P-38	1087.00	8.00	120.00	Open	2.98	760.97	760.97	0.00	0.00
P-39	758.00	8.00	120.00	Open	3.92	760.97	760.97	0.00	0.00
P-40	1294.00	8.00	120.00	Open	1.18	760.97	760.97	0.00	0.00
P-41	1283.00	8.00	120.00	Open	3.08	760.97	760.97	0.00	0.00
P-42	396.00	8.00	120.00	Open	-9.31	760.98	760.98	0.00	0.00
P-43	803.00	8.00	120.00	Open	-8.25	760.97	760.98	0.00	0.00
P-44	866.00	8.00	120.00	Open	0.77	760.97	760.97	0.00	0.00
P-45	150.00	8.00	120.00	Open	1.58	760.97	760.97	0.00	0.00
P-46	1764.00	8.00	120.00	Open	6.94	760.98	760.97	0.00	0.00
P-47	573.00	8.00	120.00	Open	17.43	760.98	760.98	0.01	0.00
P-48	1343.00	8.00	120.00	Open	-16.43	760.97	760.98	0.01	0.00
P-49	2431.00	8.00	120.00	Open	-16.09	760.95	760.97	0.02	0.00
P-50	978.00	8.00	120.00	Open	-15.04	760.94	760.95	0.01	0.00
P-51	1346.00	8.00	120.00	Open	-14.58	760.93	760.94	0.01	0.00
P-52	1207.00	8.00	120.00	Open	-13.89	760.92	760.93	0.01	0.00
P-53	1377.00	8.00	120.00	Open	-13.43	760.91	760.92	0.01	0.00
P-54	556.00	8.00	120.00	Open	-10.02	760.90	760.91	0.00	0.00
P-55	198.00	8.00	120.00	Open	-7.39	760.90	760.90	0.00	0.00
P-56	996.00	8.00	120.00	Open	-4.14	760.90	760.90	0.00	0.00
P-57	959.00	8.00	120.00	Open	-2.72	760.90	760.90	0.00	0.00
P-58	1275.00	8.00	120.00	Open	-1.18	760.90	760.90	0.00	0.00
P-59A	268.00	8.00	120.00	Open	0.00	760.90	760.90	0.00	0.00
P-59B	25.00	8.00	120.00	Open	0.00	760.90	760.90	0.00	0.00
P-59C	25.00	8.00	120.00	Open	0.00	706.99	706.99	0.00	0.00
P-59D	1211.00	8.00	120.00	Open	0.00	706.99	706.99	0.00	0.00
P-59E	32.00	8.00	120.00	Open	0.00	760.90	760.90	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	706.99	706.99	0.00	0.00
P-60	1927.00	8.00	120.00	Open	0.00	706.99	706.99	0.00	0.00
P-61	623.00	6.00	120.00	Open	2.02	706.99	706.99	0.00	0.00
P-61A	623.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62	605.00	6.00	120.00	Open	6.67	706.99	706.99	0.00	0.00
P-62A	605.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63	647.00	6.00	120.00	Open	8.45	707.00	706.99	0.01	0.00
P-63A	647.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-64	198.00	6.00	120.00	Open	21.10	707.02	707.00	0.01	0.00
P-65	657.00	4.00	120.00	Open	-1.06	707.00	707.00	0.00	0.00
P-66	660.00	4.00	120.00	Open	1.18	707.00	707.00	0.00	0.00
P-67	206.00	6.00	120.00	Open	3.17	707.00	707.00	0.00	0.00
P-68	211.00	6.00	120.00	Open	0.06	707.00	707.00	0.00	0.00
P-69	778.00	6.00	120.00	Open	0.70	706.99	706.99	0.00	0.00
P-70	85.00	6.00	120.00	Open	7.64	706.99	706.99	0.00	0.00
P-71	157.00	8.00	120.00	Open	8.22	706.99	706.99	0.00	0.00
P-72	105.00	8.00	120.00	Open	8.67	706.99	706.99	0.00	0.00
P-73	48.00	8.00	120.00	Open	9.12	706.99	706.99	0.00	0.00
P-74	79.00	8.00	120.00	Open	11.51	706.99	706.99	0.00	0.00
P-75	398.00	6.00	120.00	Open	12.08	707.00	706.99	0.01	0.00
P-76	70.00	6.00	120.00	Open	12.96	707.00	707.00	0.00	0.00
P-77	542.00	6.00	120.00	Open	2.67	707.02	707.02	0.00	0.00
P-78	270.00	6.00	120.00	Open	-3.63	707.02	707.02	0.00	0.00
P-79	347.00	4.00	120.00	Open	-2.69	707.01	707.02	0.00	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-1.63	706.96	707.01	0.05	0.00
P-81	1620.00	8.00	120.00	Open	44.03	707.23	707.12	0.11	0.00
P-82	3361.00	8.00	120.00	Open	-16.72	707.08	707.12	0.04	0.00
P-83	2159.00	8.00	120.00	Open	-16.39	707.06	707.08	0.02	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-14.33	707.06	707.06	0.00	0.00
P-85	615.00	6.00	120.00	Open	34.17	707.23	707.12	0.10	0.00
P-86	441.00	6.00	120.00	Open	11.33	707.01	707.00	0.01	0.00
P-87	129.00	6.00	120.00	Open	12.15	707.01	707.01	0.00	0.00
P-88	71.00	6.00	120.00	Open	10.40	707.02	707.01	0.00	0.00
P-89	41.00	6.00	120.00	Open	32.08	707.02	707.02	0.01	0.00
P-90	583.00	6.00	120.00	Open	18.48	707.05	707.02	0.03	0.00
P-91	63.00	6.00	120.00	Open	19.86	707.06	707.05	0.00	0.00
P-92	258.00	6.00	120.00	Open	22.09	707.08	707.06	0.02	0.00
P-93	516.00	6.00	120.00	Open	24.09	707.12	707.08	0.04	0.00
P-94	860.00	6.00	120.00	Open	2.69	707.00	707.00	0.00	0.00
P-95	375.00	4.00	120.00	Open	4.83	707.02	707.00	0.01	0.00
P-96	467.00	4.00	120.00	Open	6.13	707.04	707.02	0.02	0.00
P-97	300.00	6.00	120.00	Open	21.36	707.06	707.04	0.02	0.00
P-98	33.00	6.00	120.00	Open	29.98	707.06	707.06	0.00	0.00
P-99	422.00	6.00	120.00	Open	31.69	707.12	707.06	0.06	0.00
P-100	1029.00	4.00	120.00	Open	1.18	707.12	707.12	0.00	0.00
P-100A	1029.00	6.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-101	1478.00	6.00	120.00	Open	4.38	706.99	706.98	0.01	0.00
P-102	608.00	6.00	120.00	Open	-4.51	706.99	706.99	0.00	0.00
P-103	334.00	6.00	120.00	Open	-3.12	706.99	706.99	0.00	0.00
P-104	913.00	6.00	120.00	Open	-2.19	706.99	706.99	0.00	0.00
P-105	415.00	6.00	120.00	Open	3.13	706.99	706.99	0.00	0.00
P-106	82.00	6.00	120.00	Open	1.71	706.99	706.99	0.00	0.00
P-107	482.00	6.00	120.00	Open	3.94	706.99	706.99	0.00	0.00
P-108	1167.00	6.00	120.00	Open	9.95	707.01	706.99	0.02	0.00
P-109	1019.00	6.00	120.00	Open	11.98	707.03	707.01	0.02	0.00
P-110	832.00	6.00	120.00	Open	13.52	707.06	707.03	0.02	0.00
P-111	2178.00	2.00	120.00	Open	1.06	708.94	708.82	0.12	0.00
P-112	2060.00	6.00	120.00	Open	-87.40	708.94	710.88	1.94	0.00
P-113	1535.00	4.00	120.00	Open	1.06	707.00	707.00	0.00	0.00
P-114	1091.00	6.00	120.00	Open	5.57	707.00	706.99	0.01	0.00
P-115	1112.00	6.00	120.00	Open	6.02	707.00	707.00	0.01	0.00
P-116	161.00	6.00	120.00	Open	7.66	707.00	707.00	0.00	0.00
P-117A	2061.00	6.00	120.00	Open	85.05	708.94	707.09	1.85	0.00
P-117B	100.00	6.00	120.00	Open	85.05	707.09	707.00	0.09	0.00
P-118	1082.00	6.00	120.00	Open	80.59	708.10	707.23	0.88	0.00
P-119	3401.00	6.00	120.00	Open	80.92	710.88	708.10	2.78	0.00
P-120	211.00	6.00	120.00	Open	3.99	706.99	706.99	0.00	0.00
P-121	335.00	6.00	120.00	Open	0.70	706.99	706.99	0.00	0.00
P-122	740.00	6.00	120.00	Open	-2.35	706.99	706.99	0.00	0.00
P-123	605.00	6.00	120.00	Open	0.94	706.99	706.99	0.00	0.00
P-124	1.00	2.00	120.00	Open	168.66	540.00	539.33	0.67	0.67
P-125	80.00	2.00	120.00	Open	168.66	764.61	710.88	53.72	0.67

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 3 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.00	713.00	28.00	7.33	707.00
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.00	712.00	28.00	76.46	707.00
White_Post_Tank	625.00	746.00	761.01	765.00	22.00	-34.92	761.01
R-WTP	--	--	--	--	--	-168.66	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	On	539.33	764.61	168.66	225.28
PMP-White_Post	575.00	Off	706.99	760.90	0.00	0.00

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	760.90	706.99	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 3 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Fire Flow Report - sorted by Available Fire Flow

Node Label	Pressure Zone	Fire Flow Constraints Satisfied	Desired Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Desired (gpm)	Total Flow Available (gpm)	Desired Residual Pressure (psi)	Calculated Residual Pressure (psi)	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node	Desired Minimum System Pressure (psi)	Calculated Minimum System Pressure (psi)	Minimum System Pressure Node
J-111	Boyce/Millwood	FALSE	500.00	26.57	501.06	27.63	20.00	20.00	20.00	41.97	J-2	20.00	41.97	J-2
J-93	Boyce/Millwood	FALSE	500.00	53.79	500.94	54.72	20.00	20.05	20.00	41.97	J-2	20.00	41.97	J-2
J-86	Boyce/Millwood	FALSE	500.00	91.30	500.94	92.24	20.00	21.20	20.00	20.07	J-64	20.00	20.07	J-64
J-64	Boyce/Millwood	FALSE	500.00	91.38	500.70	92.07	20.00	20.00	20.00	21.45	J-86	20.00	21.45	J-86
J-109	Boyce/Millwood	FALSE	500.00	294.36	501.06	295.41	20.00	20.00	20.00	41.97	J-2	20.00	41.97	J-2
J-88	Boyce/Millwood	FALSE	500.00	347.60	501.18	348.78	20.00	20.00	20.00	41.95	J-2	20.00	41.95	J-2
FH-1	Boyce/Millwood	FALSE	500.00	367.21	501.18	368.38	20.00	20.00	20.00	41.95	J-2	20.00	41.95	J-2
J-71	Boyce/Millwood	FALSE	500.00	399.87	501.18	401.05	20.00	20.00	20.00	41.93	J-2	20.00	41.93	J-2
J-72	Boyce/Millwood	FALSE	500.00	410.11	501.06	411.16	20.00	20.00	20.00	41.93	J-2	20.00	41.93	J-2
J-69	Boyce/Millwood	FALSE	500.00	457.36	500.70	458.05	20.00	20.00	20.00	41.66	FH-32	20.00	41.66	FH-32
J-54	Boyce/Millwood	FALSE	500.00	493.12	500.70	493.81	20.00	20.01	20.00	41.92	J-2	20.00	41.92	J-2
FH-40	Boyce/Millwood	TRUE	500.00	514.12	501.61	515.74	20.00	20.00	20.00	20.60	FH-39	20.00	20.60	FH-39
FH-39	Boyce/Millwood	TRUE	500.00	518.07	500.57	518.64	20.00	20.00	20.00	22.56	FH-40	20.00	22.56	FH-40
J-57	Boyce/Millwood	TRUE	500.00	543.03	501.06	544.09	20.00	20.00	20.00	23.40	J-64	20.00	23.40	J-64
FH-38	Boyce/Millwood	TRUE	500.00	561.07	500.57	561.65	20.00	31.18	20.00	20.00	FH-39	20.00	20.00	FH-39
FH-36	Boyce/Millwood	TRUE	500.00	613.05	501.61	614.66	20.00	20.81	20.00	20.00	FH-39	20.00	20.00	FH-39
J-91	Boyce/Millwood	TRUE	500.00	624.46	500.70	625.16	20.00	20.00	20.00	35.96	J-37	20.00	35.96	J-37
J-116	White_Post	TRUE	500.00	666.22	500.00	666.22	20.00	20.00	20.00	22.10	FH-14	20.00	22.10	FH-14
FH-14	White_Post	TRUE	500.00	673.35	501.18	674.52	20.00	20.94	20.00	20.00	J-116	20.00	20.00	J-116
J-95	White_Post	TRUE	500.00	682.31	501.54	683.85	20.00	20.00	20.00	22.66	FH-15	20.00	22.66	FH-15
FH-15	White_Post	TRUE	500.00	701.38	501.42	702.80	20.00	20.00	20.00	21.71	J-95	20.00	21.71	J-95
FH-17	White_Post	TRUE	500.00	702.05	502.05	704.11	20.00	20.00	20.00	23.99	FH-16	20.00	23.99	FH-16
FH-16	White_Post	TRUE	500.00	725.33	503.25	728.58	20.00	20.00	20.00	21.34	J-32	20.00	21.34	J-32
J-32	White_Post	TRUE	500.00	733.19	500.57	733.76	20.00	20.32	20.00	20.00	FH-16	20.00	20.00	FH-16
FH-18	White_Post	TRUE	500.00	755.61	503.41	759.02	20.00	20.00	20.00	20.14	FH-16	20.00	20.14	FH-16
FH-35	Boyce/Millwood	TRUE	500.00	768.76	500.94	769.70	20.00	20.00	20.00	31.82	FH-39	20.00	31.82	FH-39
J-16	Boyce/Millwood	TRUE	500.00	802.48	500.94	803.42	20.00	26.59	20.00	20.00	FH-35	20.00	20.00	FH-35
J-15	Boyce/Millwood	TRUE	500.00	806.35	501.30	807.65	20.00	28.47	20.00	20.00	FH-35	20.00	20.00	FH-35
J-79	Boyce/Millwood	TRUE	500.00	806.35	500.94	807.29	20.00	20.42	20.00	20.00	FH-35	20.00	20.00	FH-35
J-42	Boyce/Millwood	TRUE	500.00	813.36	500.94	814.30	20.00	46.71	20.00	20.00	FH-35	20.00	20.00	FH-35
J-51	Boyce/Millwood	TRUE	500.00	813.37	500.70	814.06	20.00	46.57	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-41	Boyce/Millwood	TRUE	500.00	819.63	502.02	821.66	20.00	43.76	20.00	20.00	FH-35	20.00	20.00	FH-35
J-103	White_Post	TRUE	500.00	821.58	500.45	822.03	20.00	20.00	20.00	20.40	FH-18	20.00	20.40	FH-18
FH-19	White_Post	TRUE	500.00	835.04	500.70	835.74	20.00	20.00	20.00	26.60	J-103	20.00	26.60	J-103
J-110	Boyce/Millwood	TRUE	500.00	865.54	501.30	866.84	20.00	28.89	20.00	20.00	J-111	20.00	20.00	J-111
FH-34	Boyce/Millwood	TRUE	500.00	865.67	500.94	866.61	20.00	24.10	20.00	20.00	FH-35	20.00	20.00	FH-35
J-37	Boyce/Millwood	TRUE	500.00	888.25	500.70	888.95	20.00	20.00	20.00	22.02	J-91	20.00	22.02	J-91
J-56	Boyce/Millwood	TRUE	500.00	906.13	500.70	906.82	20.00	20.00	20.00	20.26	FH-35	20.00	20.26	FH-35
FH-33	Boyce/Millwood	TRUE	500.00	911.10	501.06	912.15	20.00	20.00	20.00	25.51	FH-35	20.00	25.51	FH-35
J-36	Boyce/Millwood	TRUE	500.00	915.46	501.66	917.12	20.00	21.17	20.00	20.00	J-37	20.00	20.00	J-37
FH-9	Boyce/Millwood	TRUE	500.00	918.97	502.05	921.03	20.00	20.00	20.00	25.87	J-91	20.00	25.87	J-91
J-30	Boyce/Millwood	TRUE	500.00	933.33	500.57	933.91	20.00	20.01	20.00	20.00	J-91	20.00	20.00	J-91
J-18	Boyce/Millwood	TRUE	500.00	933.39	500.94	934.32	20.00	29.33	20.00	20.00	J-91	20.00	20.00	J-91
J-48	Boyce/Millwood	TRUE	500.00	933.39	501.54	934.93	20.00	24.01	20.00	20.00	J-91	20.00	20.00	J-91
J-29	Boyce/Millwood	TRUE	500.00	933.39	501.54	934.93	20.00	21.08	20.00	20.00	J-91	20.00	20.00	J-91
FH-42	Boyce/Millwood	TRUE	500.00	939.24	502.02	941.27	20.00	38.37	20.00	20.00	FH-35	20.00	20.00	FH-35
J-97	White_Post	TRUE	500.00	944.18	500.45	944.63	20.00	26.23	20.00	20.00	FH-19	20.00	20.00	FH-19
FH-20	White_Post	TRUE	500.00	956.57	501.06	957.63	20.00	20.00	20.00	27.40	FH-19	20.00	27.40	FH-19
FH-32	Boyce/Millwood	TRUE	500.00	976.64	500.45	977.10	20.00	20.00	20.00	31.02	FH-33	20.00	31.02	FH-33
J-17	Boyce/Millwood	TRUE	500.00	1001.62	500.57	1002.20	20.00	29.62	20.00	20.00	J-91	20.00	20.00	J-91
FH-27	White_Post	TRUE	500.00	1027.66	501.18	1028.84	20.00	20.00	20.00	28.03	FH-26	20.00	28.03	FH-26
FH-8	Boyce/Millwood	TRUE	500.00	1037.74	500.45	1038.19	20.00	30.00	20.00	20.00	J-91	20.00	20.00	J-91
FH-7	Boyce/Millwood	TRUE	500.00	1064.08	500.45	1064.54	20.00	29.49	20.00	20.00	J-91	20.00	20.00	J-91
J-7	Boyce/Millwood	TRUE	500.00	1076.78	500.33	1077.11	20.00	29.01	20.00	20.00	J-91	20.00	20.00	J-91
FH-43	Boyce/Millwood	TRUE	500.00	1090.26	501.54	1091.80	20.00	29.51	20.00	20.00	FH-35	20.00	20.00	FH-35
J-14	Boyce/Millwood	TRUE	500.00	1098.74	500.57	1099.31	20.00	28.16	20.00	20.00	J-91	20.00	20.00	J-91
FH-4	Boyce/Millwood	TRUE	500.00	1102.23	500.94	1103.16	20.00	20.00	20.00	25.39	J-57	20.00	25.39	J-57
J-75	White_Post	TRUE	500.00	1120.97	500.57	1121.55	20.00	20.00	20.00	32.68	FH-25	20.00	32.68	FH-25
J-112	Boyce/Millwood	TRUE	500.00	1156.81	500.33	1157.14	20.00	27.17	20.00	20.00	J-111	20.00	20.00	J-111
FH-5	Boyce/Millwood	TRUE	500.00	1158.69	502.14	1160.83	20.00	20.00	20.00	39.44	J-91	20.00	39.44	J-91
FH-26	White_Post	TRUE	500.00	1176.31	501.90	1178.22	20.00	20.00	20.00	24.47	FH-27	20.00	24.47	FH-27
J-118	Boyce/Millwood	TRUE	500.00	1206.20	500.00	1206.20	20.00	20.00	20.00	27.57	J-117	20.00	27.57	J-117
J-87	Boyce/Millwood	TRUE	500.00	1218.05	502.14	1220.19	20.00	20.00	20.00	26.78	J-81	20.00	26.78	J-81
J-117	Boyce/Millwood	TRUE	500.00	1243.82	500.00	1243.82	20.00	20.00	20.00	21.01	J-118	20.00	20.27	J-116
J-22	White_Post	TRUE	500.00	1269.90	500.57	1270.47	20.00	27.25	20.00	20.00	J-75	20.00	20.00	J-75
FH-25	White_Post	TRUE	500.00	1269.90	500.57	1270.47	20.00	23.78	20.00	20.00	J-75	20.00	20.00	J-75
J-45	Boyce/Millwood	TRUE	500.00	1272.24	500.94	1273.18	20.00	22.86	20.00	20.00	J-54	20.00	20.00	J-54
J-77	Boyce/Millwood	TRUE	500.00	1285.90	500.82	1286.71	20.00	20.08	20.00	20.00	FH-35	20.00	20.00	FH-35
J-26	White_Post	TRUE	500.00	1291.66	500.57	1292.24	20.00	20.00	20.00	23.38	J-75	20.00	23.38	J-75
J-21	White_Post	TRUE	500.00	1300.01	500.57	1300.59	20.00	27.54	20.00	20.00	J-75	20.00	20.00	J-75
J-113	Boyce/Millwood	TRUE	500.00	1310.67	500.33	1311.01	20.00	20.00	20.00	28.74	FH-35	20.00	28.74	FH-35
J-52	White_Post	TRUE	500.00	1312.76	500.45	1313.22	20.00	20.00	20.00	26.12	J-75	20.00	26.12	J-75
J-25	White_Post	TRUE	500.00	1321.78	500.45	1322.23	20.00	20.23	20.00	20.00	J-26	20.00	20.00	J-26
FH-29	White_Post	TRUE	500.00	1321.82	500.82	1322.63	20.00	21.79	20.00	20.00	J-26	20.00	20.00	J-26
J-78	Boyce/Millwood	TRUE	500.00	1333.42	502.05	1335.48	20.00	21.70	20.00	20.00	FH-35	20.00	20.00	FH-35
J-81	Boyce/Millwood	TRUE	500.00	1347.41	502.51	1349.92	20.00	20.00	20.00	23.26	J-87	20.00	23.26	J-87
FH-13	Boyce/Millwood	TRUE	500.00	1352.86	502.02	1354.88	20.00	22.85	20.00	20.00	J-118	20.00	20.00	J-118
J-73	White_Post	TRUE	500.00	1369.41	501.18	1370.59	20.00	24.45	20.00	20.00	J-75	20.00	20.00	J-75
FH-24	White_Post	TRUE	500.00	1371.90	501.18	1373.08	20.00	24.22	20.00	20.00	J-75	20.00	20.00	J-75
J-53	White_Post	TRUE	500.00	1429.24	500.82	1430.05	20.00	22.76	20.00	20.00	J-52	20.00	20.00	J-52
J-94	Boyce/Millwood	TRUE	500.00	1443.47	500.33	1443.80	20.00	20.00	20.00	32.55	J-111	20.00	32.55	J-111
FH-28	White_Post	TRUE	500.00	1462.62	500.94	1463.56	20.00	22.30	20.00	20.00	J-75	20.00	20.00	J-75
FH-12	Boyce/Millwood	TRUE	500.00	1489.03	501.78	1490.82	20.00	20.00	20.00	31.46	J-81	20.00	31.46	J-81
J-107	White_Post	TRUE	500.00	1490.21	500.33	1490.54	20.00	26.53	20.00	20.00	FH-20	20.00	20.00	FH-20
J-19	White_Post	TRUE	500.00	1530.29	500.57	1530.87	20.00	22.51	20.00	20.00	J-52	20.00	20.00	J-52
FH-23	White_Post	TRUE	500.00	1542.39	500.82	1543.21	20.00	21.68	20.00	20.00	J-52	20.00	20.00	J-52
J-89	White_Post	TRUE	500.00	1561.35	502.02	1563.37	20.00	24.59	20.00	20.00	J-75	20.00	20.00	J-75

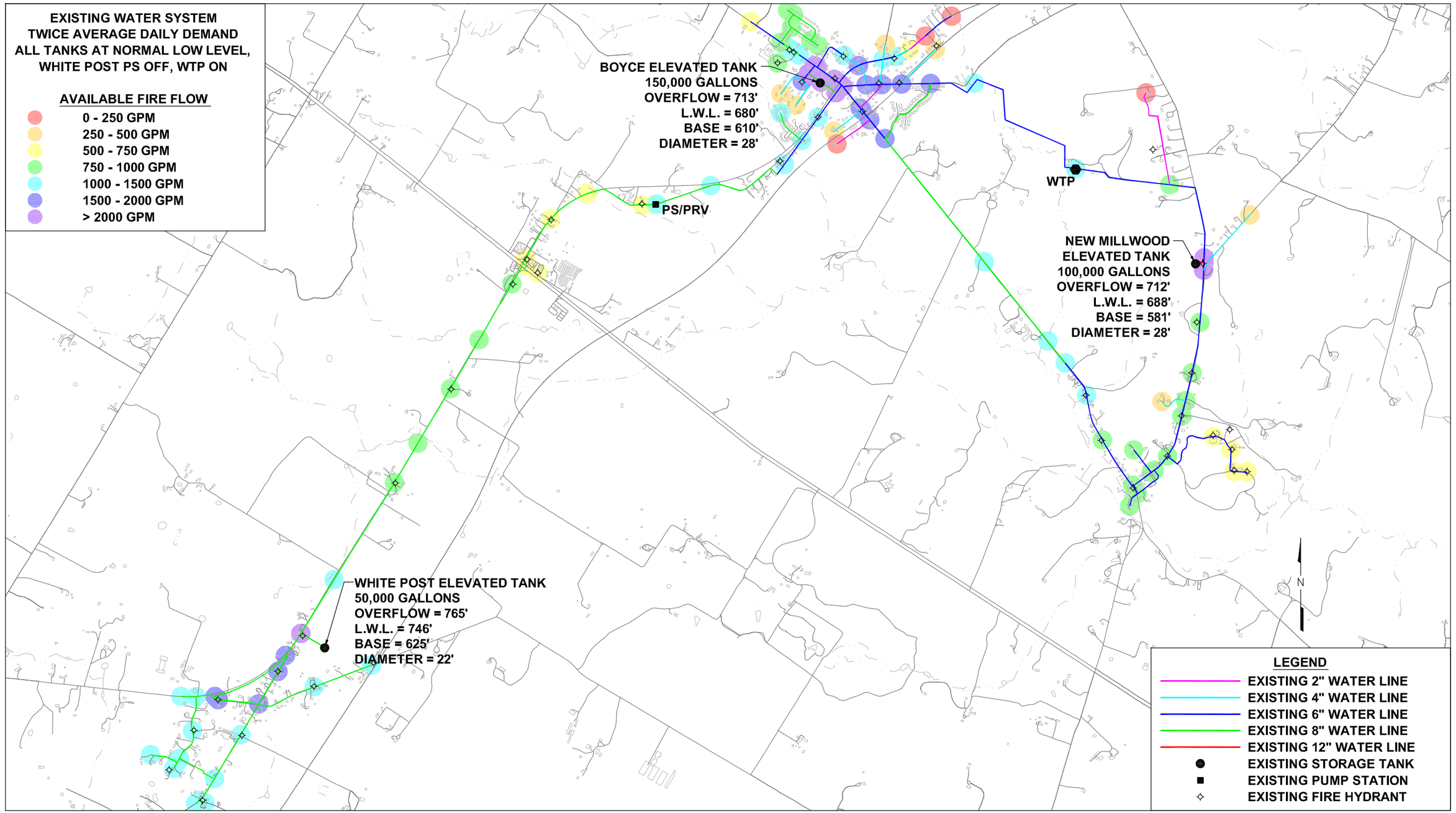
Node	Pressure	Fire Flow Constraints	Desired Fire Flow	Available Fire Flow	Total Flow Desired	Total Flow Available	Desired Residual Pressure	Calculated Residual Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure	Desired Minimum System Pressure	Calculated Minimum System Pressure	Minimum System Pressure
J-43	Boyce/Millwood	TRUE	500.00	1610.65	501.06	1611.71	20.00	25.21	20.00	20.00	J-93	20.00	20.00	J-93
FH-11	Boyce/Millwood	TRUE	500.00	1639.62	501.06	1640.68	20.00	24.80	20.00	20.00	J-88	20.00	20.00	J-88
J-10	Boyce/Millwood	TRUE	500.00	1701.52	501.90	1703.43	20.00	23.51	20.00	20.00	J-88	20.00	20.00	J-88
FH-22	White_Post	TRUE	500.00	1706.16	501.06	1707.22	20.00	21.21	20.00	20.00	J-75	20.00	20.00	J-75
J-70	Boyce/Millwood	TRUE	500.00	1717.61	503.23	1720.84	20.00	20.00	20.00	28.56	J-93	20.00	28.56	J-93
J-58	Boyce/Millwood	TRUE	500.00	1810.63	501.66	1812.29	20.00	20.00	20.00	24.46	J-54	20.00	24.46	J-54
J-61	White_Post	TRUE	500.00	1823.16	501.18	1824.33	20.00	23.60	20.00	20.00	J-75	20.00	20.00	J-75
FH-2	Boyce/Millwood	TRUE	500.00	1827.27	501.30	1828.57	20.00	20.00	20.00	26.92	FH-1	20.00	26.92	FH-1
FH-10	Boyce/Millwood	TRUE	500.00	1841.31	500.94	1842.25	20.00	20.00	20.00	24.21	J-71	20.00	24.21	J-71
J-50	Boyce/Millwood	TRUE	500.00	1887.03	500.82	1887.85	20.00	20.00	20.00	29.81	FH-3	20.00	29.81	FH-3
J-3	Boyce/Millwood	TRUE	500.00	1890.57	501.18	1891.75	20.00	20.00	20.00	21.08	FH-3	20.00	21.08	FH-3
FH-3	Boyce/Millwood	TRUE	500.00	1900.37	500.70	1901.07	20.00	20.00	20.00	21.26	J-3	20.00	21.26	J-3
J-83	Boyce/Millwood	TRUE	500.00	1941.22	502.39	1943.60	20.00	20.00	20.00	23.32	J-70	20.00	23.32	J-70
FH-6	Boyce/Millwood	TRUE	500.00	2348.39	500.82	2349.21	20.00	20.00	20.00	29.94	FH-5	20.00	29.94	FH-5
J-12	Boyce/Millwood	TRUE	500.00	2458.61	500.82	2459.43	20.00	24.39	20.00	20.00	J-91	20.00	20.00	J-91
J-11	Boyce/Millwood	TRUE	500.00	2530.18	501.06	2531.24	20.00	20.00	20.00	20.94	FH-5	20.00	20.94	FH-5
J-34	Boyce/Millwood	TRUE	500.00	2568.38	500.57	2568.95	20.00	21.07	20.00	20.00	FH-32	20.00	20.00	FH-32
FH-21	White_Post	TRUE	500.00	2625.89	501.06	2626.95	20.00	25.38	20.00	20.00	J-75	20.00	20.00	J-75
J-5	Boyce/Millwood	TRUE	500.00	2870.33	500.82	2871.14	20.00	20.00	20.00	20.97	J-50	20.00	20.97	J-50
J-13	Boyce/Millwood	TRUE	500.00	2894.81	500.57	2895.39	20.00	20.00	20.00	20.46	FH-6	20.00	20.46	FH-6
J-2	Boyce/Millwood	TRUE	500.00	3000.00	500.70	3000.69	20.00	40.49	20.00	41.86	J-91	20.00	41.86	J-91
J-6	Boyce/Millwood	TRUE	500.00	3000.00	500.57	3000.57	20.00	22.88	20.00	22.39	J-58	20.00	22.39	J-58
FH-30	Boyce/Millwood	TRUE	500.00	3000.00	500.94	3000.94	20.00	49.40	20.00	41.27	J-111	20.00	41.27	J-111
J-38	Boyce/Millwood	TRUE	500.00	3000.00	501.06	3001.06	20.00	34.33	20.00	34.35	FH-12	20.00	34.35	FH-12
J-39	Boyce/Millwood	TRUE	500.00	3000.00	500.45	3000.45	20.00	29.68	20.00	31.22	J-91	20.00	31.22	J-91
J-119	Boyce/Millwood	TRUE	500.00	3000.00	500.00	3000.00	20.00	26.48	20.00	26.44	J-111	20.00	26.44	J-111

CLARKE COUNTY SANITARY AUTHORITY

EXISTING WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT NORMAL LOW LEVEL,
WHITE POST PS OFF, WTP ON

AVAILABLE FIRE FLOW

- 0 - 250 GPM
- 250 - 500 GPM
- 500 - 750 GPM
- 750 - 1000 GPM
- 1000 - 1500 GPM
- 1500 - 2000 GPM
- > 2000 GPM



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SCALE IN FEET

ANDERSON AND ASSOCIATES, Inc.

RUN #3 - AVAILABLE FIRE FLOW EXHIBIT
JUNE 22, 2015

Run #4 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow:

Existing Water System
Boyce Tank – Normal Low
Millwood Tank – Normal Low
White Post Tank – Normal Low
Water Treatment Plant – On
White Post Pump Station – Fire Pump On.

Purpose – To identify critical hydrants in the existing system and report their available fire flows while maintaining 20 psi for all users in the system.

Result – As flow through the White Post pump station increases, a critical junction along the pump station's suction line falls below the required 20 psi minimum pressure, limiting available fire flows in the White Post pressure zone. See the fire flow report for details.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 4 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction
Existing Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-118	582.00	Boyce/Millwood	0.00	651.57	30.10
J-117	575.00	Boyce/Millwood	0.00	644.83	30.21
FH-12	596.84	Boyce/Millwood	1.78	690.56	40.55
J-81	582.80	Boyce/Millwood	2.51	676.52	40.55
J-2	610.00	Boyce/Millwood	0.70	706.89	41.92
J-111	610.64	Boyce/Millwood	1.06	708.65	42.41
J-91	606.86	Boyce/Millwood	0.70	706.54	43.13
FH-5	605.84	Boyce/Millwood	2.14	706.42	43.51
J-87	575.25	Boyce/Millwood	2.14	676.52	43.81
FH-13	558.71	Boyce/Millwood	2.02	662.31	44.83
J-39	602.18	Boyce/Millwood	0.45	706.79	45.26
J-58	600.56	Boyce/Millwood	1.66	706.25	45.73
J-11	599.91	Boyce/Millwood	1.06	706.49	46.11
FH-6	599.69	Boyce/Millwood	0.82	706.27	46.11
FH-32	599.76	Boyce/Millwood	0.45	706.85	46.34
J-50	598.85	Boyce/Millwood	0.82	706.25	46.47
J-37	598.00	Boyce/Millwood	0.70	706.54	46.96
J-12	596.72	Boyce/Millwood	0.82	706.55	47.52
J-36	595.30	Boyce/Millwood	1.66	706.54	48.13
J-38	594.22	Boyce/Millwood	1.06	705.68	48.22
J-54	594.28	Boyce/Millwood	0.70	706.25	48.44
J-29	594.00	Boyce/Millwood	1.54	706.54	48.69
J-13	593.62	Boyce/Millwood	0.57	706.21	48.71
J-30	593.67	Boyce/Millwood	0.57	706.54	48.83
J-6	592.70	Boyce/Millwood	0.57	706.15	49.09
J-5	592.37	Boyce/Millwood	0.82	706.18	49.24
J-88	591.09	Boyce/Millwood	1.18	706.29	49.84
FH-10	590.96	Boyce/Millwood	0.94	706.79	50.12
J-48	590.22	Boyce/Millwood	1.54	706.54	50.33
J-34	590.00	Boyce/Millwood	0.57	706.98	50.61
FH-3	588.55	Boyce/Millwood	0.70	706.29	50.94
FH-30	589.03	Boyce/Millwood	0.94	707.00	51.04
J-119	589.09	Boyce/Millwood	0.00	707.08	51.05
J-93	588.18	Boyce/Millwood	0.94	706.31	51.11
J-14	588.00	Boyce/Millwood	0.57	706.54	51.29
J-110	590.21	Boyce/Millwood	1.30	708.78	51.30
J-45	587.66	Boyce/Millwood	0.94	706.25	51.31
J-70	587.31	Boyce/Millwood	3.23	706.47	51.55
FH-35	587.32	Boyce/Millwood	0.94	706.56	51.59
J-3	586.89	Boyce/Millwood	1.18	706.29	51.66
J-7	586.03	Boyce/Millwood	0.33	706.54	52.14
J-18	585.30	Boyce/Millwood	0.94	706.54	52.45
FH-7	584.92	Boyce/Millwood	0.45	706.54	52.62
J-17	584.61	Boyce/Millwood	0.57	706.54	52.75
FH-9	584.24	Boyce/Millwood	2.05	706.54	52.91
FH-8	583.74	Boyce/Millwood	0.45	706.54	53.13
FH-4	581.71	Boyce/Millwood	0.94	706.25	53.88
FH-33	581.47	Boyce/Millwood	1.06	706.73	54.20
J-71	581.24	Boyce/Millwood	1.18	706.79	54.32
J-10	580.50	Boyce/Millwood	1.90	706.28	54.42
FH-11	580.00	Boyce/Millwood	1.06	706.29	54.64
J-75	637.43	White_Post	0.57	763.88	54.71
J-52	636.38	White_Post	0.45	763.88	55.16
J-72	577.84	Boyce/Millwood	1.06	706.79	55.79
J-43	576.17	Boyce/Millwood	1.06	706.35	56.32
FH-26	630.00	White_Post	1.90	763.88	57.92
J-53	630.00	White_Post	0.82	763.88	57.92
J-19	630.00	White_Post	0.57	763.88	57.92
FH-22	630.00	White_Post	1.06	763.89	57.93
J-56	572.76	Boyce/Millwood	0.70	706.67	57.94
FH-2	572.00	Boyce/Millwood	1.30	706.39	58.14
FH-23	629.31	White_Post	0.82	763.88	58.22
J-61	629.12	White_Post	1.18	763.89	58.31
J-83	571.29	Boyce/Millwood	2.39	706.55	58.52
J-57	569.25	Boyce/Millwood	1.06	706.24	59.27
FH-21	625.02	White_Post	1.06	763.89	60.08
J-89	623.98	White_Post	2.02	763.88	60.53
FH-25	623.87	White_Post	0.57	763.88	60.57
FH-34	566.63	Boyce/Millwood	0.94	706.64	60.57
FH-24	623.56	White_Post	1.18	763.88	60.71
FH-28	622.96	White_Post	0.94	763.88	60.97
J-16	565.12	Boyce/Millwood	0.94	706.54	61.18
J-22	620.68	White_Post	0.57	763.88	61.96
J-21	620.00	White_Post	0.57	763.88	62.25
FH-27	619.66	White_Post	1.18	763.88	62.40
J-73	619.54	White_Post	1.18	763.88	62.45
J-64	561.35	Boyce/Millwood	0.70	706.19	62.67
FH-39	560.00	Boyce/Millwood	0.57	706.55	63.41
J-109	560.00	Boyce/Millwood	1.06	706.98	63.59
J-15	558.57	Boyce/Millwood	1.30	706.54	64.02
J-86	558.00	Boyce/Millwood	0.94	706.19	64.11
FH-36	558.14	Boyce/Millwood	1.61	706.56	64.21
J-26	615.16	White_Post	0.57	763.88	64.34
J-113	557.64	Boyce/Millwood	0.33	706.47	64.39
FH-1	556.00	Boyce/Millwood	1.18	706.39	65.07
FH-40	554.08	Boyce/Millwood	1.61	706.55	65.97
FH-29	611.02	White_Post	0.82	763.88	66.13
J-25	610.52	White_Post	0.45	763.88	66.35
FH-20	626.39	White_Post	1.06	783.65	68.04

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-69	548.01	Boyce/Millwood	0.70	706.67	68.64
J-107	611.32	White_Post	0.33	770.92	69.05
J-112	547.12	Boyce/Millwood	0.33	710.56	70.71
J-79	542.18	Boyce/Millwood	0.94	706.54	71.11
J-94	540.00	Boyce/Millwood	0.33	707.51	72.47
FH-38	534.15	Boyce/Millwood	0.57	706.55	74.59
J-77	528.14	Boyce/Millwood	0.82	706.47	77.16
FH-41	522.12	Boyce/Millwood	2.02	706.53	79.78
J-78	522.03	Boyce/Millwood	2.05	706.47	79.80
FH-19	609.26	White_Post	0.70	795.88	80.74
FH-43	519.63	Boyce/Millwood	1.54	706.49	80.84
FH-42	515.59	Boyce/Millwood	2.02	706.50	82.60
J-97	594.87	White_Post	0.45	788.79	83.90
J-42	512.17	Boyce/Millwood	0.94	706.53	84.09
J-103	594.00	White_Post	0.45	802.25	90.10
J-51	492.81	Boyce/Millwood	0.70	706.53	92.47
FH-18	593.08	White_Post	3.41	809.54	93.65
J-32	592.00	White_Post	0.57	812.52	95.41
FH-16	592.75	White_Post	3.25	813.59	95.55
FH-17	588.00	White_Post	2.05	812.52	97.14
FH-15	588.89	White_Post	1.42	819.06	99.58
J-95	584.95	White_Post	1.54	824.35	103.58
J-116	575.00	White_Post	0.00	832.91	111.59
FH-14	572.83	White_Post	1.18	831.42	111.88

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 4 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-2.05	706.54	706.54	0.00	0.00
P-2	311.00	6.00	120.00	Open	2.05	812.52	812.52	0.00	0.00
P-3	22.00	8.00	120.00	Open	452.87	707.00	706.89	0.11	0.01
P-4	867.00	2.00	120.00	Open	-0.94	706.31	706.35	0.04	0.00
P-5	327.00	4.00	120.00	Open	0.70	706.25	706.25	0.00	0.00
P-6	198.00	8.00	120.00	Open	0.70	706.54	706.54	0.00	0.00
P-7	150.00	8.00	120.00	Open	0.57	706.54	706.54	0.00	0.00
P-8	324.00	8.00	120.00	Open	-2.46	706.54	706.54	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.35	706.54	706.54	0.00	0.00
P-10	498.00	8.00	120.00	Open	2.01	706.54	706.54	0.00	0.00
P-11	391.00	8.00	120.00	Open	6.01	706.54	706.54	0.00	0.00
P-12	758.00	8.00	120.00	Open	2.14	676.52	676.52	0.00	0.00
P-13	596.00	8.00	120.00	Open	-451.34	761.00	763.89	2.89	0.01
P-14	505.00	6.00	120.00	Open	-2.76	706.55	706.56	0.00	0.00
P-15	532.00	6.00	120.00	Open	-2.19	706.55	706.55	0.00	0.00
P-16	290.00	6.00	120.00	Open	-1.61	706.55	706.55	0.00	0.00
P-17	598.00	4.00	120.00	Open	-0.70	706.67	706.67	0.00	0.00
P-18	541.00	4.00	120.00	Open	7.58	706.29	706.25	0.04	0.00
P-19	696.00	6.00	120.00	Open	-0.94	706.19	706.19	0.00	0.00
P-20	560.00	6.00	120.00	Open	-20.19	706.21	706.25	0.03	0.00
P-21	492.00	6.00	120.00	Open	31.05	706.25	706.18	0.07	0.00
P-22	680.00	2.00	120.00	Open	-0.61	706.28	706.29	0.01	0.00
P-23	746.00	4.00	120.00	Open	-1.18	706.29	706.29	0.00	0.00
P-24	399.00	8.00	120.00	Open	350.76	706.89	705.68	1.21	0.00
P-25	320.00	8.00	120.00	Open	-101.42	706.79	706.89	0.10	0.00
P-26	185.00	12.00	120.00	Open	-50.58	707.00	707.00	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	0.57	763.88	763.88	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.45	763.88	763.88	0.00	0.00
P-29	561.00	8.00	120.00	Open	1.84	763.88	763.88	0.00	0.00
P-30	601.00	8.00	120.00	Open	0.57	763.88	763.88	0.00	0.00
P-31	146.00	8.00	120.00	Open	0.57	763.88	763.88	0.00	0.00
P-32	98.00	8.00	120.00	Open	1.72	763.88	763.88	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.45	763.88	763.88	0.00	0.00
P-34	698.00	8.00	120.00	Open	2.34	763.88	763.88	0.00	0.00
P-35	743.00	8.00	120.00	Open	3.52	763.88	763.88	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.04	763.88	763.88	0.00	0.00
P-37	417.00	8.00	120.00	Open	-4.79	763.88	763.88	0.00	0.00
P-38	1087.00	8.00	120.00	Open	2.98	763.88	763.88	0.00	0.00
P-39	758.00	8.00	120.00	Open	3.92	763.88	763.88	0.00	0.00
P-40	1294.00	8.00	120.00	Open	1.18	763.88	763.88	0.00	0.00
P-41	1283.00	8.00	120.00	Open	3.08	763.88	763.88	0.00	0.00
P-42	396.00	8.00	120.00	Open	-9.31	763.89	763.89	0.00	0.00
P-43	803.00	8.00	120.00	Open	-8.25	763.88	763.89	0.00	0.00
P-44	866.00	8.00	120.00	Open	0.77	763.88	763.88	0.00	0.00
P-45	150.00	8.00	120.00	Open	1.58	763.88	763.88	0.00	0.00
P-46	1764.00	8.00	120.00	Open	6.94	763.89	763.88	0.00	0.00
P-47	573.00	8.00	120.00	Open	17.43	763.89	763.89	0.01	0.00
P-48	1343.00	8.00	120.00	Open	469.83	770.92	763.89	7.02	0.01
P-49	2431.00	8.00	120.00	Open	470.16	783.65	770.92	12.73	0.01
P-50	978.00	8.00	120.00	Open	471.22	788.79	783.65	5.14	0.01
P-51	1346.00	8.00	120.00	Open	471.67	795.88	788.79	7.09	0.01
P-52	1207.00	8.00	120.00	Open	472.37	802.25	795.88	6.38	0.01
P-53	1377.00	8.00	120.00	Open	472.82	809.54	802.25	7.29	0.01
P-54	556.00	8.00	120.00	Open	476.24	812.52	809.54	2.98	0.01
P-55	198.00	8.00	120.00	Open	478.86	813.59	812.52	1.07	0.01
P-56	996.00	8.00	120.00	Open	482.12	819.06	813.59	5.46	0.01
P-57	959.00	8.00	120.00	Open	483.54	824.35	819.06	5.29	0.01
P-58	1275.00	8.00	120.00	Open	485.08	831.42	824.35	7.07	0.01
P-59A	268.00	8.00	120.00	Open	-486.25	831.42	832.91	1.49	0.01
P-59B	25.00	8.00	120.00	Open	-486.26	832.91	833.05	0.14	0.01
P-59C	25.00	8.00	120.00	Open	-486.26	644.69	644.83	0.14	0.01
P-59D	1211.00	8.00	120.00	Open	-486.25	644.83	651.57	6.75	0.01
P-59E	32.00	8.00	120.00	Open	0.00	832.91	832.91	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	644.83	644.83	0.00	0.00
P-60	1927.00	8.00	120.00	Open	-486.25	651.57	662.31	10.74	0.01
P-61	623.00	6.00	120.00	Open	488.28	676.52	662.31	14.21	0.02
P-61A	623.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62	605.00	6.00	120.00	Open	492.93	690.56	676.52	14.04	0.02
P-62A	605.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63	647.00	6.00	120.00	Open	494.71	705.68	690.56	15.12	0.02
P-63A	647.00	8.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-64	198.00	6.00	120.00	Open	145.01	706.15	705.68	0.48	0.00
P-65	657.00	4.00	120.00	Open	-1.06	706.79	706.79	0.00	0.00
P-66	660.00	4.00	120.00	Open	1.18	706.79	706.79	0.00	0.00
P-67	206.00	6.00	120.00	Open	3.17	706.79	706.79	0.00	0.00
P-68	211.00	6.00	120.00	Open	-97.79	706.55	706.79	0.24	0.00
P-69	778.00	6.00	120.00	Open	0.70	706.54	706.54	0.00	0.00
P-70	85.00	6.00	120.00	Open	7.64	706.54	706.54	0.00	0.00
P-71	157.00	8.00	120.00	Open	8.22	706.54	706.54	0.00	0.00
P-72	105.00	8.00	120.00	Open	8.67	706.54	706.54	0.00	0.00
P-73	48.00	8.00	120.00	Open	9.12	706.54	706.54	0.00	0.00
P-74	79.00	8.00	120.00	Open	11.51	706.54	706.54	0.00	0.00
P-75	398.00	6.00	120.00	Open	12.08	706.55	706.54	0.01	0.00
P-76	70.00	6.00	120.00	Open	-84.89	706.49	706.55	0.06	0.00
P-77	542.00	6.00	120.00	Open	2.33	706.25	706.25	0.00	0.00
P-78	270.00	6.00	120.00	Open	-3.63	706.25	706.25	0.00	0.00
P-79	347.00	4.00	120.00	Open	-2.69	706.24	706.25	0.00	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-1.63	706.19	706.24	0.05	0.00
P-81	1620.00	8.00	120.00	Open	38.92	706.55	706.47	0.08	0.00
P-82	3361.00	8.00	120.00	Open	5.23	706.47	706.47	0.00	0.00
P-83	2159.00	8.00	120.00	Open	5.56	706.47	706.47	0.00	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	7.61	706.47	706.47	0.00	0.00
P-85	615.00	6.00	120.00	Open	43.40	706.55	706.39	0.16	0.00
P-86	441.00	6.00	120.00	Open	-61.16	706.27	706.49	0.21	0.00
P-87	129.00	6.00	120.00	Open	-60.34	706.21	706.27	0.06	0.00
P-88	71.00	6.00	120.00	Open	-79.96	706.15	706.21	0.06	0.00
P-89	41.00	6.00	120.00	Open	65.62	706.18	706.15	0.02	0.00
P-90	583.00	6.00	120.00	Open	35.39	706.28	706.18	0.10	0.00
P-91	63.00	6.00	120.00	Open	36.68	706.29	706.28	0.01	0.00
P-92	258.00	6.00	120.00	Open	38.92	706.35	706.29	0.05	0.00
P-93	516.00	6.00	120.00	Open	40.91	706.47	706.35	0.12	0.00
P-94	860.00	6.00	120.00	Open	-22.68	706.42	706.49	0.07	0.00
P-95	375.00	4.00	120.00	Open	-20.53	706.25	706.42	0.17	0.00
P-96	467.00	4.00	120.00	Open	-1.00	706.25	706.25	0.00	0.00
P-97	300.00	6.00	120.00	Open	30.86	706.29	706.25	0.04	0.00
P-98	33.00	6.00	120.00	Open	39.14	706.29	706.29	0.01	0.00
P-99	422.00	6.00	120.00	Open	40.93	706.39	706.29	0.10	0.00
P-100	1029.00	4.00	120.00	Open	1.18	706.39	706.39	0.00	0.00
P-100A	1029.00	6.00	121.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-101	1478.00	6.00	120.00	Open	4.38	706.56	706.56	0.01	0.00
P-102	608.00	6.00	120.00	Open	-26.46	706.67	706.73	0.06	0.00
P-103	334.00	6.00	120.00	Open	-25.07	706.64	706.67	0.03	0.00
P-104	913.00	6.00	120.00	Open	-24.13	706.56	706.64	0.08	0.00
P-105	415.00	6.00	120.00	Open	-18.82	706.54	706.56	0.02	0.00
P-106	82.00	6.00	120.00	Open	-10.81	706.54	706.54	0.00	0.00
P-107	482.00	6.00	120.00	Open	-8.58	706.53	706.54	0.01	0.00
P-108	1167.00	6.00	120.00	Open	-11.99	706.50	706.53	0.03	0.00
P-109	1019.00	6.00	120.00	Open	-9.97	706.49	706.50	0.02	0.00
P-110	832.00	6.00	120.00	Open	-8.43	706.47	706.49	0.01	0.00
P-111	2178.00	2.00	120.00	Open	1.06	708.78	708.65	0.12	0.00
P-112	2060.00	6.00	120.00	Open	-83.47	708.78	710.56	1.78	0.00
P-113	1535.00	4.00	120.00	Open	1.06	706.98	706.98	0.00	0.00
P-114	1091.00	6.00	120.00	Open	27.51	706.85	706.73	0.12	0.00
P-115	1112.00	6.00	120.00	Open	27.97	706.98	706.85	0.13	0.00
P-116	161.00	6.00	120.00	Open	29.60	707.00	706.98	0.02	0.00
P-117A	2061.00	6.00	120.00	Open	81.12	708.78	707.08	1.69	0.00
P-117B	100.00	6.00	120.00	Open	81.12	707.08	707.00	0.08	0.00
P-118	1082.00	6.00	120.00	Open	84.71	707.51	706.55	0.96	0.00
P-119	3401.00	6.00	120.00	Open	85.04	710.56	707.51	3.05	0.00
P-120	211.00	6.00	120.00	Open	-5.44	706.53	706.53	0.00	0.00
P-121	335.00	6.00	120.00	Open	0.70	706.53	706.53	0.00	0.00
P-122	740.00	6.00	120.00	Open	7.07	706.54	706.53	0.01	0.00
P-123	605.00	6.00	120.00	Open	0.94	706.54	706.54	0.00	0.00
P-124	1.00	2.00	120.00	Open	168.85	540.00	539.33	0.67	0.67
P-125	80.00	2.00	120.00	Open	168.85	764.39	710.56	53.84	0.67

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 4 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.00	713.00	28.00	-452.87	707.00
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.00	712.00	28.00	50.58	707.00
White_Post_Tank	625.00	746.00	761.00	765.00	22.00	451.34	761.00
R-WTP	--	--	--	--	--	-168.85	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	On	539.33	764.39	168.85	225.07
PMP-White_Post	575.00	On	644.69	833.05	486.26	188.37

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	832.91	644.83	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 4 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Existing Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Fire Flow Report - sorted by Available Fire Flow

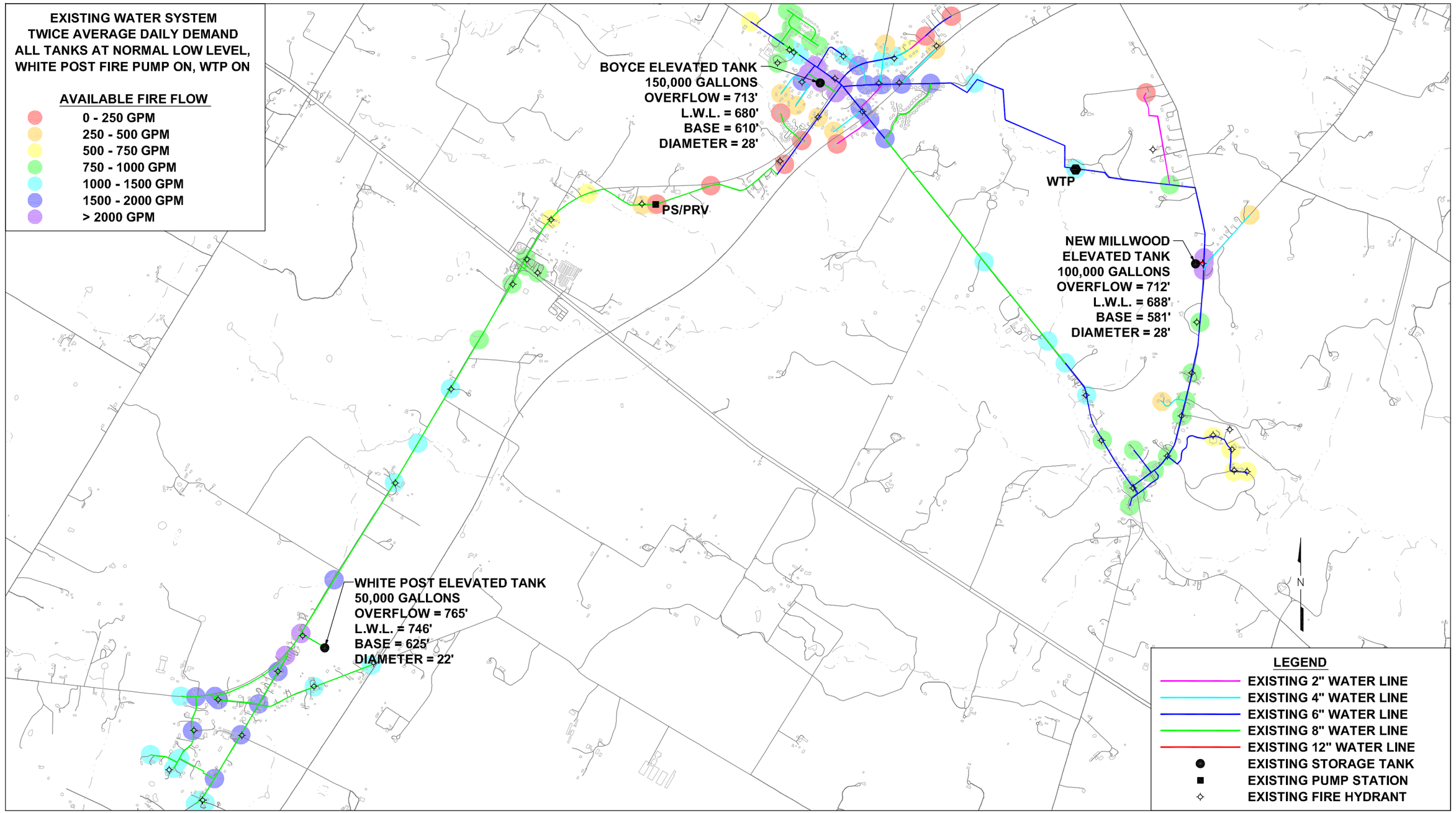
Node Label	Pressure Zone	Fire Flow Constraints Satisfied	Desired Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Desired (gpm)	Total Flow Available (gpm)	Desired Residual Pressure (psi)	Calculated Residual Pressure (psi)	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node	Desired Minimum System Pressure (psi)	Calculated Minimum System Pressure (psi)	Minimum System Pressure Node
J-111	Boyce/Millwood	FALSE	500.00	26.53	501.06	27.59	20.00	20.00	20.00	30.10	J-118	20.00	30.10	J-118
J-93	Boyce/Millwood	FALSE	500.00	53.39	500.94	54.33	20.00	20.00	20.00	30.04	J-118	20.00	30.04	J-118
J-86	Boyce/Millwood	FALSE	500.00	90.67	500.94	91.61	20.00	21.20	20.00	20.06	J-64	20.00	20.06	J-64
J-64	Boyce/Millwood	FALSE	500.00	90.74	500.70	91.43	20.00	20.01	20.00	21.46	J-86	20.00	21.46	J-86
J-117	Boyce/Millwood	FALSE	500.00	130.18	500.00	130.18	20.00	20.00	20.00	21.01	J-118	20.00	21.01	J-118
J-118	Boyce/Millwood	FALSE	500.00	137.82	500.00	137.82	20.00	20.00	20.00	20.49	J-117	20.00	20.49	J-117
FH-13	Boyce/Millwood	FALSE	500.00	167.43	502.02	169.46	20.00	34.12	20.00	20.00	J-118	20.00	20.00	J-118
J-81	Boyce/Millwood	FALSE	500.00	234.14	502.51	236.64	20.00	29.05	20.00	20.00	J-118	20.00	20.00	J-118
J-87	Boyce/Millwood	FALSE	500.00	234.17	502.14	236.32	20.00	31.83	20.00	20.00	J-118	20.00	20.00	J-118
J-109	Boyce/Millwood	FALSE	500.00	294.15	501.06	295.20	20.00	20.00	20.00	30.06	J-118	20.00	30.06	J-118
J-88	Boyce/Millwood	FALSE	500.00	342.44	501.18	343.62	20.00	20.00	20.00	29.55	J-118	20.00	29.55	J-118
FH-1	Boyce/Millwood	FALSE	500.00	363.69	501.18	364.87	20.00	20.00	20.00	29.52	J-118	20.00	29.52	J-118
FH-12	Boyce/Millwood	FALSE	500.00	390.34	501.78	392.12	20.00	28.26	20.00	20.00	J-118	20.00	20.00	J-118
J-71	Boyce/Millwood	FALSE	500.00	397.64	501.18	398.82	20.00	20.00	20.00	29.90	J-118	20.00	29.90	J-118
J-116	White_Post	FALSE	500.00	405.49	500.00	405.49	20.00	84.71	20.00	53.60	J-75	20.00	20.00	J-117
J-72	Boyce/Millwood	FALSE	500.00	407.90	501.06	408.96	20.00	20.00	20.00	29.89	J-118	20.00	29.89	J-118
FH-14	White_Post	FALSE	500.00	423.08	501.18	424.26	20.00	84.76	20.00	53.57	J-75	20.00	20.00	J-117
J-69	Boyce/Millwood	FALSE	500.00	455.77	500.70	456.47	20.00	20.00	20.00	29.80	J-118	20.00	29.80	J-118
J-54	Boyce/Millwood	FALSE	500.00	484.50	500.70	485.19	20.00	20.00	20.00	29.27	J-118	20.00	29.27	J-118
FH-40	Boyce/Millwood	TRUE	500.00	511.76	501.61	513.38	20.00	20.00	20.00	20.58	FH-39	20.00	20.58	FH-39
FH-39	Boyce/Millwood	TRUE	500.00	515.55	500.57	516.12	20.00	20.00	20.00	22.56	FH-40	20.00	22.56	FH-40
J-57	Boyce/Millwood	TRUE	500.00	535.79	501.06	536.84	20.00	20.00	20.00	23.40	J-64	20.00	23.40	J-64
FH-38	Boyce/Millwood	TRUE	500.00	558.31	500.57	558.88	20.00	31.18	20.00	20.00	FH-39	20.00	20.00	FH-39
FH-36	Boyce/Millwood	TRUE	500.00	609.97	501.61	611.58	20.00	20.81	20.00	20.00	FH-39	20.00	20.00	FH-39
J-91	Boyce/Millwood	TRUE	500.00	615.22	500.70	615.92	20.00	20.00	20.00	29.34	J-118	20.00	29.34	J-118
J-95	White_Post	TRUE	500.00	639.46	501.54	641.00	20.00	75.28	20.00	53.39	J-75	20.00	20.00	J-117
FH-15	White_Post	TRUE	500.00	740.67	501.42	742.09	20.00	70.41	20.00	53.19	J-75	20.00	20.00	J-117
FH-35	Boyce/Millwood	TRUE	500.00	763.15	500.94	764.09	20.00	20.00	20.00	29.44	J-118	20.00	29.44	J-118
J-16	Boyce/Millwood	TRUE	500.00	796.75	500.94	797.69	20.00	26.59	20.00	20.00	FH-35	20.00	20.00	FH-35
J-15	Boyce/Millwood	TRUE	500.00	800.60	501.30	801.90	20.00	28.48	20.00	20.00	FH-35	20.00	20.00	FH-35
J-79	Boyce/Millwood	TRUE	500.00	800.60	500.94	801.54	20.00	20.62	20.00	20.00	FH-35	20.00	20.00	FH-35
J-42	Boyce/Millwood	TRUE	500.00	807.56	500.94	808.49	20.00	46.73	20.00	20.00	FH-35	20.00	20.00	FH-35
J-51	Boyce/Millwood	TRUE	500.00	807.56	500.70	808.26	20.00	46.70	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-41	Boyce/Millwood	TRUE	500.00	813.82	502.02	815.84	20.00	43.77	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-16	White_Post	TRUE	500.00	818.75	503.25	822.00	20.00	65.46	20.00	52.96	J-75	20.00	20.00	J-117
FH-17	White_Post	TRUE	500.00	833.35	502.05	835.40	20.00	58.57	20.00	52.91	J-75	20.00	20.00	J-117
J-32	White_Post	TRUE	500.00	833.35	500.57	833.93	20.00	65.14	20.00	52.91	J-75	20.00	20.00	J-117
FH-34	Boyce/Millwood	TRUE	500.00	858.98	500.94	859.92	20.00	24.24	20.00	20.00	FH-35	20.00	20.00	FH-35
J-110	Boyce/Millwood	TRUE	500.00	860.36	501.30	861.66	20.00	28.89	20.00	20.00	J-111	20.00	20.00	J-111
FH-18	White_Post	TRUE	500.00	873.89	503.41	877.30	20.00	62.88	20.00	52.76	J-75	20.00	20.00	J-117
J-37	Boyce/Millwood	TRUE	500.00	875.19	500.70	875.88	20.00	20.00	20.00	21.86	J-91	20.00	21.86	J-91
J-56	Boyce/Millwood	TRUE	500.00	901.54	500.70	902.23	20.00	20.00	20.00	20.10	FH-35	20.00	20.10	FH-35
J-36	Boyce/Millwood	TRUE	500.00	901.79	501.66	903.45	20.00	21.17	20.00	20.00	J-37	20.00	20.00	J-37
FH-33	Boyce/Millwood	TRUE	500.00	906.59	501.06	907.65	20.00	20.00	20.00	25.29	FH-35	20.00	25.29	FH-35
FH-9	Boyce/Millwood	TRUE	500.00	907.70	502.05	909.75	20.00	20.00	20.00	25.52	J-91	20.00	25.52	J-91
J-18	Boyce/Millwood	TRUE	500.00	917.00	500.94	917.93	20.00	29.33	20.00	20.00	J-91	20.00	20.00	J-91
J-48	Boyce/Millwood	TRUE	500.00	917.00	501.54	918.54	20.00	24.11	20.00	20.00	J-91	20.00	20.00	J-91
J-30	Boyce/Millwood	TRUE	500.00	917.00	500.57	917.58	20.00	20.19	20.00	20.00	J-91	20.00	20.00	J-91
J-29	Boyce/Millwood	TRUE	500.00	917.00	501.54	918.54	20.00	21.22	20.00	20.00	J-91	20.00	20.00	J-91
FH-42	Boyce/Millwood	TRUE	500.00	932.65	502.02	934.67	20.00	38.37	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-32	Boyce/Millwood	TRUE	500.00	972.10	500.45	972.55	20.00	20.00	20.00	29.63	J-118	20.00	29.63	J-118
J-103	White_Post	TRUE	500.00	976.87	500.45	977.33	20.00	58.08	20.00	50.33	FH-20	20.00	20.00	J-117
J-17	Boyce/Millwood	TRUE	500.00	983.45	500.57	984.02	20.00	29.62	20.00	20.00	J-91	20.00	20.00	J-91
FH-8	Boyce/Millwood	TRUE	500.00	1018.60	500.45	1019.05	20.00	30.00	20.00	20.00	J-91	20.00	20.00	J-91
FH-7	Boyce/Millwood	TRUE	500.00	1044.22	500.45	1044.67	20.00	29.49	20.00	20.00	J-91	20.00	20.00	J-91
J-7	Boyce/Millwood	TRUE	500.00	1056.56	500.33	1056.90	20.00	29.01	20.00	20.00	J-91	20.00	20.00	J-91
J-14	Boyce/Millwood	TRUE	500.00	1077.91	500.57	1078.48	20.00	28.16	20.00	20.00	J-91	20.00	20.00	J-91
FH-19	White_Post	TRUE	500.00	1077.92	500.70	1078.62	20.00	47.63	20.00	46.42	FH-20	20.00	20.00	J-117
FH-4	Boyce/Millwood	TRUE	500.00	1078.55	500.94	1079.49	20.00	20.00	20.00	25.39	J-57	20.00	25.39	J-57
FH-43	Boyce/Millwood	TRUE	500.00	1082.40	501.54	1083.94	20.00	29.51	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-27	White_Post	TRUE	500.00	1086.95	501.18	1088.13	20.00	20.00	20.00	29.39	FH-26	20.00	29.26	J-118
FH-5	Boyce/Millwood	TRUE	500.00	1128.69	502.14	1130.83	20.00	20.00	20.00	28.11	J-118	20.00	28.11	J-118
J-112	Boyce/Millwood	TRUE	500.00	1150.99	500.33	1151.32	20.00	27.18	20.00	20.00	J-111	20.00	20.00	J-111
J-75	White_Post	TRUE	500.00	1209.73	500.57	1210.31	20.00	20.00	20.00	33.71	FH-25	20.00	29.03	J-117
J-97	White_Post	TRUE	500.00	1214.79	500.45	1215.24	20.00	49.57	20.00	39.98	FH-20	20.00	20.00	J-117
J-45	Boyce/Millwood	TRUE	500.00	1237.27	500.94	1238.21	20.00	22.86	20.00	20.00	J-54	20.00	20.00	J-54
FH-26	White_Post	TRUE	500.00	1265.57	501.90	1267.48	20.00	20.00	20.00	24.47	FH-27	20.00	24.47	FH-27
J-77	Boyce/Millwood	TRUE	500.00	1275.40	500.82	1276.21	20.00	20.08	20.00	20.00	FH-35	20.00	20.00	FH-35
J-113	Boyce/Millwood	TRUE	500.00	1294.92	500.33	1295.25	20.00	20.00	20.00	28.06	J-118	20.00	28.06	J-118
J-78	Boyce/Millwood	TRUE	500.00	1322.20	502.05	1324.25	20.00	21.70	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-20	White_Post	TRUE	500.00	1342.58	501.06	1343.64	20.00	32.83	20.00	47.63	FH-19	20.00	20.00	J-117
J-26	White_Post	TRUE	500.00	1383.51	500.57	1384.08	20.00	20.00	20.00	23.81	FH-29	20.00	23.81	FH-29
J-22	White_Post	TRUE	500.00	1385.77	500.57	1386.34	20.00	27.25	20.00	20.00	J-75	20.00	20.00	J-75
FH-25	White_Post	TRUE	500.00	1385.78	500.57	1386.35	20.00	23.42	20.00	20.00	J-75	20.00	20.00	J-75
J-25	White_Post	TRUE	500.00	1417.86	500.45	1418.31	20.00	20.00	20.00	20.02	J-26	20.00	20.02	J-26
FH-29	White_Post	TRUE	500.00	1418.27	500.82	1419.08	20.00	21.79	20.00	20.00	J-26	20.00	20.00	J-26
J-21	White_Post	TRUE	500.00	1421.83	500.57	1422.40	20.00	27.54	20.00	20.00	J-75	20.00	20.00	J-75
J-94	Boyce/Millwood	TRUE	500.00	1429.58	500.33	1429.91	20.00	20.00	20.00	27.94	J-118	20.00	27.94	J-118
J-52	White_Post	TRUE	500.00	1435.27	500.45	1435.72	20.00	20.00	20.00	27.31	J-75	20.00	27.31	J-75
J-73	White_Post	TRUE	500.00	1505.56	501.18	1506.73	20.00	23.82	20.00	20.00	J-75	20.00	20.00	J-75
FH-24	White_Post	TRUE	500.00	1508.57	501.18	1509.75	20.00	23.88	20.00	20.00	J-75	20.00	20.00	J-75
J-43	Boyce/Millwood	TRUE	500.00	1567.61	501.06	1568.67	20.00	25.21	20.00	20.00	J-93	20.00	20.00	J-93
J-53	White_Post	TRUE	500.00	1576.15	500.82	1576.97	20.00	22.76	20.00	20.00	J-52	20.00	20.00	J-52
FH-11	Boyce/Millwood	TRUE	500.00	1590.96	501.06	1592.02	20.00	24.80	20.00	20.00	J-88	20.00	20.00	J-88
FH-28	White_Post	TRUE	500.00	1619.35	500.94	1620.29	20.00	21.47	20.00	20.00	J-75	20.00	20.00	J-75
J-10	Boyce/Millwood	TRUE	500.00	1649.74	501.90	1651.65	20.00	23.56	20.00	20.00	J-88	20.00	20.00	J-88
J-70	Boyce/Millwood	TRUE	500.00	1675.91	503.23	1679.14	20.00	20.00	20.00	26.74	J-118	20.00	26.74	J-118

Node	Pressure	Fire Flow Constraints	Desired Fire Flow	Available Fire Flow	Total Flow Desired	Total Flow Available	Desired Residual Pressure	Calculated Residual Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure	Desired Minimum System Pressure	Calculated Minimum System Pressure	Minimum System Pressure
J-19	White_Post	TRUE	500.00	1700.32	500.57	1700.89	20.00	22.45	20.00	20.00	J-52	20.00	20.00	J-52
FH-23	White_Post	TRUE	500.00	1715.31	500.82	1716.13	20.00	21.38	20.00	20.00	J-52	20.00	20.00	J-52
J-89	White_Post	TRUE	500.00	1741.55	502.02	1743.58	20.00	24.31	20.00	20.00	J-75	20.00	20.00	J-75
J-58	Boyce/Millwood	TRUE	500.00	1743.18	501.66	1744.84	20.00	20.00	20.00	24.33	J-54	20.00	24.33	J-54
FH-2	Boyce/Millwood	TRUE	500.00	1784.36	501.30	1785.66	20.00	20.00	20.00	26.07	J-118	20.00	26.07	J-118
J-50	Boyce/Millwood	TRUE	500.00	1813.29	500.82	1814.10	20.00	20.00	20.00	25.55	J-118	20.00	25.55	J-118
FH-10	Boyce/Millwood	TRUE	500.00	1821.08	500.94	1822.01	20.00	20.00	20.00	24.21	J-71	20.00	24.21	J-71
J-3	Boyce/Millwood	TRUE	500.00	1831.43	501.18	1832.61	20.00	20.00	20.00	20.96	FH-3	20.00	20.96	FH-3
FH-3	Boyce/Millwood	TRUE	500.00	1838.98	500.70	1839.68	20.00	20.00	20.00	21.24	J-3	20.00	21.24	J-3
J-83	Boyce/Millwood	TRUE	500.00	1900.27	502.39	1902.66	20.00	20.00	20.00	22.89	J-70	20.00	22.89	J-70
FH-22	White_Post	TRUE	500.00	1924.22	501.06	1925.28	20.00	20.70	20.00	20.00	J-75	20.00	20.00	J-75
J-107	White_Post	TRUE	500.00	1956.23	500.33	1956.56	20.00	31.66	20.00	32.83	FH-20	20.00	20.00	J-117
J-61	White_Post	TRUE	500.00	2074.46	501.18	2075.64	20.00	23.60	20.00	20.00	J-75	20.00	20.00	J-75
FH-6	Boyce/Millwood	TRUE	500.00	2252.38	500.82	2253.19	20.00	20.00	20.00	24.46	J-118	20.00	24.46	J-118
J-38	Boyce/Millwood	TRUE	500.00	2263.64	501.06	2264.70	20.00	35.10	20.00	20.00	J-118	20.00	20.00	J-118
J-12	Boyce/Millwood	TRUE	500.00	2387.04	500.82	2387.86	20.00	24.39	20.00	20.00	J-91	20.00	20.00	J-91
J-11	Boyce/Millwood	TRUE	500.00	2454.65	501.06	2455.71	20.00	20.00	20.00	20.57	FH-5	20.00	20.57	FH-5
J-34	Boyce/Millwood	TRUE	500.00	2558.95	500.57	2559.52	20.00	21.18	20.00	20.00	FH-32	20.00	20.00	FH-32
J-5	Boyce/Millwood	TRUE	500.00	2728.17	500.82	2728.99	20.00	20.00	20.00	20.78	J-50	20.00	20.78	J-50
J-13	Boyce/Millwood	TRUE	500.00	2755.18	500.57	2755.75	20.00	20.00	20.00	20.42	FH-6	20.00	20.42	FH-6
J-6	Boyce/Millwood	TRUE	500.00	2936.71	500.57	2937.28	20.00	20.93	20.00	20.00	J-118	20.00	20.00	J-118
J-2	Boyce/Millwood	TRUE	500.00	3000.00	500.70	3000.69	20.00	40.03	20.00	28.71	J-118	20.00	28.71	J-118
FH-30	Boyce/Millwood	TRUE	500.00	3000.00	500.94	3000.94	20.00	49.38	20.00	29.99	J-118	20.00	29.99	J-118
J-39	Boyce/Millwood	TRUE	500.00	3000.00	500.45	3000.45	20.00	28.86	20.00	26.83	J-118	20.00	26.83	J-118
FH-21	White_Post	TRUE	500.00	3000.00	501.06	3001.06	20.00	29.59	20.00	24.22	J-75	20.00	22.13	J-117
J-119	Boyce/Millwood	TRUE	500.00	3000.00	500.00	3000.00	20.00	26.40	20.00	26.20	J-111	20.00	26.20	J-111

CLARKE COUNTY SANITARY AUTHORITY

EXISTING WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT NORMAL LOW LEVEL,
WHITE POST FIRE PUMP ON, WTP ON

AVAILABLE FIRE FLOW
- 0 - 250 GPM
- 250 - 500 GPM
- 500 - 750 GPM
- 750 - 1000 GPM
- 1000 - 1500 GPM
- 1500 - 2000 GPM
- > 2000 GPM



1000 500 0 1000 2000 3000
SCALE IN FEET

ANDERSON
AND
ASSOCIATES, Inc.

RUN #4 - AVAILABLE FIRE FLOW EXHIBIT
JUNE 22, 2015

Run #5 – Steady state analysis of twice average daily demand. Initial conditions are as follow:

Proposed Water System Improvements – Constructed

Boyce Tank – Absolute Low

Millwood Tank – Absolute Low

White Post Tank – Absolute Low

Water Treatment Plant – Off

White Post Pump Station – Off.

Purpose – To determine the minimum tank level in the proposed water system necessary to maintain 20 psi for all users under twice average daily conditions.

Result – The White Post Tank serving the high pressure zone can empty and still maintain 20 psi for all users in the system. The minimum hydraulic grade in the Boyce and Millwood Tanks serving the low pressure zone is 688’ which corresponds to 8.00’ of water in the Boyce Tank and the Millwood Tank empty.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 5 - Twice Average Daily Demand.
Proposed Water System.
All Tanks at Absolute Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-111	610.64	Boyce/Millwood	2.15	687.47	33.24
J-2	610.00	Boyce/Millwood	1.42	688.00	33.75
J-91	606.86	Boyce/Millwood	1.42	687.85	35.04
FH-5	605.84	Boyce/Millwood	4.37	687.88	35.49
J-39	602.18	Boyce/Millwood	0.92	687.97	37.12
J-58	600.56	Boyce/Millwood	3.38	687.86	37.77
J-11	599.91	Boyce/Millwood	2.15	687.89	38.06
FH-32	599.76	Boyce/Millwood	0.92	687.88	38.12
FH-6	599.69	Boyce/Millwood	1.66	687.88	38.16
J-50	598.85	Boyce/Millwood	1.66	687.85	38.51
J-37	598.00	Boyce/Millwood	1.42	687.85	38.87
FH-12	596.84	Boyce/Millwood	3.63	687.94	39.41
J-12	596.72	Boyce/Millwood	1.66	687.90	39.45
J-36	595.30	Boyce/Millwood	3.38	687.85	40.04
J-54	594.28	Boyce/Millwood	1.42	687.84	40.48
J-38	594.22	Boyce/Millwood	2.15	687.94	40.55
J-29	594.00	Boyce/Millwood	3.14	687.85	40.60
J-30	593.67	Boyce/Millwood	1.17	687.85	40.75
J-13	593.62	Boyce/Millwood	1.17	687.88	40.78
J-6	592.70	Boyce/Millwood	1.17	687.88	41.18
J-5	592.37	Boyce/Millwood	1.66	687.87	41.32
J-88	591.09	Boyce/Millwood	2.40	687.81	41.85
FH-10	590.96	Boyce/Millwood	1.91	687.96	41.97
J-48	590.22	Boyce/Millwood	3.14	687.85	42.24
J-110	590.21	Boyce/Millwood	2.64	687.92	42.28
J-34	590.00	Boyce/Millwood	1.17	687.99	42.39
J-119	589.09	Boyce/Millwood	0.00	688.00	42.80
FH-30	589.03	Boyce/Millwood	1.91	688.01	42.82
FH-3	588.55	Boyce/Millwood	1.42	687.84	42.96
J-93	588.18	Boyce/Millwood	1.91	687.66	43.04
J-14	588.00	Boyce/Millwood	1.17	687.86	43.21
J-45	587.66	Boyce/Millwood	1.91	687.84	43.34
FH-35	587.32	Boyce/Millwood	1.91	687.66	43.41
J-70	587.31	Boyce/Millwood	6.58	687.80	43.47
J-3	586.89	Boyce/Millwood	2.40	687.84	43.68
J-7	586.03	Boyce/Millwood	0.68	687.86	44.06
J-18	585.30	Boyce/Millwood	1.91	687.85	44.37
FH-7	584.92	Boyce/Millwood	0.92	687.86	44.54
J-17	584.61	Boyce/Millwood	1.17	687.86	44.67
FH-9	584.24	Boyce/Millwood	4.18	687.86	44.83
FH-8	583.74	Boyce/Millwood	0.92	687.86	45.05
J-81	582.80	Boyce/Millwood	5.10	687.93	45.49
J-118	582.00	Boyce/Millwood	0.00	687.93	45.83
FH-4	581.71	Boyce/Millwood	1.91	687.84	45.92
FH-33	581.47	Boyce/Millwood	2.15	687.77	45.99
J-71	581.24	Boyce/Millwood	2.40	687.96	46.17
J-10	580.50	Boyce/Millwood	3.87	687.82	46.43
FH-11	580.00	Boyce/Millwood	2.15	687.82	46.65
J-75	637.43	White_Post	1.17	745.87	46.92
J-52	636.38	White_Post	0.92	745.87	47.37
J-72	577.84	Boyce/Millwood	2.15	687.96	47.64
J-43	576.17	Boyce/Millwood	2.15	687.81	48.30
J-87	575.25	Boyce/Millwood	4.37	687.93	48.75
J-117	575.00	Boyce/Millwood	0.00	687.93	48.86
J-56	572.76	Boyce/Millwood	1.42	687.73	49.74
FH-2	572.00	Boyce/Millwood	2.64	687.82	50.11
FH-26	630.00	White_Post	3.87	745.87	50.13
J-53	630.00	White_Post	1.66	745.87	50.13
J-19	630.00	White_Post	1.17	745.88	50.13
FH-22	630.00	White_Post	2.15	745.89	50.14
J-83	571.29	Boyce/Millwood	4.86	687.81	50.41
FH-23	629.31	White_Post	1.66	745.88	50.43
J-61	629.12	White_Post	2.40	745.89	50.52
J-57	569.25	Boyce/Millwood	2.15	687.83	51.30
FH-20	626.39	White_Post	2.15	745.77	51.65
FH-21	625.02	White_Post	2.15	745.92	52.31
FH-34	566.63	Boyce/Millwood	1.91	687.70	52.38
J-89	623.98	White_Post	4.12	745.88	52.74
FH-25	623.87	White_Post	1.17	745.87	52.78
FH-24	623.56	White_Post	2.40	745.87	52.92
J-16	565.12	Boyce/Millwood	1.91	687.65	53.01
FH-28	622.96	White_Post	1.91	745.87	53.18
J-22	620.68	White_Post	1.17	745.87	54.16
J-21	620.00	White_Post	1.17	745.87	54.46
FH-27	619.66	White_Post	2.40	745.87	54.61
J-64	561.35	Boyce/Millwood	1.42	687.63	54.63
J-73	619.54	White_Post	2.40	745.87	54.66
FH-39	560.00	Boyce/Millwood	1.17	687.63	55.22
J-109	560.00	Boyce/Millwood	2.15	687.98	55.37
J-15	558.57	Boyce/Millwood	2.64	687.65	55.85
FH-13	558.71	Boyce/Millwood	4.12	687.93	55.91
FH-36	558.14	Boyce/Millwood	3.29	687.64	56.03
J-86	558.00	Boyce/Millwood	1.91	687.63	56.08
J-113	557.64	Boyce/Millwood	0.68	687.74	56.29
J-26	615.16	White_Post	1.17	745.87	56.55
FH-1	556.00	Boyce/Millwood	2.40	687.82	57.03
FH-40	554.08	Boyce/Millwood	3.29	687.63	57.78
J-107	611.32	White_Post	0.68	745.86	58.21
FH-29	611.02	White_Post	1.66	745.87	58.34

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-25	610.52	White_Post	0.92	745.87	58.56
FH-19	609.26	White_Post	1.42	745.70	59.03
J-69	548.01	Boyce/Millwood	1.42	687.72	60.45
J-112	547.12	Boyce/Millwood	0.68	687.88	60.90
J-79	542.18	Boyce/Millwood	1.91	687.65	62.94
J-94	540.00	Boyce/Millwood	0.68	687.83	63.96
J-97	594.87	White_Post	0.92	745.74	65.27
J-103	594.00	White_Post	0.92	745.66	65.62
FH-18	593.08	White_Post	6.95	745.62	66.00
FH-16	592.75	White_Post	6.63	745.61	66.14
FH-38	534.15	Boyce/Millwood	1.17	687.63	66.40
J-32	592.00	White_Post	1.17	745.62	66.46
FH-15	588.89	White_Post	2.89	745.61	67.81
FH-17	588.00	White_Post	4.18	745.61	68.19
J-77	528.14	Boyce/Millwood	1.66	687.71	69.04
J-95	584.95	White_Post	3.14	745.61	69.51
FH-41	522.12	Boyce/Millwood	4.12	687.65	71.62
J-78	522.03	Boyce/Millwood	4.18	687.71	71.68
FH-43	519.63	Boyce/Millwood	3.14	687.68	72.71
J-116	575.00	White_Post	0.00	745.61	73.81
FH-42	515.59	Boyce/Millwood	4.12	687.66	74.45
FH-14	572.83	White_Post	2.40	745.61	74.75
J-42	512.17	Boyce/Millwood	1.91	687.65	75.92
J-51	492.81	Boyce/Millwood	1.42	687.65	84.30

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 5 - Twice Average Daily Demand.
Proposed Water System.
All Tanks at Absolute Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-4.18	687.86	687.86	0.00	0.00
P-2	311.00	6.00	120.00	Open	4.18	745.62	745.61	0.00	0.00
P-3	22.00	8.00	120.00	Open	125.97	688.01	688.00	0.01	0.00
P-4	867.00	2.00	120.00	Open	-1.91	687.66	687.81	0.14	0.00
P-5	327.00	4.00	120.00	Open	1.42	687.84	687.84	0.00	0.00
P-6	198.00	8.00	120.00	Open	1.42	687.85	687.85	0.00	0.00
P-7	150.00	8.00	120.00	Open	1.17	687.85	687.85	0.00	0.00
P-8	324.00	8.00	120.00	Open	-5.00	687.85	687.85	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.69	687.85	687.85	0.00	0.00
P-10	498.00	8.00	120.00	Open	4.10	687.85	687.85	0.00	0.00
P-11	391.00	8.00	120.00	Open	12.24	687.85	687.85	0.00	0.00
P-12	758.00	8.00	120.00	Open	4.37	687.93	687.93	0.00	0.00
P-13	596.00	8.00	120.00	Open	71.09	746.01	745.92	0.09	0.00
P-14	505.00	6.00	120.00	Open	-5.63	687.63	687.64	0.00	0.00
P-15	532.00	6.00	120.00	Open	-4.46	687.63	687.63	0.00	0.00
P-16	290.00	6.00	120.00	Open	-3.29	687.63	687.63	0.00	0.00
P-17	598.00	4.00	120.00	Open	-1.42	687.72	687.73	0.00	0.00
P-18	541.00	4.00	120.00	Open	-2.73	687.84	687.84	0.01	0.00
P-19	696.00	6.00	120.00	Open	-1.91	687.63	687.63	0.00	0.00
P-20	560.00	6.00	120.00	Open	14.65	687.88	687.86	0.02	0.00
P-21	492.00	6.00	120.00	Open	-15.35	687.85	687.87	0.02	0.00
P-22	680.00	2.00	120.00	Open	-0.64	687.82	687.84	0.01	0.00
P-23	746.00	4.00	120.00	Open	-2.40	687.81	687.82	0.01	0.00
P-24	399.00	8.00	120.00	Open	67.59	688.00	687.94	0.06	0.00
P-25	320.00	8.00	120.00	Open	-56.96	687.97	688.00	0.03	0.00
P-26	185.00	12.00	120.00	Open	46.86	688.01	688.01	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	1.17	745.87	745.87	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.92	745.87	745.87	0.00	0.00
P-29	561.00	8.00	120.00	Open	3.75	745.87	745.87	0.00	0.00
P-30	601.00	8.00	120.00	Open	1.17	745.87	745.87	0.00	0.00
P-31	146.00	8.00	120.00	Open	1.17	745.87	745.87	0.00	0.00
P-32	98.00	8.00	120.00	Open	3.51	745.87	745.87	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.92	745.87	745.87	0.00	0.00
P-34	698.00	8.00	120.00	Open	4.76	745.87	745.87	0.00	0.00
P-35	743.00	8.00	120.00	Open	7.16	745.87	745.87	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.09	745.87	745.87	0.00	0.00
P-37	417.00	8.00	120.00	Open	-9.75	745.87	745.88	0.00	0.00
P-38	1087.00	8.00	120.00	Open	6.07	745.87	745.87	0.00	0.00
P-39	758.00	8.00	120.00	Open	7.97	745.88	745.87	0.00	0.00
P-40	1294.00	8.00	120.00	Open	2.40	745.87	745.87	0.00	0.00
P-41	1283.00	8.00	120.00	Open	6.27	745.88	745.87	0.00	0.00
P-42	396.00	8.00	120.00	Open	-18.96	745.89	745.89	0.01	0.00
P-43	803.00	8.00	120.00	Open	-16.81	745.88	745.89	0.01	0.00
P-44	866.00	8.00	120.00	Open	1.56	745.88	745.88	0.00	0.00
P-45	150.00	8.00	120.00	Open	3.22	745.88	745.88	0.00	0.00
P-46	1764.00	8.00	120.00	Open	14.14	745.89	745.88	0.01	0.00
P-47	573.00	8.00	120.00	Open	35.49	745.92	745.89	0.03	0.00
P-48	1343.00	8.00	120.00	Open	-33.45	745.86	745.92	0.05	0.00
P-49	2431.00	8.00	120.00	Open	-32.77	745.77	745.86	0.09	0.00
P-50	978.00	8.00	120.00	Open	-30.62	745.74	745.77	0.03	0.00
P-51	1346.00	8.00	120.00	Open	-29.69	745.70	745.74	0.04	0.00
P-52	1207.00	8.00	120.00	Open	-28.28	745.66	745.70	0.03	0.00
P-53	1377.00	8.00	120.00	Open	-27.35	745.62	745.66	0.04	0.00
P-54	556.00	8.00	120.00	Open	-20.40	745.62	745.62	0.01	0.00
P-55	198.00	8.00	120.00	Open	-15.05	745.61	745.62	0.00	0.00
P-56	996.00	8.00	120.00	Open	-8.43	745.61	745.61	0.00	0.00
P-57	959.00	8.00	120.00	Open	-5.54	745.61	745.61	0.00	0.00
P-58	1275.00	8.00	120.00	Open	-2.40	745.61	745.61	0.00	0.00
P-59A	268.00	8.00	120.00	Open	0.00	745.61	745.61	0.00	0.00
P-59B	25.00	8.00	120.00	Open	0.00	745.61	745.61	0.00	0.00
P-59C	25.00	8.00	120.00	Open	0.00	687.93	687.93	0.00	0.00
P-59D	1211.00	8.00	120.00	Open	0.00	687.93	687.93	0.00	0.00
P-59E	32.00	8.00	120.00	Open	0.00	745.61	745.61	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	687.93	687.93	0.00	0.00
P-60	1927.00	8.00	120.00	Open	0.00	687.93	687.93	0.00	0.00
P-61	623.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-61A	623.00	8.00	121.00	Open	4.12	687.93	687.93	0.00	0.00
P-62	605.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62A	605.00	8.00	121.00	Open	13.59	687.94	687.93	0.00	0.00
P-63	647.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63A	647.00	8.00	121.00	Open	17.22	687.94	687.94	0.01	0.00
P-64	198.00	6.00	120.00	Open	-48.22	687.88	687.94	0.06	0.00
P-65	657.00	4.00	120.00	Open	-2.15	687.96	687.96	0.00	0.00
P-66	660.00	4.00	120.00	Open	2.40	687.96	687.96	0.01	0.00
P-67	206.00	6.00	120.00	Open	6.46	687.97	687.96	0.00	0.00
P-68	211.00	6.00	120.00	Open	-49.58	687.90	687.97	0.07	0.00
P-69	778.00	6.00	120.00	Open	1.42	687.85	687.85	0.00	0.00
P-70	85.00	6.00	120.00	Open	15.56	687.86	687.85	0.00	0.00
P-71	157.00	8.00	120.00	Open	16.73	687.86	687.86	0.00	0.00
P-72	105.00	8.00	120.00	Open	17.65	687.86	687.86	0.00	0.00
P-73	48.00	8.00	120.00	Open	18.58	687.86	687.86	0.00	0.00
P-74	79.00	8.00	120.00	Open	23.44	687.86	687.86	0.00	0.00
P-75	398.00	6.00	120.00	Open	24.60	687.90	687.86	0.04	0.00
P-76	70.00	6.00	120.00	Open	-23.31	687.89	687.90	0.01	0.00
P-77	542.00	6.00	120.00	Open	-13.43	687.84	687.86	0.02	0.00
P-78	270.00	6.00	120.00	Open	-7.38	687.84	687.84	0.00	0.00
P-79	347.00	4.00	120.00	Open	-5.47	687.83	687.84	0.01	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-3.32	687.63	687.83	0.20	0.00
P-81	1620.00	8.00	120.00	Open	14.93	687.81	687.80	0.01	0.00
P-82	3361.00	8.00	120.00	Open	-20.23	687.74	687.80	0.05	0.00
P-83	2159.00	8.00	120.00	Open	-19.55	687.71	687.74	0.03	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-15.37	687.71	687.71	0.01	0.00
P-85	615.00	6.00	120.00	Open	-10.39	687.81	687.82	0.01	0.00
P-86	441.00	6.00	120.00	Open	-11.16	687.88	687.89	0.01	0.00
P-87	129.00	6.00	120.00	Open	-9.50	687.88	687.88	0.00	0.00
P-88	71.00	6.00	120.00	Open	6.32	687.88	687.88	0.00	0.00
P-89	41.00	6.00	120.00	Open	-40.73	687.87	687.88	0.01	0.00
P-90	583.00	6.00	120.00	Open	-23.72	687.82	687.87	0.05	0.00
P-91	63.00	6.00	120.00	Open	-20.49	687.82	687.82	0.00	0.00
P-92	258.00	6.00	120.00	Open	-15.94	687.81	687.82	0.01	0.00
P-93	516.00	6.00	120.00	Open	-11.88	687.80	687.81	0.01	0.00
P-94	860.00	6.00	120.00	Open	-10.00	687.88	687.89	0.01	0.00
P-95	375.00	4.00	120.00	Open	-5.63	687.86	687.88	0.02	0.00
P-96	467.00	4.00	120.00	Open	-3.47	687.85	687.86	0.01	0.00
P-97	300.00	6.00	120.00	Open	-17.15	687.84	687.85	0.01	0.00
P-98	33.00	6.00	120.00	Open	-18.47	687.84	687.84	0.00	0.00
P-99	422.00	6.00	120.00	Open	-15.43	687.82	687.84	0.02	0.00
P-100	1029.00	4.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-100A	1029.00	6.00	121.00	Open	2.40	687.82	687.82	0.00	0.00
P-101	1478.00	6.00	120.00	Open	8.91	687.66	687.64	0.02	0.00
P-102	608.00	6.00	120.00	Open	-23.00	687.73	687.77	0.05	0.00
P-103	334.00	6.00	120.00	Open	-20.17	687.70	687.73	0.02	0.00
P-104	913.00	6.00	120.00	Open	-18.26	687.66	687.70	0.05	0.00
P-105	415.00	6.00	120.00	Open	-7.44	687.65	687.66	0.00	0.00
P-106	82.00	6.00	120.00	Open	-4.03	687.65	687.65	0.00	0.00
P-107	482.00	6.00	120.00	Open	0.52	687.65	687.65	0.00	0.00
P-108	1167.00	6.00	120.00	Open	6.46	687.66	687.65	0.01	0.00
P-109	1019.00	6.00	120.00	Open	10.58	687.68	687.66	0.02	0.00
P-110	832.00	6.00	120.00	Open	13.71	687.71	687.68	0.03	0.00
P-111	2178.00	2.00	120.00	Open	2.15	687.92	687.47	0.45	0.00
P-112	2060.00	6.00	120.00	Open	10.76	687.92	687.88	0.04	0.00
P-113	1535.00	4.00	120.00	Open	2.15	687.99	687.98	0.01	0.00
P-114	1091.00	6.00	120.00	Open	25.15	687.88	687.77	0.10	0.00
P-115	1112.00	6.00	120.00	Open	26.08	687.99	687.88	0.11	0.00
P-116	161.00	6.00	120.00	Open	29.40	688.01	687.99	0.02	0.00
P-117A	2061.00	6.00	120.00	Open	-15.56	687.92	688.00	0.08	0.00
P-117B	100.00	6.00	120.00	Open	-15.56	688.00	688.01	0.00	0.00
P-118	1082.00	6.00	120.00	Open	9.40	687.83	687.81	0.02	0.00
P-119	3401.00	6.00	120.00	Open	10.08	687.88	687.83	0.06	0.00
P-120	211.00	6.00	120.00	Open	1.82	687.65	687.65	0.00	0.00
P-121	335.00	6.00	120.00	Open	1.42	687.65	687.65	0.00	0.00
P-122	740.00	6.00	120.00	Open	1.50	687.65	687.65	0.00	0.00
P-123	605.00	6.00	120.00	Open	1.91	687.65	687.65	0.00	0.00
P-124	1.00	2.00	120.00	Open	0.00	540.00	540.00	0.00	0.00
P-125	80.00	2.00	120.00	Open	0.00	687.88	687.88	0.00	0.00

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 5 - Twice Average Daily Demand.
Proposed Water System.
All Tanks at Absolute Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	688.01	713.00	28.00	-125.97	688.01
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	688.01	712.00	28.00	-46.86	688.01
White_Post_Tank	625.00	746.00	746.01	765.00	22.00	-71.09	746.01
R-WTP	--	--	--	--	--	0.00	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	Off	540.00	687.88	0.00	0.00
PMP-White_Post	575.00	Off	687.93	745.61	0.00	0.00

Valve Report

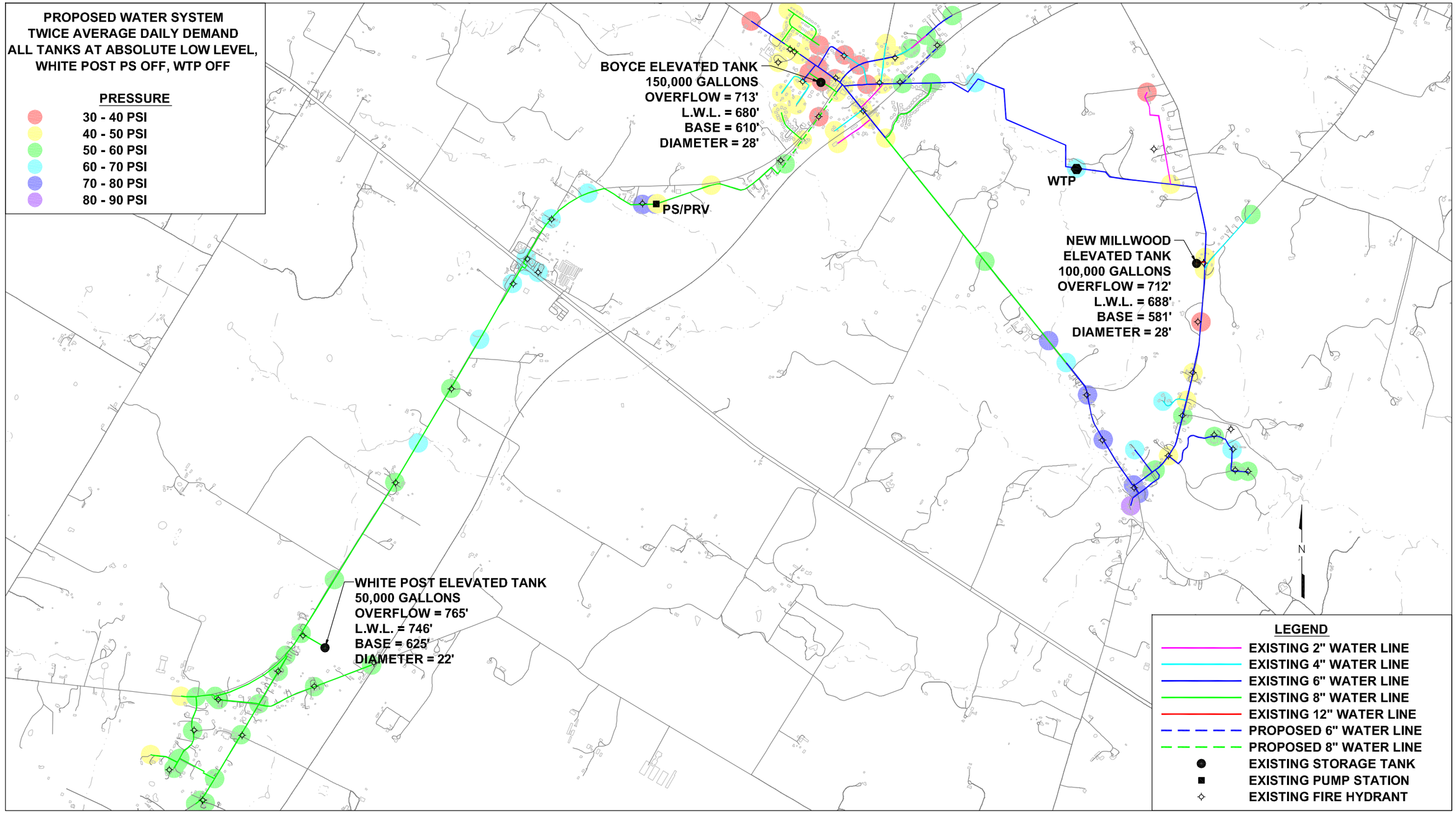
Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	745.61	687.93	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY SANITARY AUTHORITY

PROPOSED WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT ABSOLUTE LOW LEVEL,
WHITE POST PS OFF, WTP OFF

PRESSURE

- 30 - 40 PSI
- 40 - 50 PSI
- 50 - 60 PSI
- 60 - 70 PSI
- 70 - 80 PSI
- 80 - 90 PSI



LEGEND

- EXISTING 2" WATER LINE
- EXISTING 4" WATER LINE
- EXISTING 6" WATER LINE
- EXISTING 8" WATER LINE
- EXISTING 12" WATER LINE
- PROPOSED 6" WATER LINE
- PROPOSED 8" WATER LINE
- EXISTING STORAGE TANK
- EXISTING PUMP STATION
- EXISTING FIRE HYDRANT

1000 500 0 1000 2000 3000
SCALE IN FEET

ANDERSON AND ASSOCIATES, Inc.

RUN #5 - PRESSURE EXHIBIT
JUNE 22, 2015

Run #6 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow:

Proposed Water System Improvements – Constructed

Boyce Tank – Normal Low

Millwood Tank – Normal Low

White Post Tank – Normal Low

Water Treatment Plant – Off

White Post Pump Station – Off.

Purpose – To identify critical hydrants in the proposed system and report their available fire flows while maintaining 20 psi for all users in the system.

Result – All hydrants in the proposed water system exceed 500 gpm available fire flow. See the fire flow report for details.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 6 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-111	610.64	Boyce/Millwood	2.15	706.47	41.46
J-2	610.00	Boyce/Millwood	1.42	707.00	41.97
J-91	606.86	Boyce/Millwood	1.42	706.85	43.26
FH-5	605.84	Boyce/Millwood	4.37	706.88	43.71
J-39	602.18	Boyce/Millwood	0.92	706.97	45.34
J-58	600.56	Boyce/Millwood	3.38	706.86	45.99
J-11	599.91	Boyce/Millwood	2.15	706.89	46.28
FH-32	599.76	Boyce/Millwood	0.92	706.88	46.34
FH-6	599.69	Boyce/Millwood	1.66	706.88	46.38
J-50	598.85	Boyce/Millwood	1.66	706.85	46.73
J-37	598.00	Boyce/Millwood	1.42	706.85	47.09
FH-12	596.84	Boyce/Millwood	3.63	706.94	47.63
J-12	596.72	Boyce/Millwood	1.66	706.90	47.67
J-36	595.30	Boyce/Millwood	3.38	706.85	48.26
J-54	594.28	Boyce/Millwood	1.42	706.84	48.70
J-38	594.22	Boyce/Millwood	2.15	706.94	48.77
J-29	594.00	Boyce/Millwood	3.14	706.85	48.82
J-30	593.67	Boyce/Millwood	1.17	706.85	48.97
J-13	593.62	Boyce/Millwood	1.17	706.88	49.00
J-6	592.70	Boyce/Millwood	1.17	706.88	49.40
J-5	592.37	Boyce/Millwood	1.66	706.87	49.54
J-88	591.09	Boyce/Millwood	2.40	706.81	50.07
FH-10	590.96	Boyce/Millwood	1.91	706.96	50.19
J-48	590.22	Boyce/Millwood	3.14	706.85	50.46
J-110	590.21	Boyce/Millwood	2.64	706.92	50.50
J-34	590.00	Boyce/Millwood	1.17	706.99	50.62
J-119	589.09	Boyce/Millwood	0.00	707.00	51.02
FH-30	589.03	Boyce/Millwood	1.91	707.01	51.04
FH-3	588.55	Boyce/Millwood	1.42	706.84	51.18
J-93	588.18	Boyce/Millwood	1.91	706.66	51.26
J-14	588.00	Boyce/Millwood	1.17	706.86	51.43
J-45	587.66	Boyce/Millwood	1.91	706.84	51.56
FH-35	587.32	Boyce/Millwood	1.91	706.66	51.63
J-70	587.31	Boyce/Millwood	6.58	706.80	51.69
J-3	586.89	Boyce/Millwood	2.40	706.84	51.90
J-7	586.03	Boyce/Millwood	0.68	706.86	52.28
J-18	585.30	Boyce/Millwood	1.91	706.85	52.59
FH-7	584.92	Boyce/Millwood	0.92	706.86	52.76
J-17	584.61	Boyce/Millwood	1.17	706.86	52.89
FH-9	584.24	Boyce/Millwood	4.18	706.86	53.05
FH-8	583.74	Boyce/Millwood	0.92	706.86	53.27
J-75	637.43	White_Post	1.17	760.87	53.41
J-81	582.80	Boyce/Millwood	5.10	706.93	53.71
J-52	636.38	White_Post	0.92	760.87	53.86
J-118	582.00	Boyce/Millwood	0.00	706.93	54.05
FH-4	581.71	Boyce/Millwood	1.91	706.84	54.14
FH-33	581.47	Boyce/Millwood	2.15	706.77	54.21
J-71	581.24	Boyce/Millwood	2.40	706.96	54.39
J-10	580.50	Boyce/Millwood	3.87	706.82	54.65
FH-11	580.00	Boyce/Millwood	2.15	706.82	54.87
J-72	577.84	Boyce/Millwood	2.15	706.96	55.86
J-43	576.17	Boyce/Millwood	2.15	706.81	56.52
FH-26	630.00	White_Post	3.87	760.87	56.62
J-53	630.00	White_Post	1.66	760.87	56.62
J-19	630.00	White_Post	1.17	760.88	56.62
FH-22	630.00	White_Post	2.15	760.89	56.63
FH-23	629.31	White_Post	1.66	760.88	56.92
J-87	575.25	Boyce/Millwood	4.37	706.93	56.97
J-61	629.12	White_Post	2.40	760.89	57.01
J-117	575.00	Boyce/Millwood	0.00	706.93	57.08
J-56	572.76	Boyce/Millwood	1.42	706.73	57.96
FH-20	626.39	White_Post	2.15	760.77	58.14
FH-2	572.00	Boyce/Millwood	2.64	706.82	58.33
J-83	571.29	Boyce/Millwood	4.86	706.81	58.63
FH-21	625.02	White_Post	2.15	760.92	58.80
J-89	623.98	White_Post	4.12	760.88	59.23
FH-25	623.87	White_Post	1.17	760.87	59.27
FH-24	623.56	White_Post	2.40	760.87	59.41
J-57	569.25	Boyce/Millwood	2.15	706.83	59.52
FH-28	622.96	White_Post	1.91	760.87	59.67
FH-34	566.63	Boyce/Millwood	1.91	706.70	60.60
J-22	620.68	White_Post	1.17	760.87	60.65
J-21	620.00	White_Post	1.17	760.87	60.95
FH-27	619.66	White_Post	2.40	760.87	61.10
J-73	619.54	White_Post	2.40	760.87	61.15
J-16	565.12	Boyce/Millwood	1.91	706.65	61.23
J-64	561.35	Boyce/Millwood	1.42	706.63	62.86
J-26	615.16	White_Post	1.17	760.87	63.04
FH-39	560.00	Boyce/Millwood	1.17	706.63	63.44
J-109	560.00	Boyce/Millwood	2.15	706.98	63.59
J-15	558.57	Boyce/Millwood	2.64	706.65	64.07
FH-13	558.71	Boyce/Millwood	4.12	706.93	64.13
FH-36	558.14	Boyce/Millwood	3.29	706.64	64.25
J-86	558.00	Boyce/Millwood	1.91	706.63	64.30
J-113	557.64	Boyce/Millwood	0.68	706.74	64.51
J-107	611.32	White_Post	0.68	760.86	64.70
FH-29	611.02	White_Post	1.66	760.87	64.83
J-25	610.52	White_Post	0.92	760.87	65.05
FH-1	556.00	Boyce/Millwood	2.40	706.82	65.25

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-19	609.26	White_Post	1.42	760.70	65.52
FH-40	554.08	Boyce/Millwood	3.29	706.63	66.00
J-69	548.01	Boyce/Millwood	1.42	706.72	68.67
J-112	547.12	Boyce/Millwood	0.68	706.88	69.12
J-79	542.18	Boyce/Millwood	1.91	706.65	71.16
J-97	594.87	White_Post	0.92	760.74	71.76
J-103	594.00	White_Post	0.92	760.66	72.11
J-94	540.00	Boyce/Millwood	0.68	706.83	72.18
FH-18	593.08	White_Post	6.95	760.62	72.49
FH-16	592.75	White_Post	6.63	760.61	72.63
J-32	592.00	White_Post	1.17	760.62	72.95
FH-15	588.89	White_Post	2.89	760.61	74.30
FH-38	534.15	Boyce/Millwood	1.17	706.63	74.62
FH-17	588.00	White_Post	4.18	760.61	74.68
J-95	584.95	White_Post	3.14	760.61	76.00
J-77	528.14	Boyce/Millwood	1.66	706.71	77.26
FH-41	522.12	Boyce/Millwood	4.12	706.65	79.84
J-78	522.03	Boyce/Millwood	4.18	706.71	79.90
J-116	575.00	White_Post	0.00	760.61	80.30
FH-43	519.63	Boyce/Millwood	3.14	706.68	80.93
FH-14	572.83	White_Post	2.40	760.61	81.24
FH-42	515.59	Boyce/Millwood	4.12	706.66	82.67
J-42	512.17	Boyce/Millwood	1.91	706.65	84.14
J-51	492.81	Boyce/Millwood	1.42	706.65	92.52

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 6 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-4.18	706.86	706.86	0.00	0.00
P-2	311.00	6.00	120.00	Open	4.18	760.62	760.61	0.00	0.00
P-3	22.00	8.00	120.00	Open	125.97	707.01	707.00	0.01	0.00
P-4	867.00	2.00	120.00	Open	-1.91	706.66	706.81	0.14	0.00
P-5	327.00	4.00	120.00	Open	1.42	706.84	706.84	0.00	0.00
P-6	198.00	8.00	120.00	Open	1.42	706.85	706.85	0.00	0.00
P-7	150.00	8.00	120.00	Open	1.17	706.85	706.85	0.00	0.00
P-8	324.00	8.00	120.00	Open	-5.00	706.85	706.85	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.69	706.85	706.85	0.00	0.00
P-10	498.00	8.00	120.00	Open	4.10	706.85	706.85	0.00	0.00
P-11	391.00	8.00	120.00	Open	12.24	706.85	706.85	0.00	0.00
P-12	758.00	8.00	120.00	Open	4.37	706.93	706.93	0.00	0.00
P-13	596.00	8.00	120.00	Open	71.09	761.01	760.92	0.09	0.00
P-14	505.00	6.00	120.00	Open	-5.63	706.63	706.64	0.00	0.00
P-15	532.00	6.00	120.00	Open	-4.46	706.63	706.63	0.00	0.00
P-16	290.00	6.00	120.00	Open	-3.29	706.63	706.63	0.00	0.00
P-17	598.00	4.00	120.00	Open	-1.42	706.72	706.73	0.00	0.00
P-18	541.00	4.00	120.00	Open	-2.73	706.84	706.84	0.01	0.00
P-19	696.00	6.00	120.00	Open	-1.91	706.63	706.63	0.00	0.00
P-20	560.00	6.00	120.00	Open	14.65	706.88	706.86	0.02	0.00
P-21	492.00	6.00	120.00	Open	-15.35	706.85	706.87	0.02	0.00
P-22	680.00	2.00	120.00	Open	-0.64	706.82	706.84	0.01	0.00
P-23	746.00	4.00	120.00	Open	-2.40	706.81	706.82	0.01	0.00
P-24	399.00	8.00	120.00	Open	67.59	707.00	706.94	0.06	0.00
P-25	320.00	8.00	120.00	Open	-56.96	706.97	707.00	0.03	0.00
P-26	185.00	12.00	120.00	Open	46.86	707.01	707.01	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	1.17	760.87	760.87	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.92	760.87	760.87	0.00	0.00
P-29	561.00	8.00	120.00	Open	3.75	760.87	760.87	0.00	0.00
P-30	601.00	8.00	120.00	Open	1.17	760.87	760.87	0.00	0.00
P-31	146.00	8.00	120.00	Open	1.17	760.87	760.87	0.00	0.00
P-32	98.00	8.00	120.00	Open	3.51	760.87	760.87	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.92	760.87	760.87	0.00	0.00
P-34	698.00	8.00	120.00	Open	4.76	760.87	760.87	0.00	0.00
P-35	743.00	8.00	120.00	Open	7.16	760.87	760.87	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.09	760.87	760.87	0.00	0.00
P-37	417.00	8.00	120.00	Open	-9.75	760.87	760.88	0.00	0.00
P-38	1087.00	8.00	120.00	Open	6.07	760.87	760.87	0.00	0.00
P-39	758.00	8.00	120.00	Open	7.97	760.88	760.87	0.00	0.00
P-40	1294.00	8.00	120.00	Open	2.40	760.87	760.87	0.00	0.00
P-41	1283.00	8.00	120.00	Open	6.27	760.88	760.87	0.00	0.00
P-42	396.00	8.00	120.00	Open	-18.96	760.89	760.89	0.01	0.00
P-43	803.00	8.00	120.00	Open	-16.81	760.88	760.89	0.01	0.00
P-44	866.00	8.00	120.00	Open	1.56	760.88	760.88	0.00	0.00
P-45	150.00	8.00	120.00	Open	3.22	760.88	760.88	0.00	0.00
P-46	1764.00	8.00	120.00	Open	14.14	760.89	760.88	0.01	0.00
P-47	573.00	8.00	120.00	Open	35.49	760.92	760.89	0.03	0.00
P-48	1343.00	8.00	120.00	Open	-33.45	760.86	760.92	0.05	0.00
P-49	2431.00	8.00	120.00	Open	-32.77	760.77	760.86	0.09	0.00
P-50	978.00	8.00	120.00	Open	-30.61	760.74	760.77	0.03	0.00
P-51	1346.00	8.00	120.00	Open	-29.69	760.70	760.74	0.04	0.00
P-52	1207.00	8.00	120.00	Open	-28.28	760.66	760.70	0.03	0.00
P-53	1377.00	8.00	120.00	Open	-27.35	760.62	760.66	0.04	0.00
P-54	556.00	8.00	120.00	Open	-20.40	760.62	760.62	0.01	0.00
P-55	198.00	8.00	120.00	Open	-15.05	760.61	760.62	0.00	0.00
P-56	996.00	8.00	120.00	Open	-8.42	760.61	760.61	0.00	0.00
P-57	959.00	8.00	120.00	Open	-5.53	760.61	760.61	0.00	0.00
P-58	1275.00	8.00	120.00	Open	-2.40	760.61	760.61	0.00	0.00
P-59A	268.00	8.00	120.00	Open	0.00	760.61	760.61	0.00	0.00
P-59B	25.00	8.00	120.00	Open	0.00	760.61	760.61	0.00	0.00
P-59C	25.00	8.00	120.00	Open	0.00	706.93	706.93	0.00	0.00
P-59D	1211.00	8.00	120.00	Open	0.00	706.93	706.93	0.00	0.00
P-59E	32.00	8.00	120.00	Open	0.00	760.61	760.61	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	706.93	706.93	0.00	0.00
P-60	1927.00	8.00	120.00	Open	0.00	706.93	706.93	0.00	0.00
P-61	623.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-61A	623.00	8.00	121.00	Open	4.12	706.93	706.93	0.00	0.00
P-62	605.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62A	605.00	8.00	121.00	Open	13.59	706.94	706.93	0.00	0.00
P-63	647.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63A	647.00	8.00	121.00	Open	17.22	706.94	706.94	0.01	0.00
P-64	198.00	6.00	120.00	Open	-48.22	706.88	706.94	0.06	0.00
P-65	657.00	4.00	120.00	Open	-2.15	706.96	706.96	0.00	0.00
P-66	660.00	4.00	120.00	Open	2.40	706.96	706.96	0.01	0.00
P-67	206.00	6.00	120.00	Open	6.46	706.97	706.96	0.00	0.00
P-68	211.00	6.00	120.00	Open	-49.58	706.90	706.97	0.07	0.00
P-69	778.00	6.00	120.00	Open	1.42	706.85	706.85	0.00	0.00
P-70	85.00	6.00	120.00	Open	15.56	706.86	706.85	0.00	0.00
P-71	157.00	8.00	120.00	Open	16.73	706.86	706.86	0.00	0.00
P-72	105.00	8.00	120.00	Open	17.65	706.86	706.86	0.00	0.00
P-73	48.00	8.00	120.00	Open	18.58	706.86	706.86	0.00	0.00
P-74	79.00	8.00	120.00	Open	23.44	706.86	706.86	0.00	0.00
P-75	398.00	6.00	120.00	Open	24.60	706.90	706.86	0.04	0.00
P-76	70.00	6.00	120.00	Open	-23.31	706.89	706.90	0.01	0.00
P-77	542.00	6.00	120.00	Open	-13.43	706.84	706.86	0.02	0.00
P-78	270.00	6.00	120.00	Open	-7.38	706.84	706.84	0.00	0.00
P-79	347.00	4.00	120.00	Open	-5.47	706.83	706.84	0.01	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-3.32	706.63	706.83	0.20	0.00
P-81	1620.00	8.00	120.00	Open	14.93	706.81	706.80	0.01	0.00
P-82	3361.00	8.00	120.00	Open	-20.23	706.74	706.80	0.05	0.00
P-83	2159.00	8.00	120.00	Open	-19.55	706.71	706.74	0.03	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-15.37	706.71	706.71	0.01	0.00
P-85	615.00	6.00	120.00	Open	-10.39	706.81	706.82	0.01	0.00
P-86	441.00	6.00	120.00	Open	-11.16	706.88	706.89	0.01	0.00
P-87	129.00	6.00	120.00	Open	-9.50	706.88	706.88	0.00	0.00
P-88	71.00	6.00	120.00	Open	6.32	706.88	706.88	0.00	0.00
P-89	41.00	6.00	120.00	Open	-40.73	706.87	706.88	0.01	0.00
P-90	583.00	6.00	120.00	Open	-23.72	706.82	706.87	0.05	0.00
P-91	63.00	6.00	120.00	Open	-20.49	706.82	706.82	0.00	0.00
P-92	258.00	6.00	120.00	Open	-15.94	706.81	706.82	0.01	0.00
P-93	516.00	6.00	120.00	Open	-11.88	706.80	706.81	0.01	0.00
P-94	860.00	6.00	120.00	Open	-10.00	706.88	706.89	0.01	0.00
P-95	375.00	4.00	120.00	Open	-5.63	706.86	706.88	0.02	0.00
P-96	467.00	4.00	120.00	Open	-3.47	706.85	706.86	0.01	0.00
P-97	300.00	6.00	120.00	Open	-17.15	706.84	706.85	0.01	0.00
P-98	33.00	6.00	120.00	Open	-18.47	706.84	706.84	0.00	0.00
P-99	422.00	6.00	120.00	Open	-15.43	706.82	706.84	0.02	0.00
P-100	1029.00	4.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-100A	1029.00	6.00	121.00	Open	2.40	706.82	706.82	0.00	0.00
P-101	1478.00	6.00	120.00	Open	8.91	706.66	706.64	0.02	0.00
P-102	608.00	6.00	120.00	Open	-23.00	706.73	706.77	0.05	0.00
P-103	334.00	6.00	120.00	Open	-20.17	706.70	706.73	0.02	0.00
P-104	913.00	6.00	120.00	Open	-18.26	706.66	706.70	0.05	0.00
P-105	415.00	6.00	120.00	Open	-7.44	706.65	706.66	0.00	0.00
P-106	82.00	6.00	120.00	Open	-4.03	706.65	706.65	0.00	0.00
P-107	482.00	6.00	120.00	Open	0.52	706.65	706.65	0.00	0.00
P-108	1167.00	6.00	120.00	Open	6.46	706.66	706.65	0.01	0.00
P-109	1019.00	6.00	120.00	Open	10.58	706.68	706.66	0.02	0.00
P-110	832.00	6.00	120.00	Open	13.71	706.71	706.68	0.03	0.00
P-111	2178.00	2.00	120.00	Open	2.15	706.92	706.47	0.45	0.00
P-112	2060.00	6.00	120.00	Open	10.76	706.92	706.88	0.04	0.00
P-113	1535.00	4.00	120.00	Open	2.15	706.99	706.98	0.01	0.00
P-114	1091.00	6.00	120.00	Open	25.15	706.88	706.77	0.10	0.00
P-115	1112.00	6.00	120.00	Open	26.08	706.99	706.88	0.11	0.00
P-116	161.00	6.00	120.00	Open	29.40	707.01	706.99	0.02	0.00
P-117A	2061.00	6.00	120.00	Open	-15.56	706.92	707.00	0.08	0.00
P-117B	100.00	6.00	120.00	Open	-15.56	707.00	707.01	0.00	0.00
P-118	1082.00	6.00	120.00	Open	9.40	706.83	706.81	0.02	0.00
P-119	3401.00	6.00	120.00	Open	10.08	706.88	706.83	0.06	0.00
P-120	211.00	6.00	120.00	Open	1.82	706.65	706.65	0.00	0.00
P-121	335.00	6.00	120.00	Open	1.42	706.65	706.65	0.00	0.00
P-122	740.00	6.00	120.00	Open	1.50	706.65	706.65	0.00	0.00
P-123	605.00	6.00	120.00	Open	1.91	706.65	706.65	0.00	0.00
P-124	1.00	2.00	120.00	Open	0.00	540.00	540.00	0.00	0.00
P-125	80.00	2.00	120.00	Open	0.00	706.88	706.88	0.00	0.00

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 6 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.01	713.00	28.00	-125.97	707.01
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.01	712.00	28.00	-46.86	707.01
White_Post_Tank	625.00	746.00	761.01	765.00	22.00	-71.09	761.01
R-WTP	--	--	--	--	--	0.00	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	Off	540.00	706.88	0.00	0.00
PMP-White_Post	575.00	Off	706.93	760.61	0.00	0.00

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	760.61	706.93	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 6 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump Off.
Steady State Analysis
Fire Flow Report - sorted by Available Fire Flow

Node Label	Pressure Zone	Fire Flow Constraints Satisfied	Desired Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Desired (gpm)	Total Flow Available (gpm)	Desired Residual Pressure (psi)	Calculated Residual Pressure (psi)	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node
J-111	Boyce/Millwood	FALSE	500.00	25.03	502.15	27.18	20.00	20.04	20.00	41.97	J-2	20.00	41.97	J-2
J-93	Boyce/Millwood	FALSE	500.00	52.68	501.91	54.59	20.00	20.00	20.00	41.43	J-111	20.00	41.43	J-111
J-86	Boyce/Millwood	FALSE	500.00	89.39	501.91	91.30	20.00	21.20	20.00	20.06	J-64	20.00	20.06	J-64
J-64	Boyce/Millwood	FALSE	500.00	89.43	501.42	90.85	20.00	20.02	20.00	21.47	J-86	20.00	21.47	J-86
J-109	Boyce/Millwood	FALSE	500.00	292.95	502.15	295.10	20.00	20.00	20.00	41.42	J-111	20.00	41.42	J-111
J-88	Boyce/Millwood	FALSE	500.00	343.34	502.40	345.74	20.00	20.00	20.00	41.14	J-111	20.00	41.14	J-111
J-71	Boyce/Millwood	FALSE	500.00	397.96	502.40	400.36	20.00	20.00	20.00	41.39	J-111	20.00	41.39	J-111
J-72	Boyce/Millwood	FALSE	500.00	408.32	502.15	410.47	20.00	20.00	20.00	41.39	J-111	20.00	41.39	J-111
J-69	Boyce/Millwood	FALSE	500.00	452.14	501.42	453.56	20.00	20.00	20.00	41.21	J-111	20.00	41.21	J-111
J-54	Boyce/Millwood	FALSE	500.00	488.02	501.42	489.44	20.00	20.00	20.00	41.11	J-111	20.00	41.11	J-111
FH-40	Boyce/Millwood	TRUE	500.00	504.21	503.29	507.50	20.00	20.00	20.00	20.51	FH-39	20.00	20.51	FH-39
FH-39	Boyce/Millwood	TRUE	500.00	507.56	501.17	508.73	20.00	20.00	20.00	22.56	FH-40	20.00	22.56	FH-40
J-57	Boyce/Millwood	TRUE	500.00	536.70	502.15	538.85	20.00	20.00	20.00	23.33	J-64	20.00	23.33	J-64
FH-38	Boyce/Millwood	TRUE	500.00	549.31	501.17	550.48	20.00	31.18	20.00	20.00	FH-39	20.00	20.00	FH-39
FH-36	Boyce/Millwood	TRUE	500.00	599.77	503.29	603.06	20.00	20.81	20.00	20.00	FH-39	20.00	20.00	FH-39
J-91	Boyce/Millwood	TRUE	500.00	615.34	501.42	616.75	20.00	20.00	20.00	35.66	J-37	20.00	35.66	J-37
J-116	White_Post	TRUE	500.00	653.31	500.00	653.31	20.00	20.00	20.00	22.06	FH-14	20.00	22.06	FH-14
FH-14	White_Post	TRUE	500.00	660.21	502.40	662.61	20.00	20.94	20.00	20.00	J-116	20.00	20.00	J-116
J-95	White_Post	TRUE	500.00	667.91	503.14	671.05	20.00	20.00	20.00	22.53	FH-15	20.00	22.53	FH-15
FH-15	White_Post	TRUE	500.00	685.99	502.89	688.88	20.00	20.01	20.00	21.71	J-95	20.00	21.71	J-95
FH-17	White_Post	TRUE	500.00	687.03	504.18	691.21	20.00	20.01	20.00	23.79	FH-16	20.00	23.79	FH-16
FH-16	White_Post	TRUE	500.00	708.86	506.63	715.49	20.00	20.01	20.00	21.33	J-32	20.00	21.33	J-32
J-32	White_Post	TRUE	500.00	716.58	501.17	717.75	20.00	20.32	20.00	20.00	FH-16	20.00	20.00	FH-16
FH-18	White_Post	TRUE	500.00	738.65	506.95	745.61	20.00	20.00	20.00	20.14	FH-16	20.00	20.14	FH-16
J-110	Boyce/Millwood	TRUE	500.00	740.39	502.64	743.04	20.00	29.04	20.00	20.00	J-111	20.00	20.00	J-111
FH-35	Boyce/Millwood	TRUE	500.00	746.42	501.91	748.33	20.00	20.00	20.00	31.71	J-16	20.00	31.71	J-16
J-16	Boyce/Millwood	TRUE	500.00	778.45	501.91	780.36	20.00	26.70	20.00	20.00	FH-35	20.00	20.00	FH-35
J-15	Boyce/Millwood	TRUE	500.00	782.12	502.64	784.77	20.00	28.63	20.00	20.00	FH-35	20.00	20.00	FH-35
J-79	Boyce/Millwood	TRUE	500.00	782.13	501.91	784.04	20.00	21.37	20.00	20.00	FH-35	20.00	20.00	FH-35
J-51	Boyce/Millwood	TRUE	500.00	788.74	501.42	790.15	20.00	47.28	20.00	20.00	FH-35	20.00	20.00	FH-35
J-42	Boyce/Millwood	TRUE	500.00	788.78	501.91	790.69	20.00	46.96	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-41	Boyce/Millwood	TRUE	500.00	794.74	504.12	798.86	20.00	43.95	20.00	20.00	FH-35	20.00	20.00	FH-35
J-103	White_Post	TRUE	500.00	804.12	500.92	805.04	20.00	20.00	20.00	20.38	FH-18	20.00	20.38	FH-18
FH-19	White_Post	TRUE	500.00	817.03	501.42	818.45	20.00	20.00	20.00	26.59	J-103	20.00	26.59	J-103
FH-34	Boyce/Millwood	TRUE	500.00	838.76	501.91	840.67	20.00	24.59	20.00	20.00	FH-35	20.00	20.00	FH-35
J-37	Boyce/Millwood	TRUE	500.00	873.48	501.42	874.90	20.00	20.00	20.00	21.89	J-91	20.00	21.89	J-91
J-56	Boyce/Millwood	TRUE	500.00	881.41	501.42	882.83	20.00	20.36	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-33	Boyce/Millwood	TRUE	500.00	892.10	502.15	894.25	20.00	20.00	20.00	24.77	FH-35	20.00	24.77	FH-35
J-36	Boyce/Millwood	TRUE	500.00	899.90	503.38	903.28	20.00	21.17	20.00	20.00	J-37	20.00	20.00	J-37
FH-9	Boyce/Millwood	TRUE	500.00	907.15	504.18	911.33	20.00	20.00	20.00	25.57	J-91	20.00	25.57	J-91
FH-42	Boyce/Millwood	TRUE	500.00	908.21	504.12	912.33	20.00	39.12	20.00	20.00	FH-35	20.00	20.00	FH-35
J-18	Boyce/Millwood	TRUE	500.00	915.70	501.91	917.61	20.00	29.33	20.00	20.00	J-91	20.00	20.00	J-91
J-48	Boyce/Millwood	TRUE	500.00	915.71	503.14	918.84	20.00	24.08	20.00	20.00	J-91	20.00	20.00	J-91
J-29	Boyce/Millwood	TRUE	500.00	915.71	503.14	918.85	20.00	21.19	20.00	20.00	J-91	20.00	20.00	J-91
J-30	Boyce/Millwood	TRUE	500.00	915.71	501.17	916.88	20.00	20.16	20.00	20.00	J-91	20.00	20.00	J-91
J-97	White_Post	TRUE	500.00	925.24	500.92	926.16	20.00	26.25	20.00	20.00	FH-19	20.00	20.00	FH-19
J-112	Boyce/Millwood	TRUE	500.00	926.90	500.68	927.58	20.00	27.64	20.00	20.00	J-111	20.00	20.00	J-111
FH-1	Boyce/Millwood	TRUE	500.00	929.68	502.40	932.08	20.00	20.00	20.00	39.43	J-111	20.00	39.43	J-111
FH-20	White_Post	TRUE	500.00	937.07	502.15	939.23	20.00	20.00	20.00	27.38	FH-19	20.00	27.38	FH-19
FH-32	Boyce/Millwood	TRUE	500.00	959.00	500.92	959.92	20.00	20.00	20.00	30.66	FH-33	20.00	30.66	FH-33
J-17	Boyce/Millwood	TRUE	500.00	982.67	501.17	983.84	20.00	29.62	20.00	20.00	J-91	20.00	20.00	J-91
FH-27	White_Post	TRUE	500.00	1016.97	502.40	1019.37	20.00	20.00	20.00	27.81	FH-26	20.00	27.81	FH-26
FH-8	Boyce/Millwood	TRUE	500.00	1018.13	500.92	1019.06	20.00	30.00	20.00	20.00	J-91	20.00	20.00	J-91
FH-7	Boyce/Millwood	TRUE	500.00	1044.01	500.92	1044.93	20.00	29.49	20.00	20.00	J-91	20.00	20.00	J-91
FH-43	Boyce/Millwood	TRUE	500.00	1051.18	503.14	1054.32	20.00	30.82	20.00	20.00	FH-35	20.00	20.00	FH-35
J-7	Boyce/Millwood	TRUE	500.00	1056.49	500.68	1057.17	20.00	29.02	20.00	20.00	J-91	20.00	20.00	J-91
J-14	Boyce/Millwood	TRUE	500.00	1078.15	501.17	1079.32	20.00	28.16	20.00	20.00	J-91	20.00	20.00	J-91
FH-4	Boyce/Millwood	TRUE	500.00	1085.74	501.91	1087.65	20.00	20.00	20.00	25.38	J-57	20.00	25.38	J-57
J-75	White_Post	TRUE	500.00	1106.09	501.17	1107.26	20.00	20.00	20.00	32.52	FH-25	20.00	32.52	FH-25
FH-5	Boyce/Millwood	TRUE	500.00	1142.26	504.37	1146.62	20.00	20.00	20.00	39.10	J-91	20.00	39.10	J-91
FH-26	White_Post	TRUE	500.00	1161.46	503.87	1165.33	20.00	20.00	20.00	24.47	FH-27	20.00	24.47	FH-27
J-77	Boyce/Millwood	TRUE	500.00	1235.30	501.66	1236.96	20.00	21.87	20.00	20.00	FH-35	20.00	20.00	FH-35
J-45	Boyce/Millwood	TRUE	500.00	1248.52	501.91	1250.43	20.00	22.86	20.00	20.00	J-54	20.00	20.00	J-54
J-22	White_Post	TRUE	500.00	1251.34	501.17	1252.51	20.00	27.25	20.00	20.00	J-75	20.00	20.00	J-75
FH-25	White_Post	TRUE	500.00	1251.34	501.17	1252.51	20.00	23.84	20.00	20.00	J-75	20.00	20.00	J-75
J-113	Boyce/Millwood	TRUE	500.00	1275.06	500.68	1275.74	20.00	20.00	20.00	27.75	FH-35	20.00	27.75	FH-35
J-26	White_Post	TRUE	500.00	1276.48	501.17	1277.65	20.00	20.00	20.00	23.13	J-75	20.00	23.13	J-75
J-78	Boyce/Millwood	TRUE	500.00	1279.95	504.18	1284.13	20.00	23.59	20.00	20.00	FH-35	20.00	20.00	FH-35
J-21	White_Post	TRUE	500.00	1280.72	501.17	1281.89	20.00	27.54	20.00	20.00	J-75	20.00	20.00	J-75
J-52	White_Post	TRUE	500.00	1294.37	500.92	1295.29	20.00	20.00	20.00	25.93	J-75	20.00	25.93	J-75
J-25	White_Post	TRUE	500.00	1306.01	500.92	1306.93	20.00	20.26	20.00	20.00	J-26	20.00	20.00	J-26
FH-29	White_Post	TRUE	500.00	1306.01	501.66	1307.67	20.00	21.79	20.00	20.00	J-26	20.00	20.00	J-26
J-94	Boyce/Millwood	TRUE	500.00	1337.34	500.68	1338.02	20.00	20.00	20.00	26.36	J-111	20.00	26.36	J-111
J-73	White_Post	TRUE	500.00	1348.24	502.40	1350.64	20.00	24.54	20.00	20.00	J-75	20.00	20.00	J-75
FH-24	White_Post	TRUE	500.00	1350.73	502.40	1353.13	20.00	24.29	20.00	20.00	J-75	20.00	20.00	J-75
J-53	White_Post	TRUE	500.00	1407.82	501.66	1409.48	20.00	22.76	20.00	20.00	J-52	20.00	20.00	J-52
FH-28	White_Post	TRUE	500.00	1439.17	501.91	1441.08	20.00	22.43	20.00	20.00	J-75	20.00	20.00	J-75
J-107	White_Post	TRUE	500.00	1466.61	500.68	1467.29	20.00	26.56	20.00	20.00	FH-20	20.00	20.00	FH-20
J-19	White_Post	TRUE	500.00	1506.60	501.17	1507.77	20.00	22.52	20.00	20.00	J-52	20.00	20.00	J-52
J-117	Boyce/Millwood	TRUE	500.00	1515.68	500.00	1515.68	20.00	20.00	20.00	25.44	J-118	20.00	20.27	J-116
FH-23	White_Post	TRUE	500.00	1518.40	501.66	1520.06	20.00	21.73	20.00	20.00	J-52	20.00	20.00	J-52
J-89	White_Post	TRUE	500.00	1535.96	504.12	1540.08	20.00	24.65	20.00	20.00	J-75	20.00	20.00	J-75
J-43	Boyce/Millwood	TRUE	500.00	1553.16	502.15	1555.32	20.00	25.26	20.00	20.00	J-93	20.00	20.00	J-93
J-118	Boyce/Millwood	TRUE	500.00	1555.59	500.00	1555.59	20.00	20.00	20.00	27.41	J-117	20.00	27.41	J-117
FH-11	Boyce/Millwood	TRUE	500.00	1586.42	502.15	1588.57	20.00	24.80	20.00	20.00	J-88	20.00	20.00	J-88
J-70	Boyce/Millwood	TRUE	500.00	1636.79	506.58	1643.37	20.00	20.00	20.00	28.28	J-93	20.00	28.28	J-93
J-10	Boyce/Millwood	TRUE	500.00	1644.92	503.87	1648.80	20.00	23.63	20.00	20.00	J-88	20.00	20.00	J-88

Node	Pressure	Fire Flow Constraints	Desired Fire Flow	Available Fire Flow	Total Flow Desired	Total Flow Available	Desired Residual Pressure	Calculated Residual Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure
J-87	Boyce/Millwood	TRUE	500.00	1657.40	504.37	1661.76	20.00	20.00	20.00	34.53	J-81	20.00	34.53	J-81
FH-22	White_Post	TRUE	500.00	1678.04	502.15	1680.19	20.00	21.33	20.00	20.00	J-75	20.00	20.00	J-75
FH-2	Boyce/Millwood	TRUE	500.00	1762.85	502.64	1765.50	20.00	20.00	20.00	26.92	FH-1	20.00	26.92	FH-1
J-58	Boyce/Millwood	TRUE	500.00	1765.58	503.38	1768.96	20.00	20.00	20.00	24.31	J-54	20.00	24.31	J-54
J-61	White_Post	TRUE	500.00	1795.63	502.40	1798.03	20.00	23.61	20.00	20.00	J-75	20.00	20.00	J-75
J-50	Boyce/Millwood	TRUE	500.00	1828.69	501.66	1830.35	20.00	20.00	20.00	29.35	FH-3	20.00	29.35	FH-3
FH-10	Boyce/Millwood	TRUE	500.00	1829.75	501.91	1831.65	20.00	20.00	20.00	24.20	J-71	20.00	24.20	J-71
J-3	Boyce/Millwood	TRUE	500.00	1829.97	502.40	1832.37	20.00	20.00	20.00	21.03	FH-3	20.00	21.03	FH-3
J-83	Boyce/Millwood	TRUE	500.00	1837.46	504.86	1842.32	20.00	20.00	20.00	22.95	J-70	20.00	22.95	J-70
FH-3	Boyce/Millwood	TRUE	500.00	1839.52	501.42	1840.94	20.00	20.00	20.00	21.20	J-3	20.00	21.20	J-3
FH-13	Boyce/Millwood	TRUE	500.00	2099.08	504.12	2103.20	20.00	23.10	20.00	20.00	J-118	20.00	20.00	J-118
J-81	Boyce/Millwood	TRUE	500.00	2173.11	505.10	2178.21	20.00	20.00	20.00	23.26	J-87	20.00	23.26	J-87
FH-6	Boyce/Millwood	TRUE	500.00	2291.28	501.66	2292.94	20.00	20.00	20.00	29.52	FH-5	20.00	29.52	FH-5
J-12	Boyce/Millwood	TRUE	500.00	2410.89	501.66	2412.55	20.00	24.40	20.00	20.00	J-91	20.00	20.00	J-91
FH-12	Boyce/Millwood	TRUE	500.00	2434.95	503.63	2438.58	20.00	20.00	20.00	27.58	J-81	20.00	27.58	J-81
J-11	Boyce/Millwood	TRUE	500.00	2481.02	502.15	2483.18	20.00	20.00	20.00	20.71	FH-5	20.00	20.71	FH-5
J-34	Boyce/Millwood	TRUE	500.00	2527.84	501.17	2529.01	20.00	21.47	20.00	20.00	FH-32	20.00	20.00	FH-32
FH-21	White_Post	TRUE	500.00	2589.12	502.15	2591.27	20.00	25.39	20.00	20.00	J-75	20.00	20.00	J-75
J-5	Boyce/Millwood	TRUE	500.00	2770.30	501.66	2771.97	20.00	20.00	20.00	20.47	J-50	20.00	20.47	J-50
J-13	Boyce/Millwood	TRUE	500.00	2806.58	501.17	2807.75	20.00	20.00	20.00	20.40	FH-6	20.00	20.40	FH-6
J-2	Boyce/Millwood	TRUE	500.00	3000.00	501.42	3001.42	20.00	40.39	20.00	41.07	J-111	20.00	41.07	J-111
J-6	Boyce/Millwood	TRUE	500.00	3000.00	501.17	3001.17	20.00	21.42	20.00	20.71	J-50	20.00	20.71	J-50
FH-30	Boyce/Millwood	TRUE	500.00	3000.00	501.91	3001.91	20.00	49.31	20.00	39.99	J-111	20.00	39.99	J-111
J-38	Boyce/Millwood	TRUE	500.00	3000.00	502.15	3002.15	20.00	34.54	20.00	33.96	FH-12	20.00	33.96	FH-12
J-39	Boyce/Millwood	TRUE	500.00	3000.00	500.92	3000.92	20.00	29.28	20.00	30.58	J-91	20.00	30.58	J-91
J-119	Boyce/Millwood	TRUE	500.00	3000.00	500.00	3000.00	20.00	25.06	20.00	21.06	J-111	20.00	21.06	J-111

CLARKE COUNTY SANITARY AUTHORITY

PROPOSED WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT NORMAL LOW LEVEL,
WHITE POST FIRE PUMP OFF, WTP OFF

AVAILABLE FIRE FLOW

- 0 - 250 GPM
- 250 - 500 GPM
- 500 - 750 GPM
- 750 - 1000 GPM
- 1000 - 1500 GPM
- 1500 - 2000 GPM
- > 2000 GPM

BOYCE ELEVATED TANK
150,000 GALLONS
OVERFLOW = 713'
L.W.L. = 680'
BASE = 610'
DIAMETER = 28'

PS/PRV

WTP

NEW MILLWOOD
ELEVATED TANK
100,000 GALLONS
OVERFLOW = 712'
L.W.L. = 688'
BASE = 581'
DIAMETER = 28'

WHITE POST ELEVATED TANK
50,000 GALLONS
OVERFLOW = 765'
L.W.L. = 746'
BASE = 625'
DIAMETER = 22'

N

LEGEND

- EXISTING 2" WATER LINE
- EXISTING 4" WATER LINE
- EXISTING 6" WATER LINE
- EXISTING 8" WATER LINE
- EXISTING 12" WATER LINE
- PROPOSED 6" WATER LINE
- PROPOSED 8" WATER LINE
- EXISTING STORAGE TANK
- EXISTING PUMP STATION
- EXISTING FIRE HYDRANT

1000 500 0 1000 2000 3000
SCALE IN FEET

RUN #6 - AVAILABLE FIRE FLOW EXHIBIT
JUNE 22, 2015

ANDERSON AND ASSOCIATES, Inc.

Run #7 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow:

Proposed Water System Improvements – Constructed

Boyce Tank – Normal Low

Millwood Tank – Normal Low

White Post Tank – Normal Low

Water Treatment Plant – On

White Post Pump Station – Off.

Purpose – To identify critical hydrants in the proposed system and report their available fire flows while maintaining 20 psi for all users in the system.

Result – All hydrants in the proposed water system exceed 500 gpm available fire flow. See the fire flow report for details.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 7 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-2	610.00	Boyce/Millwood	1.42	707.00	41.97
J-111	610.64	Boyce/Millwood	2.15	708.37	42.28
J-91	606.86	Boyce/Millwood	1.42	706.93	43.30
FH-5	605.84	Boyce/Millwood	4.37	706.97	43.75
J-39	602.18	Boyce/Millwood	0.92	706.99	45.35
J-58	600.56	Boyce/Millwood	3.38	706.98	46.04
J-11	599.91	Boyce/Millwood	2.15	706.97	46.32
FH-32	599.76	Boyce/Millwood	0.92	706.91	46.36
FH-6	599.69	Boyce/Millwood	1.66	706.98	46.42
J-50	598.85	Boyce/Millwood	1.66	706.99	46.79
J-37	598.00	Boyce/Millwood	1.42	706.92	47.13
FH-12	596.84	Boyce/Millwood	3.63	706.98	47.65
J-12	596.72	Boyce/Millwood	1.66	706.97	47.70
J-36	595.30	Boyce/Millwood	3.38	706.92	48.29
J-54	594.28	Boyce/Millwood	1.42	706.97	48.76
J-38	594.22	Boyce/Millwood	2.15	706.99	48.79
J-29	594.00	Boyce/Millwood	3.14	706.92	48.86
J-30	593.67	Boyce/Millwood	1.17	706.92	49.00
J-13	593.62	Boyce/Millwood	1.17	706.98	49.05
J-6	592.70	Boyce/Millwood	1.17	706.98	49.45
J-5	592.37	Boyce/Millwood	1.66	706.98	49.59
J-88	591.09	Boyce/Millwood	2.40	706.98	50.14
FH-10	590.96	Boyce/Millwood	1.91	706.99	50.20
J-48	590.22	Boyce/Millwood	3.14	706.93	50.49
J-34	590.00	Boyce/Millwood	1.17	706.99	50.62
FH-30	589.03	Boyce/Millwood	1.91	707.00	51.04
J-119	589.09	Boyce/Millwood	0.00	707.09	51.05
FH-3	588.55	Boyce/Millwood	1.42	707.00	51.25
J-110	590.21	Boyce/Millwood	2.64	708.83	51.32
J-93	588.18	Boyce/Millwood	1.91	706.84	51.34
J-14	588.00	Boyce/Millwood	1.17	706.94	51.46
J-45	587.66	Boyce/Millwood	1.91	706.97	51.62
FH-35	587.32	Boyce/Millwood	1.91	706.77	51.68
J-70	587.31	Boyce/Millwood	6.58	707.01	51.78
J-3	586.89	Boyce/Millwood	2.40	707.00	51.97
J-7	586.03	Boyce/Millwood	0.68	706.93	52.31
J-18	585.30	Boyce/Millwood	1.91	706.93	52.62
FH-7	584.92	Boyce/Millwood	0.92	706.93	52.79
J-17	584.61	Boyce/Millwood	1.17	706.93	52.92
FH-9	584.24	Boyce/Millwood	4.18	706.93	53.08
FH-8	583.74	Boyce/Millwood	0.92	706.93	53.30
J-75	637.43	White_Post	1.17	760.87	53.41
J-81	582.80	Boyce/Millwood	5.10	706.97	53.73
J-52	636.38	White_Post	0.92	760.87	53.86
J-118	582.00	Boyce/Millwood	0.00	706.97	54.07
FH-4	581.71	Boyce/Millwood	1.91	706.97	54.19
FH-33	581.47	Boyce/Millwood	2.15	706.84	54.24
J-71	581.24	Boyce/Millwood	2.40	706.98	54.40
J-10	580.50	Boyce/Millwood	3.87	706.98	54.72
FH-11	580.00	Boyce/Millwood	2.15	706.98	54.94
J-72	577.84	Boyce/Millwood	2.15	706.98	55.87
J-43	576.17	Boyce/Millwood	2.15	706.99	56.60
FH-26	630.00	White_Post	3.87	760.87	56.62
J-53	630.00	White_Post	1.66	760.87	56.62
J-19	630.00	White_Post	1.17	760.88	56.62
FH-22	630.00	White_Post	2.15	760.89	56.63
FH-23	629.31	White_Post	1.66	760.88	56.92
J-87	575.25	Boyce/Millwood	4.37	706.97	56.99
J-61	629.12	White_Post	2.40	760.89	57.01
J-117	575.00	Boyce/Millwood	0.00	706.97	57.10
J-56	572.76	Boyce/Millwood	1.42	706.81	58.00
FH-20	626.39	White_Post	2.15	760.77	58.14
FH-2	572.00	Boyce/Millwood	2.64	707.04	58.42
J-83	571.29	Boyce/Millwood	4.86	707.12	58.77
FH-21	625.02	White_Post	2.15	760.92	58.80
J-89	623.98	White_Post	4.12	760.88	59.23
FH-25	623.87	White_Post	1.17	760.87	59.27
FH-24	623.56	White_Post	2.40	760.87	59.41
J-57	569.25	Boyce/Millwood	2.15	706.96	59.58
FH-28	622.96	White_Post	1.91	760.87	59.67
FH-34	566.63	Boyce/Millwood	1.91	706.80	60.64
J-22	620.68	White_Post	1.17	760.87	60.65
J-21	620.00	White_Post	1.17	760.87	60.95
FH-27	619.66	White_Post	2.40	760.87	61.10
J-73	619.54	White_Post	2.40	760.87	61.15
J-16	565.12	Boyce/Millwood	1.91	706.77	61.28
J-64	561.35	Boyce/Millwood	1.42	706.76	62.91
J-26	615.16	White_Post	1.17	760.87	63.04
FH-39	560.00	Boyce/Millwood	1.17	706.74	63.49
J-109	560.00	Boyce/Millwood	2.15	706.98	63.59
J-15	558.57	Boyce/Millwood	2.64	706.77	64.12
FH-13	558.71	Boyce/Millwood	4.12	706.97	64.15
FH-36	558.14	Boyce/Millwood	3.29	706.75	64.30
J-86	558.00	Boyce/Millwood	1.91	706.76	64.36
J-113	557.64	Boyce/Millwood	0.68	706.93	64.59
J-107	611.32	White_Post	0.68	760.86	64.70
FH-29	611.02	White_Post	1.66	760.87	64.83
J-25	610.52	White_Post	0.92	760.87	65.05
FH-1	556.00	Boyce/Millwood	2.40	707.04	65.35

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-19	609.26	White_Post	1.42	760.70	65.52
FH-40	554.08	Boyce/Millwood	3.29	706.74	66.05
J-69	548.01	Boyce/Millwood	1.42	706.81	68.70
J-112	547.12	Boyce/Millwood	0.68	710.76	70.80
J-79	542.18	Boyce/Millwood	1.91	706.77	71.21
J-97	594.87	White_Post	0.92	760.74	71.76
J-103	594.00	White_Post	0.92	760.66	72.11
FH-18	593.08	White_Post	6.95	760.62	72.49
FH-16	592.75	White_Post	6.63	760.61	72.63
J-94	540.00	Boyce/Millwood	0.68	707.99	72.68
J-32	592.00	White_Post	1.17	760.62	72.95
FH-15	588.89	White_Post	2.89	760.61	74.30
FH-38	534.15	Boyce/Millwood	1.17	706.74	74.67
FH-17	588.00	White_Post	4.18	760.61	74.68
J-95	584.95	White_Post	3.14	760.61	76.00
J-77	528.14	Boyce/Millwood	1.66	706.87	77.33
FH-41	522.12	Boyce/Millwood	4.12	706.77	79.89
J-78	522.03	Boyce/Millwood	4.18	706.88	79.98
J-116	575.00	White_Post	0.00	760.61	80.30
FH-43	519.63	Boyce/Millwood	3.14	706.83	80.99
FH-14	572.83	White_Post	2.40	760.61	81.24
FH-42	515.59	Boyce/Millwood	4.12	706.79	82.72
J-42	512.17	Boyce/Millwood	1.91	706.77	84.19
J-51	492.81	Boyce/Millwood	1.42	706.77	92.57

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 7 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-4.18	706.93	706.93	0.00	0.00
P-2	311.00	6.00	120.00	Open	4.18	760.62	760.61	0.00	0.00
P-3	22.00	8.00	120.00	Open	59.83	707.00	707.00	0.00	0.00
P-4	867.00	2.00	120.00	Open	-1.91	706.84	706.99	0.14	0.00
P-5	327.00	4.00	120.00	Open	1.42	706.97	706.97	0.00	0.00
P-6	198.00	8.00	120.00	Open	1.42	706.92	706.92	0.00	0.00
P-7	150.00	8.00	120.00	Open	1.17	706.92	706.92	0.00	0.00
P-8	324.00	8.00	120.00	Open	-5.00	706.92	706.93	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.69	706.92	706.92	0.00	0.00
P-10	498.00	8.00	120.00	Open	4.10	706.93	706.92	0.00	0.00
P-11	391.00	8.00	120.00	Open	12.24	706.93	706.93	0.00	0.00
P-12	758.00	8.00	120.00	Open	4.37	706.97	706.97	0.00	0.00
P-13	596.00	8.00	120.00	Open	71.09	761.01	760.92	0.09	0.00
P-14	505.00	6.00	120.00	Open	-5.63	706.74	706.75	0.00	0.00
P-15	532.00	6.00	120.00	Open	-4.46	706.74	706.74	0.00	0.00
P-16	290.00	6.00	120.00	Open	-3.29	706.74	706.74	0.00	0.00
P-17	598.00	4.00	120.00	Open	-1.42	706.81	706.81	0.00	0.00
P-18	541.00	4.00	120.00	Open	5.96	707.00	706.97	0.03	0.00
P-19	696.00	6.00	120.00	Open	-1.91	706.76	706.76	0.00	0.00
P-20	560.00	6.00	120.00	Open	6.18	706.98	706.98	0.00	0.00
P-21	492.00	6.00	120.00	Open	8.03	706.99	706.98	0.01	0.00
P-22	680.00	2.00	120.00	Open	-0.69	706.98	707.00	0.02	0.00
P-23	746.00	4.00	120.00	Open	-2.40	706.98	706.98	0.01	0.00
P-24	399.00	8.00	120.00	Open	28.90	707.00	706.99	0.01	0.00
P-25	320.00	8.00	120.00	Open	-29.52	706.99	707.00	0.01	0.00
P-26	185.00	12.00	120.00	Open	-55.74	707.00	707.00	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	1.17	760.87	760.87	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.92	760.87	760.87	0.00	0.00
P-29	561.00	8.00	120.00	Open	3.75	760.87	760.87	0.00	0.00
P-30	601.00	8.00	120.00	Open	1.17	760.87	760.87	0.00	0.00
P-31	146.00	8.00	120.00	Open	1.17	760.87	760.87	0.00	0.00
P-32	98.00	8.00	120.00	Open	3.51	760.87	760.87	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.92	760.87	760.87	0.00	0.00
P-34	698.00	8.00	120.00	Open	4.76	760.87	760.87	0.00	0.00
P-35	743.00	8.00	120.00	Open	7.16	760.87	760.87	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.09	760.87	760.87	0.00	0.00
P-37	417.00	8.00	120.00	Open	-9.75	760.87	760.88	0.00	0.00
P-38	1087.00	8.00	120.00	Open	6.07	760.87	760.87	0.00	0.00
P-39	758.00	8.00	120.00	Open	7.97	760.88	760.87	0.00	0.00
P-40	1294.00	8.00	120.00	Open	2.40	760.87	760.87	0.00	0.00
P-41	1283.00	8.00	120.00	Open	6.27	760.88	760.87	0.00	0.00
P-42	396.00	8.00	120.00	Open	-18.96	760.89	760.89	0.01	0.00
P-43	803.00	8.00	120.00	Open	-16.81	760.88	760.89	0.01	0.00
P-44	866.00	8.00	120.00	Open	1.56	760.88	760.88	0.00	0.00
P-45	150.00	8.00	120.00	Open	3.22	760.88	760.88	0.00	0.00
P-46	1764.00	8.00	120.00	Open	14.14	760.89	760.88	0.01	0.00
P-47	573.00	8.00	120.00	Open	35.49	760.92	760.89	0.03	0.00
P-48	1343.00	8.00	120.00	Open	-33.45	760.86	760.92	0.05	0.00
P-49	2431.00	8.00	120.00	Open	-32.77	760.77	760.86	0.09	0.00
P-50	978.00	8.00	120.00	Open	-30.62	760.74	760.77	0.03	0.00
P-51	1346.00	8.00	120.00	Open	-29.69	760.70	760.74	0.04	0.00
P-52	1207.00	8.00	120.00	Open	-28.28	760.66	760.70	0.03	0.00
P-53	1377.00	8.00	120.00	Open	-27.35	760.62	760.66	0.04	0.00
P-54	556.00	8.00	120.00	Open	-20.40	760.62	760.62	0.01	0.00
P-55	198.00	8.00	120.00	Open	-15.05	760.61	760.62	0.00	0.00
P-56	996.00	8.00	120.00	Open	-8.43	760.61	760.61	0.00	0.00
P-57	959.00	8.00	120.00	Open	-5.53	760.61	760.61	0.00	0.00
P-58	1275.00	8.00	120.00	Open	-2.40	760.61	760.61	0.00	0.00
P-59A	268.00	8.00	120.00	Open	0.00	760.61	760.61	0.00	0.00
P-59B	25.00	8.00	120.00	Open	0.00	760.61	760.61	0.00	0.00
P-59C	25.00	8.00	120.00	Open	0.00	706.97	706.97	0.00	0.00
P-59D	1211.00	8.00	120.00	Open	0.00	706.97	706.97	0.00	0.00
P-59E	32.00	8.00	120.00	Open	0.00	760.61	760.61	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	706.97	706.97	0.00	0.00
P-60	1927.00	8.00	120.00	Open	0.00	706.97	706.97	0.00	0.00
P-61	623.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-61A	623.00	8.00	121.00	Open	4.12	706.97	706.97	0.00	0.00
P-62	605.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62A	605.00	8.00	121.00	Open	13.59	706.98	706.97	0.00	0.00
P-63	647.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63A	647.00	8.00	121.00	Open	17.22	706.99	706.98	0.01	0.00
P-64	198.00	6.00	120.00	Open	-9.53	706.98	706.99	0.00	0.00
P-65	657.00	4.00	120.00	Open	-2.15	706.98	706.99	0.00	0.00
P-66	660.00	4.00	120.00	Open	2.40	706.99	706.98	0.01	0.00
P-67	206.00	6.00	120.00	Open	6.46	706.99	706.99	0.00	0.00
P-68	211.00	6.00	120.00	Open	-22.14	706.97	706.99	0.02	0.00
P-69	778.00	6.00	120.00	Open	1.42	706.93	706.93	0.00	0.00
P-70	85.00	6.00	120.00	Open	15.56	706.93	706.93	0.00	0.00
P-71	157.00	8.00	120.00	Open	16.73	706.93	706.93	0.00	0.00
P-72	105.00	8.00	120.00	Open	17.65	706.93	706.93	0.00	0.00
P-73	48.00	8.00	120.00	Open	18.58	706.93	706.93	0.00	0.00
P-74	79.00	8.00	120.00	Open	23.44	706.94	706.93	0.00	0.00
P-75	398.00	6.00	120.00	Open	24.60	706.97	706.94	0.04	0.00
P-76	70.00	6.00	120.00	Open	4.13	706.97	706.97	0.00	0.00
P-77	542.00	6.00	120.00	Open	-4.75	706.97	706.98	0.00	0.00
P-78	270.00	6.00	120.00	Open	-7.38	706.97	706.97	0.00	0.00
P-79	347.00	4.00	120.00	Open	-5.47	706.96	706.97	0.01	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-3.32	706.76	706.96	0.20	0.00
P-81	1620.00	8.00	120.00	Open	45.58	707.12	707.01	0.11	0.00
P-82	3361.00	8.00	120.00	Open	-24.88	706.93	707.01	0.08	0.00
P-83	2159.00	8.00	120.00	Open	-24.20	706.88	706.93	0.05	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-20.02	706.87	706.88	0.01	0.00
P-85	615.00	6.00	120.00	Open	29.74	707.12	707.04	0.08	0.00
P-86	441.00	6.00	120.00	Open	8.05	706.98	706.97	0.01	0.00
P-87	129.00	6.00	120.00	Open	9.71	706.98	706.98	0.00	0.00
P-88	71.00	6.00	120.00	Open	17.06	706.98	706.98	0.00	0.00
P-89	41.00	6.00	120.00	Open	8.70	706.98	706.98	0.00	0.00
P-90	583.00	6.00	120.00	Open	2.33	706.98	706.98	0.00	0.00
P-91	63.00	6.00	120.00	Open	5.52	706.98	706.98	0.00	0.00
P-92	258.00	6.00	120.00	Open	10.07	706.99	706.98	0.00	0.00
P-93	516.00	6.00	120.00	Open	14.13	707.01	706.99	0.02	0.00
P-94	860.00	6.00	120.00	Open	-1.77	706.97	706.97	0.00	0.00
P-95	375.00	4.00	120.00	Open	2.60	706.98	706.97	0.00	0.00
P-96	467.00	4.00	120.00	Open	4.54	706.99	706.98	0.01	0.00
P-97	300.00	6.00	120.00	Open	14.24	707.00	706.99	0.01	0.00
P-98	33.00	6.00	120.00	Open	21.61	707.00	707.00	0.00	0.00
P-99	422.00	6.00	120.00	Open	24.69	707.04	707.00	0.04	0.00
P-100	1029.00	4.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-100A	1029.00	6.00	121.00	Open	2.40	707.04	707.04	0.00	0.00
P-101	1478.00	6.00	120.00	Open	8.91	706.77	706.75	0.02	0.00
P-102	608.00	6.00	120.00	Open	-18.36	706.81	706.84	0.03	0.00
P-103	334.00	6.00	120.00	Open	-15.53	706.80	706.81	0.01	0.00
P-104	913.00	6.00	120.00	Open	-13.62	706.77	706.80	0.03	0.00
P-105	415.00	6.00	120.00	Open	-2.80	706.77	706.77	0.00	0.00
P-106	82.00	6.00	120.00	Open	-1.64	706.77	706.77	0.00	0.00
P-107	482.00	6.00	120.00	Open	2.91	706.77	706.77	0.00	0.00
P-108	1167.00	6.00	120.00	Open	11.10	706.79	706.77	0.02	0.00
P-109	1019.00	6.00	120.00	Open	15.22	706.83	706.79	0.04	0.00
P-110	832.00	6.00	120.00	Open	18.36	706.87	706.83	0.04	0.00
P-111	2178.00	2.00	120.00	Open	2.15	708.83	708.37	0.45	0.00
P-112	2060.00	6.00	120.00	Open	-87.20	708.83	710.76	1.93	0.00
P-113	1535.00	4.00	120.00	Open	2.15	706.99	706.98	0.01	0.00
P-114	1091.00	6.00	120.00	Open	20.51	706.91	706.84	0.07	0.00
P-115	1112.00	6.00	120.00	Open	21.43	706.99	706.91	0.08	0.00
P-116	161.00	6.00	120.00	Open	24.76	707.00	706.99	0.01	0.00
P-117A	2061.00	6.00	120.00	Open	82.40	708.83	707.09	1.74	0.00
P-117B	100.00	6.00	120.00	Open	82.40	707.09	707.00	0.08	0.00
P-118	1082.00	6.00	120.00	Open	80.18	707.99	707.12	0.87	0.00
P-119	3401.00	6.00	120.00	Open	80.85	710.76	707.99	2.78	0.00
P-120	211.00	6.00	120.00	Open	4.07	706.77	706.77	0.00	0.00
P-121	335.00	6.00	120.00	Open	1.42	706.77	706.77	0.00	0.00
P-122	740.00	6.00	120.00	Open	-0.75	706.77	706.77	0.00	0.00
P-123	605.00	6.00	120.00	Open	1.91	706.77	706.77	0.00	0.00
P-124	1.00	2.00	120.00	Open	168.73	540.00	539.33	0.67	0.67
P-125	80.00	2.00	120.00	Open	168.73	764.53	710.76	53.77	0.67

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 7 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.00	713.00	28.00	-59.83	707.00
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.00	712.00	28.00	55.74	707.00
White_Post_Tank	625.00	746.00	761.01	765.00	22.00	-71.09	761.01
R-WTP	--	--	--	--	--	-168.73	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	On	539.33	764.53	168.73	225.20
PMP-White_Post	575.00	Off	706.97	760.61	0.00	0.00

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	760.61	706.97	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 7 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS Off, & WTP Pump On.
Steady State Analysis
Fire Flow Report - sorted by Available Fire Flow

Node Label	Pressure Zone	Fire Flow Constraints Satisfied	Desired Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Desired (gpm)	Total Flow Available (gpm)	Desired Residual Pressure (psi)	Calculated Residual Pressure (psi)	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node	Desired Minimum System Pressure (psi)	Calculated Minimum System Pressure (psi)	Minimum System Pressure Node
J-111	Boyce/Millwood	FALSE	500.00	25.46	502.15	27.61	20.00	20.00	20.00	41.97	J-2	20.00	41.97	J-2
J-93	Boyce/Millwood	FALSE	500.00	52.78	501.91	54.68	20.00	20.02	20.00	41.96	J-2	20.00	41.96	J-2
J-86	Boyce/Millwood	FALSE	500.00	89.50	501.91	91.41	20.00	21.20	20.00	20.06	J-64	20.00	20.06	J-64
J-64	Boyce/Millwood	FALSE	500.00	89.55	501.42	90.97	20.00	20.02	20.00	21.47	J-86	20.00	21.47	J-86
J-109	Boyce/Millwood	FALSE	500.00	293.05	502.15	295.20	20.00	20.00	20.00	41.97	J-2	20.00	41.97	J-2
J-88	Boyce/Millwood	FALSE	500.00	344.90	502.40	347.30	20.00	20.00	20.00	41.94	J-2	20.00	41.94	J-2
J-71	Boyce/Millwood	FALSE	500.00	398.23	502.40	400.63	20.00	20.00	20.00	41.92	J-2	20.00	41.92	J-2
J-72	Boyce/Millwood	FALSE	500.00	408.58	502.15	410.73	20.00	20.00	20.00	41.92	J-2	20.00	41.92	J-2
J-69	Boyce/Millwood	FALSE	500.00	452.88	501.42	454.30	20.00	20.00	20.00	41.39	FH-32	20.00	41.39	FH-32
J-54	Boyce/Millwood	FALSE	500.00	489.78	501.42	491.20	20.00	20.00	20.00	41.91	J-2	20.00	41.91	J-2
FH-40	Boyce/Millwood	TRUE	500.00	505.38	503.29	508.66	20.00	20.00	20.00	20.52	FH-39	20.00	20.52	FH-39
FH-39	Boyce/Millwood	TRUE	500.00	508.80	501.17	509.97	20.00	20.00	20.00	22.56	FH-40	20.00	22.56	FH-40
J-57	Boyce/Millwood	TRUE	500.00	538.17	502.15	540.33	20.00	20.00	20.00	23.33	J-64	20.00	23.33	J-64
FH-38	Boyce/Millwood	TRUE	500.00	550.71	501.17	551.88	20.00	31.18	20.00	20.00	FH-39	20.00	20.00	FH-39
FH-36	Boyce/Millwood	TRUE	500.00	601.37	503.29	604.66	20.00	20.81	20.00	20.00	FH-39	20.00	20.00	FH-39
J-91	Boyce/Millwood	TRUE	500.00	616.83	501.42	618.25	20.00	20.00	20.00	35.71	J-37	20.00	35.71	J-37
J-116	White_Post	TRUE	500.00	653.31	500.00	653.31	20.00	20.00	20.00	22.06	FH-14	20.00	22.06	FH-14
FH-14	White_Post	TRUE	500.00	660.21	502.40	662.61	20.00	20.94	20.00	20.00	J-116	20.00	20.00	J-116
J-95	White_Post	TRUE	500.00	667.91	503.14	671.05	20.00	20.00	20.00	22.53	FH-15	20.00	22.53	FH-15
FH-15	White_Post	TRUE	500.00	685.99	502.89	688.88	20.00	20.01	20.00	21.71	J-95	20.00	21.71	J-95
FH-17	White_Post	TRUE	500.00	687.03	504.18	691.21	20.00	20.01	20.00	23.79	FH-16	20.00	23.79	FH-16
FH-16	White_Post	TRUE	500.00	708.91	506.63	715.54	20.00	20.00	20.00	21.32	J-32	20.00	21.32	J-32
J-32	White_Post	TRUE	500.00	716.58	501.17	717.75	20.00	20.32	20.00	20.00	FH-16	20.00	20.00	FH-16
FH-18	White_Post	TRUE	500.00	738.65	506.95	745.60	20.00	20.00	20.00	20.14	FH-16	20.00	20.14	FH-16
FH-35	Boyce/Millwood	TRUE	500.00	749.50	501.91	751.41	20.00	20.00	20.00	31.74	J-16	20.00	31.74	J-16
J-16	Boyce/Millwood	TRUE	500.00	781.68	501.91	783.59	20.00	26.70	20.00	20.00	FH-35	20.00	20.00	FH-35
J-15	Boyce/Millwood	TRUE	500.00	785.38	502.64	788.02	20.00	28.62	20.00	20.00	FH-35	20.00	20.00	FH-35
J-79	Boyce/Millwood	TRUE	500.00	785.38	501.91	787.29	20.00	21.25	20.00	20.00	FH-35	20.00	20.00	FH-35
J-51	Boyce/Millwood	TRUE	500.00	792.04	501.42	793.46	20.00	47.20	20.00	20.00	FH-35	20.00	20.00	FH-35
J-42	Boyce/Millwood	TRUE	500.00	792.08	501.91	793.99	20.00	46.94	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-41	Boyce/Millwood	TRUE	500.00	798.02	504.12	802.14	20.00	43.95	20.00	20.00	FH-35	20.00	20.00	FH-35
J-103	White_Post	TRUE	500.00	804.12	500.92	805.04	20.00	20.00	20.00	20.38	FH-18	20.00	20.38	FH-18
FH-19	White_Post	TRUE	500.00	817.03	501.42	818.45	20.00	20.00	20.00	26.59	J-103	20.00	26.59	J-103
FH-34	Boyce/Millwood	TRUE	500.00	842.45	501.91	844.36	20.00	24.52	20.00	20.00	FH-35	20.00	20.00	FH-35
J-110	Boyce/Millwood	TRUE	500.00	858.30	502.64	860.94	20.00	29.04	20.00	20.00	J-111	20.00	20.00	J-111
J-37	Boyce/Millwood	TRUE	500.00	875.60	501.42	877.01	20.00	20.00	20.00	21.92	J-91	20.00	21.92	J-91
J-56	Boyce/Millwood	TRUE	500.00	885.36	501.42	886.78	20.00	20.27	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-33	Boyce/Millwood	TRUE	500.00	894.73	502.15	896.88	20.00	20.00	20.00	24.88	FH-35	20.00	24.88	FH-35
J-36	Boyce/Millwood	TRUE	500.00	902.11	503.38	905.49	20.00	21.17	20.00	20.00	J-37	20.00	20.00	J-37
FH-9	Boyce/Millwood	TRUE	500.00	908.97	504.18	913.15	20.00	20.00	20.00	25.63	J-91	20.00	25.63	J-91
FH-42	Boyce/Millwood	TRUE	500.00	912.41	504.12	916.53	20.00	39.11	20.00	20.00	FH-35	20.00	20.00	FH-35
J-18	Boyce/Millwood	TRUE	500.00	918.35	501.91	920.25	20.00	29.33	20.00	20.00	J-91	20.00	20.00	J-91
J-48	Boyce/Millwood	TRUE	500.00	918.35	503.14	921.49	20.00	24.06	20.00	20.00	J-91	20.00	20.00	J-91
J-29	Boyce/Millwood	TRUE	500.00	918.35	503.14	921.49	20.00	21.16	20.00	20.00	J-91	20.00	20.00	J-91
J-30	Boyce/Millwood	TRUE	500.00	918.35	501.17	919.52	20.00	20.13	20.00	20.00	J-91	20.00	20.00	J-91
J-97	White_Post	TRUE	500.00	925.24	500.92	926.17	20.00	26.25	20.00	20.00	FH-19	20.00	20.00	FH-19
FH-20	White_Post	TRUE	500.00	937.08	502.15	939.23	20.00	20.00	20.00	27.38	FH-19	20.00	27.38	FH-19
FH-1	Boyce/Millwood	TRUE	500.00	938.28	502.40	940.68	20.00	20.00	20.00	41.46	J-111	20.00	41.46	J-111
FH-32	Boyce/Millwood	TRUE	500.00	961.80	500.92	962.72	20.00	20.00	20.00	30.70	FH-33	20.00	30.70	FH-33
J-17	Boyce/Millwood	TRUE	500.00	985.60	501.17	986.77	20.00	29.62	20.00	20.00	J-91	20.00	20.00	J-91
FH-27	White_Post	TRUE	500.00	1016.97	502.40	1019.37	20.00	20.00	20.00	27.81	FH-26	20.00	27.81	FH-26
FH-8	Boyce/Millwood	TRUE	500.00	1021.21	500.92	1022.14	20.00	30.00	20.00	20.00	J-91	20.00	20.00	J-91
FH-7	Boyce/Millwood	TRUE	500.00	1047.20	500.92	1048.13	20.00	29.49	20.00	20.00	J-91	20.00	20.00	J-91
FH-43	Boyce/Millwood	TRUE	500.00	1057.34	503.14	1060.48	20.00	30.80	20.00	20.00	FH-35	20.00	20.00	FH-35
J-7	Boyce/Millwood	TRUE	500.00	1059.74	500.68	1060.42	20.00	29.02	20.00	20.00	J-91	20.00	20.00	J-91
J-14	Boyce/Millwood	TRUE	500.00	1081.50	501.17	1082.67	20.00	28.16	20.00	20.00	J-91	20.00	20.00	J-91
FH-4	Boyce/Millwood	TRUE	500.00	1091.19	501.91	1093.09	20.00	20.00	20.00	25.38	J-57	20.00	25.38	J-57
J-75	White_Post	TRUE	500.00	1106.09	501.17	1107.26	20.00	20.00	20.00	32.52	FH-25	20.00	32.52	FH-25
J-112	Boyce/Millwood	TRUE	500.00	1146.25	500.68	1146.93	20.00	27.65	20.00	20.00	J-111	20.00	20.00	J-111
FH-5	Boyce/Millwood	TRUE	500.00	1147.70	504.37	1152.07	20.00	20.00	20.00	39.20	J-91	20.00	39.20	J-91
FH-26	White_Post	TRUE	500.00	1161.46	503.87	1165.33	20.00	20.00	20.00	24.47	FH-27	20.00	24.47	FH-27
J-77	Boyce/Millwood	TRUE	500.00	1245.46	501.66	1247.12	20.00	21.85	20.00	20.00	FH-35	20.00	20.00	FH-35
J-22	White_Post	TRUE	500.00	1251.34	501.17	1252.51	20.00	27.25	20.00	20.00	J-75	20.00	20.00	J-75
FH-25	White_Post	TRUE	500.00	1251.34	501.17	1252.51	20.00	23.84	20.00	20.00	J-75	20.00	20.00	J-75
J-45	Boyce/Millwood	TRUE	500.00	1257.38	501.91	1259.29	20.00	22.86	20.00	20.00	J-54	20.00	20.00	J-54
J-26	White_Post	TRUE	500.00	1276.48	501.17	1277.65	20.00	20.00	20.00	23.13	J-75	20.00	23.13	J-75
J-21	White_Post	TRUE	500.00	1280.72	501.17	1281.89	20.00	27.54	20.00	20.00	J-75	20.00	20.00	J-75
J-113	Boyce/Millwood	TRUE	500.00	1290.95	500.68	1291.62	20.00	20.00	20.00	27.76	FH-35	20.00	27.76	FH-35
J-78	Boyce/Millwood	TRUE	500.00	1291.18	504.18	1295.36	20.00	23.57	20.00	20.00	FH-35	20.00	20.00	FH-35
J-52	White_Post	TRUE	500.00	1294.37	500.92	1295.29	20.00	20.00	20.00	25.93	J-75	20.00	25.93	J-75
FH-29	White_Post	TRUE	500.00	1306.01	501.66	1307.67	20.00	21.79	20.00	20.00	J-26	20.00	20.00	J-26
J-25	White_Post	TRUE	500.00	1306.01	500.92	1306.93	20.00	20.26	20.00	20.00	J-26	20.00	20.00	J-26
J-73	White_Post	TRUE	500.00	1348.24	502.40	1350.64	20.00	24.54	20.00	20.00	J-75	20.00	20.00	J-75
FH-24	White_Post	TRUE	500.00	1350.73	502.40	1353.13	20.00	24.29	20.00	20.00	J-75	20.00	20.00	J-75
J-53	White_Post	TRUE	500.00	1407.82	501.66	1409.48	20.00	22.76	20.00	20.00	J-52	20.00	20.00	J-52
J-94	Boyce/Millwood	TRUE	500.00	1434.72	500.68	1435.40	20.00	20.00	20.00	32.30	J-111	20.00	32.30	J-111
FH-28	White_Post	TRUE	500.00	1439.17	501.91	1441.08	20.00	22.43	20.00	20.00	J-75	20.00	20.00	J-75
J-107	White_Post	TRUE	500.00	1466.61	500.68	1467.29	20.00	26.56	20.00	20.00	FH-20	20.00	20.00	FH-20
J-19	White_Post	TRUE	500.00	1506.60	501.17	1507.77	20.00	22.52	20.00	20.00	J-52	20.00	20.00	J-52
J-117	Boyce/Millwood	TRUE	500.00	1517.13	500.00	1517.13	20.00	20.00	20.00	25.46	J-118	20.00	20.27	J-116
FH-23	White_Post	TRUE	500.00	1518.40	501.66	1520.06	20.00	21.73	20.00	20.00	J-52	20.00	20.00	J-52
J-89	White_Post	TRUE	500.00	1535.96	504.12	1540.08	20.00	24.65	20.00	20.00	J-75	20.00	20.00	J-75
J-118	Boyce/Millwood	TRUE	500.00	1557.40	500.00	1557.40	20.00	20.00	20.00	27.41	J-117	20.00	27.41	J-117
J-43	Boyce/Millwood	TRUE	500.00	1585.69	502.15	1587.85	20.00	25.26	20.00	20.00	J-93	20.00	20.00	J-93
FH-11	Boyce/Millwood	TRUE	500.00	1615.90	502.15	1618.05	20.00	24.80	20.00	20.00	J-88	20.00	20.00	J-88
J-87	Boyce/Millwood	TRUE	500.00	1659.89	504.37	1664.26	20.00	20.00	20.00	34.58	J-81	20.00	34.58	J-81
J-10	Boyce/Millwood	TRUE	500.00	1676.30	503.87	1680.18	20.00	23.56	20.00	20.00	J-88	20.00	20.00	J-88

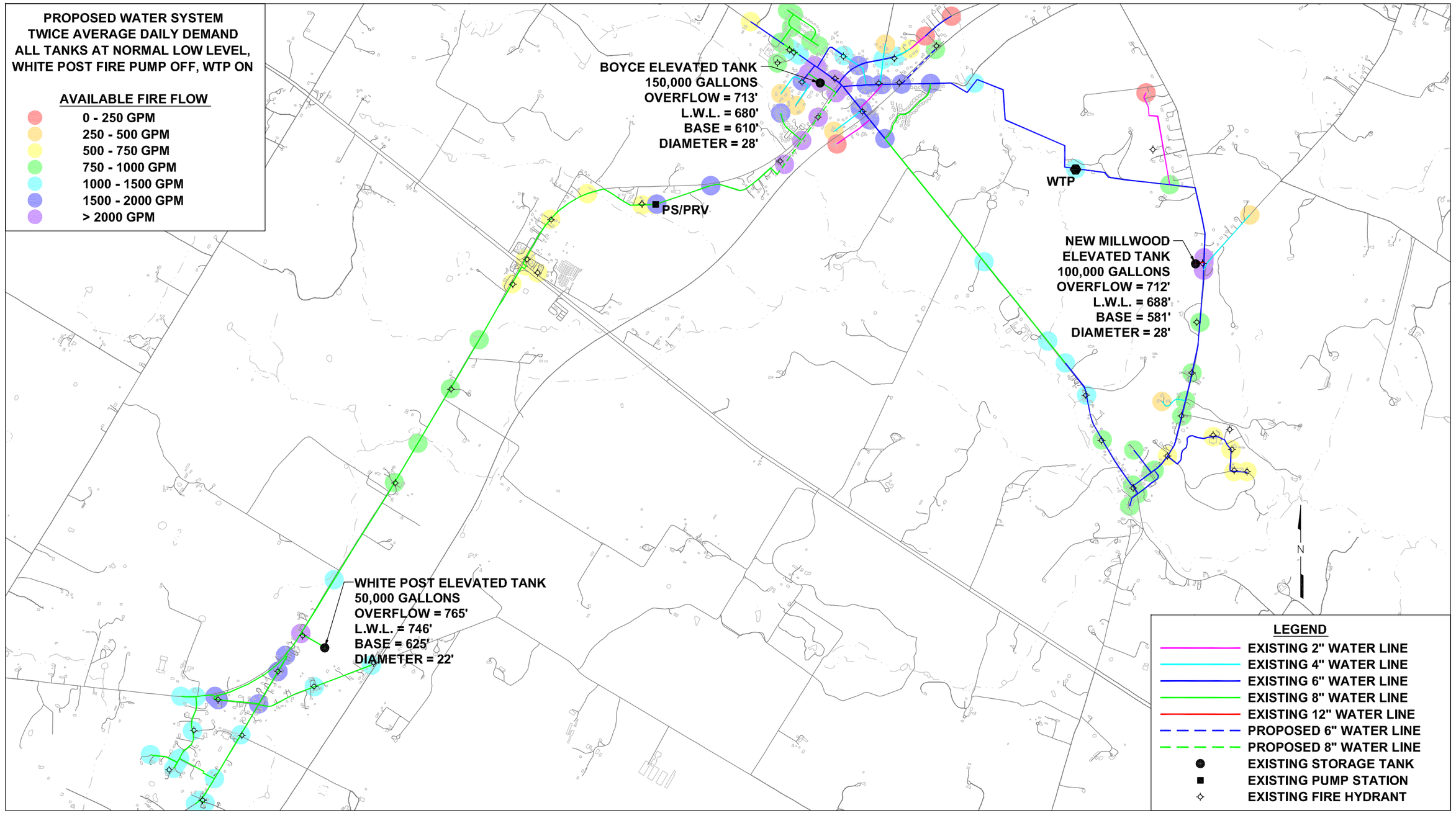
Node	Pressure	Fire Flow Constraints	Desired Fire Flow	Available Fire Flow	Total Flow Desired	Total Flow Available	Desired Residual Pressure	Calculated Residual Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure	Desired Minimum System Pressure	Calculated Minimum System Pressure	Minimum System Pressure
FH-22	White_Post	TRUE	500.00	1678.04	502.15	1680.19	20.00	21.33	20.00	20.00	J-75	20.00	20.00	J-75
J-70	Boyce/Millwood	TRUE	500.00	1688.08	506.58	1694.65	20.00	20.00	20.00	28.35	J-93	20.00	28.35	J-93
J-58	Boyce/Millwood	TRUE	500.00	1786.29	503.38	1789.67	20.00	20.00	20.00	24.36	J-54	20.00	24.36	J-54
J-61	White_Post	TRUE	500.00	1795.63	502.40	1798.03	20.00	23.61	20.00	20.00	J-75	20.00	20.00	J-75
FH-2	Boyce/Millwood	TRUE	500.00	1805.93	502.64	1808.58	20.00	20.00	20.00	26.92	FH-1	20.00	26.92	FH-1
FH-10	Boyce/Millwood	TRUE	500.00	1832.37	501.91	1834.27	20.00	20.00	20.00	24.20	J-71	20.00	24.20	J-71
J-50	Boyce/Millwood	TRUE	500.00	1861.51	501.66	1863.17	20.00	20.00	20.00	29.64	FH-3	20.00	29.64	FH-3
J-3	Boyce/Millwood	TRUE	500.00	1866.58	502.40	1868.98	20.00	20.00	20.00	21.05	FH-3	20.00	21.05	FH-3
FH-3	Boyce/Millwood	TRUE	500.00	1875.92	501.42	1877.34	20.00	20.00	20.00	21.24	J-3	20.00	21.24	J-3
J-83	Boyce/Millwood	TRUE	500.00	1915.10	504.86	1919.96	20.00	20.00	20.00	22.95	J-70	20.00	22.95	J-70
FH-13	Boyce/Millwood	TRUE	500.00	2102.09	504.12	2106.21	20.00	23.10	20.00	20.00	J-118	20.00	20.00	J-118
J-81	Boyce/Millwood	TRUE	500.00	2177.34	505.10	2182.44	20.00	20.00	20.00	23.26	J-87	20.00	23.26	J-87
FH-6	Boyce/Millwood	TRUE	500.00	2319.14	501.66	2320.80	20.00	20.00	20.00	29.68	FH-5	20.00	29.68	FH-5
J-12	Boyce/Millwood	TRUE	500.00	2426.68	501.66	2428.34	20.00	24.40	20.00	20.00	J-91	20.00	20.00	J-91
FH-12	Boyce/Millwood	TRUE	500.00	2442.19	503.63	2445.82	20.00	20.00	20.00	27.58	J-81	20.00	27.58	J-81
J-11	Boyce/Millwood	TRUE	500.00	2499.78	502.15	2501.93	20.00	20.00	20.00	20.81	FH-5	20.00	20.81	FH-5
J-34	Boyce/Millwood	TRUE	500.00	2537.56	501.17	2538.72	20.00	21.41	20.00	20.00	FH-32	20.00	20.00	FH-32
FH-21	White_Post	TRUE	500.00	2589.12	502.15	2591.27	20.00	25.39	20.00	20.00	J-75	20.00	20.00	J-75
J-5	Boyce/Millwood	TRUE	500.00	2827.44	501.66	2829.10	20.00	20.00	20.00	20.80	J-50	20.00	20.80	J-50
J-13	Boyce/Millwood	TRUE	500.00	2853.81	501.17	2854.98	20.00	20.00	20.00	20.41	FH-6	20.00	20.41	FH-6
J-2	Boyce/Millwood	TRUE	500.00	3000.00	501.42	3001.42	20.00	40.43	20.00	41.77	J-91	20.00	41.77	J-91
J-6	Boyce/Millwood	TRUE	500.00	3000.00	501.17	3001.17	20.00	22.28	20.00	21.67	J-58	20.00	21.67	J-58
FH-30	Boyce/Millwood	TRUE	500.00	3000.00	501.91	3001.91	20.00	49.38	20.00	41.06	J-111	20.00	41.06	J-111
J-38	Boyce/Millwood	TRUE	500.00	3000.00	502.15	3002.15	20.00	34.77	20.00	34.17	FH-12	20.00	34.17	FH-12
J-39	Boyce/Millwood	TRUE	500.00	3000.00	500.92	3000.92	20.00	29.40	20.00	30.77	J-91	20.00	30.77	J-91
J-119	Boyce/Millwood	TRUE	500.00	3000.00	500.00	3000.00	20.00	26.41	20.00	26.09	J-111	20.00	26.09	J-111

CLARKE COUNTY SANITARY AUTHORITY

PROPOSED WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT NORMAL LOW LEVEL,
WHITE POST FIRE PUMP OFF, WTP ON

AVAILABLE FIRE FLOW

- 0 - 250 GPM
- 250 - 500 GPM
- 500 - 750 GPM
- 750 - 1000 GPM
- 1000 - 1500 GPM
- 1500 - 2000 GPM
- > 2000 GPM



1000 500 0 1000 2000 3000
SCALE IN FEET

RUN #7 - AVAILABLE FIRE FLOW EXHIBIT
JUNE 22, 2015

ANDERSON AND ASSOCIATES, Inc.

Run #8 – Steady state analysis of twice average daily demand plus maximum available fire flow calculated for each junction. Initial conditions are as follow:

Proposed Water System Improvements – Constructed

Boyce Tank – Normal Low

Millwood Tank – Normal Low

White Post Tank – Normal Low

Water Treatment Plant – On

White Post Pump Station – Fire Pump On.

Purpose – To identify critical hydrants in the proposed system and report their available fire flows while maintaining 20 psi for all users in the system.

Result – All hydrants in the proposed water system's high pressure zone exceed 500 gpm available fire flow. See the fire flow report for details.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 8 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-2	610.00	Boyce/Millwood	1.42	706.84	41.90
J-117	575.00	Boyce/Millwood	0.00	671.96	41.95
J-111	610.64	Boyce/Millwood	2.15	708.09	42.16
J-118	582.00	Boyce/Millwood	0.00	679.91	42.36
J-91	606.86	Boyce/Millwood	1.42	706.16	42.96
FH-5	605.84	Boyce/Millwood	4.37	705.98	43.32
FH-12	596.84	Boyce/Millwood	3.63	700.75	44.96
J-39	602.18	Boyce/Millwood	0.92	706.65	45.20
J-58	600.56	Boyce/Millwood	3.38	705.70	45.49
FH-6	599.69	Boyce/Millwood	1.66	705.77	45.90
J-11	599.91	Boyce/Millwood	2.15	706.10	45.94
J-50	598.85	Boyce/Millwood	1.66	705.68	46.22
FH-32	599.76	Boyce/Millwood	0.92	706.63	46.24
J-37	598.00	Boyce/Millwood	1.42	706.15	46.79
J-12	596.72	Boyce/Millwood	1.66	706.20	47.37
J-36	595.30	Boyce/Millwood	3.38	706.15	47.96
J-38	594.22	Boyce/Millwood	2.15	705.19	48.01
J-54	594.28	Boyce/Millwood	1.42	705.69	48.20
J-13	593.62	Boyce/Millwood	1.17	705.68	48.48
J-29	594.00	Boyce/Millwood	3.14	706.15	48.52
J-30	593.67	Boyce/Millwood	1.17	706.15	48.67
J-6	592.70	Boyce/Millwood	1.17	705.61	48.85
J-5	592.37	Boyce/Millwood	1.66	705.63	49.00
J-81	582.80	Boyce/Millwood	5.10	696.65	49.26
J-88	591.09	Boyce/Millwood	2.40	705.68	49.58
FH-10	590.96	Boyce/Millwood	1.91	706.65	50.06
J-48	590.22	Boyce/Millwood	3.14	706.15	50.16
J-34	590.00	Boyce/Millwood	1.17	706.95	50.60
FH-3	588.55	Boyce/Millwood	1.42	705.71	50.69
J-93	588.18	Boyce/Millwood	1.91	705.58	50.80
FH-30	589.03	Boyce/Millwood	1.91	707.00	51.04
J-119	589.09	Boyce/Millwood	0.00	707.07	51.05
J-45	587.66	Boyce/Millwood	1.91	705.69	51.07
J-14	588.00	Boyce/Millwood	1.17	706.16	51.12
J-110	590.21	Boyce/Millwood	2.64	708.55	51.20
J-70	587.31	Boyce/Millwood	6.58	705.82	51.27
FH-35	587.32	Boyce/Millwood	1.91	705.93	51.32
J-3	586.89	Boyce/Millwood	2.40	705.71	51.41
J-7	586.03	Boyce/Millwood	0.68	706.16	51.98
J-18	585.30	Boyce/Millwood	1.91	706.16	52.29
FH-7	584.92	Boyce/Millwood	0.92	706.16	52.46
J-87	575.25	Boyce/Millwood	4.37	696.65	52.52
J-17	584.61	Boyce/Millwood	1.17	706.16	52.59
FH-9	584.24	Boyce/Millwood	4.18	706.16	52.75
FH-8	583.74	Boyce/Millwood	0.92	706.16	52.97
FH-4	581.71	Boyce/Millwood	1.91	705.69	53.64
FH-33	581.47	Boyce/Millwood	2.15	706.34	54.03
J-10	580.50	Boyce/Millwood	3.87	705.68	54.16
J-71	581.24	Boyce/Millwood	2.40	706.65	54.26
FH-11	580.00	Boyce/Millwood	2.15	705.69	54.38
J-75	637.43	White_Post	1.17	763.96	54.74
J-52	636.38	White_Post	0.92	763.96	55.20
J-72	577.84	Boyce/Millwood	2.15	706.65	55.73
J-43	576.17	Boyce/Millwood	2.15	705.72	56.05
J-56	572.76	Boyce/Millwood	1.42	706.18	57.73
FH-2	572.00	Boyce/Millwood	2.64	705.79	57.88
FH-13	558.71	Boyce/Millwood	4.12	692.57	57.91
FH-26	630.00	White_Post	3.87	763.96	57.96
J-53	630.00	White_Post	1.66	763.96	57.96
J-19	630.00	White_Post	1.17	763.96	57.96
FH-22	630.00	White_Post	2.15	763.97	57.96
J-83	571.29	Boyce/Millwood	4.86	705.92	58.25
FH-23	629.31	White_Post	1.66	763.96	58.26
J-61	629.12	White_Post	2.40	763.97	58.35
J-57	569.25	Boyce/Millwood	2.15	705.68	59.02
FH-21	625.02	White_Post	2.15	764.00	60.13
FH-34	566.63	Boyce/Millwood	1.91	706.11	60.35
J-89	623.98	White_Post	4.12	763.96	60.56
FH-25	623.87	White_Post	1.17	763.96	60.61
FH-24	623.56	White_Post	2.40	763.96	60.74
J-16	565.12	Boyce/Millwood	1.91	705.88	60.90
FH-28	622.96	White_Post	1.91	763.96	61.00
J-22	620.68	White_Post	1.17	763.96	61.99
J-21	620.00	White_Post	1.17	763.96	62.28
J-64	561.35	Boyce/Millwood	1.42	705.48	62.36
FH-27	619.66	White_Post	2.40	763.96	62.43
J-73	619.54	White_Post	2.40	763.96	62.48
FH-39	560.00	Boyce/Millwood	1.17	705.90	63.13
J-109	560.00	Boyce/Millwood	2.15	706.94	63.57
J-15	558.57	Boyce/Millwood	2.64	705.88	63.73
J-86	558.00	Boyce/Millwood	1.91	705.47	63.81
FH-36	558.14	Boyce/Millwood	3.29	705.91	63.93
J-113	557.64	Boyce/Millwood	0.68	705.82	64.11
J-26	615.16	White_Post	1.17	763.96	64.38
FH-1	556.00	Boyce/Millwood	2.40	705.78	64.80
FH-40	554.08	Boyce/Millwood	3.29	705.90	65.69
FH-29	611.02	White_Post	1.66	763.96	66.17
J-25	610.52	White_Post	0.92	763.96	66.38
J-69	548.01	Boyce/Millwood	1.42	706.18	68.43

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-20	626.39	White_Post	2.15	786.00	69.06
J-107	611.32	White_Post	0.68	771.82	69.44
J-112	547.12	Boyce/Millwood	0.68	710.20	70.56
J-79	542.18	Boyce/Millwood	1.91	705.88	70.83
J-94	540.00	Boyce/Millwood	0.68	706.94	72.23
FH-38	534.15	Boyce/Millwood	1.17	705.90	74.31
J-77	528.14	Boyce/Millwood	1.66	705.82	76.87
FH-41	522.12	Boyce/Millwood	4.12	705.87	79.50
J-78	522.03	Boyce/Millwood	4.18	705.82	79.52
FH-43	519.63	Boyce/Millwood	3.14	705.82	80.55
FH-42	515.59	Boyce/Millwood	4.12	705.84	82.31
FH-19	609.26	White_Post	1.42	799.70	82.39
J-42	512.17	Boyce/Millwood	1.91	705.87	83.81
J-97	594.87	White_Post	0.92	791.75	85.18
J-103	594.00	White_Post	0.92	806.86	92.09
J-51	492.81	Boyce/Millwood	1.42	705.87	92.18
FH-18	593.08	White_Post	6.95	815.06	96.04
J-32	592.00	White_Post	1.17	818.45	97.97
FH-16	592.75	White_Post	6.63	819.68	98.18
FH-17	588.00	White_Post	4.18	818.45	99.70
FH-15	588.89	White_Post	2.89	826.03	102.60
J-95	584.95	White_Post	3.14	832.21	106.98
J-116	575.00	White_Post	0.00	842.27	115.63
FH-14	572.83	White_Post	2.40	840.51	115.81

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 8 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-4.18	706.16	706.16	0.00	0.00
P-2	311.00	6.00	120.00	Open	4.18	818.45	818.45	0.00	0.00
P-3	22.00	8.00	120.00	Open	559.46	707.00	706.84	0.16	0.01
P-4	867.00	2.00	120.00	Open	-1.91	705.58	705.72	0.14	0.00
P-5	327.00	4.00	120.00	Open	1.42	705.69	705.69	0.00	0.00
P-6	198.00	8.00	120.00	Open	1.42	706.15	706.15	0.00	0.00
P-7	150.00	8.00	120.00	Open	1.17	706.15	706.15	0.00	0.00
P-8	324.00	8.00	120.00	Open	-5.02	706.15	706.15	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.71	706.15	706.15	0.00	0.00
P-10	498.00	8.00	120.00	Open	4.08	706.15	706.15	0.00	0.00
P-11	391.00	8.00	120.00	Open	12.24	706.16	706.15	0.00	0.00
P-12	758.00	8.00	120.00	Open	4.37	696.65	696.65	0.00	0.00
P-13	596.00	8.00	120.00	Open	-460.14	761.00	764.00	3.00	0.01
P-14	505.00	6.00	120.00	Open	-5.63	705.90	705.91	0.00	0.00
P-15	532.00	6.00	120.00	Open	-4.46	705.90	705.90	0.00	0.00
P-16	290.00	6.00	120.00	Open	-3.29	705.90	705.90	0.00	0.00
P-17	598.00	4.00	120.00	Open	-1.42	706.18	706.18	0.00	0.00
P-18	541.00	4.00	120.00	Open	4.90	705.71	705.69	0.02	0.00
P-19	696.00	6.00	120.00	Open	-1.91	705.47	705.48	0.00	0.00
P-20	560.00	6.00	120.00	Open	-13.05	705.68	705.70	0.02	0.00
P-21	492.00	6.00	120.00	Open	27.64	705.68	705.63	0.05	0.00
P-22	680.00	2.00	120.00	Open	-1.01	705.68	705.71	0.04	0.00
P-23	746.00	4.00	120.00	Open	-2.40	705.68	705.69	0.01	0.00
P-24	399.00	8.00	120.00	Open	414.27	706.84	705.19	1.65	0.00
P-25	320.00	8.00	120.00	Open	-143.78	706.65	706.84	0.19	0.00
P-26	185.00	12.00	120.00	Open	-24.45	707.00	707.00	0.00	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	1.17	763.96	763.96	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.92	763.96	763.96	0.00	0.00
P-29	561.00	8.00	120.00	Open	3.75	763.96	763.96	0.00	0.00
P-30	601.00	8.00	120.00	Open	1.17	763.96	763.96	0.00	0.00
P-31	146.00	8.00	120.00	Open	1.17	763.96	763.96	0.00	0.00
P-32	98.00	8.00	120.00	Open	3.51	763.96	763.96	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.92	763.96	763.96	0.00	0.00
P-34	698.00	8.00	120.00	Open	4.76	763.96	763.96	0.00	0.00
P-35	743.00	8.00	120.00	Open	7.16	763.96	763.96	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.09	763.96	763.96	0.00	0.00
P-37	417.00	8.00	120.00	Open	-9.75	763.96	763.96	0.00	0.00
P-38	1087.00	8.00	120.00	Open	6.07	763.96	763.96	0.00	0.00
P-39	758.00	8.00	120.00	Open	7.97	763.96	763.96	0.00	0.00
P-40	1294.00	8.00	120.00	Open	2.40	763.96	763.96	0.00	0.00
P-41	1283.00	8.00	120.00	Open	6.27	763.96	763.96	0.00	0.00
P-42	396.00	8.00	120.00	Open	-18.96	763.97	763.97	0.01	0.00
P-43	803.00	8.00	120.00	Open	-16.81	763.96	763.97	0.01	0.00
P-44	866.00	8.00	120.00	Open	1.56	763.96	763.96	0.00	0.00
P-45	150.00	8.00	120.00	Open	3.22	763.96	763.96	0.00	0.00
P-46	1764.00	8.00	120.00	Open	14.14	763.97	763.96	0.01	0.00
P-47	573.00	8.00	120.00	Open	35.49	764.00	763.97	0.03	0.00
P-48	1343.00	8.00	120.00	Open	497.79	771.82	764.00	7.82	0.01
P-49	2431.00	8.00	120.00	Open	498.47	786.00	771.82	14.19	0.01
P-50	978.00	8.00	120.00	Open	500.62	791.75	786.00	5.75	0.01
P-51	1346.00	8.00	120.00	Open	501.54	799.70	791.75	7.94	0.01
P-52	1207.00	8.00	120.00	Open	502.96	806.86	799.70	7.16	0.01
P-53	1377.00	8.00	120.00	Open	503.88	815.06	806.86	8.20	0.01
P-54	556.00	8.00	120.00	Open	510.83	818.45	815.06	3.39	0.01
P-55	198.00	8.00	120.00	Open	516.18	819.68	818.45	1.23	0.01
P-56	996.00	8.00	120.00	Open	522.81	826.03	819.68	6.35	0.01
P-57	959.00	8.00	120.00	Open	525.70	832.21	826.03	6.18	0.01
P-58	1275.00	8.00	120.00	Open	528.84	840.51	832.21	8.30	0.01
P-59A	268.00	8.00	120.00	Open	-531.24	840.51	842.27	1.76	0.01
P-59B	25.00	8.00	120.00	Open	-531.24	842.27	842.43	0.16	0.01
P-59C	25.00	8.00	120.00	Open	-531.24	671.80	671.96	0.16	0.01
P-59D	1211.00	8.00	120.00	Open	-531.24	671.96	679.91	7.95	0.01
P-59E	32.00	8.00	120.00	Open	0.00	842.27	842.27	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	671.96	671.96	0.00	0.00
P-60	1927.00	8.00	120.00	Open	-531.24	679.91	692.57	12.65	0.01
P-61	623.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-61A	623.00	8.00	121.00	Open	535.35	696.65	692.57	4.09	0.01
P-62	605.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62A	605.00	8.00	121.00	Open	544.82	700.75	696.65	4.10	0.01
P-63	647.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63A	647.00	8.00	121.00	Open	548.45	705.19	700.75	4.44	0.01
P-64	198.00	6.00	120.00	Open	136.34	705.61	705.19	0.43	0.00
P-65	657.00	4.00	120.00	Open	-2.15	706.65	706.65	0.00	0.00
P-66	660.00	4.00	120.00	Open	2.40	706.65	706.65	0.01	0.00
P-67	206.00	6.00	120.00	Open	6.46	706.65	706.65	0.00	0.00
P-68	211.00	6.00	120.00	Open	-136.40	706.20	706.65	0.45	0.00
P-69	778.00	6.00	120.00	Open	1.42	706.16	706.16	0.00	0.00
P-70	85.00	6.00	120.00	Open	15.56	706.16	706.16	0.00	0.00
P-71	157.00	8.00	120.00	Open	16.73	706.16	706.16	0.00	0.00
P-72	105.00	8.00	120.00	Open	17.65	706.16	706.16	0.00	0.00
P-73	48.00	8.00	120.00	Open	18.58	706.16	706.16	0.00	0.00
P-74	79.00	8.00	120.00	Open	23.44	706.16	706.16	0.00	0.00
P-75	398.00	6.00	120.00	Open	24.60	706.20	706.16	0.04	0.00
P-76	70.00	6.00	120.00	Open	-110.13	706.10	706.20	0.10	0.00
P-77	542.00	6.00	120.00	Open	-5.81	705.69	705.70	0.00	0.00
P-78	270.00	6.00	120.00	Open	-7.38	705.69	705.69	0.00	0.00
P-79	347.00	4.00	120.00	Open	-5.47	705.68	705.69	0.01	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-3.32	705.48	705.68	0.20	0.00
P-81	1620.00	8.00	120.00	Open	43.12	705.92	705.82	0.10	0.00
P-82	3361.00	8.00	120.00	Open	-0.63	705.82	705.82	0.00	0.00
P-83	2159.00	8.00	120.00	Open	0.05	705.82	705.82	0.00	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	4.23	705.82	705.82	0.00	0.00
P-85	615.00	6.00	120.00	Open	39.56	705.92	705.79	0.13	0.00
P-86	441.00	6.00	120.00	Open	-76.86	705.77	706.10	0.33	0.00
P-87	129.00	6.00	120.00	Open	-75.20	705.68	705.77	0.09	0.00
P-88	71.00	6.00	120.00	Open	-87.08	705.61	705.68	0.07	0.00
P-89	41.00	6.00	120.00	Open	50.43	705.63	705.61	0.01	0.00
P-90	583.00	6.00	120.00	Open	24.45	705.68	705.63	0.05	0.00
P-91	63.00	6.00	120.00	Open	27.31	705.69	705.68	0.01	0.00
P-92	258.00	6.00	120.00	Open	31.86	705.72	705.69	0.04	0.00
P-93	516.00	6.00	120.00	Open	35.92	705.82	705.72	0.09	0.00
P-94	860.00	6.00	120.00	Open	-31.12	705.98	706.10	0.12	0.00
P-95	375.00	4.00	120.00	Open	-26.75	705.70	705.98	0.28	0.00
P-96	467.00	4.00	120.00	Open	-4.51	705.68	705.70	0.01	0.00
P-97	300.00	6.00	120.00	Open	24.79	705.71	705.68	0.03	0.00
P-98	33.00	6.00	120.00	Open	31.10	705.71	705.71	0.00	0.00
P-99	422.00	6.00	120.00	Open	34.51	705.79	705.71	0.07	0.00
P-100	1029.00	4.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-100A	1029.00	6.00	121.00	Open	2.40	705.79	705.78	0.00	0.00
P-101	1478.00	6.00	120.00	Open	8.91	705.93	705.91	0.02	0.00
P-102	608.00	6.00	120.00	Open	-42.61	706.18	706.34	0.15	0.00
P-103	334.00	6.00	120.00	Open	-39.78	706.11	706.18	0.07	0.00
P-104	913.00	6.00	120.00	Open	-37.87	705.93	706.11	0.18	0.00
P-105	415.00	6.00	120.00	Open	-27.05	705.88	705.93	0.04	0.00
P-106	82.00	6.00	120.00	Open	-15.60	705.88	705.88	0.00	0.00
P-107	482.00	6.00	120.00	Open	-11.05	705.87	705.88	0.01	0.00
P-108	1167.00	6.00	120.00	Open	-13.15	705.84	705.87	0.03	0.00
P-109	1019.00	6.00	120.00	Open	-9.03	705.82	705.84	0.01	0.00
P-110	832.00	6.00	120.00	Open	-5.89	705.82	705.82	0.01	0.00
P-111	2178.00	2.00	120.00	Open	2.15	708.55	708.09	0.45	0.00
P-112	2060.00	6.00	120.00	Open	-80.16	708.55	710.20	1.65	0.00
P-113	1535.00	4.00	120.00	Open	2.15	706.95	706.94	0.01	0.00
P-114	1091.00	6.00	120.00	Open	44.76	706.63	706.34	0.30	0.00
P-115	1112.00	6.00	120.00	Open	45.68	706.95	706.63	0.32	0.00
P-116	161.00	6.00	120.00	Open	49.01	707.00	706.95	0.05	0.00
P-117A	2061.00	6.00	120.00	Open	75.36	708.55	707.07	1.48	0.00
P-117B	100.00	6.00	120.00	Open	75.36	707.07	707.00	0.07	0.00
P-118	1082.00	6.00	120.00	Open	87.54	706.94	705.92	1.02	0.00
P-119	3401.00	6.00	120.00	Open	88.21	710.20	706.94	3.26	0.00
P-120	211.00	6.00	120.00	Open	-6.22	705.87	705.87	0.00	0.00
P-121	335.00	6.00	120.00	Open	1.42	705.87	705.87	0.00	0.00
P-122	740.00	6.00	120.00	Open	9.54	705.88	705.87	0.01	0.00
P-123	605.00	6.00	120.00	Open	1.91	705.88	705.88	0.00	0.00
P-124	1.00	2.00	120.00	Open	169.05	540.00	539.33	0.67	0.67
P-125	80.00	2.00	120.00	Open	169.05	764.16	710.20	53.96	0.67

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 8 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.00	713.00	28.00	-559.46	707.00
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.00	712.00	28.00	24.45	707.00
White_Post_Tank	625.00	746.00	761.00	765.00	22.00	460.14	761.00
R-WTP	--	--	--	--	--	-169.05	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	On	539.33	764.16	169.05	224.83
PMP-White_Post	575.00	On	671.80	842.43	531.24	170.63

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	842.27	671.96	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 8 - Twice Average Daily Demand plus maximum available fire flow calculated for each junction.
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Steady State Analysis
Fire Flow Report - sorted by Available Fire Flow

Node Label	Pressure Zone	Fire Flow Constraints Satisfied	Desired Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Desired (gpm)	Total Flow Available (gpm)	Desired Residual Pressure (psi)	Calculated Residual Pressure (psi)	Desired Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Pressure Node	Desired Minimum System Pressure (psi)	Calculated Minimum System Pressure (psi)	Minimum System Pressure Node
J-111	Boyce/Millwood	FALSE	500.00	25.39	502.15	27.54	20.00	20.00	20.00	41.90	J-2	20.00	41.90	J-2
J-93	Boyce/Millwood	FALSE	500.00	52.17	501.91	54.08	20.00	20.00	20.00	41.87	J-117	20.00	41.87	J-117
J-86	Boyce/Millwood	FALSE	500.00	88.63	501.91	90.54	20.00	21.20	20.00	20.05	J-64	20.00	20.05	J-64
J-64	Boyce/Millwood	FALSE	500.00	88.67	501.42	90.09	20.00	20.02	20.00	21.47	J-86	20.00	21.47	J-86
J-109	Boyce/Millwood	FALSE	500.00	292.68	502.15	294.83	20.00	20.00	20.00	41.89	J-2	20.00	41.89	J-2
J-88	Boyce/Millwood	FALSE	500.00	338.70	502.40	341.10	20.00	20.00	20.00	41.26	J-117	20.00	41.26	J-117
J-71	Boyce/Millwood	FALSE	500.00	395.30	502.40	397.70	20.00	20.00	20.00	41.71	J-117	20.00	41.71	J-117
J-72	Boyce/Millwood	FALSE	500.00	405.67	502.15	407.82	20.00	20.00	20.00	41.70	J-117	20.00	41.70	J-117
J-117	Boyce/Millwood	FALSE	500.00	410.96	500.00	410.96	20.00	20.00	20.00	25.46	J-118	20.00	25.46	J-118
J-69	Boyce/Millwood	FALSE	500.00	450.91	501.42	452.33	20.00	20.00	20.00	41.26	FH-32	20.00	41.26	FH-32
J-54	Boyce/Millwood	FALSE	500.00	479.41	501.42	480.82	20.00	20.00	20.00	40.91	J-117	20.00	40.91	J-117
J-118	Boyce/Millwood	FALSE	500.00	495.75	500.00	495.75	20.00	20.00	20.00	20.43	J-117	20.00	20.43	J-117
FH-40	Boyce/Millwood	TRUE	500.00	502.50	503.29	505.79	20.00	20.00	20.00	20.49	FH-39	20.00	20.49	FH-39
FH-39	Boyce/Millwood	TRUE	500.00	505.73	501.17	506.90	20.00	20.00	20.00	22.56	FH-40	20.00	22.56	FH-40
J-57	Boyce/Millwood	TRUE	500.00	529.57	502.15	531.72	20.00	20.00	20.00	23.33	J-64	20.00	23.33	J-64
FH-38	Boyce/Millwood	TRUE	500.00	547.34	501.17	548.51	20.00	31.18	20.00	20.00	FH-39	20.00	20.00	FH-39
FH-36	Boyce/Millwood	TRUE	500.00	597.64	503.29	600.93	20.00	20.81	20.00	20.00	FH-39	20.00	20.00	FH-39
J-91	Boyce/Millwood	TRUE	500.00	605.63	501.42	607.04	20.00	20.00	20.00	35.32	J-37	20.00	35.32	J-37
FH-35	Boyce/Millwood	TRUE	500.00	742.79	501.91	744.70	20.00	20.00	20.00	31.66	J-16	20.00	31.66	J-16
J-16	Boyce/Millwood	TRUE	500.00	774.84	501.91	776.74	20.00	26.70	20.00	20.00	FH-35	20.00	20.00	FH-35
J-15	Boyce/Millwood	TRUE	500.00	778.51	502.64	781.15	20.00	28.63	20.00	20.00	FH-35	20.00	20.00	FH-35
J-79	Boyce/Millwood	TRUE	500.00	778.52	501.91	780.43	20.00	21.50	20.00	20.00	FH-35	20.00	20.00	FH-35
J-51	Boyce/Millwood	TRUE	500.00	785.16	501.42	786.57	20.00	47.36	20.00	20.00	FH-35	20.00	20.00	FH-35
J-42	Boyce/Millwood	TRUE	500.00	785.16	501.91	787.06	20.00	46.97	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-41	Boyce/Millwood	TRUE	500.00	791.13	504.12	795.25	20.00	43.95	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-13	Boyce/Millwood	TRUE	500.00	803.58	504.12	807.70	20.00	34.20	20.00	20.00	J-118	20.00	20.00	J-118
FH-34	Boyce/Millwood	TRUE	500.00	834.48	501.91	836.38	20.00	24.69	20.00	20.00	FH-35	20.00	20.00	FH-35
J-110	Boyce/Millwood	TRUE	500.00	851.92	502.64	854.56	20.00	29.04	20.00	20.00	J-111	20.00	20.00	J-111
J-37	Boyce/Millwood	TRUE	500.00	860.13	501.42	861.54	20.00	20.00	20.00	21.73	J-91	20.00	21.73	J-91
J-56	Boyce/Millwood	TRUE	500.00	876.86	501.42	878.27	20.00	20.49	20.00	20.00	FH-35	20.00	20.00	FH-35
J-36	Boyce/Millwood	TRUE	500.00	885.98	503.38	889.36	20.00	21.17	20.00	20.00	J-37	20.00	20.00	J-37
FH-33	Boyce/Millwood	TRUE	500.00	889.26	502.15	891.41	20.00	20.00	20.00	24.63	FH-35	20.00	24.63	FH-35
FH-9	Boyce/Millwood	TRUE	500.00	895.72	504.18	899.90	20.00	20.00	20.00	25.21	J-91	20.00	25.21	J-91
J-18	Boyce/Millwood	TRUE	500.00	899.03	501.91	900.94	20.00	29.33	20.00	20.00	J-91	20.00	20.00	J-91
J-48	Boyce/Millwood	TRUE	500.00	899.05	503.14	902.18	20.00	24.18	20.00	20.00	J-91	20.00	20.00	J-91
J-29	Boyce/Millwood	TRUE	500.00	899.05	503.14	902.18	20.00	21.33	20.00	20.00	J-91	20.00	20.00	J-91
J-30	Boyce/Millwood	TRUE	500.00	899.05	501.17	900.22	20.00	20.34	20.00	20.00	J-91	20.00	20.00	J-91
FH-42	Boyce/Millwood	TRUE	500.00	904.62	504.12	908.74	20.00	39.11	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-1	Boyce/Millwood	TRUE	500.00	923.64	502.40	926.04	20.00	20.00	20.00	39.84	J-117	20.00	39.84	J-117
FH-32	Boyce/Millwood	TRUE	500.00	956.23	500.92	957.15	20.00	20.00	20.00	30.59	FH-33	20.00	30.59	FH-33
J-17	Boyce/Millwood	TRUE	500.00	964.27	501.17	965.44	20.00	29.62	20.00	20.00	J-91	20.00	20.00	J-91
FH-8	Boyce/Millwood	TRUE	500.00	998.80	500.92	999.72	20.00	30.00	20.00	20.00	J-91	20.00	20.00	J-91
FH-7	Boyce/Millwood	TRUE	500.00	1023.98	500.92	1024.90	20.00	29.49	20.00	20.00	J-91	20.00	20.00	J-91
J-81	Boyce/Millwood	TRUE	500.00	1025.81	505.10	1030.91	20.00	25.12	20.00	20.00	J-118	20.00	20.00	J-118
J-87	Boyce/Millwood	TRUE	500.00	1025.85	504.37	1030.21	20.00	21.04	20.00	20.00	J-118	20.00	20.00	J-118
J-7	Boyce/Millwood	TRUE	500.00	1036.12	500.68	1036.80	20.00	29.02	20.00	20.00	J-91	20.00	20.00	J-91
FH-43	Boyce/Millwood	TRUE	500.00	1048.10	503.14	1051.24	20.00	30.80	20.00	20.00	FH-35	20.00	20.00	FH-35
J-14	Boyce/Millwood	TRUE	500.00	1057.20	501.17	1058.36	20.00	28.16	20.00	20.00	J-91	20.00	20.00	J-91
FH-4	Boyce/Millwood	TRUE	500.00	1064.06	501.91	1065.97	20.00	20.00	20.00	25.38	J-57	20.00	25.38	J-57
FH-27	White_Post	TRUE	500.00	1082.07	502.40	1084.47	20.00	20.00	20.00	29.31	FH-26	20.00	29.31	FH-26
FH-5	Boyce/Millwood	TRUE	500.00	1113.11	504.37	1117.47	20.00	20.00	20.00	38.46	J-91	20.00	38.46	J-91
J-112	Boyce/Millwood	TRUE	500.00	1139.27	500.68	1139.95	20.00	27.65	20.00	20.00	J-111	20.00	20.00	J-111
J-75	White_Post	TRUE	500.00	1203.26	501.17	1204.43	20.00	20.00	20.00	33.64	FH-25	20.00	33.64	FH-25
J-45	Boyce/Millwood	TRUE	500.00	1217.58	501.91	1219.48	20.00	22.86	20.00	20.00	J-54	20.00	20.00	J-54
J-77	Boyce/Millwood	TRUE	500.00	1233.21	501.66	1234.88	20.00	21.86	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-26	White_Post	TRUE	500.00	1259.16	503.87	1263.03	20.00	20.00	20.00	24.47	FH-27	20.00	24.47	FH-27
J-113	Boyce/Millwood	TRUE	500.00	1272.78	500.68	1273.45	20.00	20.00	20.00	27.76	FH-35	20.00	27.76	FH-35
J-78	Boyce/Millwood	TRUE	500.00	1278.13	504.18	1282.31	20.00	23.57	20.00	20.00	FH-35	20.00	20.00	FH-35
FH-17	White_Post	TRUE	500.00	1300.86	504.18	1305.04	20.00	20.00	20.00	37.22	J-32	20.00	30.29	J-117
J-26	White_Post	TRUE	500.00	1376.94	501.17	1378.11	20.00	20.00	20.00	23.80	FH-29	20.00	23.80	FH-29
J-22	White_Post	TRUE	500.00	1377.88	501.17	1379.05	20.00	27.25	20.00	20.00	J-75	20.00	20.00	J-75
FH-25	White_Post	TRUE	500.00	1377.88	501.17	1379.05	20.00	23.44	20.00	20.00	J-75	20.00	20.00	J-75
J-25	White_Post	TRUE	500.00	1411.32	500.92	1412.24	20.00	20.00	20.00	20.01	J-26	20.00	20.01	J-26
FH-29	White_Post	TRUE	500.00	1411.46	501.66	1413.12	20.00	21.79	20.00	20.00	J-26	20.00	20.00	J-26
J-21	White_Post	TRUE	500.00	1413.69	501.17	1414.86	20.00	27.54	20.00	20.00	J-75	20.00	20.00	J-75
J-94	Boyce/Millwood	TRUE	500.00	1418.66	500.68	1419.34	20.00	20.00	20.00	32.29	J-111	20.00	32.29	J-111
J-52	White_Post	TRUE	500.00	1428.17	500.92	1429.10	20.00	20.00	20.00	27.21	J-75	20.00	27.21	J-75
FH-12	Boyce/Millwood	TRUE	500.00	1458.14	503.63	1461.77	20.00	20.39	20.00	20.00	J-118	20.00	20.00	J-118
FH-15	White_Post	TRUE	500.00	1479.26	502.89	1482.15	20.00	20.00	20.00	22.98	FH-16	20.00	22.98	FH-16
J-95	White_Post	TRUE	500.00	1481.21	503.14	1484.34	20.00	20.01	20.00	22.53	FH-15	20.00	22.53	FH-15
FH-16	White_Post	TRUE	500.00	1482.59	506.63	1489.22	20.00	20.00	20.00	21.32	J-32	20.00	21.32	J-32
J-32	White_Post	TRUE	500.00	1490.74	501.17	1491.91	20.00	20.00	20.00	20.76	FH-16	20.00	20.76	FH-16
J-73	White_Post	TRUE	500.00	1496.69	502.40	1499.09	20.00	23.86	20.00	20.00	J-75	20.00	20.00	J-75
FH-24	White_Post	TRUE	500.00	1499.75	502.40	1502.15	20.00	23.92	20.00	20.00	J-75	20.00	20.00	J-75
FH-18	White_Post	TRUE	500.00	1501.36	506.95	1508.31	20.00	20.00	20.00	23.40	J-32	20.00	23.40	J-32
J-116	White_Post	TRUE	500.00	1505.62	500.00	1505.62	20.00	20.01	20.00	22.06	FH-14	20.00	21.02	J-117
FH-14	White_Post	TRUE	500.00	1515.80	502.40	1518.20	20.00	20.01	20.00	20.31	J-95	20.00	20.31	J-95
FH-19	White_Post	TRUE	500.00	1529.35	501.42	1530.77	20.00	20.00	20.00	28.26	FH-20	20.00	28.26	FH-20
J-43	Boyce/Millwood	TRUE	500.00	1537.00	502.15	1539.15	20.00	25.26	20.00	20.00	J-93	20.00	20.00	J-93
J-103	White_Post	TRUE	500.00	1547.84	500.92	1548.76	20.00	20.00	20.00	21.27	FH-19	20.00	21.27	FH-19
FH-11	Boyce/Millwood	TRUE	500.00	1560.97	502.15	1563.12	20.00	24.80	20.00	20.00	J-88	20.00	20.00	J-88
J-53	White_Post	TRUE	500.00	1568.02	501.66	1569.68	20.00	22.76	20.00	20.00	J-52	20.00	20.00	J-52
FH-20	White_Post	TRUE	500.00	1605.51	502.15	1607.66	20.00	20.00	20.00	36.69	FH-19	20.00	34.01	J-117
FH-28	White_Post	TRUE	500.00	1609.87	501.91	1611.78	20.00	21.54	20.00	20.00	J-75	20.00	20.00	J-75
J-10	Boyce/Millwood	TRUE	500.00	1617.95	503.87	1621.82	20.00	23.61	20.00	20.00	J-88	20.00	20.00	J-88
J-97	White_Post	TRUE	500.00	1636.87	500.92	1637.79	20.00	25.20	20.00	20.00	FH-20	20.00	20.00	FH-20
J-70	Boyce/Millwood	TRUE	500.00	1640.96	506.58	1647.54	20.00	20.00	20.00	27.70	J-93	20.00	27.70	J-93

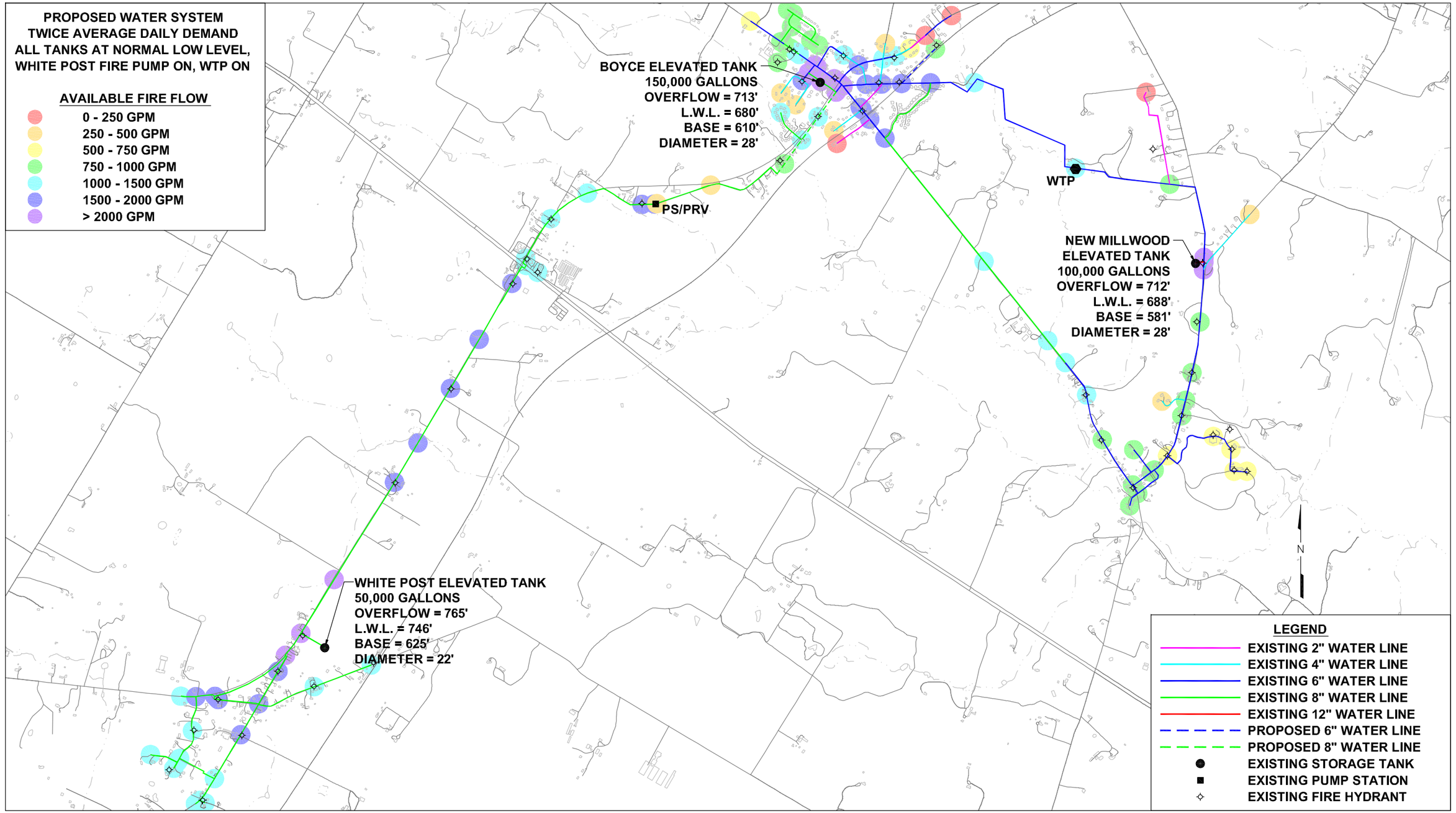
Node	Pressure	Fire Flow Constraints	Desired Fire Flow	Available Fire Flow	Total Flow Desired	Total Flow Available	Desired Residual Pressure	Calculated Residual Pressure	Desired Minimum Zone Pressure	Calculated Minimum Zone Pressure	Minimum Zone Pressure	Desired Minimum System Pressure	Calculated Minimum System Pressure	Minimum System Pressure
J-19	White_Post	TRUE	500.00	1691.82	501.17	1692.99	20.00	22.46	20.00	20.00	J-52	20.00	20.00	J-52
FH-23	White_Post	TRUE	500.00	1706.76	501.66	1708.42	20.00	21.40	20.00	20.00	J-52	20.00	20.00	J-52
J-58	Boyce/Millwood	TRUE	500.00	1710.29	503.38	1713.67	20.00	20.00	20.00	24.22	J-54	20.00	24.22	J-54
J-89	White_Post	TRUE	500.00	1732.11	504.12	1736.23	20.00	24.35	20.00	20.00	J-75	20.00	20.00	J-75
FH-2	Boyce/Millwood	TRUE	500.00	1757.55	502.64	1760.19	20.00	20.00	20.00	26.92	FH-1	20.00	26.92	FH-1
J-50	Boyce/Millwood	TRUE	500.00	1778.71	501.66	1780.37	20.00	20.00	20.00	29.27	FH-3	20.00	29.27	FH-3
J-3	Boyce/Millwood	TRUE	500.00	1800.05	502.40	1802.45	20.00	20.00	20.00	20.91	FH-3	20.00	20.91	FH-3
FH-3	Boyce/Millwood	TRUE	500.00	1806.87	501.42	1808.29	20.00	20.00	20.00	21.22	J-3	20.00	21.22	J-3
FH-10	Boyce/Millwood	TRUE	500.00	1808.93	501.91	1810.84	20.00	20.00	20.00	24.20	J-71	20.00	24.20	J-71
J-83	Boyce/Millwood	TRUE	500.00	1868.89	504.86	1873.74	20.00	20.00	20.00	22.47	J-70	20.00	22.47	J-70
FH-22	White_Post	TRUE	500.00	1915.22	502.15	1917.37	20.00	20.79	20.00	20.00	J-75	20.00	20.00	J-75
J-61	White_Post	TRUE	500.00	2069.30	502.40	2071.70	20.00	23.61	20.00	20.00	J-75	20.00	20.00	J-75
FH-6	Boyce/Millwood	TRUE	500.00	2211.69	501.66	2213.35	20.00	20.00	20.00	29.08	FH-5	20.00	29.08	FH-5
J-107	White_Post	TRUE	500.00	2262.67	500.68	2263.34	20.00	20.00	20.00	22.90	FH-20	20.00	22.90	FH-20
J-12	Boyce/Millwood	TRUE	500.00	2345.61	501.66	2347.27	20.00	24.40	20.00	20.00	J-91	20.00	20.00	J-91
J-11	Boyce/Millwood	TRUE	500.00	2414.63	502.15	2416.78	20.00	20.00	20.00	20.40	FH-5	20.00	20.40	FH-5
J-34	Boyce/Millwood	TRUE	500.00	2526.33	501.17	2527.50	20.00	21.53	20.00	20.00	FH-32	20.00	20.00	FH-32
J-5	Boyce/Millwood	TRUE	500.00	2670.22	501.66	2671.88	20.00	20.00	20.00	20.59	J-50	20.00	20.59	J-50
J-13	Boyce/Millwood	TRUE	500.00	2699.14	501.17	2700.31	20.00	20.00	20.00	20.36	FH-6	20.00	20.36	FH-6
J-6	Boyce/Millwood	TRUE	500.00	2901.69	501.17	2902.86	20.00	20.43	20.00	20.00	J-58	20.00	20.00	J-58
J-2	Boyce/Millwood	TRUE	500.00	3000.00	501.42	3001.42	20.00	39.92	20.00	40.34	J-117	20.00	40.34	J-117
FH-30	Boyce/Millwood	TRUE	500.00	3000.00	501.91	3001.91	20.00	49.35	20.00	40.82	J-111	20.00	40.82	J-111
J-38	Boyce/Millwood	TRUE	500.00	3000.00	502.15	3002.15	20.00	26.85	20.00	23.45	J-118	20.00	23.45	J-118
J-39	Boyce/Millwood	TRUE	500.00	3000.00	500.92	3000.92	20.00	28.47	20.00	29.46	J-91	20.00	29.46	J-91
FH-21	White_Post	TRUE	500.00	3000.00	502.15	3002.15	20.00	29.89	20.00	24.51	J-75	20.00	24.51	J-75
J-119	Boyce/Millwood	TRUE	500.00	3000.00	500.00	3000.00	20.00	26.31	20.00	25.79	J-111	20.00	25.79	J-111

CLARKE COUNTY SANITARY AUTHORITY

PROPOSED WATER SYSTEM
TWICE AVERAGE DAILY DEMAND
ALL TANKS AT NORMAL LOW LEVEL,
WHITE POST FIRE PUMP ON, WTP ON

AVAILABLE FIRE FLOW

- 0 - 250 GPM
- 250 - 500 GPM
- 500 - 750 GPM
- 750 - 1000 GPM
- 1000 - 1500 GPM
- 1500 - 2000 GPM
- > 2000 GPM



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SCALE IN FEET

RUN #8 - AVAILABLE FIRE FLOW EXHIBIT
JUNE 22, 2015

ANDERSON AND ASSOCIATES, Inc.

Run #9 – Extended period analysis of twice average daily demand plus 500 gpm 2 hour fire flow event at hydrant FH-38. Initial conditions are as follow:

Proposed Water System Improvements – Constructed
Boyce Tank – Normal Low
Millwood Tank – Normal Low
White Post Tank – Normal Low
Water Treatment Plant – On
White Post Pump Station – On.

Purpose – To identify if the proposed water system is capable of supporting the described fire flow event while maintaining 20 psi for all users in the system.

Result – The minimum required pressure of 20 psi is maintained for all users in the system for the duration of the fire flow event. Hydrants FH-39 and FH-40 fail to maintain 20 psi throughout the system for the entire fire flow duration when analyzed under a similar fire flow event.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 9 - Twice Average Daily Demand plus 500 gpm fire flow event at hydrant FH-38.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS On, & WTP Pump On.
Extended Period Analysis - Reported after 2 of 2 hours
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-39	560.00	Boyce/Millwood	1.17	614.55	23.60
FH-40	554.08	Boyce/Millwood	3.29	614.55	26.16
FH-36	558.14	Boyce/Millwood	3.29	626.83	29.72
FH-35	587.32	Boyce/Millwood	1.91	663.22	32.84
FH-38	534.15	Boyce/Millwood	501.17	614.55	34.78
J-2	610.00	Boyce/Millwood	1.42	697.44	37.83
FH-32	599.76	Boyce/Millwood	0.92	689.23	38.71
J-91	606.86	Boyce/Millwood	1.42	696.94	38.97
J-111	610.64	Boyce/Millwood	2.15	701.21	39.19
FH-5	605.84	Boyce/Millwood	4.37	696.82	39.36
J-39	602.18	Boyce/Millwood	0.92	697.31	41.16
J-58	600.56	Boyce/Millwood	3.38	696.61	41.56
J-11	599.91	Boyce/Millwood	2.15	696.91	41.97
FH-6	599.69	Boyce/Millwood	1.66	696.72	41.98
J-50	598.85	Boyce/Millwood	1.66	696.47	42.24
FH-33	581.47	Boyce/Millwood	2.15	679.41	42.37
J-37	598.00	Boyce/Millwood	1.42	696.93	42.80
FH-12	596.84	Boyce/Millwood	3.63	696.74	43.22
J-12	596.72	Boyce/Millwood	1.66	696.98	43.38
J-16	565.12	Boyce/Millwood	1.91	665.42	43.39
J-56	572.76	Boyce/Millwood	1.42	674.01	43.80
J-36	595.30	Boyce/Millwood	3.38	696.93	43.97
J-54	594.28	Boyce/Millwood	1.42	696.55	44.25
J-38	594.22	Boyce/Millwood	2.15	696.94	44.44
J-29	594.00	Boyce/Millwood	3.14	696.93	44.53
J-13	593.62	Boyce/Millwood	1.17	696.66	44.58
J-30	593.67	Boyce/Millwood	1.17	696.93	44.68
J-6	592.70	Boyce/Millwood	1.17	696.65	44.98
J-5	592.37	Boyce/Millwood	1.66	696.56	45.08
FH-34	566.63	Boyce/Millwood	1.91	671.09	45.19
J-88	591.09	Boyce/Millwood	2.40	695.70	45.26
FH-10	590.96	Boyce/Millwood	1.91	697.30	46.01
J-48	590.22	Boyce/Millwood	3.14	696.93	46.17
J-15	558.57	Boyce/Millwood	2.64	665.58	46.29
J-93	588.18	Boyce/Millwood	1.91	695.24	46.32
J-70	587.31	Boyce/Millwood	6.58	694.80	46.50
FH-3	588.55	Boyce/Millwood	1.42	696.38	46.65
J-45	587.66	Boyce/Millwood	1.91	696.55	47.11
J-14	588.00	Boyce/Millwood	1.17	696.94	47.14
J-34	590.00	Boyce/Millwood	1.17	699.30	47.29
J-3	586.89	Boyce/Millwood	2.40	696.36	47.36
J-7	586.03	Boyce/Millwood	0.68	696.94	47.99
J-110	590.21	Boyce/Millwood	2.64	701.67	48.22
J-18	585.30	Boyce/Millwood	1.91	696.94	48.30
J-119	589.09	Boyce/Millwood	0.00	700.83	48.34
FH-30	589.03	Boyce/Millwood	1.91	700.79	48.35
FH-7	584.92	Boyce/Millwood	0.92	696.94	48.47
J-17	584.61	Boyce/Millwood	1.17	696.94	48.60
FH-9	584.24	Boyce/Millwood	4.18	696.94	48.76
FH-8	583.74	Boyce/Millwood	0.92	696.94	48.98
J-81	582.80	Boyce/Millwood	5.10	696.57	49.22
J-118	582.00	Boyce/Millwood	0.00	695.98	49.31
FH-4	581.71	Boyce/Millwood	1.91	696.55	49.69
J-10	580.50	Boyce/Millwood	3.87	695.79	49.88
FH-11	580.00	Boyce/Millwood	2.15	695.71	50.06
J-71	581.24	Boyce/Millwood	2.40	697.30	50.21
J-43	576.17	Boyce/Millwood	2.15	695.39	51.58
J-72	577.84	Boyce/Millwood	2.15	697.30	51.68
J-117	575.00	Boyce/Millwood	0.00	695.71	52.22
J-87	575.25	Boyce/Millwood	4.37	696.57	52.49
J-79	542.18	Boyce/Millwood	1.91	665.58	53.39
FH-2	572.00	Boyce/Millwood	2.64	696.17	53.72
J-83	571.29	Boyce/Millwood	4.86	695.95	53.93
J-75	637.43	White_Post	1.17	762.18	53.97
J-52	636.38	White_Post	0.92	762.18	54.43
J-69	548.01	Boyce/Millwood	1.42	674.00	54.51
J-57	569.25	Boyce/Millwood	2.15	696.54	55.07
J-113	557.64	Boyce/Millwood	0.68	689.35	56.98
FH-26	630.00	White_Post	3.87	762.18	57.19
J-53	630.00	White_Post	1.66	762.18	57.19
J-19	630.00	White_Post	1.17	762.18	57.19
FH-22	630.00	White_Post	2.15	762.19	57.19
FH-23	629.31	White_Post	1.66	762.18	57.49
J-61	629.12	White_Post	2.40	762.19	57.58
J-64	561.35	Boyce/Millwood	1.42	696.34	58.40
FH-20	626.39	White_Post	2.15	762.57	58.92
FH-21	625.02	White_Post	2.15	762.22	59.36
FH-13	558.71	Boyce/Millwood	4.12	696.42	59.58
J-89	623.98	White_Post	4.12	762.18	59.79
FH-25	623.87	White_Post	1.17	762.18	59.84
J-86	558.00	Boyce/Millwood	1.91	696.33	59.85
FH-24	623.56	White_Post	2.40	762.18	59.97
FH-28	622.96	White_Post	1.91	762.18	60.23
J-109	560.00	Boyce/Millwood	2.15	699.29	60.26
FH-1	556.00	Boyce/Millwood	2.40	696.17	60.65
J-22	620.68	White_Post	1.17	762.18	61.22
J-21	620.00	White_Post	1.17	762.18	61.51
FH-27	619.66	White_Post	2.40	762.18	61.66
J-73	619.54	White_Post	2.40	762.18	61.71

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-41	522.12	Boyce/Millwood	4.12	666.54	62.48
J-26	615.16	White_Post	1.17	762.18	63.61
J-107	611.32	White_Post	0.68	762.34	65.34
FH-29	611.02	White_Post	1.66	762.18	65.40
J-25	610.52	White_Post	0.92	762.18	65.61
FH-19	609.26	White_Post	1.42	762.80	66.43
J-42	512.17	Boyce/Millwood	1.91	666.28	66.68
J-112	547.12	Boyce/Millwood	0.68	702.65	67.29
J-77	528.14	Boyce/Millwood	1.66	684.92	67.83
J-94	540.00	Boyce/Millwood	0.68	697.55	68.16
FH-42	515.59	Boyce/Millwood	4.12	673.46	68.30
FH-43	519.63	Boyce/Millwood	3.14	679.70	69.25
J-78	522.03	Boyce/Millwood	4.18	685.86	70.88
J-97	594.87	White_Post	0.92	762.66	72.60
J-103	594.00	White_Post	0.92	762.93	73.09
FH-18	593.08	White_Post	6.95	763.08	73.55
FH-16	592.75	White_Post	6.63	763.19	73.74
J-32	592.00	White_Post	1.17	763.16	74.05
J-51	492.81	Boyce/Millwood	1.42	666.28	75.05
FH-15	588.89	White_Post	2.89	763.38	75.49
FH-17	588.00	White_Post	4.18	763.16	75.78
J-95	584.95	White_Post	3.14	763.57	77.28
J-116	575.00	White_Post	0.00	763.90	81.73
FH-14	572.83	White_Post	2.40	763.84	82.64

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 9 - Twice Average Daily Demand plus 500 gpm fire flow event at hydrant FH-38.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS On, & WTP Pump On.
Extended Period Analysis - Reported after 2 of 2 hours
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-4.18	696.94	696.94	0.00	0.00
P-2	311.00	6.00	120.00	Open	4.18	763.16	763.16	0.00	0.00
P-3	22.00	8.00	120.00	Open	339.30	697.50	697.44	0.06	0.00
P-4	867.00	2.00	120.00	Open	-1.91	695.24	695.39	0.14	0.00
P-5	327.00	4.00	120.00	Open	1.42	696.55	696.55	0.00	0.00
P-6	198.00	8.00	120.00	Open	1.42	696.93	696.93	0.00	0.00
P-7	150.00	8.00	120.00	Open	1.17	696.93	696.93	0.00	0.00
P-8	324.00	8.00	120.00	Open	-5.00	696.93	696.93	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.69	696.93	696.93	0.00	0.00
P-10	498.00	8.00	120.00	Open	4.10	696.93	696.93	0.00	0.00
P-11	391.00	8.00	120.00	Open	12.24	696.94	696.93	0.00	0.00
P-12	758.00	8.00	120.00	Open	4.37	696.57	696.57	0.00	0.00
P-13	596.00	8.00	120.00	Open	-14.92	762.21	762.22	0.01	0.00
P-14	505.00	6.00	120.00	Open	-505.63	614.55	626.83	12.29	0.02
P-15	532.00	6.00	120.00	Open	-4.46	614.55	614.55	0.00	0.00
P-16	290.00	6.00	120.00	Open	-3.29	614.55	614.55	0.00	0.00
P-17	598.00	4.00	120.00	Open	-1.42	674.00	674.01	0.00	0.00
P-18	541.00	4.00	120.00	Open	-16.92	696.38	696.55	0.18	0.00
P-19	696.00	6.00	120.00	Open	-1.91	696.33	696.34	0.00	0.00
P-20	560.00	6.00	120.00	Open	24.43	696.66	696.61	0.05	0.00
P-21	492.00	6.00	120.00	Open	-34.80	696.47	696.56	0.08	0.00
P-22	680.00	2.00	120.00	Open	-4.56	695.79	696.36	0.57	0.00
P-23	746.00	4.00	120.00	Open	-2.40	695.70	695.71	0.01	0.00
P-24	399.00	8.00	120.00	Open	216.61	697.44	696.94	0.50	0.00
P-25	320.00	8.00	120.00	Open	-121.27	697.31	697.44	0.14	0.00
P-26	185.00	12.00	120.00	Open	246.16	700.83	700.79	0.04	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	1.17	762.18	762.18	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.92	762.18	762.18	0.00	0.00
P-29	561.00	8.00	120.00	Open	3.75	762.18	762.18	0.00	0.00
P-30	601.00	8.00	120.00	Open	1.17	762.18	762.18	0.00	0.00
P-31	146.00	8.00	120.00	Open	1.17	762.18	762.18	0.00	0.00
P-32	98.00	8.00	120.00	Open	3.51	762.18	762.18	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.92	762.18	762.18	0.00	0.00
P-34	698.00	8.00	120.00	Open	4.76	762.18	762.18	0.00	0.00
P-35	743.00	8.00	120.00	Open	7.16	762.18	762.18	0.00	0.00
P-36	894.00	8.00	120.00	Open	-0.09	762.18	762.18	0.00	0.00
P-37	417.00	8.00	120.00	Open	-9.75	762.18	762.18	0.00	0.00
P-38	1087.00	8.00	120.00	Open	6.07	762.18	762.18	0.00	0.00
P-39	758.00	8.00	120.00	Open	7.97	762.18	762.18	0.00	0.00
P-40	1294.00	8.00	120.00	Open	2.40	762.18	762.18	0.00	0.00
P-41	1283.00	8.00	120.00	Open	6.27	762.18	762.18	0.00	0.00
P-42	396.00	8.00	120.00	Open	-18.96	762.19	762.19	0.01	0.00
P-43	803.00	8.00	120.00	Open	-16.81	762.18	762.19	0.01	0.00
P-44	866.00	8.00	120.00	Open	1.56	762.18	762.18	0.00	0.00
P-45	150.00	8.00	120.00	Open	3.22	762.18	762.18	0.00	0.00
P-46	1764.00	8.00	120.00	Open	14.14	762.19	762.18	0.01	0.00
P-47	573.00	8.00	120.00	Open	35.49	762.22	762.19	0.03	0.00
P-48	1343.00	8.00	120.00	Open	52.57	762.34	762.22	0.12	0.00
P-49	2431.00	8.00	120.00	Open	53.25	762.57	762.34	0.23	0.00
P-50	978.00	8.00	120.00	Open	55.40	762.66	762.57	0.10	0.00
P-51	1346.00	8.00	120.00	Open	56.32	762.80	762.66	0.14	0.00
P-52	1207.00	8.00	120.00	Open	57.74	762.93	762.80	0.13	0.00
P-53	1377.00	8.00	120.00	Open	58.66	763.08	762.93	0.15	0.00
P-54	556.00	8.00	120.00	Open	65.61	763.16	763.08	0.08	0.00
P-55	198.00	8.00	120.00	Open	70.96	763.19	763.16	0.03	0.00
P-56	996.00	8.00	120.00	Open	77.59	763.38	763.19	0.19	0.00
P-57	959.00	8.00	120.00	Open	80.48	763.57	763.38	0.19	0.00
P-58	1275.00	8.00	120.00	Open	83.62	763.84	763.57	0.27	0.00
P-59A	268.00	8.00	120.00	Open	-86.01	763.84	763.90	0.06	0.00
P-59B	25.00	8.00	120.00	Open	-86.01	763.90	763.91	0.01	0.00
P-59C	25.00	8.00	120.00	Open	-86.01	695.70	695.71	0.01	0.00
P-59D	1211.00	8.00	120.00	Open	-86.01	695.71	695.98	0.27	0.00
P-59E	32.00	8.00	120.00	Open	0.00	763.90	763.90	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	695.71	695.71	0.00	0.00
P-60	1927.00	8.00	120.00	Open	-86.01	695.98	696.42	0.43	0.00
P-61	623.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-61A	623.00	8.00	121.00	Open	90.13	696.57	696.42	0.15	0.00
P-62	605.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62A	605.00	8.00	121.00	Open	99.60	696.74	696.57	0.18	0.00
P-63	647.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63A	647.00	8.00	121.00	Open	103.23	696.94	696.74	0.20	0.00
P-64	198.00	6.00	120.00	Open	-111.23	696.65	696.94	0.29	0.00
P-65	657.00	4.00	120.00	Open	-2.15	697.30	697.30	0.00	0.00
P-66	660.00	4.00	120.00	Open	2.40	697.30	697.30	0.01	0.00
P-67	206.00	6.00	120.00	Open	6.46	697.31	697.30	0.00	0.00
P-68	211.00	6.00	120.00	Open	-113.89	696.98	697.31	0.32	0.00
P-69	778.00	6.00	120.00	Open	1.42	696.94	696.94	0.00	0.00
P-70	85.00	6.00	120.00	Open	15.56	696.94	696.94	0.00	0.00
P-71	157.00	8.00	120.00	Open	16.73	696.94	696.94	0.00	0.00
P-72	105.00	8.00	120.00	Open	17.65	696.94	696.94	0.00	0.00
P-73	48.00	8.00	120.00	Open	18.58	696.94	696.94	0.00	0.00
P-74	79.00	8.00	120.00	Open	23.44	696.94	696.94	0.00	0.00
P-75	398.00	6.00	120.00	Open	24.60	696.98	696.94	0.04	0.00
P-76	70.00	6.00	120.00	Open	-87.63	696.91	696.98	0.07	0.00
P-77	542.00	6.00	120.00	Open	-27.62	696.55	696.61	0.06	0.00
P-78	270.00	6.00	120.00	Open	-7.38	696.55	696.55	0.00	0.00
P-79	347.00	4.00	120.00	Open	-5.47	696.54	696.55	0.01	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-3.32	696.34	696.54	0.20	0.00
P-81	1620.00	8.00	120.00	Open	159.51	695.95	694.80	1.15	0.00
P-82	3361.00	8.00	120.00	Open	-249.76	689.35	694.80	5.45	0.00
P-83	2159.00	8.00	120.00	Open	-249.09	685.86	689.35	3.49	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	-244.91	684.92	685.86	0.94	0.00
P-85	615.00	6.00	120.00	Open	-52.75	695.95	696.17	0.23	0.00
P-86	441.00	6.00	120.00	Open	-58.43	696.72	696.91	0.20	0.00
P-87	129.00	6.00	120.00	Open	-56.77	696.66	696.72	0.05	0.00
P-88	71.00	6.00	120.00	Open	-31.17	696.65	696.66	0.01	0.00
P-89	41.00	6.00	120.00	Open	-141.23	696.56	696.65	0.09	0.00
P-90	583.00	6.00	120.00	Open	-104.76	695.79	696.56	0.77	0.00
P-91	63.00	6.00	120.00	Open	-105.45	695.71	695.79	0.08	0.00
P-92	258.00	6.00	120.00	Open	-100.90	695.39	695.71	0.32	0.00
P-93	516.00	6.00	120.00	Open	-96.84	694.80	695.39	0.59	0.00
P-94	860.00	6.00	120.00	Open	-27.04	696.82	696.91	0.09	0.00
P-95	375.00	4.00	120.00	Open	-22.68	696.61	696.82	0.21	0.00
P-96	467.00	4.00	120.00	Open	-16.11	696.47	696.61	0.14	0.00
P-97	300.00	6.00	120.00	Open	-49.25	696.38	696.47	0.10	0.00
P-98	33.00	6.00	120.00	Open	-64.75	696.36	696.38	0.02	0.00
P-99	422.00	6.00	120.00	Open	-57.79	696.17	696.36	0.18	0.00
P-100	1029.00	4.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-100A	1029.00	6.00	121.00	Open	2.40	696.17	696.17	0.00	0.00
P-101	1478.00	6.00	120.00	Open	508.91	663.22	626.83	36.39	0.03
P-102	608.00	6.00	120.00	Open	-293.47	674.01	679.41	5.40	0.01
P-103	334.00	6.00	120.00	Open	-290.64	671.09	674.01	2.91	0.01
P-104	913.00	6.00	120.00	Open	-288.73	663.22	671.09	7.87	0.01
P-105	415.00	6.00	120.00	Open	222.09	665.42	663.22	2.20	0.01
P-106	82.00	6.00	120.00	Open	126.44	665.58	665.42	0.15	0.00
P-107	482.00	6.00	120.00	Open	130.99	666.54	665.58	0.96	0.00
P-108	1167.00	6.00	120.00	Open	235.99	673.46	666.54	6.92	0.01
P-109	1019.00	6.00	120.00	Open	240.11	679.70	673.46	6.24	0.01
P-110	832.00	6.00	120.00	Open	243.24	684.92	679.70	5.22	0.01
P-111	2178.00	2.00	120.00	Open	2.15	701.67	701.21	0.45	0.00
P-112	2060.00	6.00	120.00	Open	-60.41	701.67	702.65	0.98	0.00
P-113	1535.00	4.00	120.00	Open	2.15	699.30	699.29	0.01	0.00
P-114	1091.00	6.00	120.00	Open	295.62	689.23	679.41	9.82	0.01
P-115	1112.00	6.00	120.00	Open	296.55	699.30	689.23	10.07	0.01
P-116	161.00	6.00	120.00	Open	299.87	700.79	699.30	1.49	0.01
P-117A	2061.00	6.00	120.00	Open	55.62	701.67	700.83	0.84	0.00
P-117B	100.00	6.00	120.00	Open	55.62	700.83	700.79	0.04	0.00
P-118	1082.00	6.00	120.00	Open	111.61	697.55	695.95	1.60	0.00
P-119	3401.00	6.00	120.00	Open	112.29	702.65	697.55	5.10	0.00
P-120	211.00	6.00	120.00	Open	100.88	666.54	666.28	0.26	0.00
P-121	335.00	6.00	120.00	Open	1.42	666.28	666.28	0.00	0.00
P-122	740.00	6.00	120.00	Open	-97.56	665.42	666.28	0.85	0.00
P-123	605.00	6.00	120.00	Open	1.91	665.58	665.58	0.00	0.00
P-124	1.00	2.00	120.00	Open	173.38	540.00	539.29	0.71	0.71
P-125	80.00	2.00	120.00	Open	173.38	759.19	702.65	56.54	0.71

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 9 - Twice Average Daily Demand plus 500 gpm fire flow event at hydrant FH-38.
Proposed Water System.
All Tanks at Normal Low Level, White Post PS On, & WTP Pump On.
Extended Period Analysis - Reported after 2 of 2 hours
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.00	713.00	28.00	-339.30	697.50
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.00	712.00	28.00	-246.16	700.83
White_Post_Tank	625.00	746.00	761.00	765.00	22.00	14.92	762.21
R-WTP	--	--	--	--	--	-173.38	540.00

Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	On	539.29	759.19	173.38	219.90
PMP-White_Post	575.00	On	695.70	763.91	86.01	68.20

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	763.90	695.71	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

Run #10 – Extended period analysis of twice average daily demand plus 750 gpm 2 hour fire flow event at hydrant FH-27. Initial conditions are as follow:

Proposed Water System Improvements – Constructed

Boyce Tank – Normal Low

Millwood Tank – Normal Low

White Post Tank – Normal Low

Water Treatment Plant – On

White Post Pump Station – Fire Pump On.

Purpose – To identify if the proposed water system is capable of supporting the described fire flow event while maintaining 20 psi for all users in the system.

Result – The minimum required pressure of 20 psi is maintained for all users in the system for the duration of the fire flow event.

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 10 - Twice Average Daily Demand plus 750 gpm fire flow event at hydrant FH-27.
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Extended Period Analysis - Reported after 2 of 2 hours
Junction Report - sorted by pressure

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH-27	619.66	White_Post	752.40	701.64	35.47
J-117	575.00	Boyce/Millwood	0.00	659.05	36.36
J-2	610.00	Boyce/Millwood	1.42	694.07	36.37
J-118	582.00	Boyce/Millwood	0.00	667.13	36.83
J-91	606.86	Boyce/Millwood	1.42	693.81	37.62
FH-26	630.00	White_Post	3.87	717.83	38.00
FH-5	605.84	Boyce/Millwood	4.37	693.82	38.06
FH-12	596.84	Boyce/Millwood	3.63	688.32	39.58
J-39	602.18	Boyce/Millwood	0.92	694.00	39.73
J-58	600.56	Boyce/Millwood	3.38	693.81	40.34
J-11	599.91	Boyce/Millwood	2.15	693.84	40.64
FH-6	599.69	Boyce/Millwood	1.66	693.76	40.70
J-111	610.64	Boyce/Millwood	2.15	705.49	41.03
J-50	598.85	Boyce/Millwood	1.66	693.96	41.15
J-37	598.00	Boyce/Millwood	1.42	693.81	41.45
J-12	596.72	Boyce/Millwood	1.66	693.86	42.03
J-75	637.43	White_Post	1.17	734.72	42.09
J-36	595.30	Boyce/Millwood	3.38	693.81	42.62
J-38	594.22	Boyce/Millwood	2.15	692.83	42.66
J-52	636.38	White_Post	0.92	735.16	42.74
J-54	594.28	Boyce/Millwood	1.42	693.83	43.07
J-29	594.00	Boyce/Millwood	3.14	693.81	43.18
J-13	593.62	Boyce/Millwood	1.17	693.73	43.32
J-30	593.67	Boyce/Millwood	1.17	693.81	43.33
J-6	592.70	Boyce/Millwood	1.17	693.70	43.70
J-81	582.80	Boyce/Millwood	5.10	684.15	43.85
J-5	592.37	Boyce/Millwood	1.66	693.78	43.88
FH-10	590.96	Boyce/Millwood	1.91	694.00	44.58
J-88	591.09	Boyce/Millwood	2.40	694.39	44.69
J-48	590.22	Boyce/Millwood	3.14	693.81	44.82
FH-32	599.76	Boyce/Millwood	0.92	703.76	44.99
J-53	630.00	White_Post	1.66	735.16	45.50
J-19	630.00	White_Post	1.17	735.30	45.56
FH-3	588.55	Boyce/Millwood	1.42	694.15	45.69
FH-23	629.31	White_Post	1.66	735.11	45.78
J-14	588.00	Boyce/Millwood	1.17	693.82	45.78
J-45	587.66	Boyce/Millwood	1.91	693.83	45.93
J-93	588.18	Boyce/Millwood	1.91	694.55	46.02
J-3	586.89	Boyce/Millwood	2.40	694.19	46.42
J-7	586.03	Boyce/Millwood	0.68	693.82	46.64
FH-22	630.00	White_Post	2.15	738.00	46.72
J-70	587.31	Boyce/Millwood	6.58	695.33	46.73
J-18	585.30	Boyce/Millwood	1.91	693.81	46.95
J-87	575.25	Boyce/Millwood	4.37	684.15	47.11
FH-7	584.92	Boyce/Millwood	0.92	693.82	47.12
J-17	584.61	Boyce/Millwood	1.17	693.82	47.25
FH-9	584.24	Boyce/Millwood	4.18	693.82	47.41
J-89	623.98	White_Post	4.12	734.03	47.61
FH-8	583.74	Boyce/Millwood	0.92	693.82	47.63
FH-25	623.87	White_Post	1.17	734.72	47.96
J-61	629.12	White_Post	2.40	739.97	47.96
FH-28	622.96	White_Post	1.91	734.21	48.13
FH-24	623.56	White_Post	2.40	734.93	48.19
FH-35	587.32	Boyce/Millwood	1.91	699.37	48.48
FH-4	581.71	Boyce/Millwood	1.91	693.82	48.51
J-71	581.24	Boyce/Millwood	2.40	694.00	48.79
J-10	580.50	Boyce/Millwood	3.87	694.33	49.25
J-22	620.68	White_Post	1.17	734.72	49.34
FH-11	580.00	Boyce/Millwood	2.15	694.39	49.49
J-21	620.00	White_Post	1.17	734.72	49.63
J-73	619.54	White_Post	2.40	734.47	49.73
J-34	590.00	Boyce/Millwood	1.17	705.52	49.98
J-110	590.21	Boyce/Millwood	2.64	705.94	50.07
J-72	577.84	Boyce/Millwood	2.15	694.00	50.26
J-119	589.09	Boyce/Millwood	0.00	705.80	50.50
FH-30	589.03	Boyce/Millwood	1.91	705.79	50.52
J-43	576.17	Boyce/Millwood	2.15	694.69	51.28
J-26	615.16	White_Post	1.17	734.47	51.62
FH-33	581.47	Boyce/Millwood	2.15	702.05	52.17
FH-13	558.71	Boyce/Millwood	4.12	680.00	52.48
FH-2	572.00	Boyce/Millwood	2.64	694.66	53.07
FH-21	625.02	White_Post	2.15	747.73	53.09
FH-29	611.02	White_Post	1.66	734.47	53.41
J-25	610.52	White_Post	0.92	734.47	53.63
J-83	571.29	Boyce/Millwood	4.86	695.41	53.70
J-57	569.25	Boyce/Millwood	2.15	693.81	53.89
J-56	572.76	Boyce/Millwood	1.42	701.13	55.54
J-64	561.35	Boyce/Millwood	1.42	693.61	57.22
J-16	565.12	Boyce/Millwood	1.91	698.90	57.88
FH-34	566.63	Boyce/Millwood	1.91	700.65	57.98
J-86	558.00	Boyce/Millwood	1.91	693.61	58.67
J-113	557.64	Boyce/Millwood	0.68	695.84	59.79
FH-1	556.00	Boyce/Millwood	2.40	694.66	59.99
FH-39	560.00	Boyce/Millwood	1.17	699.35	60.29
J-15	558.57	Boyce/Millwood	2.64	698.86	60.70
FH-36	558.14	Boyce/Millwood	3.29	699.35	61.10
FH-20	626.39	White_Post	2.15	770.13	62.19
J-107	611.32	White_Post	0.68	755.69	62.46
FH-40	554.08	Boyce/Millwood	3.29	699.35	62.85

Node Label	Elevation (ft)	Pressure Zone	Demand (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-109	560.00	Boyce/Millwood	2.15	705.51	62.96
J-69	548.01	Boyce/Millwood	1.42	701.13	66.25
J-79	542.18	Boyce/Millwood	1.91	698.86	67.79
J-94	540.00	Boyce/Millwood	0.68	697.99	68.35
J-112	547.12	Boyce/Millwood	0.68	706.15	68.80
FH-38	534.15	Boyce/Millwood	1.17	699.35	71.47
J-77	528.14	Boyce/Millwood	1.66	696.28	72.75
J-78	522.03	Boyce/Millwood	4.18	696.18	75.35
FH-19	609.26	White_Post	1.42	784.07	75.63
FH-41	522.12	Boyce/Millwood	4.12	698.69	76.39
FH-43	519.63	Boyce/Millwood	3.14	696.89	76.69
J-97	594.87	White_Post	0.92	775.98	78.36
FH-42	515.59	Boyce/Millwood	4.12	697.69	78.79
J-42	512.17	Boyce/Millwood	1.91	698.73	80.72
J-103	594.00	White_Post	0.92	791.35	85.39
J-51	492.81	Boyce/Millwood	1.42	698.73	89.09
FH-18	593.08	White_Post	6.95	799.70	89.39
J-32	592.00	White_Post	1.17	803.15	91.35
FH-16	592.75	White_Post	6.63	804.40	91.57
FH-17	588.00	White_Post	4.18	803.15	93.08
FH-15	588.89	White_Post	2.89	810.86	96.04
J-95	584.95	White_Post	3.14	817.14	100.46
J-116	575.00	White_Post	0.00	827.37	109.19
FH-14	572.83	White_Post	2.40	825.58	109.35

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 10 - Twice Average Daily Demand plus 750 gpm fire flow event at hydrant FH-27.
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Extended Period Analysis - Reported after 2 of 2 hours
Pipe Report - sorted by link label

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	490.00	6.00	120.00	Open	-4.18	693.82	693.82	0.00	0.00
P-2	311.00	6.00	120.00	Open	4.18	803.15	803.15	0.00	0.00
P-3	22.00	8.00	120.00	Open	437.52	694.17	694.07	0.10	0.01
P-4	867.00	2.00	120.00	Open	-1.91	694.55	694.69	0.14	0.00
P-5	327.00	4.00	120.00	Open	1.42	693.83	693.83	0.00	0.00
P-6	198.00	8.00	120.00	Open	1.42	693.81	693.81	0.00	0.00
P-7	150.00	8.00	120.00	Open	1.17	693.81	693.81	0.00	0.00
P-8	324.00	8.00	120.00	Open	-5.00	693.81	693.81	0.00	0.00
P-9	824.00	8.00	120.00	Open	-0.69	693.81	693.81	0.00	0.00
P-10	498.00	8.00	120.00	Open	4.10	693.81	693.81	0.00	0.00
P-11	391.00	8.00	120.00	Open	12.24	693.81	693.81	0.00	0.00
P-12	758.00	8.00	120.00	Open	4.37	684.15	684.15	0.00	0.00
P-13	596.00	8.00	120.00	Open	285.07	748.97	747.73	1.24	0.00
P-14	505.00	6.00	120.00	Open	-5.63	699.35	699.35	0.00	0.00
P-15	532.00	6.00	120.00	Open	-4.46	699.35	699.35	0.00	0.00
P-16	290.00	6.00	120.00	Open	-3.29	699.35	699.35	0.00	0.00
P-17	598.00	4.00	120.00	Open	-1.42	701.13	701.13	0.00	0.00
P-18	541.00	4.00	120.00	Open	23.58	694.15	693.83	0.32	0.00
P-19	696.00	6.00	120.00	Open	-1.91	693.61	693.61	0.00	0.00
P-20	560.00	6.00	120.00	Open	-31.17	693.73	693.81	0.08	0.00
P-21	492.00	6.00	120.00	Open	51.99	693.96	693.78	0.18	0.00
P-22	680.00	2.00	120.00	Open	2.13	694.33	694.19	0.14	0.00
P-23	746.00	4.00	120.00	Open	-2.40	694.39	694.39	0.01	0.00
P-24	399.00	8.00	120.00	Open	354.90	694.07	692.83	1.24	0.00
P-25	320.00	8.00	120.00	Open	-81.20	694.00	694.07	0.06	0.00
P-26	185.00	12.00	120.00	Open	99.93	705.80	705.79	0.01	0.00
P-26A	185.00	12.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-27	121.00	8.00	120.00	Open	1.17	734.47	734.47	0.00	0.00
P-28	116.00	8.00	120.00	Open	0.92	734.47	734.47	0.00	0.00
P-29	561.00	8.00	120.00	Open	3.75	734.47	734.47	0.00	0.00
P-30	601.00	8.00	120.00	Open	1.17	734.72	734.72	0.00	0.00
P-31	146.00	8.00	120.00	Open	1.17	734.72	734.72	0.00	0.00
P-32	98.00	8.00	120.00	Open	3.51	734.72	734.72	0.00	0.00
P-33	321.00	8.00	120.00	Open	-0.92	735.16	735.16	0.00	0.00
P-34	698.00	8.00	120.00	Open	100.64	734.93	734.72	0.21	0.00
P-35	743.00	8.00	120.00	Open	103.04	735.16	734.93	0.23	0.00
P-36	894.00	8.00	120.00	Open	-95.96	734.47	734.72	0.25	0.00
P-37	417.00	8.00	120.00	Open	-105.62	735.16	735.30	0.14	0.00
P-38	1087.00	8.00	120.00	Open	-89.81	734.21	734.47	0.27	0.00
P-39	758.00	8.00	120.00	Open	-87.90	734.03	734.21	0.18	0.00
P-40	1294.00	8.00	120.00	Open	752.40	717.83	701.64	16.19	0.01
P-41	1283.00	8.00	120.00	Open	756.27	734.03	717.83	16.20	0.01
P-42	396.00	8.00	120.00	Open	-457.80	738.00	739.97	1.97	0.01
P-43	803.00	8.00	120.00	Open	-455.64	734.03	738.00	3.97	0.01
P-44	866.00	8.00	120.00	Open	216.84	735.11	734.03	1.08	0.00
P-45	150.00	8.00	120.00	Open	218.51	735.30	735.11	0.19	0.00
P-46	1764.00	8.00	120.00	Open	325.30	739.97	735.30	4.67	0.00
P-47	573.00	8.00	120.00	Open	785.49	747.73	739.97	7.76	0.01
P-48	1343.00	8.00	120.00	Open	502.57	755.69	747.73	7.96	0.01
P-49	2431.00	8.00	120.00	Open	503.25	770.13	755.69	14.44	0.01
P-50	978.00	8.00	120.00	Open	505.40	775.98	770.13	5.85	0.01
P-51	1346.00	8.00	120.00	Open	506.33	784.07	775.98	8.08	0.01
P-52	1207.00	8.00	120.00	Open	507.74	791.35	784.07	7.29	0.01
P-53	1377.00	8.00	120.00	Open	508.67	799.70	791.35	8.34	0.01
P-54	556.00	8.00	120.00	Open	515.62	803.15	799.70	3.45	0.01
P-55	198.00	8.00	120.00	Open	520.97	804.40	803.15	1.25	0.01
P-56	996.00	8.00	120.00	Open	527.59	810.86	804.40	6.46	0.01
P-57	959.00	8.00	120.00	Open	530.48	817.14	810.86	6.28	0.01
P-58	1275.00	8.00	120.00	Open	533.62	825.58	817.14	8.44	0.01
P-59A	268.00	8.00	120.00	Open	-536.02	825.58	827.37	1.79	0.01
P-59B	25.00	8.00	120.00	Open	-536.02	827.37	827.54	0.17	0.01
P-59C	25.00	8.00	120.00	Open	-536.02	658.88	659.05	0.17	0.01
P-59D	1211.00	8.00	120.00	Open	-536.02	659.05	667.13	8.08	0.01
P-59E	32.00	8.00	120.00	Open	0.00	827.37	827.37	0.00	0.00
P-59F	32.00	8.00	120.00	Open	0.00	659.05	659.05	0.00	0.00
P-60	1927.00	8.00	120.00	Open	-536.02	667.13	680.00	12.86	0.01
P-61	623.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-61A	623.00	8.00	121.00	Open	540.14	684.15	680.00	4.15	0.01
P-62	605.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-62A	605.00	8.00	121.00	Open	549.61	688.32	684.15	4.17	0.01
P-63	647.00	6.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-63A	647.00	8.00	121.00	Open	553.24	692.83	688.32	4.51	0.01
P-64	198.00	6.00	120.00	Open	200.49	693.70	692.83	0.87	0.00
P-65	657.00	4.00	120.00	Open	-2.15	694.00	694.00	0.00	0.00
P-66	660.00	4.00	120.00	Open	2.40	694.00	694.00	0.01	0.00
P-67	206.00	6.00	120.00	Open	6.46	694.00	694.00	0.00	0.00
P-68	211.00	6.00	120.00	Open	-73.82	693.86	694.00	0.15	0.00
P-69	778.00	6.00	120.00	Open	1.42	693.81	693.81	0.00	0.00
P-70	85.00	6.00	120.00	Open	15.56	693.82	693.81	0.00	0.00
P-71	157.00	8.00	120.00	Open	16.73	693.82	693.82	0.00	0.00
P-72	105.00	8.00	120.00	Open	17.65	693.82	693.82	0.00	0.00
P-73	48.00	8.00	120.00	Open	18.58	693.82	693.82	0.00	0.00
P-74	79.00	8.00	120.00	Open	23.44	693.82	693.82	0.00	0.00
P-75	398.00	6.00	120.00	Open	24.60	693.86	693.82	0.04	0.00
P-76	70.00	6.00	120.00	Open	-47.55	693.84	693.86	0.02	0.00
P-77	542.00	6.00	120.00	Open	12.88	693.83	693.81	0.01	0.00
P-78	270.00	6.00	120.00	Open	-7.38	693.82	693.83	0.00	0.00
P-79	347.00	4.00	120.00	Open	-5.47	693.81	693.82	0.01	0.00

Link Label	Length (ft)	Diameter (in)	Roughness Coefficient	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)	Headloss Gradient (ft/1000ft)
P-80	430.00	2.00	120.00	Open	-3.32	693.61	693.81	0.20	0.00
P-81	1620.00	8.00	120.00	Open	38.44	695.41	695.33	0.08	0.00
P-82	3361.00	8.00	120.00	Open	69.57	695.84	695.33	0.51	0.00
P-83	2159.00	8.00	120.00	Open	70.25	696.18	695.84	0.33	0.00
P-83A	1562.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83B	100.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-83C	497.00	8.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-84	600.00	8.00	120.00	Open	74.43	696.28	696.18	0.10	0.00
P-85	615.00	6.00	120.00	Open	100.77	695.41	694.66	0.75	0.00
P-86	441.00	6.00	120.00	Open	-36.17	693.76	693.84	0.08	0.00
P-87	129.00	6.00	120.00	Open	-34.51	693.73	693.76	0.02	0.00
P-88	71.00	6.00	120.00	Open	-64.52	693.70	693.73	0.04	0.00
P-89	41.00	6.00	120.00	Open	137.14	693.78	693.70	0.09	0.00
P-90	583.00	6.00	120.00	Open	86.81	694.33	693.78	0.54	0.00
P-91	63.00	6.00	120.00	Open	92.82	694.39	694.33	0.07	0.00
P-92	258.00	6.00	120.00	Open	97.37	694.69	694.39	0.30	0.00
P-93	516.00	6.00	120.00	Open	101.43	695.33	694.69	0.64	0.00
P-94	860.00	6.00	120.00	Open	-9.23	693.82	693.84	0.01	0.00
P-95	375.00	4.00	120.00	Open	-4.86	693.81	693.82	0.01	0.00
P-96	467.00	4.00	120.00	Open	16.81	693.96	693.81	0.15	0.00
P-97	300.00	6.00	120.00	Open	70.46	694.15	693.96	0.19	0.00
P-98	33.00	6.00	120.00	Open	95.46	694.19	694.15	0.04	0.00
P-99	422.00	6.00	120.00	Open	95.73	694.66	694.19	0.47	0.00
P-100	1029.00	4.00	120.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
P-100A	1029.00	6.00	121.00	Open	2.40	694.66	694.66	0.00	0.00
P-101	1478.00	6.00	120.00	Open	8.91	699.37	699.35	0.02	0.00
P-102	608.00	6.00	120.00	Open	-112.80	701.13	702.05	0.92	0.00
P-103	334.00	6.00	120.00	Open	-109.97	700.65	701.13	0.48	0.00
P-104	913.00	6.00	120.00	Open	-108.06	699.37	700.65	1.27	0.00
P-105	415.00	6.00	120.00	Open	-97.24	698.90	699.37	0.48	0.00
P-106	82.00	6.00	120.00	Open	-55.60	698.86	698.90	0.03	0.00
P-107	482.00	6.00	120.00	Open	-51.05	698.69	698.86	0.17	0.00
P-108	1167.00	6.00	120.00	Open	-83.34	697.69	698.69	1.01	0.00
P-109	1019.00	6.00	120.00	Open	-79.22	696.89	697.69	0.80	0.00
P-110	832.00	6.00	120.00	Open	-76.09	696.28	696.89	0.61	0.00
P-111	2178.00	2.00	120.00	Open	2.15	705.94	705.49	0.45	0.00
P-112	2060.00	6.00	120.00	Open	-25.97	705.94	706.15	0.21	0.00
P-113	1535.00	4.00	120.00	Open	2.15	705.52	705.51	0.01	0.00
P-114	1091.00	6.00	120.00	Open	114.95	703.76	702.05	1.71	0.00
P-115	1112.00	6.00	120.00	Open	115.88	705.52	703.76	1.77	0.00
P-116	161.00	6.00	120.00	Open	119.20	705.79	705.52	0.27	0.00
P-117A	2061.00	6.00	120.00	Open	21.17	705.94	705.80	0.14	0.00
P-117B	100.00	6.00	120.00	Open	21.17	705.80	705.79	0.01	0.00
P-118	1082.00	6.00	120.00	Open	144.07	697.99	695.41	2.57	0.00
P-119	3401.00	6.00	120.00	Open	144.74	706.15	697.99	8.16	0.00
P-120	211.00	6.00	120.00	Open	-36.41	698.69	698.73	0.04	0.00
P-121	335.00	6.00	120.00	Open	1.42	698.73	698.73	0.00	0.00
P-122	740.00	6.00	120.00	Open	39.73	698.90	698.73	0.16	0.00
P-123	605.00	6.00	120.00	Open	1.91	698.86	698.86	0.00	0.00
P-124	1.00	2.00	120.00	Open	171.39	540.00	539.31	0.69	0.69
P-125	80.00	2.00	120.00	Open	171.39	761.49	706.15	55.35	0.69

CLARKE COUNTY WATER SYSTEM
HYDRAULIC ANALYSIS
JUNE 22, 2015

Run 10 - Twice Average Daily Demand plus 750 gpm fire flow event at hydrant FH-27.
Proposed Water System.
All Tanks at Normal Low Level, White Post Fire Pump On, & WTP Pump On.
Extended Period Analysis - Reported after 2 of 2 hours
Tank Report

Node Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial Elevation (ft)	Maximum Elevation (ft)	Diameter (ft)	Inflow (gpm)	Hydraulic Grade (ft)
Boyce_Tank	610.00	680.00	707.00	713.00	28.00	-437.52	694.17
Existing_Millwood_Tank	585.00	653.00	680.72	686.00	20.00	(N/A)	(N/A)
New_Millwood_Tank	581.00	688.00	707.00	712.00	28.00	-99.93	705.80
White_Post_Tank	625.00	746.00	761.00	765.00	22.00	-285.07	748.97
R-WTP	--	--	--	--	--	-171.39	540.00

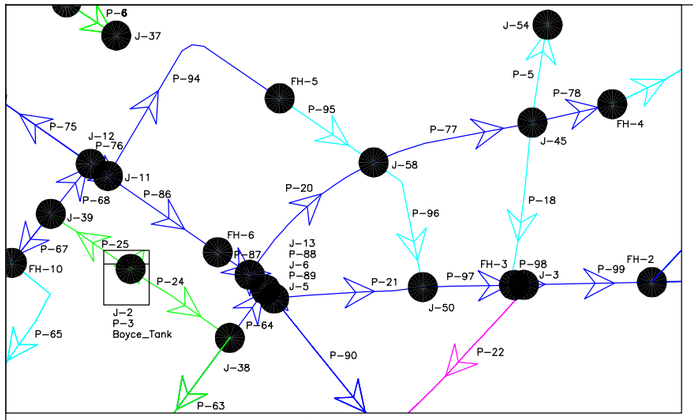
Pump Report

Pump Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-WTP	537.00	On	539.31	761.49	171.39	222.18
PMP-White_Post	575.00	On	658.88	827.54	536.02	168.65

Valve Report

Valve Label	Elevation (ft)	Diameter (in)	Control Status	Discharge (gpm)	Upstream Hydraulic Grade (ft)	Downstream Hydraulic Grade (ft)	Headloss (ft)
PRV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
PRV-White_Post	575.00	6.00	Closed	0.00	827.37	659.05	0.00
FCV-Millwood	520.00	6.00	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

CLARKE COUNTY SANITARY AUTHORITY



DETAIL A

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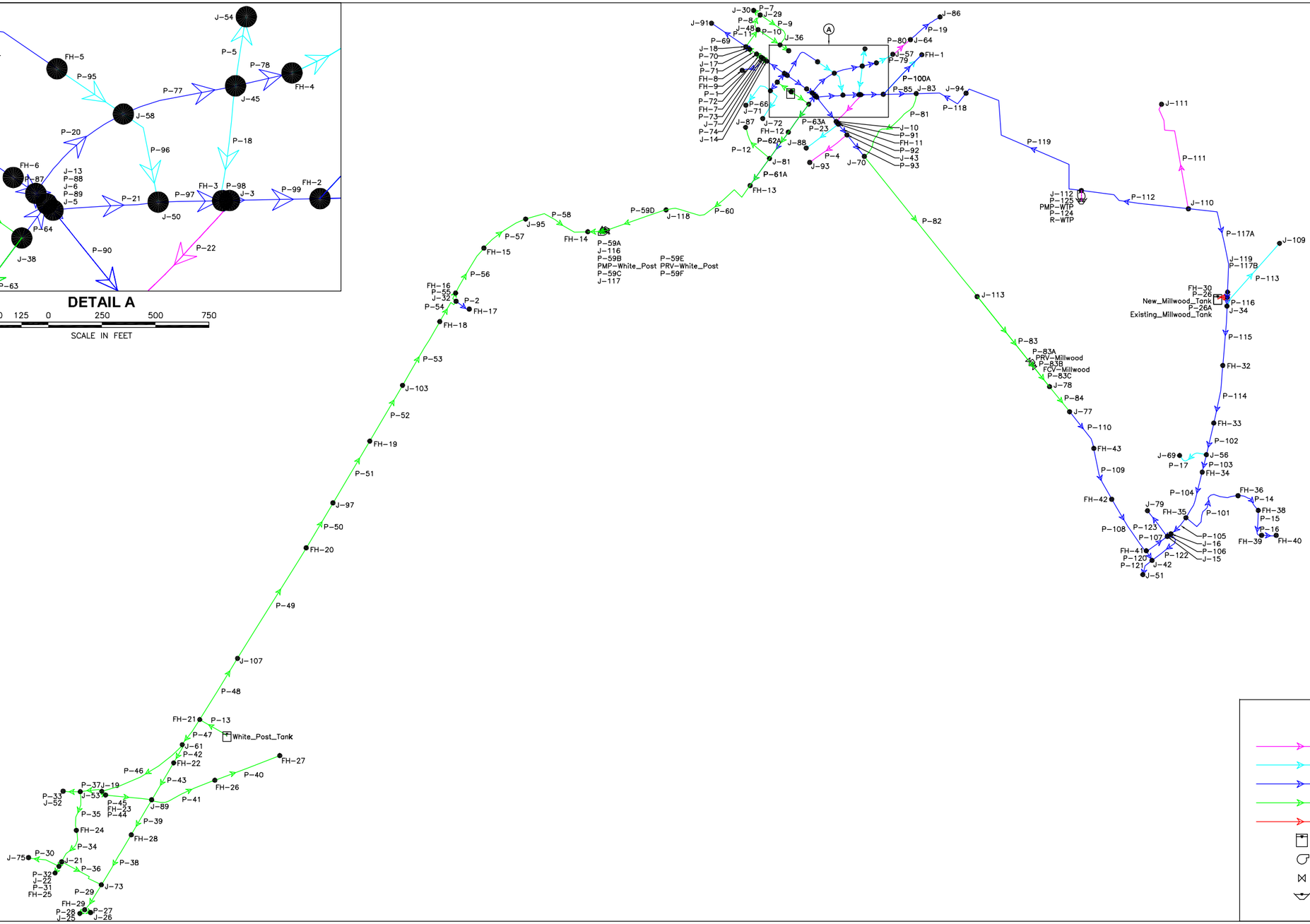
SCALE IN FEET



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LEGEND

- 2" WATER LINE
- 4" WATER LINE
- 6" WATER LINE
- 8" WATER LINE
- 12" WATER LINE
- TANK
- PUMP STATION
- PRV
- RESERVOIR

HYDRAULIC MODEL
JUNE 22, 2015

ANDERSON AND ASSOCIATES, Inc.

APPENDIX F

Model Calibration

Fire Hydrant Flow Test Data Sheet

Job Number	31168
Location	White Post Road
Water System	Clarke County, Virginia
Flow Test #	1
Date	May 26, 2015
Time	2:00 PM
Tested by	BJM, TJK, JPT
Pressure Zone	White Post
Tank(s)	White Post - 761'
Pump(s) In	White Post - Off White Post - Off
Pump(s) Out	

Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Hydrant ID	FH-28					Hydrant ID	FH-29			Hydrant ID			
Location	398 White Post Road					Location	White Post & Carters Line Rd			Location			
Manufacturer	American Darling Valve					Manufacturer				Manufacturer			
Model	MK 73-1					Model				Model			
Elevation (ft)	623					Elevation (ft)	611			Elevation (ft)			
Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Static Pressure (psi)	60	58				Static Pressure	65	62		Static Pressure			
Pitot Pressure (psi)			Estimated Flow (gpm)			Residual Pressure				Residual Pressure			
1		5	1	380	380	1	62	59		1			
2		10	2	530	530	2	59	56		2			
3		20	3	750	750	3	55	51		3			
4		30	4	920	920	4	50	48		4			
5			5			5				5			
6			6			6	Static -	62		6			
7			7			7				7			
8			8			8				8			
9			9			9				9			
10			10			10				10			

Notes

White Post Tank: Overflow - 765'

Model results shown in blue (at average daily demand)

Hydrant Geometry - Smooth Radius Edge

Initial Tank Levels -	Boyce	87%	709 ft	Final Tank Levels -	Boyce	82%	707 ft
	Millwood	80%	679 ft		Millwood	84%	681 ft
	White Post	79%	761 ft		White Post	80%	761 ft

Model Roughness Coefficient, C=120

Fire Hydrant Flow Test Data Sheet

Job Number	31168
Location	Lord Fairfax Highway
Water System	Clarke County, Virginia
Flow Test #	2
Date	May 26, 2015
Time	2:30 PM
Tested by	BJM, TJK, JPT
Pressure Zone	White Post
Tank(s)	White Post - 761'
Pump(s) In	White Post - Off White Post - Off
Pump(s) Out	

Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Hydrant ID	FH-15					Hydrant ID	FH-14			Hydrant ID			
Location	12391 Lord Fairfax Highway					Location	624 Old Waterloo Road			Location			
Manufacturer	American Darling Valve					Manufacturer				Manufacturer			
Model	MK 73-1					Model				Model			
Elevation (ft)	589					Elevation (ft)	573			Elevation (ft)			
Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Static Pressure (psi)	74	75				Static Pressure		81	80	Static Pressure			
Pitot Pressure (psi)			Estimated Flow (gpm)			Residual Pressure				Residual Pressure			
1		10	1	408	408	1		62	61	1			
2		12.5	2	456	456	2		57	57	2			
3			3			3				3			
4			4			4		Static -	79	4			
5			5			5				5			
6			6			6				6			
7			7			7				7			
8			8			8				8			
9			9			9				9			
10			10			10				10			

Notes

White Post Tank: Overflow - 765'

Model results shown in blue (at average daily demand)

Hydrant Geometry - Raised Square Lip

Pressure and flow varied greatly during test, steady measurements could not be taken

Initial Tank Levels -	Boyce	87%	709 ft	Final Tank Levels -	Boyce	82%	707 ft
	Millwood	80%	679 ft		Millwood	84%	681 ft
	White Post	79%	761 ft		White Post	80%	761 ft

Model Roughness Coefficient, C=120

Fire Hydrant Flow Test Data Sheet

Job Number	31168
Location	S Greenway Avenue
Water System	Clarke County, Virginia
Flow Test #	3
Date	May 26, 2015
Time	3:30 PM
Tested by	BJM, TJK, JPT

Pressure Zone	Boyce	
Tank(s)	Boyce - 708.71'	
Pump(s) In	WTP - On	WTP - On
Pump(s) Out	White Post - On	White Post - On, Powhatan PRV - Open

Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Hydrant ID	FH-12					Hydrant ID	FH-13			Hydrant ID			
Location	23 S Geenway Avenue					Location	17 Old Waterloo Road			Location			
Manufacturer	Mueller					Manufacturer				Manufacturer			
Model	107					Model				Model			
Elevation (ft)	597					Elevation (ft)	559			Elevation (ft)			
Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Static Pressure (psi)	48	47				Static Pressure		64	64	Static Pressure			
Pitot Pressure (psi)			Estimated Flow (gpm)			Residual Pressure				Residual Pressure			
1		5	1	380	380	1		58	61	1			
2		10	2	530	530	2		55	59	2			
3		20	3	750	750	3		54	56	3			
4		30	4	920	920	4		53	55	4			
5			5			5				5			
6			6			6		Static -	63	6			
7			7			7				7			
8			8			8				8			
9			9			9				9			
10			10			10				10			

Notes

Boyce Tank: Overflow - 713'

Model results shown in blue (at average daily demand)

Hydrant Geometry - Smooth Radius Edge

Initial Tank Levels -	Boyce	87%	709 ft	Final Tank Levels -	Boyce	82%	707 ft
	Millwood	80%	679 ft		Millwood	84%	681 ft
	White Post	79%	761 ft		White Post	80%	761 ft

Model Roughness Coefficient, C=120

Fire Hydrant Flow Test Data Sheet

Job Number	31168
Location	Bishop Meade Ed
Water System	Clarke County, Virginia
Flow Test #	4
Date	May 26, 2015
Time	3:00 PM
Tested by	BJM, TJK, JPT
Pressure Zone	Millwood
Tank(s)	Millwood - 680.06'
Pump(s) In	Powhatan PRV - Open Powhatan PRV - Open
Pump(s) Out	

Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Hydrant ID	FH-41					Hydrant ID	FH-35			Hydrant ID			
Location	Int of Millwood & Bishop Meade					Location	801 Bishop Meade Rd			Location			
Manufacturer	Mueller					Manufacturer				Manufacturer			
Model	107					Model				Model			
Elevation (ft)	560					Elevation (ft)	554			Elevation (ft)			
Flow Hydrant						Gauge Hydrant #1				Gauge Hydrant #2			
Static Pressure (psi)	70	70				Static Pressure		41	39	Static Pressure			
Pitot Pressure (psi)			Estimated Flow (gpm)			Residual Pressure				Residual Pressure			
1		5	1	380	380	1		28	26	1			
2		7.5	2	460	460	2		20	20	2			
3			3			3				3			
4			4			4		Static -	41	4			
5			5			5				5			
6			6			6				6			
7			7			7				7			
8			8			8				8			
9			9			9				9			
10			10			10				10			

Notes

Millwood Tank: Overflow - 686'

Model results shown in blue (at average daily demand)

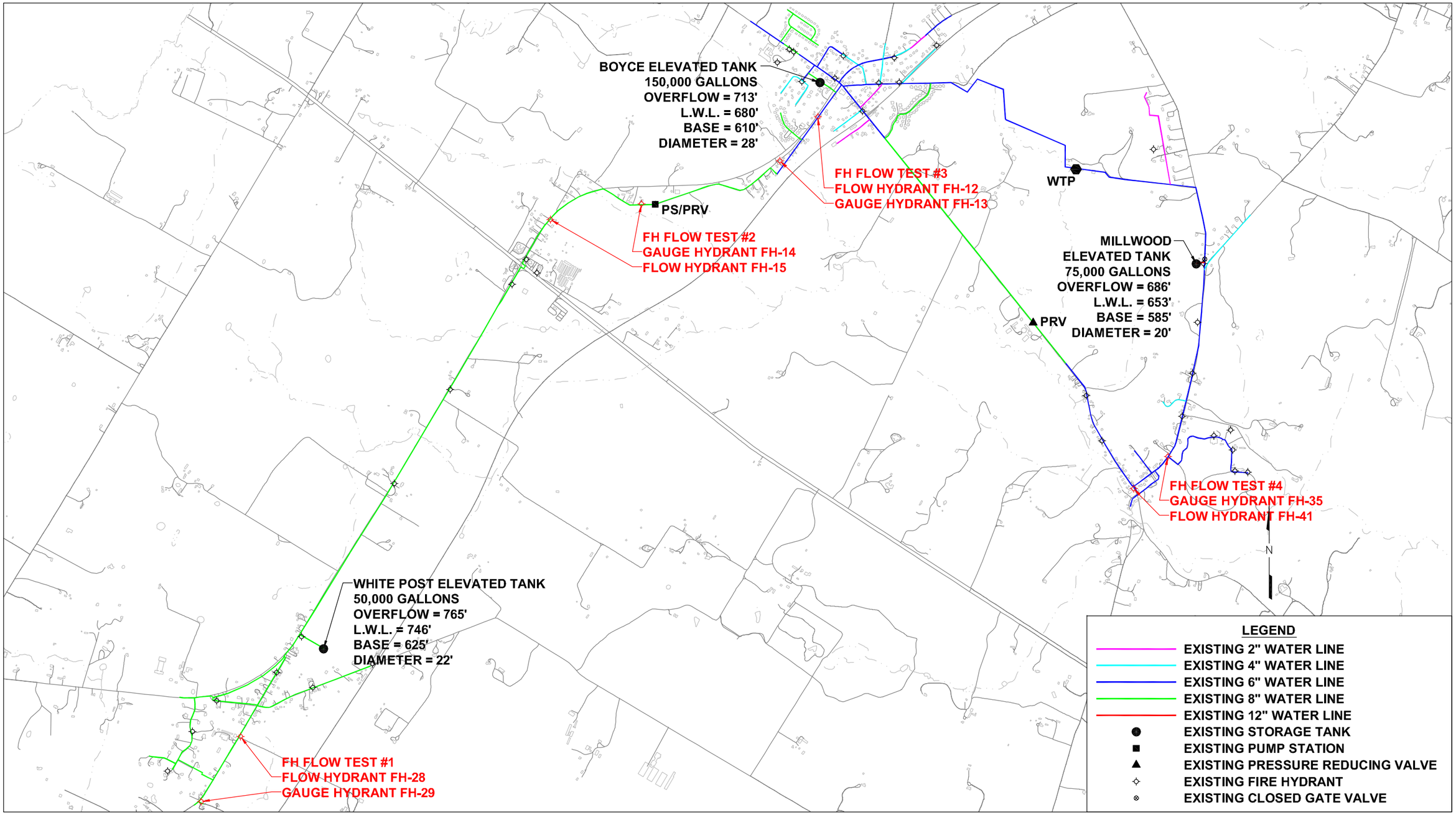
Hydrant Geometry - Smooth Radius Edge

FCV added to reduce flow through PRV to 140 gpm to represent size

Initial Tank Levels -	Boyce	87%	709 ft	Final Tank Levels -	Boyce	82%	707 ft
	Millwood	80%	679 ft		Millwood	84%	681 ft
	White Post	79%	761 ft		White Post	80%	761 ft

Model Roughness Coefficient, C=120

CLARKE COUNTY SANITARY AUTHORITY



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SCALE IN FEET

ANDERSON AND ASSOCIATES, Inc.

FIRE HYDRANT FLOW TEST EXHIBIT

MAY 27, 2015

APPENDIX G

Effective Storage Calculations

EFFECTIVE STORAGE CALCULATIONS
CLARKE COUNTY WATER SYSTEM
JUNE 22, 2015
JN 31168

Existing Water System
Low Pressure Zone

Boyce Tank

Maximum Tank Elevation	713.00	ft.
Minimum Tank Elevation	680.00	ft.
Tank Diameter	28.00	
Minimum Hydraulic Grade necessary to maintain 20 psi for all connections	688.00	ft.
Maximum Hydraulic Grade	712.00	
Effective Storage	110,540	gal.
Percent of Tank Effective	72.73	%

Millwood Tank

Maximum Tank Elevation	712.00	ft.
Minimum Tank Elevation	688.00	ft.
Tank Diameter	28.00	
Minimum Hydraulic Grade necessary to maintain 20 psi for all connections	688.00	ft.
Maximum Hydraulic Grade	712.00	
Effective Storage	110,540	gal.
Percent of Tank Effective	100.00	%

Total Effective Storage in Water System	221,080	gal.
Effective Storage Required in Water System*	30,553	gal.
Satifies VDH Requirement for Effective Storage	TRUE	
Available Storage in Water System	190,526	gal.

* Based on VDH requirement of 1/2 avg day storage. (See Demand Calcs - Appendix E)
** Minimum tank elevation necessary to maintain 20 psi for all users is based on Run #1 of the hydraulic analysis with 2xADD & all pumps off.

EFFECTIVE STORAGE CALCULATIONS
CLARKE COUNTY WATER SYSTEM
JUNE 22, 2015
JN 31168

Existing Water System
High Pressure Zone

White Post Tank

Maximum Tank Elevation	765.00	ft.
Minimum Tank Elevation	746.00	ft.
Tank Diameter	22.00	
Minimum Hydraulic Grade necessary to maintain 20 psi for all connections	746.00	ft.
Maximum Hydraulic Grade	765.00	
Effective Storage	54,024	gal.
Percent of Tank Effective	100.00	%

Total Effective Storage in Water System	54,024	gal.
Effective Storage Required in Water System*	12,571	gal.
Satifies VDH Requirement for Effective Storage	TRUE	
Available Storage in Water System	41,453	gal.

* Based on VDH requirement of 1/2 avg day storage. (See Demand Calcs - Appendix E)
** Minimum tank elevation necessary to maintain 20 psi for all users is based on Run #1 of the hydraulic analysis with 2xADD & all pumps off.

EFFECTIVE STORAGE CALCULATIONS
CLARKE COUNTY WATER SYSTEM
JUNE 22, 2015
JN 31168

Proposed Water System
Low Pressure Zone

Boyce Tank

Maximum Tank Elevation	713.00	ft.
Minimum Tank Elevation	680.00	ft.
Tank Diameter	28.00	
Minimum Hydraulic Grade necessary to maintain 20 psi for all connections	688.00	ft.
Maximum Hydraulic Grade	712.00	
Effective Storage	110,540	gal.
Percent of Tank Effective	72.73	%

Millwood Tank

Maximum Tank Elevation	712.00	ft.
Minimum Tank Elevation	688.00	ft.
Tank Diameter	28.00	
Minimum Hydraulic Grade necessary to maintain 20 psi for all connections	688.00	ft.
Maximum Hydraulic Grade	712.00	
Effective Storage	110,540	gal.
Percent of Tank Effective	100.00	%

Total Effective Storage in Water System	221,080	gal.
Effective Storage Required in Water System*	62,219	gal.
Satifies VDH Requirement for Effective Storage	TRUE	
Available Storage in Water System	158,861	gal.

* Based on VDH requirement of 1/2 avg day storage. (See Demand Calcs - Appendix E)
** Minimum tank elevation necessary to maintain 20 psi for all users is based on Run #5 of the hydraulic analysis with 2xADD & all pumps off.

EFFECTIVE STORAGE CALCULATIONS
CLARKE COUNTY WATER SYSTEM
JUNE 22, 2015
JN 31168

Proposed Water System
High Pressure Zone

White Post Tank

Maximum Tank Elevation	765.00	ft.
Minimum Tank Elevation	746.00	ft.
Tank Diameter	22.00	
Minimum Hydraulic Grade necessary to maintain 20 psi for all connections	746.00	ft.
Maximum Hydraulic Grade	765.00	
Effective Storage	54,024	gal.
Percent of Tank Effective	100.00	%

Total Effective Storage in Water System	54,024	gal.
Effective Storage Required in Water System*	25,592	gal.
Satifies VDH Requirement for Effective Storage	TRUE	
Available Storage in Water System	28,432	gal.

* Based on VDH requirement of 1/2 avg day storage. (See Demand Calcs - Appendix E)
** Minimum tank elevation necessary to maintain 20 psi for all users is based on Run #5 of the hydraulic analysis with 2xADD & all pumps off.

APPENDIX H

Cost Estimates

CLARKE COUNTY WATER SYSTEM IMPROVEMENTS
CLARKE COUNTY, VIRGINIA
COST ESTIMATE
JUNE 22, 2015
JN 31168

PROJECT COST ESTIMATE

	QUANTITY	UNITS	UNIT COST	COST	TOTALS	
A. CONSTRUCTION COST						
WATER DISTRIBUTION SYSTEM IMPROVEMENTS TO VIRGINIA AVENUE						
Mobilization (3%)	1	LS	$ 1,800	$ 1,800		
6" Waterline	1150	LF	$ 30	$ 34,500		
6" Gate Valve & Box	3	EA	$ 1,000	$ 3,000		
Road Bore Setup	1	EA	$ 2,000	$ 2,000		
Steel Casing Pipe	30	LF	$ 150	$ 4,500		
Reconnect Existing Services	14	EA	$ 500	$ 7,000		
Reconnect Main	1	EA	$ 1,500	$ 1,500		
Reconnect Fire Hydrant	1	EA	$ 1,000	$ 1,000		
3/4" Service Line	210	LF	$ 15	$ 3,150		
Asphalt Removal and Replacement	14	SY	$ 50	$ 700		
Subtotal - Water Distribution System Improvements to Virginia Avenue					$ 59,150	
WATER DISTRIBUTION SYSTEM IMPROVEMENTS TO SOUTH GREENWAY AVENUE						
Mobilization (3%)	1	LS	$ 3,600	$ 3,600		
8" Waterline	2300	LF	$ 35	$ 80,500		
8" Gate Valve & Box	4	EA	$ 1,200	$ 4,800		
Creek Crossing	1	EA	$ 2,000	$ 2,000		
Concrete Encasement	30	LF	$ 100	$ 3,000		
Reconnect Existing Services	25	EA	$ 500	$ 12,500		
Reconnect Main	3	EA	$ 1,500	$ 4,500		
Reconnect Fire Hydrant	2	EA	$ 1,000	$ 2,000		
3/4" Service Line	375	LF	$ 15	$ 5,625		
Asphalt Removal and Replacement	50	SY	$ 50	$ 2,500		
Subtotal - Water Distribution System Improvements to South Greenway Avenue					$ 121,025	
Subtotal - Water Distribution System Improvements					$	180,175
B. PROJECT RELATED COST						
1. Basic Engineering @ 8.5% (excludes surveying / Topo)				$ 15,400		
2. Hydraulic Model (VDH Approval)				$ 2,000		
3. RPR (Inspection) @ 800 Man-Hours				$ 48,000		
4. Surveying / Topo				$ 12,000		
5. Permitting				$ 2,000		
6. Legal				$ 5,000		
7. Easements				$ 5,000		
8. Bond Council				$ 2,000		
9. Environmental Assessment				$ 5,000		
10. 10% Construction Contingency				$ 18,100		
Subtotal - Project Related Cost					$	114,500
Total Project Cost =					**$**	**294,675**

Appendix E: Easements

Typical Form of Instrument

Standards & Procedures

Clarke
COUNTY • VIRGINIA

I. Introduction

The Clarke County Sanitary Authority (hereby known as 'the Authority'), was created January 6, 1969 as a public utility, body politic and corporate under the provisions of the Virginia Water and Waste Authorities Act (Title 15.2, Subtitle IV, Chapter 5100 et. seq., Code of Virginia, as amended). Powers conferred by the Virginia Water and Waste Authorities Act include that of issuing rules, regulations and standards for the design, construction and/or installation of any facilities to be operated and maintained by the Authority.

Developers and/or individuals wishing to obtain public water and sanitary sewer service are responsible for construction of pipelines and their appurtenances. The proposed construction plans must first be reviewed and approved by the Authority. Where not located within the rights of way of public streets, facilities are constructed within deeded easements or on land owned by the Authority. A project's approval process may include easement acquisitions. The construction plans must be approved and all necessary offsite easements must be recorded prior to issuance of a Construction Permit for the project.

The Authority is responsible for approving and processing all easements associated with land development projects. For capital projects, easement acquisition is handled by Clarke County Sanitary Authority.

II. Easement Standards and Policies

A. Exclusivity

The Authority's easements establish areas in which the landowner has agreed not to erect structures or use the land in ways that are in conflict with the Authority's uses. As such, the easements are considered exclusive; however, other utilities may cross the Authority's easements at, or as nearly as possible to a 90-degree angle with prior written consent by the Authority, provided the crossing utility does not interfere with Loudoun Water's use of their existing easement.

B. Ownership vs. Easement

It is the preference of the Authority that major facilities such as treatment plants, pumping stations, and water storage tanks be located on lots for which ownership has been deeded to the Authority. The minimum lot size required shall be in accordance with the Clarke County Zoning Ordinance.

C. Private Streets

The Authority's facilities located within private streets must be within appropriate water and sanitary sewer easements conveyed to the Authority. Where public ingress and egress is being conveyed to Clarke County, that easement is considered sufficient for water and sewer service branches.

D. Community Systems

Easements supporting community water and wastewater systems are discussed in the respective chapters of the *Design and Construction Standards*.

E. Easement Plats

An easement plat will be prepared by a Land Surveyor, licensed in the Commonwealth of Virginia, establishing the metes and bounds of the area upon which easement is being conveyed and/or vacated. These will correspond to the approved construction plans for the project they support.

F. Notary Block

Effective July 1, 2007, the laws of the Commonwealth of Virginia require that notary block be on the same page as the signature being witnessed, and that the notary's registration number appear on each notary statement.

III. "Clarke County Sanitary Authority Only" Instruments

If the Authority's easements proposed in support of a project for which no right of way or other public easement is to be dedicated or conveyed, and no subdivision or boundary adjustment is to occur, then the "Clarke County Sanitary Authority Only" process may be followed.

A. Deed of Easement

Developers have the option of submitting Deeds of Easement prepared by their attorneys or of completing the appropriate standard instrument, which is available on The Authority's website. Instruments must contain the standard Loudoun Water deed language, which is not to be altered.

B. Instrument and Plat Review

The developer or his representative shall submit a package containing the following:

1. a completed "Clarke County Sanitary Authority Only" Easement Processing Request Form, available on the website;
2. draft Deed of Easement;
3. one full-sized copy of the easement plat, prepared in accordance with the Easement Plat Checklist, available on the website;
4. upon request, a title report for the property in question.

C. Approval

The easement plat and draft deed will be reviewed by the Authority's Project Engineer, who will advise the applicant of any revisions that may be required prior to plat or deed approval. Once approved, the applicant may submit the final instrument for execution.

D. Execution

The signature package must include the original, executed instrument, and a final plat of recordation quality, with surveyor's original signature and seal. Plat must be current, and bear the most recent revision date, corresponding to that referenced in the instrument.

Prior to recordation the instrument must be signed by:

1. Owner(s) of Record. Owners of title include all parties who have an ownership interest in the property, including lenders and trustees. In situations such as property titled in the

name of an estate, or where the owner has provided power of attorney to another individual, someone other than the property owner may sign the deed. However, in such cases, proof of authorization is to be provided to the Authority in support of the signature package.

2. Clarke County Sanitary Authority. All Deeds of Easement must be signed by the Chairman, General Manager or Deputy General Manager. The original, executed Deed will then be returned to the applicant from whom it was received.

E. Recordation

All "Clarke County Sanitary Authority Only" instruments with associated plats are recorded by the applicant, within the Land Records of the Clarke County Clerk of the Circuit Court.

Appendix F: Water and Wastewater Treatment Systems Project Process

Key to Abbreviations

Chart of Design Review Process

Project Initiation Information Sheet

Agenda for Project Initiation Meeting

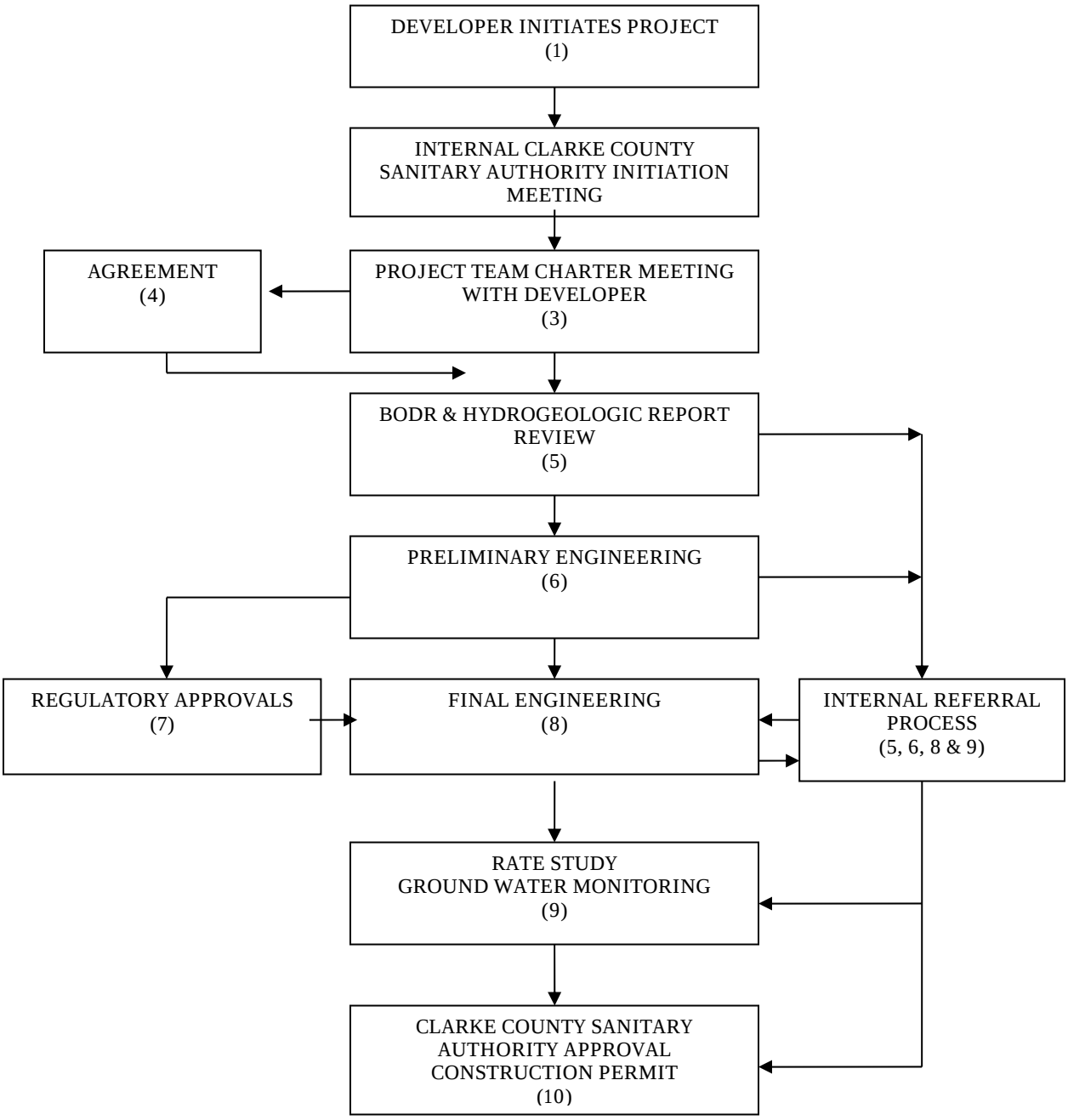
Chart of Construction Process

Agenda for Preconstruction Conference

Key to Abbreviations

CCSA	Clarke County Sanitary Authority
CTC	Certificate to Construct
CTO	Certificate to Operate
BODR	Basis of Design Report
VDEQ	Virginia Department of Environmental Quality
VDH	Virginia Department of Health

Community Systems
Design Review Process



Community Systems
Design Review Process

Box # **Description**

1 Developer initiates project; CS determines if engineering support is needed; provide required information
Indicated on Project Initiation form

2 Clarke County Sanitary Authority initiation meeting-determine scope of project establish roles & responsibilities

3 Team Charter meeting with developer –discuss Developer and Clarke County Sanitary Authority roles & responsibilities, develop schedule - initiate agreement process, prepare organizational chart (see attached meeting outline)

4 Agreement sent to developer for execution

5 Developer submits hydrogeologic & BODR to CCSA; comments provided for developer to address; BODR finalized

6 Developer submits preliminary (30%-50%) engineering to CCSA to work with developer's engineer to finalize

7 Developer submits Clarke County Sanitary Authority approved BODR and preliminary engineering to VDEQ/VDH for approval, CCSA to track VDEQ/VDH comments

8 Developer submits final (95%) engineering to CCSA for comments; work with developer's engineer to finalize

9 Developer submits rate study and groundwater monitoring plan to CCSA, for review and approval

10 CCSA issues approval letter and issues construction permit based on:

- final engineering plans/specs approved
- rate study approved
- groundwater monitoring plan approved
- record plats/deeds approved and recorded
- easements recorded
- developer submits construction cost estimate based on
- developer posts bonds
- developer sends proof of insurance
- developer executes Clarke County Sanitary Authority agreement
- VDH/DEQ issue certificates to construct

Community Systems
Project Initiation Information

Project Title: _____

Developer Contact Information:

Company name: _____

Company address: _____

_____

Contact name: _____

Phone: _____

E-mail: _____

Project Location:

_____

(Attach 8 ½" x 11" USGS map)

Types and Number of Units:

_____

Status of County Approvals: _____

_____

Water System :

Community wells
Individual wells
Other (specify)

Sewer System:

Community discharging
Community non-discharging (land application)
Individual non-discharging (land application)
Other (specify)

Schedule:

Hydrogeological Report Submitted_____ (date)
BODR Submitted _____
Final Design Submitted_____
First unit delivered _____
Project build-out _____
Rate study_____
Ground water monitoring study_____

Community Systems
Project Initiation Meeting

(Project Title)
(Project ID#)

Location:
Date:
Time:

AGENDA

1. Attendees:

   - Developer
   - Design engineer
   - Clarke County Sanitary Authority

2. Confirm meeting objectives

3. Review data provided on project initiation form

   - Address comments and any missing information
   - Provide organizational chart
   - Confirm schedule
   - Provide copy of submittal/review guidelines

4. Developer's responsibilities (to obtain construction permit):

   - Executed agreement
   - Schedule (detailed)
   - Hydrogeological report
   - BODR (bring copies of required submittals for developer to review)
   - Preliminary engineering report for sewer-per VDEQ SCAT regulations
   - Engineer's report and preliminary plans-water-per VDH Waterworks regulations
   - Final construction specifications and plans – water/sewer
   - Rate study
   - Groundwater monitoring plan
   - County and VDOT approvals
   - Engineer's cost estimate
   - Plats/deeds recorded
   - Fees:
     Design review/lab/inspection
   - Bonds
   - Proof of insurance

5. Clarke County Sanitary Authority responsibilities:

    - Draft agreement
    - Review/comment/approve :

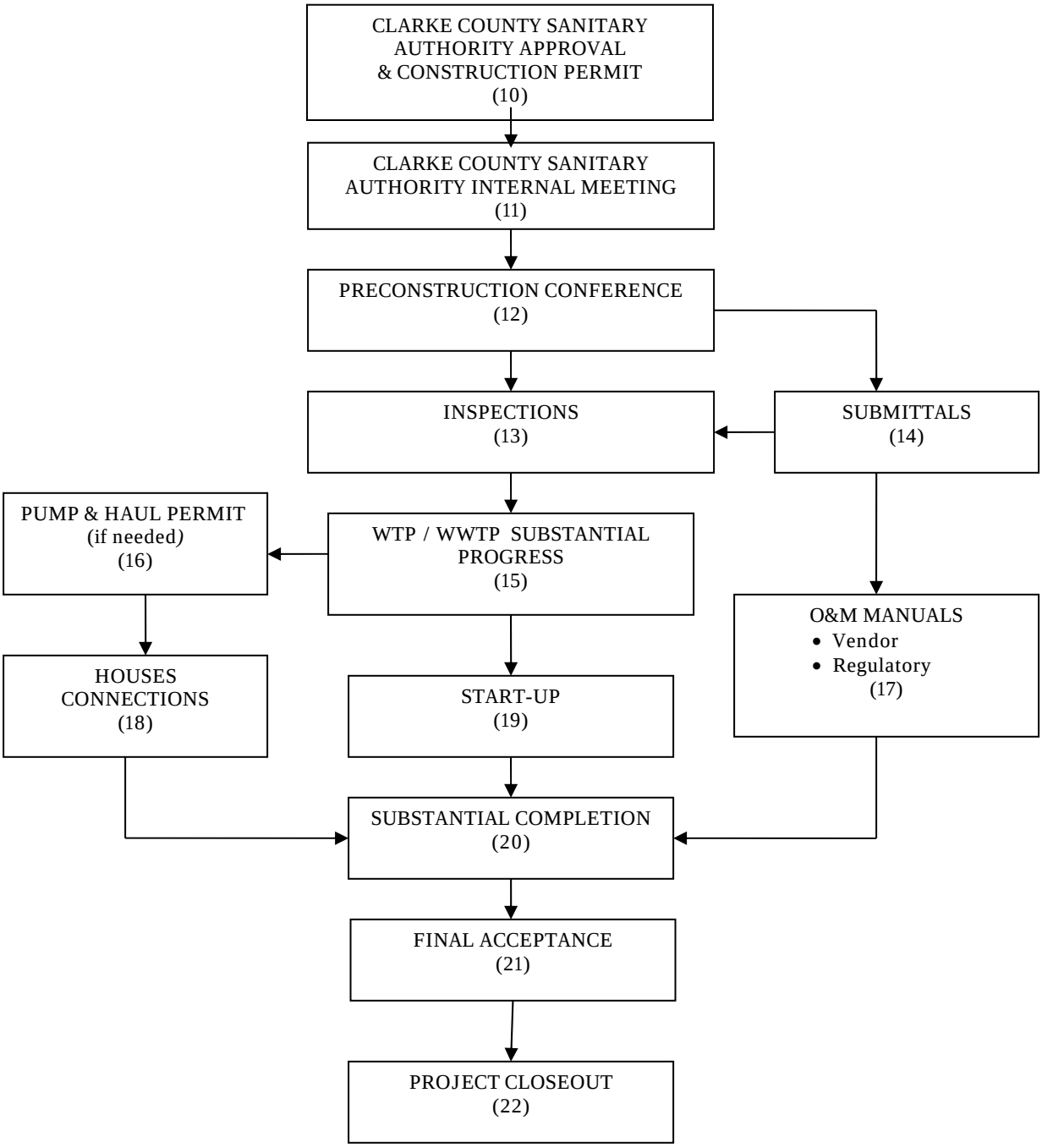
        Detailed schedule
        Hydrogeologic report
        BODR
        Preliminary engineering report and plans -sewer
        Preliminary engineering report and plans - water
        Final construction specifications and plans
        Rate study
        Ground water monitoring plan
        Plats/deeds

    - Approval letter

6. Submission procedures and points of contact within Clarke County Sanitary Authority

7. Status of review process at other agencies (Clarke County, VDEQ, Corps. Of Engineers, VDOT, etc.)

Community Systems Construction Process



Community Systems
Construction Process

Box #	Description
11	Clarke County Sanitary Authority internal meeting
12	Preconstruction Conference
13	Inspections during construction Inspector is point of contact
14	Construction submittals from Developer Engineer to CCSA – Comments; approved submittals to inspector and returned to Developer
15	At the agreed stage of completion, houses may connect to the permanent water or sewer treatment facilities; operations bond must be in place
16	Pump and Haul permit application, Developer's responsibility – CCSA writes letter of support/monitors
17	Vendor O&M manuals submitted and operations manual prepared by Developer/Engineer and submitted to CCSA for comments; Clarke County Sanitary Authority approved Operations manual forwarded by Developer to VDEQ for their approval
18	CCSA tracks house connections – number limited based on capacity of facilities
19	Approved start-up plan and procedures and Clarke County Sanitary Authority training implemented, include representatives from VDEQ (sewer)and VDH (water) • Performance testing • Reliability testing • Training
20	Substantial completion attained, punch lists generated – compiled by CCSA and transmitted to Developer/Engineer; regulatory inspection and CTO issued, pump and haul shut down • All alarms/controls operational • All safety equipment installed • All security items installed • Performance bond reduced to 20%

Community Systems
Construction Process

Box #	Description
21	Final acceptance procedures: • Developer posts 5% maintenance bond • Clarke County Sanitary Authority releases performance bond • Deeds to transfer facilities to Loudoun Water • Equipment warranties transferred to Clarke County Sanitary Authority • As-built drawings completed • Punch list items corrected or completed
22	Project closeout procedures following final acceptance: • Clarke County Sanitary Authority inspects at 11 months to identify warranty items prior to 1 year deadline • Maintenance bond (5%)released once all warranty items corrected • CCSA invoices Developer must be paid operational bond released once 90% of units sold

Community Systems
Preconstruction Conference

(Project Title)
(Project ID#)

Location:
Date:
Time:

AGENDA

1. Introduction/Points of Contact

    a. Owner – Clarke County Sanitary Authority
        - Project Manager
        - Inspectors
    b. Developer
    c. Engineer
    d. Contractor

2. Lines of Communication and Responsibility (office and field)

    a. Updated organizational chart
    b. Record documents

3. Status of Required Permits and Regulatory Approvals

    a. Review of Clarke County Sanitary Authority /Developer Agreement
    b. Clarke County grading
    c. Clarke County building
    d. VDOT
    e. VDEQ
    f. VDH
    g. Others (Rappahannock Electric Cooperative.)

4. Submittals

    a. List (to include project construction schedule, concrete test results)
    b. Review procedures/schedule
    c. Timing
    d. O&M manuals
    e. Record drawings

5. Work

    a. Sequence of critical work
    b. Site conditions
    c. Field orders/Change orders
    d. Requests for Interpretation (RFI)

6. Progress Meetings

7. Project Substantial Completion

    a. Clarke County Sanitary Authority substantial completion requirements
    b. Start-up schedule
    c. Testing
    d. Training
    e. Punch list
    f. Operation bond

9. Project Final Acceptance and Closeout

    a. Performance bond reduction/release
    b. Clarke County Sanitary Authority 1-year inspection
    c. Deeds and equipment warranties transferred to Clarke County Sanitary Authority

10. Miscellaneous Items

    a. Pump and Haul

Appendix G: Corrosion Control

Design and Installation Requirements

I. Corrosion Control

All storage tanks, pumping stations, vaults, treatment equipment, and similar facilities shall be protected from corrosion using project-specific design guidelines, which are not included within this discussion. The following is to be applied to all underground water, reclaimed water, and pressurized wastewater pipelines that are to be made of metallic pipe.

In certain cases, upon completion of the Decision Process described below, Clarke County Sanitary Authority may choose to specify a nonmetallic piping material in an application that would otherwise be built of ductile iron.

II. Design

A. Summary

This summary outlines how Clarke County Sanitary Authority will determine and implement corrosion control decisions for buried metallic pipelines. The decision process considers criteria including: pipeline's size, function, accessibility, cost of repair; anticipated corrosiveness of soil; and the potential for stray currents that may affect the pipelines. Based on an evaluation of these criteria, Clarke County Sanitary Authority will determine the level of corrosion protection to be applied to the pipeline. Three levels of protection are considered for every pipeline and include the following:

1. standard installation with no additional features
2. enhanced protection (including polyethylene encasement and mechanical joint coating)
3. specific corrosion control design (such as joint bonding, test stations, and cathodic protection)

The decision process is described in the following sections and summarized in **Figure E.1**. The decision process consists of four steps:

Step 1: classify each pipeline

Step 2: evaluate the anticipated soil conditions for each pipeline

Step 3: identify stray currents

Step 4: determine the level of corrosion protection to be applied to each pipeline and incorporate into the construction plans and specifications

B. Decision Process

Step 1: Pipeline Classification Proposed pipelines shall be designated one of three classifications (Class 1, 2, or 3). Classifications are primarily based on size, function, and

accessibility of the pipeline. Clarke County Sanitary Authority reserves the right to adjust the classification of individual pipelines at its own discretion.

Class 1 pipelines represent the highest priority classification. These pipelines meet any of the following criteria:

- all metallic sewer force mains, regardless of diameter;
- water mains 16 inches in diameter and greater.

Class 2 pipelines meet any of the following criteria:

- water mains 12 inches in diameter;
- water mains providing a single feed to distribution systems where a failure would result in significant disruption to customer service (approximately 50 or more service connections);
- any pipeline where repair or taking the line out of service would require exceptionally high repair costs, difficult repair conditions, or long-term customer service disruption.

Class 3 pipelines are:

- water mains less than 12 inches in diameter.

Step 2: Soil Evaluation Soil characteristics surrounding the pipeline trench significantly affect the rate of metallic pipeline corrosion. Where ductile iron lines are to be constructed, soil samples shall be collected and analyzed as described herein. The results of the analysis shall be submitted to Clarke County Sanitary Authority by the Engineer at the time of the second submission of construction plans. Construction plans will not be approved by Clarke County Sanitary Authority until soil results have been submitted and appropriate corrosion protection measures incorporated into the design. Guidelines for soil sample collection and analysis follow.

For all Class 1 pipes, and for Class 2 pipes where initial soil sampling and analysis warrants further investigation, Clarke County Sanitary Authority will require additional soil investigations, to include in situ soil resistivity and pH. These tests must be conducted and reports prepared under the supervision of an engineer who is certified by the National Association of Corrosion Engineers (NACE).

1. Collection of Soil Samples

   a. Soil samples may be collected by the geotechnical engineering firm performing geotechnical investigations for development activities as required by the Clarke County Facility Standards Manual. Clarke County Sanitary Authority reserves the right to require the Engineer to collect additional samples other than those detailed herein. Further, Clarke County Sanitary Authority may perform additional soil investigations for corrosion considerations.

b. Clarke County Sanitary Authority will direct the collection of additional soil samples of fill transported from offsite locations used for controlled backfill, in the backfill of rock trenches, or other fill conditions.

c. Soil samples shall be collected as follows:

i) The depths of soil samples collected for corrosion evaluation shall be representative of anticipated pipeline depths. If pipeline locations and depths are not known, the samples shall be collected at a depth approximately 4.5 feet below existing grade, or the deepest location where soil is available for testing (if rock is encountered before 4.5 feet).

ii) Soil samples shall be collected from each soil boring performed as part of subdivision geotechnical investigations. The number and location of soil borings shall be consistent with the subdivision geotechnical guidelines specified by the Clarke County Facility Standards Manual.

iii) Soil samples for pipelines outside of subdivisions evaluated by subdivision geotechnical investigations shall be taken at intervals of 1,000 linear feet along proposed pipeline alignments.

iv) Soil samples for Class 1 pipelines shall be taken at intervals of 1,000 linear feet along the anticipated alignment. Clarke County Sanitary Authority will supplement Class 1 soil samples with additional field data to design applicable corrosion protection components.

v) The coordinates and elevation where the sample was obtained shall be recorded and provided to Clarke County Sanitary Authority, including horizontal and vertical datum of the coordinate system used.

2. Analysis of Soil Samples

a. All soil samples shall be tested for pH, chloride concentrations, sulfate concentration, sulfide content and resistivity (as is and saturated). Data for each sample shall be recorded on the data sheet form that accompanied the soil sample.

b. The test methods to be used for laboratory analysis shall comply with the following ASTM standards.

i) Sample Preparation (ASTM D1193)

ii) Sulfate Content (ASTM Standard Test Method D516)

iii) Chloride Content (ASTM Standard Test Method D512)

iv) Resistivity (ASTM Standard Test Method G57)

v) pH (ASTM Standard Test Method G51)

vi) Sulfide test per sodium azide-iodine qualitative tests per AWWA C105

3. Soil Classification

Based on the soil testing results, the soil shall be categorized into one of two categories: Class A or Class B. General guidelines for categorizing soils are presented below; while

Clarke County Sanitary Authority reserves the right to adjust these guidelines based on project-specific data.

Class A-Highly Corrosive Soils The following laboratory test results from the collected soil samples will be used for interpretation of Class A soils. If any of these criteria are met, the soil will be considered Class A:

a. Soil resistivity values <= 5,000 ohm/cm

b. pH values of the soil <= 4.0

c. Consistent presence of sulfides in samples

d. Consistent presence of sulfates content > 50 ppm in samples

e. Consistent presence of chlorides > 50 ppm in samples

f. Four-pin (in situ) soil resistivity values <= 5,000 ohm/cm

g. In situ pH <= 4.0

Class B-Moderately Corrosive Soils The following laboratory test results from the collected soil samples will be used for the interpretation of Class B soils. All of these criteria must be met in order for the soil to be considered Class B:

a. Soil resistivity values > 5,000 ohm/cm

b. pH values of the soil > 4.0

c. Consistent absence of sulfides in samples

d. Consistent presence of sulfate contents < 50 ppm in samples

e. Consistent presence of chlorides < 50 ppm in samples

f. Four-pin (in situ) soil resistivity values > 5,000 ohm/cm.

g. In situ pH > 4.0

Step 3: Stray Currents Stray current risks for all classes of pipelines shall be identified and evaluated by the designer. The potential for stray currents will be determined using the database of impressed current systems, maintained by the Nation Association of Corrosion Engineers (NACE), Baltimore-Washington Chapter; and using information from the owner of the facility carrying the current. Mitigation measures will be incorporated into the design of the proposed pipe.

Step 4: Evaluation Using the information collected in Steps 1, 2, and 3, Clarke County Sanitary Authority will determine the level of corrosion protection to be included in the

pipeline design. The decision process is included in **Figure E.1**. Clarke County Sanitary Authority reserves the right to adjust the decision process as necessary based on project-specific conditions.

All Class 1 pipelines and Class 2 pipelines in highly corrosive soils (Class A) will require a project-specific corrosion protection design. The design shall be prepared by a NACE registered engineer and incorporated into the construction plans and specifications for the proposed pipe. Generally, pipeline corrosion protection in these cases may include any of the following: polyethylene encasement, joint bonding, test stations, cathodic protection, and stray current mitigation.

Class 2 pipelines in moderately corrosive soils (Class B) and Class 3 pipelines in highly corrosive soils (Class A) will require enhanced corrosion control protection. This includes stray current mitigation as necessary, wrapping in polyethylene encasement, and coating of mechanical joints.

Class 3 pipelines in moderately corrosive soils (Class B) will be installed in accordance with standard Clarke County Sanitary Authority installation requirements. With the exception of stray current mitigation where necessary, corrosion protection measures will not be required.

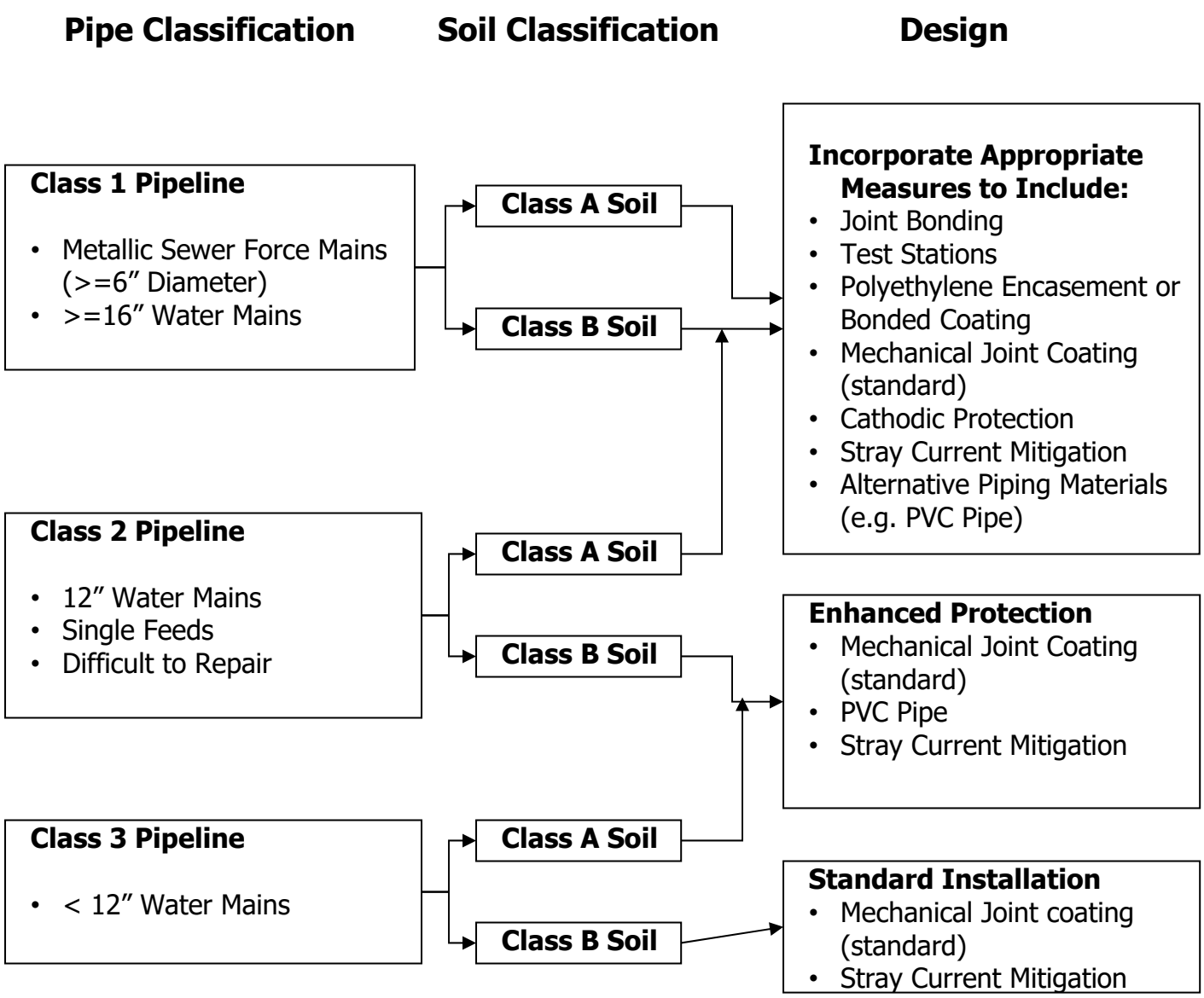


Figure E.1 – Decision Process

III. Installation Requirements

All installations of corrosion control measures shall be made according to the approved construction plans and specifications for the project, the *Standard Details* and the *Approved Materials List* (Appendices H and I of this Manual). Upon completion of the work, it shall be tested, operated, inspected and surveyed. Any and all repairs or replacement of defective or improperly installed corrosion control systems shall be made by the contractor, no additional cost to Clarke County Sanitary Authority.

A. Contractor Qualifications

1. Installation, quality assurance, and testing personnel must have demonstrated experience with similar work. Resume of work experience shall be submitted to the Clarke County Sanitary Authority for approval.

2. Personnel shall be specifically named in qualification submittal and have completed at least three successful corrosion control systems within the last three years for underground pipelines of similar type, similar size and equal complexity.

3. Personnel shall be a full-time contractor or subcontractor employees. Part-time or contract personnel hired only for this work will not be permitted.

4. Only personnel approved by Clarke County Sanitary Authority shall be permitted. Personnel changes during course of project must be minimized and submitted by Clarke County Sanitary Authority at least two (2) weeks prior to planned implementation.

5. The contractor shall oversee and certify installation and related testing, including pipe joint bonding, magnesium anode ground-beds, and corrosion control equipment.

6. The contractor shall issue a letter of compliance indicating all corrosion control measures are satisfactorily installed and are in compliance with contract documents. The letter of compliance shall be signed by the contractor's responsible person.

B. Thermite Welding

1. All thermite welds shall be made as shown on Figure CP-2 of the *Standard Details* and in accordance with the manufacturer's recommendations using the proper combination of equipment for the pipe and wire size being welded. All welding materials and equipment shall be the product of a single manufacturer.

2. Assure that the area where the attachment is to be made is absolutely dry. Remove mill coating, dirt, grime, and grease from the pipe or fitting surface at the weld location by wire brushing or by the use of suitable safety solvents. Clean a two-inch square area of the pipe or fitting surface at the weld location to a bright shiny surface, free of all serious pits and flaws by the use of a mechanical grinder.

3. Prepare the wire for welding by assuring that the cable is absolutely dry. The cable shall be free of dirt, grease, and other foreign products. Cut the cable in such a way as to avoid flattening or forcing it out of round. To prevent deformation of the cable, cut the cable with cable cutters. Remove the insulation in such a manner that will avoid damage to strands. Install adapter sleeves for all bonds and test wires prior to welding. Either prefabricated factory sleeved joint bonds or bond wires with formed sleeves made in the field are acceptable. Hold the cable at an approximate 30 degree angle to the pipe surface when welding.

4. When the weld has cooled, tap with the two pound hammer while pulling firmly on the wire. Remake unsound welds and retest. Thoroughly clean mold and mold covers after completion of each weld to assure that no slag will penetrate into the next weld.

5. After the soundness of the weld has been verified, thoroughly clean the weld with a stiff wire brush and coat with an elastometric cap. Apply primer over the entire weld area. Push the dome of the prefabricated cap containing elastometric material firmly into the weld area. Lift the wire away from the pipe and apply the elastometric material coating completely around and underneath the wire. Push the wire back down on the pipe.

C. Prepackaged Anodes

1. The prepackaged anodes shall be installed where indicated. Prior to installation, remove all shipping covers from the anode (the packaged box shall not be removed). Install the anodes in existing soils (free from rocks, roots, organic material, trash or any other debris) and backfill with existing soil (as described above). Do not install the anode in sand, rock, or gravel backfill. Do not lower the anode into the excavation by the lead wire. If necessary, temporarily wrap a rope around the anode and lower the anode into the excavation by the rope. Remove the rope after the anode is installed. Provide a minimum spacing of two feet from other pipelines. Pre-soak the anode with 5 gallons of water after placement, but prior to backfilling.

2. Anode header cable shall be buried a minimum of 18 inches below grade. Handle wire with care. All anode lead wire to header cable splices shall be made with a compression connector as shown in Figure CP-5 of the *Standard Details*. Tape the splice with three layers of high voltage rubber splicing tape (50% overlap). Terminate the ends of the anode lead cable in the test stations in accordance with Figure CP-6 of the *Standard Details*.

D. Bonded Joints

1. All pipeline joints within the cathodic protection areas, including those on pipe, fittings, valves, all branch connections, shall be bonded with two insulated copper cables as shown on Figure CP-1 of the *Standard Details*.

E. Test Station

1. Install test stations at the locations required. Test stations are to be located directly over the pipeline except in areas that would place the station in the roadway. Locate these test

stations to the closest point at the edge of the road. Test station pedestals or boxes shall be in accordance with Figures CP-6, CP-7, CP-8, CP-9, and CP-10 of the *Standard Details*. Pedestals are preferred, and will be used where suitable to their surroundings. Test boxes will be used where test station must be flush with the surrounding grade.

2. Attach test wires as indicated using the proper thermite welding equipment and charges specified for the wire size and respective pipe material. Follow all procedures as outlined above.

3. All test station wires shall be routed a minimum of 18 inches below finish grade. Maintain sufficient slack in the test wires so that the wires can extend a minimum of 18 inches from the compression thermal lugs for 0.25-inch bolt size. Install a shunt to connect the anode lead to the pipe lead where indicated on the design drawings.

4. The test stations shall be set in poured concrete in accordance with Figure CP-11 of the *Standard Details*. Cathodic protection test station pad concrete shall be Class B concrete. The flush mounted test station lids shall be free of concrete and not cemented over.

F. Clearance Requirements

1. A minimum of 6" separation shall be maintained from any foreign pipeline or structures. If 12" separation is not possible, positive separation shall be provided using glass mesh.

G. Electrical Isolation

1. Insulating Flanges: Approved insulating flanges shall be installed in accordance with specific design considerations.

2. Insulating Unions: Approved insulating unions shall be installed in accordance with specific design considerations to isolate bimetallic service lines and other type connections that may create corrosion conditions from dissimilar metallic connections.

3. Die-electric Pipe Materials: Approved die-electric pipe materials shall be used to isolate metallic pipe where specified as part of design consideration for foreign pipe line crossings as part of stray current mitigation considerations. A section of polyvinyl chloride (PVC) pipe may be a suitable material for this purpose. Pipe materials, thickness design, and pipe specifications shall be provided by Clarke County Sanitary Authority.

H. Trench Excavation

1. The trench and backfill material around the pipeline shall be clean of all debris, such as trash, wood, and rocks. Strip forms at blockings.

I. Record Drawings

Record Drawings will be prepared to accurately document the installed location and configuration of each test station, including:

1. test station number per the test station schedule on the plans and installed pipeline station number.

2. three dimensional ties between test station and existing permanent datum.

3. wire routing, size, insulation color and termination configured on terminal board.

4. pipeline station numbers for wire attachments to pipe.

5. anode locations, where installed, including pipeline station number, depth and distance from pipe.

IV. Post-Installation Quality Assurance and Acceptance Testing

After the installation is complete, the contractor or the owner's consulting engineer will conduct the following post-installation quality assurance and acceptance testing, to verify the work. The repair or replacement of any defective or improperly installed systems shall be the sole responsibility of the contractor.

A. Test Station Wires

1. All test station wires shall be field verified for electrical continuity after connection of the wires on the terminal board in the test station and prior to the installation of any shunts on the terminal board. The testing will verify that the test wires have been properly installed and have not been damaged during backfilling and final test station installation. The test station wire verification shall be performed with an industry standard high impedance voltmeter and a copper/copper sulfate reference electrode.

2. The test station wire verification shall be performed by placing a copper/copper sulfate reference electrode in the soil adjacent to the test station being tested. Connect the copper/copper sulfate reference electrode to the positive terminal of the voltmeter with a test lead. Connect the test wire to be verified to the negative terminal of the voltmeter with a test lead. Record the resultant structure-to-earth potential. Without moving the copper/copper sulfate reference electrode, repeat this measurement for every wire in the test station.

3. Acceptance criteria shall be as follows:

   a. Ductile iron pipe normally has a voltage to ground potential of between 0.50 and 0.65 volt to a copper/copper sulfate reference, adjacent test leads on the pipe shall have the exact same potential. Voltage to ground measurements outside of this range will require further evaluation.

   b. Magnesium anodes shall be between 1.55 and 1.65 volts to a copper/copper sulfate reference. Voltage to ground measurements outside of this range will require further evaluation.

4. Results of the test wire verification testing shall be documented. Documentation shall include the following (Table 1):

   a. name of the Corrosion Technician performing test;

   b. date of each test;

   c. station number of test wires;

   d. test wire color and size;

   e. structure that the test wire is connected to;

   f. structure-to-earth potential for each test wire;

   g. statement that the test wire has been installed properly in accordance with the criteria listed above. Data shall be maintained for inclusion in the final quality assurance report.

B. Linear Electrical Continuity

1. The linear electrical continuity of the bonded water main shall be tested to confirm that pipe joint bond cables have been properly installed and have not been damaged during backfilling. The testing will verify that the water main is electrically continuous in accordance with design specifications (Table 2).

2. The linear electrical continuity testing shall be performed with a combination voltmeter/ammeter, a 12-volt battery capable of at least 80 amperes short circuit current, and test wires and leads of sufficient length to extend over the length of pipe being tested (Table 2).

3. The linear electrical continuity testing shall be performed by impressing a DC current between adjacent test stations while simultaneously measuring the resultant voltage drop on the pipeline between the adjacent test stations. Voltage and current measurements shall be recorded with the current applied and immediately after the current is turned off (Table 2).

4. Calculate the voltage and current delta readings for each measurement by subtracting the "Instant Off' values from the "Current On" values. Divide the voltage delta by the current delta to calculate the measured resistance value (Table 2).

5. Calculate the theoretical resistance of the pipe section using published resistance tables for the type and diameter of the pipe that was installed (Table 3). Multiply the length of the pipe being tested by the resistance value for the type and size of pipe being tested (Table 4). Determine the number of pipe joints in the section being tested. Multiply the number of pipe joints by the theoretical resistance of the bond wires that were installed. Add the resistance value for the length of pipe to the resistance value for the pipe joints to determine the theoretical resistance value of the section of pipeline being tested.

6. Compare the measured resistance value to that calculated resistance value for the test section. The measured linear electrical resistance of the test section will be acceptable if the measured resistance value is no greater than 115% of the theoretical linear resistance value for the test station (Table 3).

7. Repeat the above test procedures between all adjacent test stations on the water main until the entire length of pipeline is tested. Actual resistances greater than 115% of the theoretical resistance will have to be re-evaluated to assure adequate electrical continuity of the pipe span.

8. Results of the linear continuity testing shall be documented. Documentation shall include the following (Tables 2 and 3):

   a. name of the Corrosion Technician performing test;

   b. date of each test;

   c. beginning and end station numbers of test section;

   d. length of the test section;

   e. amount of current applied for the test;

   f. voltage drop measured over the test section with current applied;

   g. voltage drop measured over the test section immediately after the current is turned off;

   h. calculated measured resistance of the test section;

   i. type and diameter of pipe;

   j. theoretical resistance per foot of pipe length;

   k. length, size and number of bond cables per joint;

   l. calculated resistance of bond cables across one joint;

   m. number of pipe joints in test section;

   n. calculated theoretical resistance of the entire pipe section;

   o. percentage that the measured resistance is greater than or less than the theoretical resistance of the pipe section;

   p. statement that the section of pipe has been properly bonded in accordance with acceptance criteria listed above. Continuity data shall be maintained for inclusion in the final quality assurance acceptance report.

C. Electrical Isolation

1. All insulating couplings, insulating flanges, insulating unions and insulating casing spacers shall be tested to confirm that effective electrical isolation exists between the isolated structures. The testing will verify that the insulating couplings, flanges, unions and casing spacers have been installed properly and are providing effective isolation.

2. The electrical isolation testing shall be performed with a high impedance combination volt/ammeter, a copper/copper sulfate reference electrode, a 12-volt battery and test leads of sufficient length to obtain structure-to-earth potentials and apply current to each side of the insulator.

3. The effectiveness of the electrical isolation shall be verified by measuring structure-to-earth potentials of each side of the insulator while a DC current is applied between one side of the insulator and a temporary ground-bed. Install a temporary ground-bed by inserting steel pins into the ground directly over the pipeline and approximately 50 feet from the insulator being tested. Impress a DC current between the temporary ground-bed and the opposite side of the insulator. Using a portable reference electrode placed over the insulator, measure the structure-to-earth potential on each side of the insulator. Structure-to-earth potentials shall be measured with the current applied and immediately after the current is turned off. Structure-to-earth and current readings shall be obtained simultaneously. Record the potential and current data.

4. Effective electrical isolation of the insulating coupling, insulating flange, insulating union or insulating casing spacers will be indicated by a negative potential shift ("On" reading minus the "Instant Off' reading) on the side of the insulator closest to the ground-bed. The far side of the insulator will have a positive voltage shift ("On" reading minus the "Instant Off' reading) if the test circuit is set up properly.

5. Results of the electrical isolation testing shall be documented. Documentation shall include the following (Table 5):

   a. name of the Corrosion Technician performing test;

   b. date of each test;

   c. station number of electrical isolation;

   d. location and type of insulator tested;

   e. pipe-to-earth potentials ("On" and "Instant Off' values) on both sides of the insulator;

   f. test current ("On" and "Instant Off' values);

   g. statement that the electrical isolation is effective. Electrical isolation data must be maintained for inclusion of the final quality assurance acceptance report

D. Cathodic Protection and Stray Current Mitigation Potentials

1. For pipelines with cathodic protection and/or stray current mitigation anodes, testing shall be performed to evaluate the effectiveness of the anodes. Base structure-to-earth potential data shall be obtained at all test stations before any anode lead wires are connected to the pipe leads. The initial operating structure-to-earth potentials shall be obtained at each test station immediately after installing the shunts between the pipe and the anode leads. The base and initial operating potentials shall be measured with a high impedance digital voltmeter and a copper/copper sulfate reference electrode.

2. The structure-to-earth potential between the pipeline test lead wire, which is not directly connected to the anode leads in the test station, and a portable copper/copper sulfate reference electrode contacting the soil shall be measured, using the voltmeter. The portable electrode shall be placed adjacent to the test station for the measurement. Connect the copper/copper sulfate reference electrode to the positive terminal of the voltmeter with a test lead and connect pipeline test wire to the negative terminal of the voltmeter with a test lead. Obtain structure-to-earth potentials ("On" values) on all test wires with the anode leads connected to the pipe.

3. Results of the structure-to-earth potential testing shall be documented. Documentation shall include the following (Table 1):

   a. name of the Corrosion Technician performing test;

   b. date of each test;

   c. station number of test wires;

   d. structure-to-earth potentials ("Native Potentials") on each test wire;

   e. structure-to-earth potentials ("On potentials") on all test wires with all anode lead wires connected to the appropriate pipe leads in all test stations;

   f. structure-to-earth potentials ("Instant Off Potentials") on all test wires immediately after the anode leads at the test station are temporary disconnected (testing performed with all other anode ground beds connected in their respective test stations and after the piping has had a minimum of one month to polarize);

   g. statement that the corrosion control system is operating in accordance with the designed corrosion control plan. Potential data shall be maintained for inclusion in the final quality assurance acceptance report.

E. Anode Operating Current

1. Initial anode operating current shall be measured at each test station where anodes are installed. The initial anode operating current shall be measured using the test station shunt and a digital voltmeter. The anode current shall be measured by connecting the positive terminal of the millivolt meter to one side of the shunt and the negative terminal of the millivolt meter to the other side if the shunt. The millivolt reading shall be obtained and recorded. Using the calibration factor of the shunt, calculate the anode current in

milliamps. The anode current will be equal to the voltage reading across the shunt divided by the resistance of the shunt. Record the calculated current output of the anodes.

2. Results of the initial and final anode operating current testing shall be documented. Documentation shall include the following (Table 1):

   a. name of the corrosion technician performing tests

   b. date of each test

   c. station number of anode test wires

   d. initial anode current output (shunt measurement)

   e. final anode current output (shunt measurement), testing to performed with all other anode ground-beds connected in their respective test stations and after the piping has had a minimum of one month to polarize

   f. statement that the anodes are operating in accordance with the design documents. Anode current data shall be maintained for inclusion in the final quality assurance acceptance report.

F. Close-Interval Potential Survey

1. Approximately one month after the pipeline is installed and the initial anode measurements are obtained (for pipelines designated for supplemental cathodic protection), Clarke County Sanitary Authority shall conduct a close-interval survey on the pipeline. Close interval potential survey data will be used to evaluate the effectiveness of applied cathodic protection.

2. The close-interval potential survey shall be performed using a high impedance voltmeter, a copper/ copper sulfate reference electrode, test lead wire long enough to survey the test area, and associated clips and test leads.

3. Connect the high impedance voltmeter between the pipe leads in a test station and the copper/copper sulfate reference electrode. The voltmeter is reconnected to the pipeline at each test station along the pipeline. The Corrosion Technician places the electrodes in contact with the earth directly over the pipeline and the structure-to-earth potentials at that point are recorded. The reference electrode is then placed approximately 5 feet away from the site of the first reading and the measurement is recorded. This process continues along the entire pipeline route and potential data are collected and recorded every 5 feet.

4. The data that were collected are then tabulated and entered into a database to be graphed. The tabulated data and graphs are then submitted for analysis by the NACE certified corrosion specialist.

5. Results of the close-interval potential survey shall be documented. Documentation shall include the following (Table 6):

a. name of the Corrosion Technician performing test;

b. date of the test;

c. tabulated pipe-to-earth with station numbers, test stations and features identified;

d. graphed profile data with station numbers, test stations and features identified on the graph;

e. statement that the corrosion control system is operating in accordance with the design considerations. Close interval survey data shall be maintained for inclusion in the final quality assurance acceptance report.

Appendix H: Construction Details

CLARKE COUNTY SANITARY AUTHORITY

GENERAL

CATHODIC PROTECTION

WATER

GRAVITY SEWER

SANITARY FORCE

LOW PRESSURE COLLECTION

*WASTE WATER COLLECTION BY LOW PRESSURE NOT TO BE USED EXCEPT AT THE SOLE DISCRETION OF CCSA.

PRETREATMENT

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CLARKE COUNTY SANITARY AUTHORITY

1. THE INSTALLATION CONTRACTOR WILL MAKE A FULL MATERIALS SUBMITTAL FOR THE AUTHORITY'S REVIEW AND APPROVAL, PRIOR TO PURCHASING MATERIALS. ALL MATERIALS TO BE IN ACCORDANCE WITH THE CURRENT APPROVED MATERIALS LIST OF LOUDOUN WATER, EXCEPT AS MODIFIED BELOW

2. CCSA IS NOT A MEMBER OF MISS UTILITY SYSTEM. CALL 540-955-5185 FOR WATER OR SEWER LOCATE

3. WATER MAIN TO BE PVC DR 18, CONFORMING TO AMERICAN WATERWORKS ASSOCIATION (AWWA) C900. WHERE SPECIFIED ON PROFILE, TRANSITION TO DUCTILE IRON PIPE CLASS 52, CONFORMING TO AWWA C151, LINED TO AWWA C104. DUCTILE IRON IS REQUIRED IN ALL HYDRANT ASSEMBLIES AND VERTICAL OFFSETS. ALL FITTINGS TO BE DUCTILE IRON CONFORMING TO AWWA C153 AND LINED PER AWWA C104, WITH MECHANICAL JOINT ENDS.

4. NO BLASTING IS PERMITTED WITHIN 25' OF THE AUTHORITY'S EXISTING UTILITIES.

5. WATER SERVICES TO BE 1" OR LARGER CROSS-LINKED POLYETHYLENE, PEXa, SDR9, CONFORMING TO AWWA C904, AND WITH COPPER TUBE SIZE (CTS) OUTSIDE DIMENSIONS. TUBING TO HAVE 200PSI RATING, BE BLUE IN COLOR, AND HAVE 1 YEAR WARRANTY AGAINST UV DEGREDATION. TUBING TO BE MUNICIPEX® BY REHAU OR APPROVED EQUAL. CONNECTIONS BETWEEN TUBING AND FITTINGS SHALL INCLUDE STAINLESS STEEL STIFFENERS. APPROVED CONNECTIONS ARE MUELLER 110 COMPRESSION, A.Y. MCDONALD T CTS COMPRESSION, OR FORD QUICK JOINT. TAPPING SADDLES TO BE ALL BRONZE.

6. RESIDENTIAL METER SETTERS TO BE 12" TALL, SIZED FOR ¾"X5/8" METER, HAVE INTEGRAL 1" INLET AND OUTLET, WITH FULL PORT BALL ANGLE VALVE ON INLET, AND ANGLE CARTRIDGE DUAL CHECK ON OUTLET. METER BOX AND FRAME TO BE PER LOUDOUN WATER APPROVED MATERILAS LIST. COVER TO BE CAST IRON, WILL LOCK WITH BRASS PENTAGONAL NUT AND WORM GEAR, AND HAVE NO AUTOMATED READING FEATURE. FOR METERS LARGER THAN 5/8" SEE CORRSPONDING STANDARD DETAIL.

7. ALL SANITARY MAINS AND LATERALS TO BE PVC DR25 OR DR18, AS SPECIFIED ON PROFILES, CONFORMING TO AWWA C900. FITTING TO BE PVC AND SHALL CONFORM TO AWWA C907.

8. INSTALLATION AND TESTING TO BE IN ACCORDANCE WITH CCSA DESIGN AND CONSTRUCTION STANDARDS. ALL TESTING MUST BE WITNESSED BY THE AUTHORITY'S REPRESENTATIVE. THE DEVELOPER SHALL PROVIDE CLOSED CIRCUIT TELEVISION INSPECTION OF THE SANITARY SEWER MAINS, PRIOR TO SEWERS BEING APPROVED FOR SERVICE. THE DEVELOPER WILL PROVIDE A SECOND VIDEO INSPECTION IN SUPPORT OF THE FINAL DEDICATION OF THE PUBLIC SEWERS.

9. SANITARY SEWER AND WATER MAINS SHALL HAVE A MINIMUM 15' HORIZONTAL SEPARATION FROM BUILDINGS, UNLESS PRIOR PERMISSION IS GRANTED BY THE AUTHORITY.

10. A 6" MARKING TAPE MUST BE PLACED ABOVE ALL PIPE LINES.

11. ALL PRESSURIZED PIPELINES SHALL BE RESTRAINED WITH CONCRETE REACTION BLOCKING AT ENDS AND CHANGES IN DIRECTION, EXCEPT WHERE OTHERWISE DIRECTED BY THE AUTHORITY.

12. WATER SERVICES MUST HAVE A MINIMUM 8' HORIZONTAL SEPARATION FROM SANITARY LATERALS.

13. LANDSCAPING IS NOT PERMITTED WITHIN THE AUTHORITY'S EASEMENTS, OR WITHIN 5' OF FIRE HYDRANTS AND METER BOXES.

14. PROVIDE POSITIVE DRAINAGE AWAY FROM SANITARY MANHOLES THROUGHOUT CONSTRUCTION.

15. EXISTING MANHOLES SHALL BE CORE BORED IN ORDER TO RECEIVE PROPOSED PIPE.

16. TOPS OF MANHOLES LOCATED OUTSIDE PAVEMENT MUST BE 1' ABOVE SURROUNDING GRADE. THIS REQUIREMENT SHALL NOT APPLY IN DEVELOPED LAWNS.

OCT. 2019	STANDARD NOTES	G-4

17. ALL SANITARY LATERALS SHALL BE 4" PVC DR25 (AWWA C900) AT 2.08% SLOPE UNLESS OTHERWISE SPECIFIED, AND MUST LEAVE THE MAIN AT A 90 DEGREE ANGLE.

18. ALL WATER MAINS AND SANITARY SEWERS MUST BE CONSTRUCTED IN ACCORDANCE WITH THE CURRENT CCSA DESIGN AND CONSTRUCTION STANDARDS AND PROJECT SPECIFICATIONS. OWNER MUST ENSURE THAT BUILDING PLANS ACCOMMODATE WATER AND SEWER ENTRANCE POINTS, METERING CONSIDERATIONS, PRETREATMENT DEVICES, AND BACKFLOW PREVENTION DEVICES, TO ACCOMPLISH FULL COMPLIANCE WITH CCSA'S REQUIREMENTS.

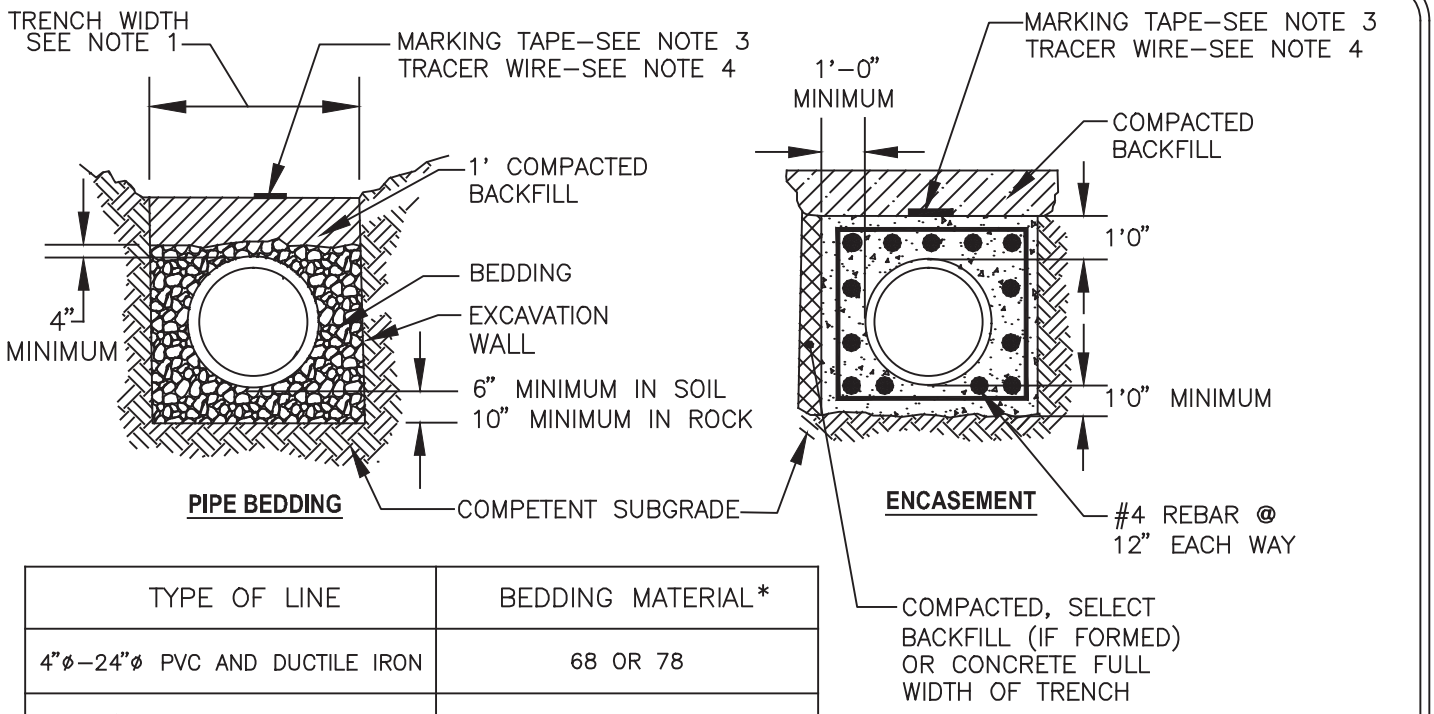
19. UTILITIES OUTSIDE THE PUBLIC RIGHT-OF-WAY AND PAVEMENT SHALL BE PROVIDED WITH ABOVE GROUND MARKING STAKES. MARKERS ARE TO BE SPACED AT INTERVALS OF 300-500 FEET, AND AT MANHOLES, VALVES, AND CHANGES IN DIRECTION, TO ACCOMPLISH A CONTINUOUS LINE OF SITE BETWEEN MARKERS.

20. ALL MECHANICAL JOINT ASSEMBLIES TO BE COATED PER STANDARD DETAIL CP-3.

21. WATER SERVICES MUST HAVE A MINIMUM 6' HORIZONTAL SEPARATION FROM EDGE OF DRIVEWAY APRONS.

22. ALL HYDRANTS AND METER BOXES MUST HAVE A MINIMUM 5' HORIZONTAL SEPARATION FROM EDGE OF DRIVEWAY APRONS.

CLARKE COUNTY SANITARY AUTHORITY



TYPE OF LINE	BEDDING MATERIAL*
4"ø–24"ø PVC AND DUCTILE IRON	68 OR 78
1 1/4" – 3" PVC AND HDPE	68, 78 OR 8
PEX AND COPPER TUBING	68, 78 OR 8

*CONFORMING TO VDOT ROAD AND BRIDGE SPECIFICATION

NOTES:

1. MINIMUM TRENCH WIDTH IN SOIL FOR LINES 16"ø AND SMALLER: PIPE DIAMETER +12"
   MINIMUM TRENCH WIDTH IN SOIL FOR LINES LARGER THAN 16"ø: PIPE DIAMETER +18"
   MINIMUM TRENCH WIDTH IN ROCK: PIPE DIAMETER +48"
2. FOR PIPES OF 30"ø AND GREATER OR OF A MATERIAL NOT LISTED ABOVE, SPECIFICATIONS SHALL BE MADE ON A PROJECT SPECIFIC BASIS, BUT SHALL BE NO LESS THAN THE ABOVE.
3. PLACE UTILITY MARKING TAPE. ADD MARKING TAPE WITH TEXT IDENTIFYING PIPE JOINTS AS RESTRAINED, WHERE ABOVE RESTRAINED JOINT PIPING SYSTEM OR PIPE JOINTS WITH LOCKING GASKETS.
4. ADD TRACER WIRE FOR PRESSURIZED PVC OR PE LINES, AND FOR ALL SANITARY LATERALS. FOR 12"ø PIPE AND LARGER, AFFIX TRACER WIRE TO PIPE ON CENTER LINE.
5. ENCASEMENT:
   A) BEGIN AND END ENCASEMENT AT A PIPE JOINT.
   B) CONCRETE TO BE CLASS A3 PER APPROVED MATERIALS LIST (3000 PSI).
   C) BUOYANCY CALCULATIONS REQUIRED FOR PIPES LARGER THAN 12"ø OR IF ENCASEMENT IS TO BE LONGER THAN 60'.

D) ALL REINFORCEMENT TO HAVE MINIMUM 2" CONCRETE COVER.

OCT. 2016	PIPE BEDDING AND ENCASEMENT	G–6

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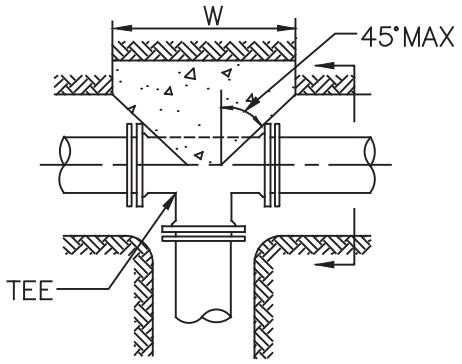
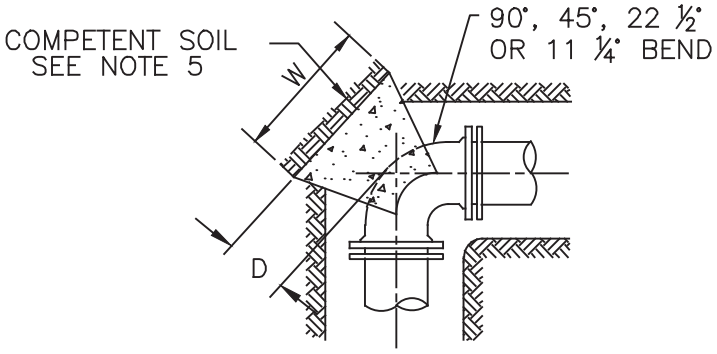
CLARKE COUNTY SANITARY AUTHORITY



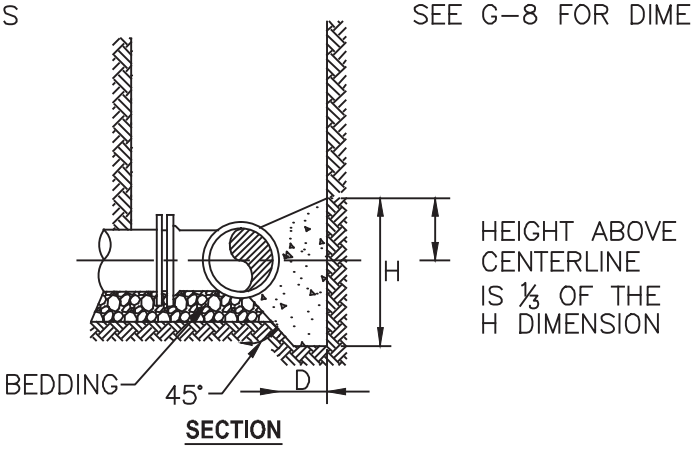
PLAN

SEE G–8 FOR DIMENSIONS



PLAN

SEE G–8 FOR DIMENSIONS



SECTION

SEE G–8 FOR DIMENSIONS

NOTES:

1. WRAP FITTING WITH POLYETHYLENE SHEETING. PROVIDE FORM WORK FOR ALL BLOCKS. PRIOR TO BACKFILL, FORMS MUST BE STRIPPED AND BLOCKING INSPECTED.
2. CONCRETE TO BE CLASS B2 (2200 PSI) OR BETTER.
3. BLOCKING MUST NOT OBSTRUCT ACCESS TO MECHANICAL JOINT ASSEMBLY.
4. AT TEE USE DIMENSIONS FOR DEAD END OF SAME DIAMETER AS BRANCH OF TEE.
5. SEE G–8 FOR DIMENSIONS. TABLE IS BASED ON $R=2PA\sin(\phi/2)$, A SOIL BEARING OF 3000 PSF, A TEST PRESSURE OF 150 PSI, AND A SAFETY FACTOR OF 1.5. INCREASE BLOCKING DIMENSIONS AS REQUIRED IN SOILS WITH LOWER BEARING VALUES.
6. FOR FITTINGS LARGER THAN 24", BLOCKING SHALL BE DESIGNED ON PROJECT SPECIFIC BASIS.

OCT. 2016	CONCRETE THRUST BLOCK	G–7

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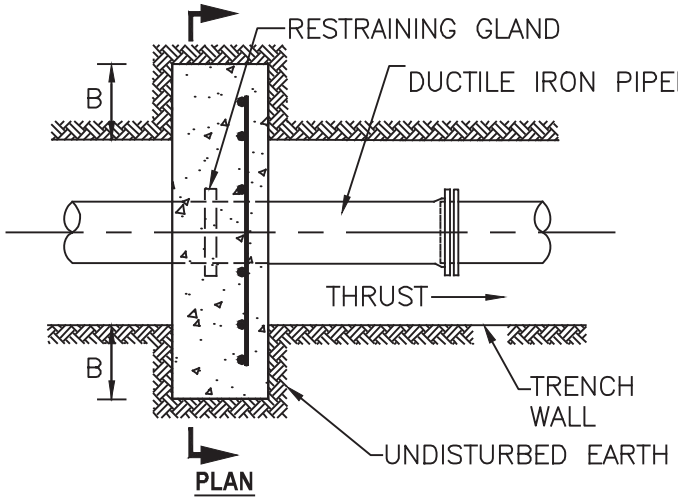
CLARKE COUNTY SANITARY AUTHORITY

MINIMUM DIMENSIONS (FEET)				
PIPE SIZE (INCHES)	BEND	W	H	D
6	DEAD END/TEE	1.75	1.25	1.0
	90	2	1.5	1.0
	45	1.75	1.0	1.0
	22 ½/11 ¼	1.25	.75	1.0
8	DEAD END/TEE	2.25	1.75	1.25
	90	2.75	2.0	1.25
	45	2.25	1.25	1.0
	22 ½/11 ¼	1.5	1.0	1.0
10	DEAD END/TEE	3.0	2.0	1.75
	90	3.0	2.75	1.75
	45	2.25	2.0	1.25
	22 ½/11 ¼	1.75	1.5	1.0
12	DEAD END/TEE	3.5	2.5	1.75
	90	3.75	3.0	1.75
	45	3.0	2.25	1.25
	22 ½/11 ¼	2.0	1.75	1.0
16	DEAD END/TEE	4.0	3.75	2.0
	90	5.0	4.25	2.0
	45	4.0	3.0	1.5
	22 ½/11 ¼	3.0	2.0	1.25
20	DEAD END/TEE	5.5	4.5	2.5
	90	6.5	5.25	2.5
	45	5.25	3.5	1.75
	22 ½/11 ¼	3.75	2.5	1.5
24	DEAD END/TEE	6.25	5.5	3.0
	90	8.0	6.0	3.0
	45	6.5	4.0	2.5
	22 ½/11 ¼	4.0	3.5	1.5

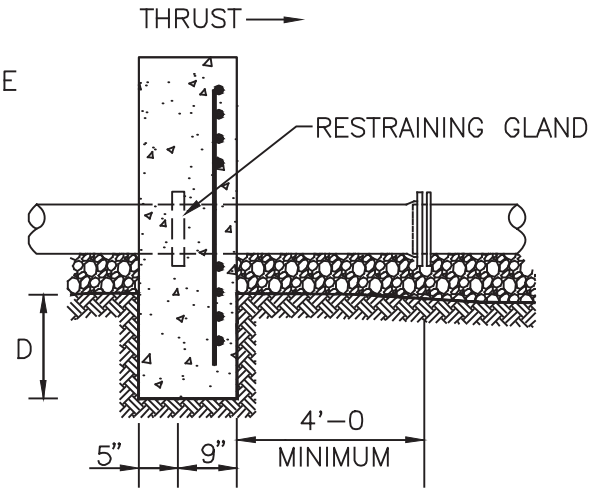
OCT. 2016	THRUST BLOCK DIMENSIONS	G–8

Clarke COUNTY · VIRGINIA

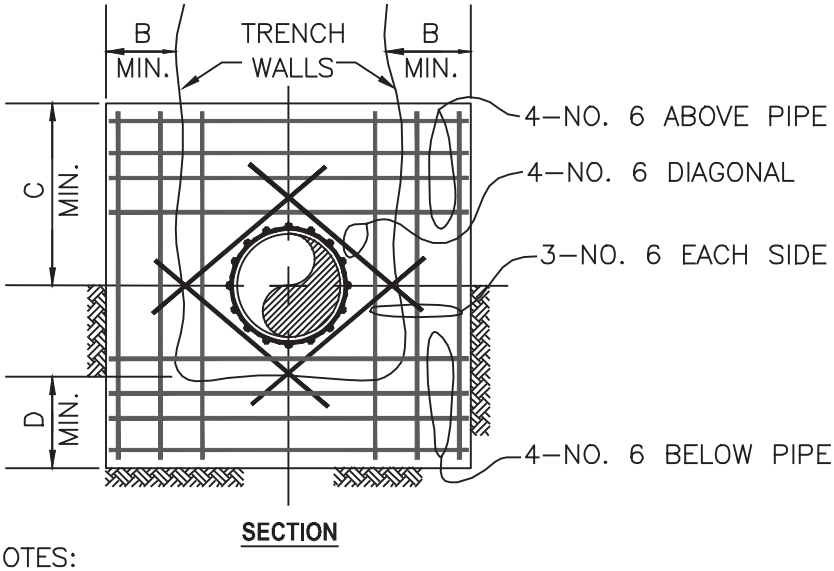
CLARKE COUNTY SANITARY AUTHORITY



PLAN



ELEVATION



SECTION

ANCHOR SCHEDULE MINIMUM DIMENSIONS (FT)			
LINE SIZE	B	C	D
6"	1.0	1.5	1.0
8"	1.0	1.5	1.0
10"	1.0	1.5	1.0
12"	1.25	1.5	1.25

NOTES:

1. DIMENSIONS "B" & "D" ARE MINIMUM VALUES FOR BEARING IN EARTH. BEARING AREA IS BASED ON 150 PSI TEST PRESSURE, A SOIL BEARING OF 3000 PSF, AND A SAFETY FACTOR OF 1.5. INCREASE BLOCKING DIMENSIONS AS REQUIRED IN SOILS WITH LOWER BEARING VALUES.
2. WHERE ANCHOR IS BEING CAST ON EXISTING MAIN, USE RESTRAINING GLANDS FOR MID–SPAN APPLICATIONS. OTHER SPLIT GLANDS PROHIBITED.
3. MAINTAIN MINIMUM 1.5" CLEARANCE BETWEEN PIPE AND REBAR. 1" MINIMUM CONCRETE COVER REQUIRED ON ALL REBAR.
4. CONCRETE TO BE CLASS A3 (3000 PSI). ANCHOR MUST BE MONOLITHIC (SINGLE POUR).
5. PRIOR TO PLACING CONCRETE, FORMS, GLAND, AND REINFORCMENT MUST BE APPROVED.
6. PRIOR TO BACKFILL, BLOCKING MUST BE INSPECTED AND APPROVED.

OCT. 2016	LINE ANCHOR	G–9

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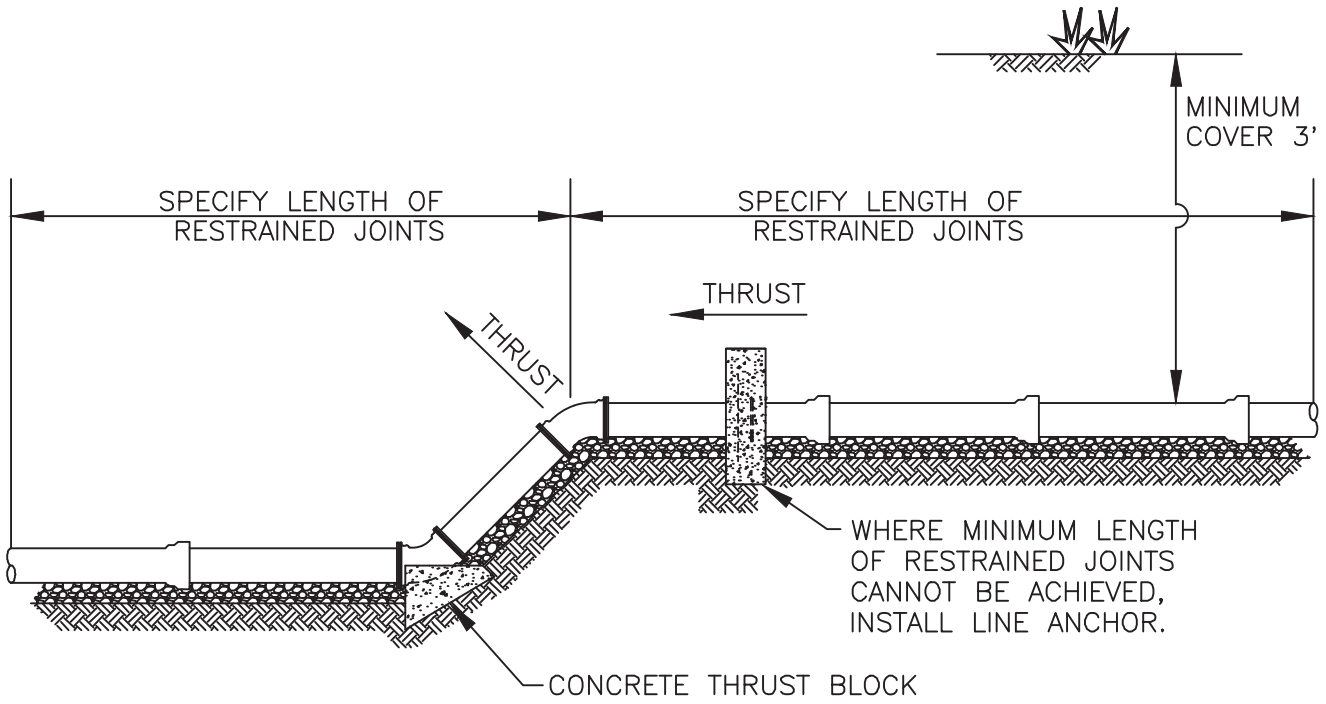
CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. RESTRAIN ALL JOINTS FOR THE SPECIFIED DIMENSIONS IN BOTH DIRECTIONS FROM THE BENDS. BENDS SHALL BE RESTRAINED TO THE ADJACENT PIECES OF PIPE. JOINT TYPES SHALL BE ONE OF THE FOLLOWING:

   16" & LARGER

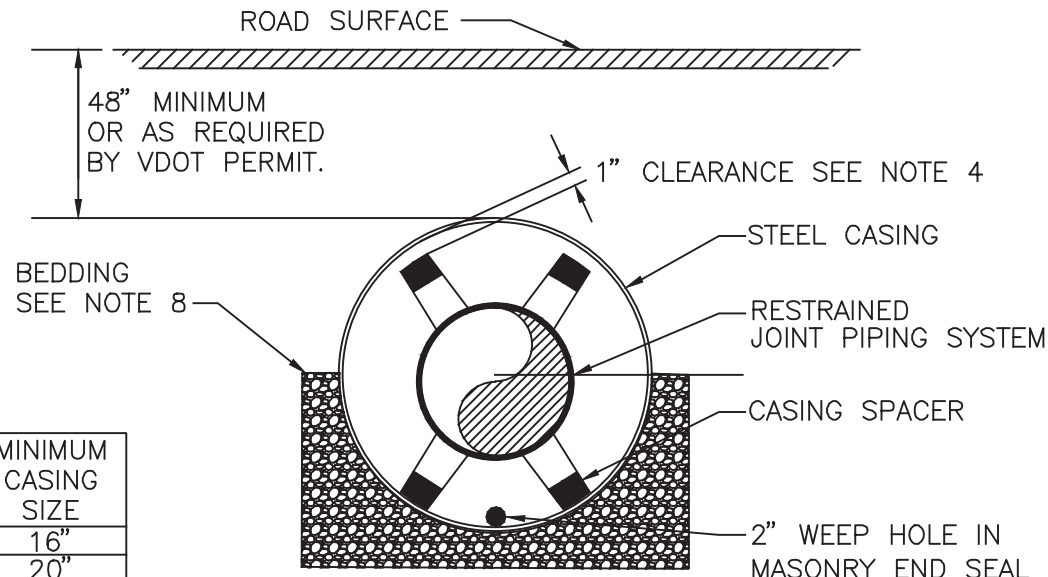
   APPROVED RESTRAINED JOINT PIPING SYSTEM AND APPROVED RESTRAINING GLAND AT FITTINGS.

   12" & SMALLER

   A) RESTRAINED JOINT PIPING SYSTEM SPECIFIED FOR THE PARTICULAR INSTALLATION.
   B) FIELD LOK ® GASKET IN PUSH-ON JOINTS.
   C) AMERICAN FASTGRIP ® IN PUSH-ON JOINTS.
   D) APPROVED RESTRAINING GLAND AT FITTINGS.

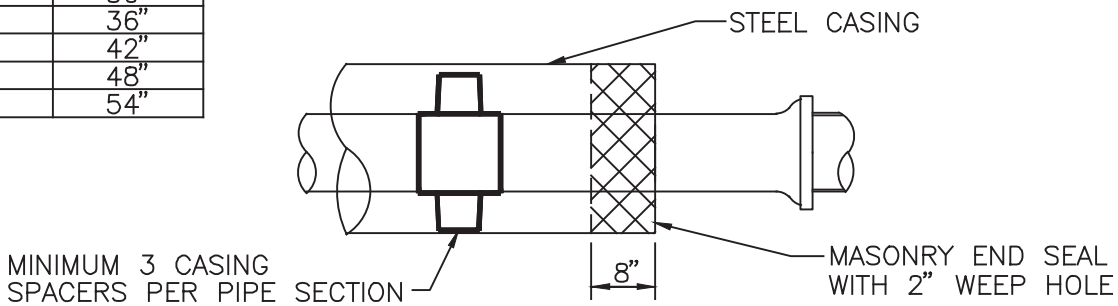
OCT. 2016	RESTRAINT OF VERTICAL OFFSET	G-11

CLARKE COUNTY SANITARY AUTHORITY



ELEVATION

PIPE SIZE	MINIMUM CASING SIZE
6"	16"
8"	20"
10"/12"	24"
16"	30"
20"	36"
24"	42"
30"	48"
36"	54"



SECTION

NOTES:

1. MATERIALS SUBMITTAL REQUIRED FOR CASING PIPE, CARRIER PIPE, AND SPACERS.
2. SEE LOUDOUN WATER'S APPROVED MATERIALS LIST FOR CASING AND SPACER REQUIREMENTS.
3. CARRIER PIPE WITHIN CASING TO BE A RESTRAINED JOINT PIPING SYSTEM.
4. SPACERS SHALL PLACE THE CARRIER PIPE IN THE CENTERED AND RESTRAINED POSITION.
5. CONSULT THE MANUFACTURER OF THE CARRIER AS TO WHETHER PIPE SHOULD BE PUSHED OR PULLED THROUGH CASING. INSTALLATION SHALL CONFORM TO MANUFACTURER'S RECOMMENDATION FOR THE TYPE OF JOINT EMPLOYED.
6. FOR CASINGS 48" AND LARGER, WELD A RUNNER IN THE BOTTOM OF THE CASING TO PREVENT THE CARRIER PIPE FROM SPINNING DURING INSTALLATION.
7. FOR GRAVITY SEWER INSTALLATIONS, FILL ANNULAR SPACE WITH GROUT. FOR ALL OTHER INSTALLATIONS, LEAVE ANNULAR SPACE EMPTY.
8. FOR CASING INSTALLED BY OPEN CUT, PROVIDE #57 STONE BEDDING, EXTENDING TO SPRING LINE OF CASING.

OCT. 2016	CASING INSTALLATION	G–12

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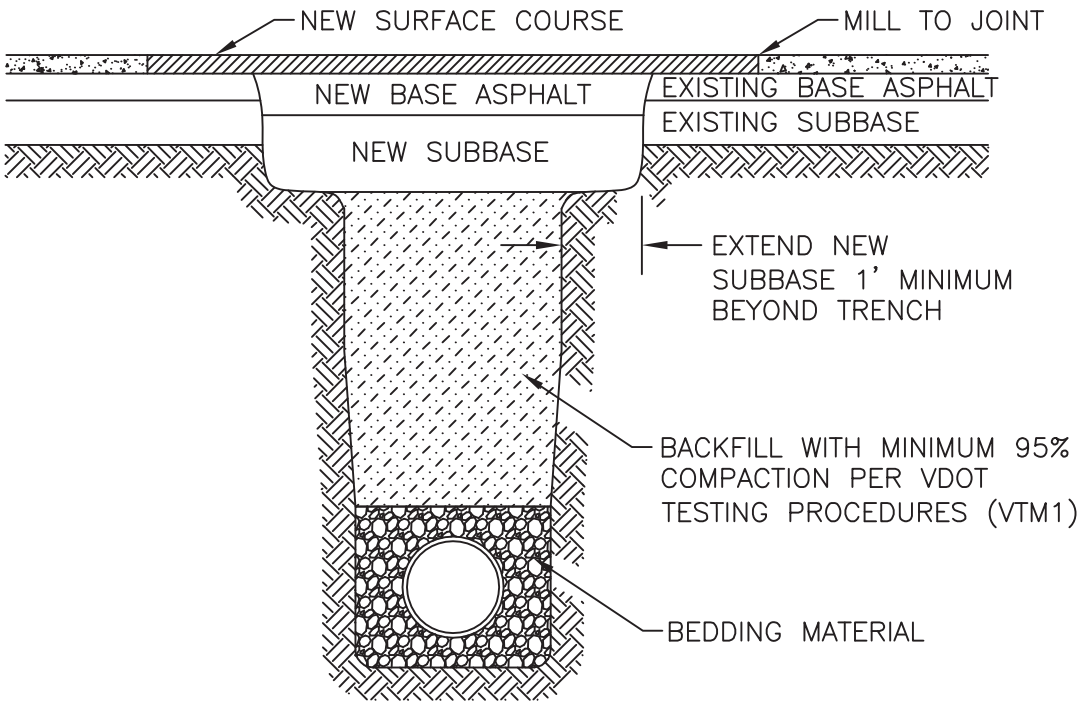
CLARKE COUNTY SANITARY AUTHORITY



	THICKNESS	MATERIAL*
SURFACE ASPHALT	1.5"	SM9.5
BASE ASPHALT	1.5 x EXISTING OR 6" MAX.	BM25d
SUBBASE	1.5 x EXISTING OR 12" MAX.	TYPE I 21A OR 21B
BACKFILL		SELECT MATERIAL

* IN ACCORDANCE WITH VDOT'S ROAD AND BRIDGE SPECIFICATIONS

NOTES:
1. THIS FIGURE IS NOT FOR USE WITHIN PUBLIC RIGHTS OF WAY.
2. EXTEND LIMITS OF PATCH SO AS TO REPLACE ALL PAVEMENT DAMAGED BY THE PIPE INSTALLATION.
3. ALL CUT OR BROKEN EDGES SHALL BE TRIMMED TO NEAT AND STRAIGHT LINES. APPLY TACK COAT OF RC-250 AT A RATE OF 0.1 GALLON PER SQUARE YARD BEFORE PLACING PLANT MIX.

APR. 2010	PAVEMENT PATCH ON PRIVATE PROPERTY	G-13

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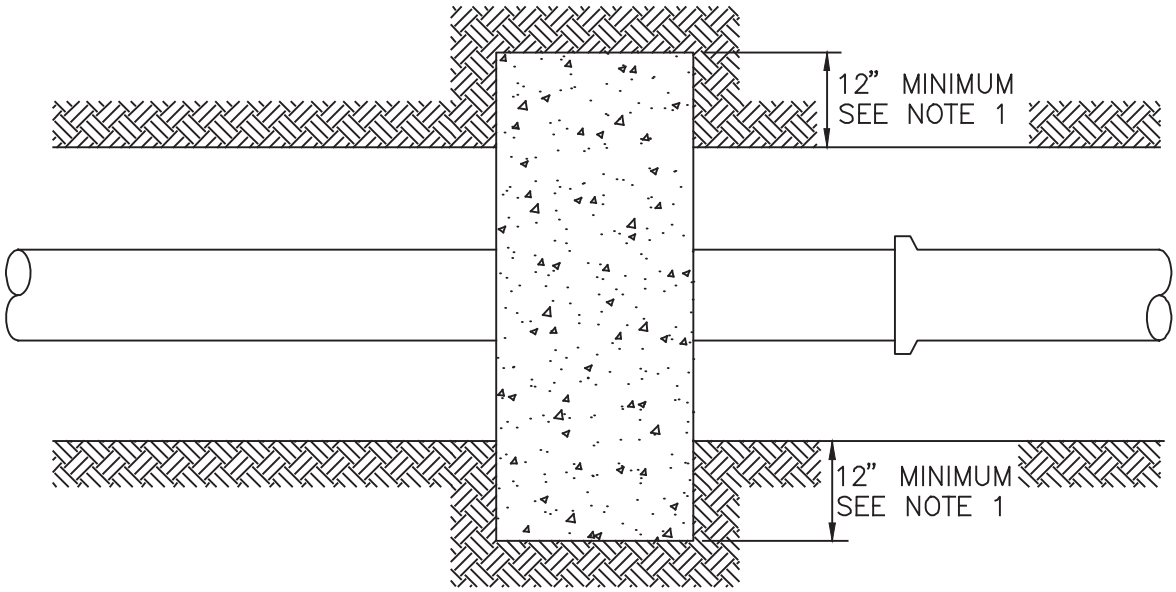
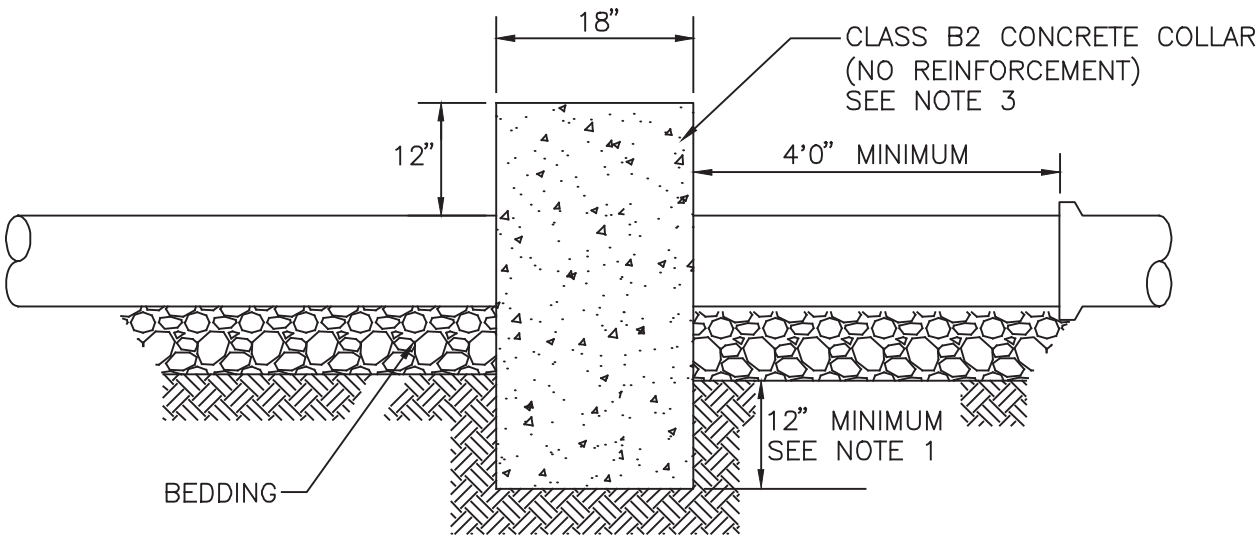
CLARKE COUNTY SANITARY AUTHORITY



PLAN



SECTION

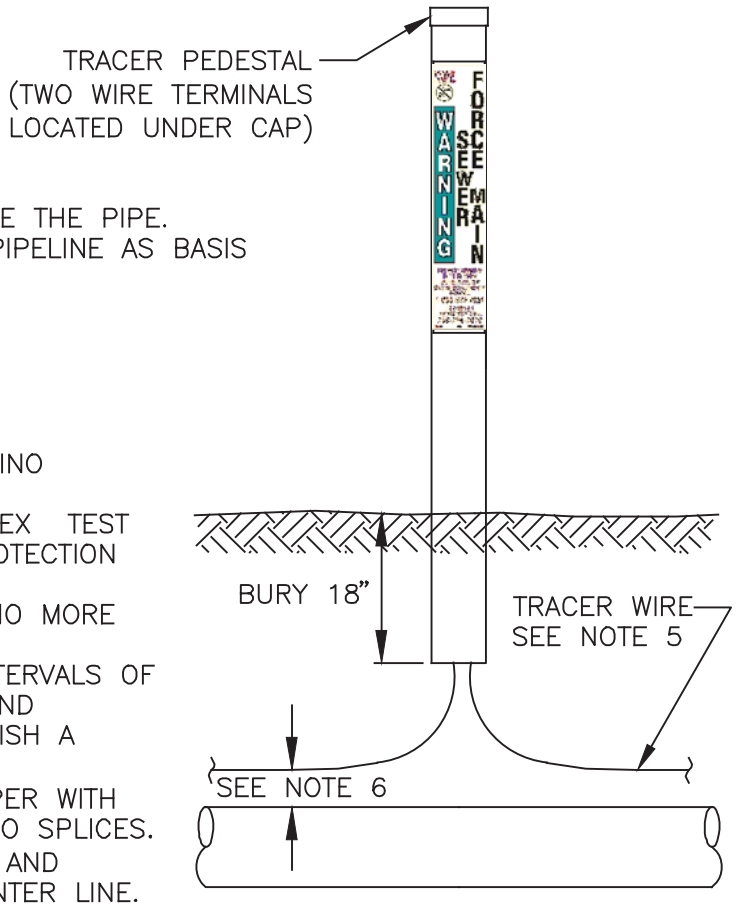
NOTES:
1. EXTEND COLLAR INTO UNDISTURBED TRENCH WALL, UNDISTURBED TRENCH BOTTOM, OR STRUCTURAL FILL.
2. PROVIDE FORMS ADEQUATE TO PREVENT COLLAR FROM BEING OVERSIZED.
3. CONCRETE COLLAR TO BE USED WITH ALL PVC PIPELINES. FOR DUCTILE IRON AND CONCRETE PIPELINES, CLAY COLLAR MAY BE USED AND COLLAR DIMENSIONS MAY BE INCREASED.

OCT. 2016	IMPERVIOUS TRENCH CHECK	G–15

Clarke COUNTY · VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY

UTILITY	TYPE OF PIPE	POST	DECALS (3 PER POST)
WATER	IRON	78" BLUE MARKER	SD–7443K
	NON–METALLIC	54" BLUE TRACER PEDESTAL AND 78" BLUE MARKER	SD–7443K
RECLAIMED WATER	IRON	78" PURPLE MARKER	SD–7617K
	NON–METALLIC	54" PURPLE TRACER PEDESTAL AND 78" PURPLE MARKER	SD–7617K
GRAVITY SEWER	ALL TYPES	78" GREEN MARKER	SD–7442K
PRESSURIZED SEWER	IRON	78" GREEN MARKER	SD–7441K
	NON–METALLIC	54" GREEN TRACER PEDESTAL AND 78" GREEN MARKER	SD–7441K



INSTALL MARKER DIRECTLY ABOVE THE PIPE.
CALL VA811 FOR MARKING OF PIPELINE AS BASIS OF INSTALLATION.

NOTES:
1. MARKER POSTS TO BE TRIVIEW BY RHINO MARKING AND PROTECTION SYSTEMS.
2. TRACER PEDESTALS TO BE TRIVIEW FLEX TEST STATION BY RHINO MARKING AND PROTECTION SYSTEMS.
3. TRACER PEDESTALS TO BE LOCATED NO MORE THAN 1000' APART.
4. MARKER POSTS TO BE SPACED AT INTERVALS OF 300'–500', AT MANHOLES, VALVES, AND CHANGES IN DIRECTION, TO ACCOMPLISH A CONTINUOUS LINE–OF–SIGHT.
5. TRACER WIRE TO BE #12 SOLID COPPER WITH 45 MIL POLYETHYLENE INSULATION. NO SPLICES.
6. TYPICALLY 4"–12". FOR PIPES 12"ø AND LARGER, AFFIX WIRE TO PIPE ON CENTER LINE.

OCT. 2016	MARKER POSTS AND TRACER PEDESTALS	G–16

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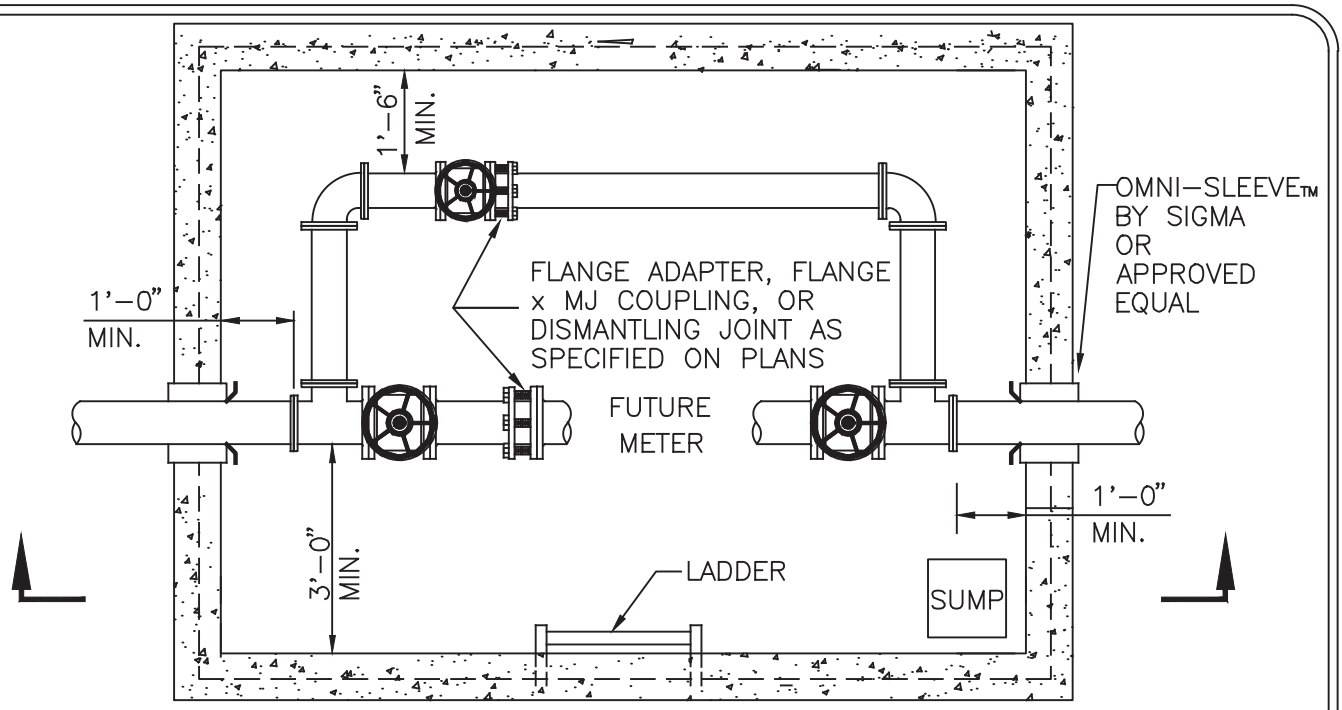
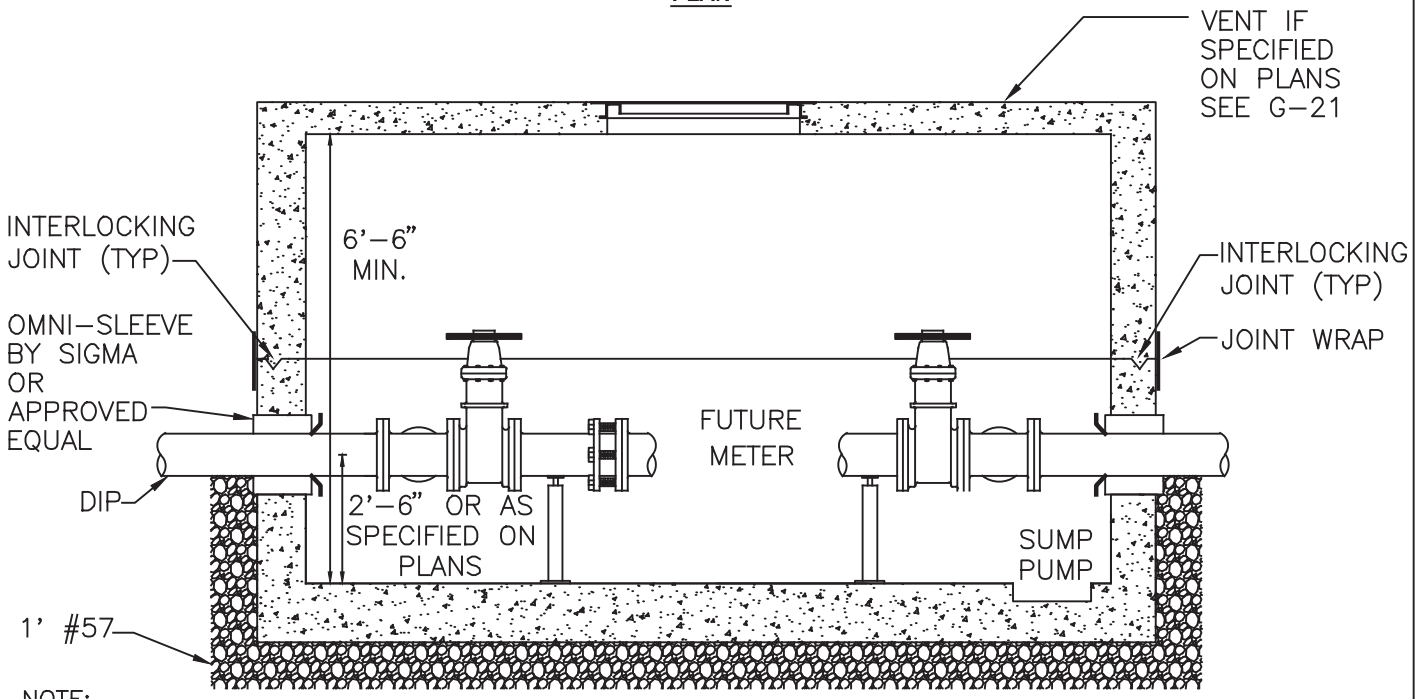
CLARKE COUNTY SANITARY AUTHORITY



PLAN



NOTE:
SEE G–21 FOR VAULT NOTES.

SECTION

AUG. 2018	VAULT FEATURES	G–20

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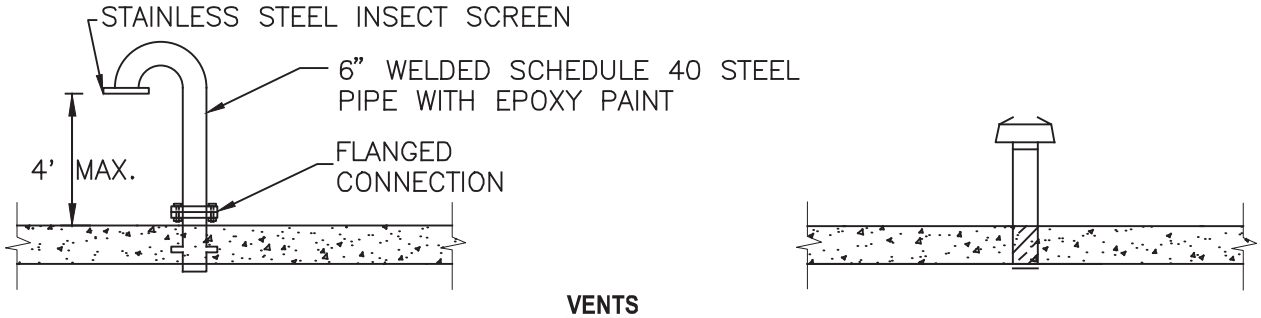
CLARKE COUNTY SANITARY AUTHORITY



VENTS

NOTES:

1. CCSA APPROVED SHOP DRAWING REQUIRED FOR ALL FABRICATIONS. SEE APPROVED MATERIALS LIST FOR ADDITIONAL REQUIREMENTS.
2. INCORPORATE VENT AS DIRECTED BY CCSA.
3. SLOPE FLOOR TO SUMP.
4. SUPPORT PIPING WITH STEEL PIPE STANDS OR CONCRETE PIERS.
5. PAINT PIPING IF SO DIRECTED BY CCSA.
6. FOR ALL UNDERGROUND STRUCTURES WHERE ENTRY IS BY ACCESS DOOR AND LADDER, INCORPORATE SAFETY FEATURES AS FOLLOWS.
   A) PROVIDE GRAB BAR WHERE POSSIBLE. WHERE SITE CONSTRAINTS PROHIBIT THE USE OF A GRAB BAR, INSTALL A LADDER MOUNTED SAFETY POST. SEE G–23.
   B) AT STRUCTURES OF 10' OR GREATER DEPTH IN THE WATER SYSTEM, PROVIDE FALL ARREST. THIS MAY BE BY THE MILLER DURAHOIST™ SYSTEM OR BY THE MILLER VI–GO™ LADDER MOUNTED CABLE SYSTEM. FOR DURAHOIST™, INSTALL DAVIT BASE, POSITIONED TO ALLOW DAVIT LINE TO BE CENTERED OVER LADDER. FOR VI–GO™, PROVIDE TWO CABLE SLEEVES.
   C) AT STRUCTURES IN WASTEWATER COLLECTION OR TREATMENT SYSTEM MAKE PROVISIONS FOR RETRIEVAL. LOUDOUN WATER USES THE DURAHOIST™ SYSTEM BY MILLER FALL PROTECTION. IF THE STRUCTURE IS AT A STATION OR FACILITY WITH APPROPRIATE STORAGE, PROVIDE THE DURAHOIST™ MIGHTEVAC™ SRL WITH EMERGENCY RETRIEVAL HOIST.
7. FINAL GRADING AROUND VAULT SHALL PROVIDE POSITIVE DRAINAGE AWAY FROM ACCESS DOOR HATCH COVER.
8. EXTERIOR OF VAULT SHALL BE COATED WITH BITUMASTIC SEALER.
9. INTERIOR WALLS OF THE VAULT SHALL BE COATED WITH WHITE DRYLOCK.
10. CONTRACTOR TO COORDINATE EXTENSION OF ELECTRIC SERVICE TO VAULT WITH OWNER.
11. AFTER WALL SLEEVES HAVE BEEN CAST INTO STRUCTURE AND WIRES HAVE BEEN INSTALLED, ALL VOIDS AROUND SLEEVES SHALL BE FILLED WITH REVERE NEO–SEAL COATING (NO B24700).
12. ALL VAULTS TO HAVE A SUMP PUMP. SUMP PUMP TO BE PROVIDED BY THE CONTRACTOR.

AUG. 2018	VAULT NOTES	G–21

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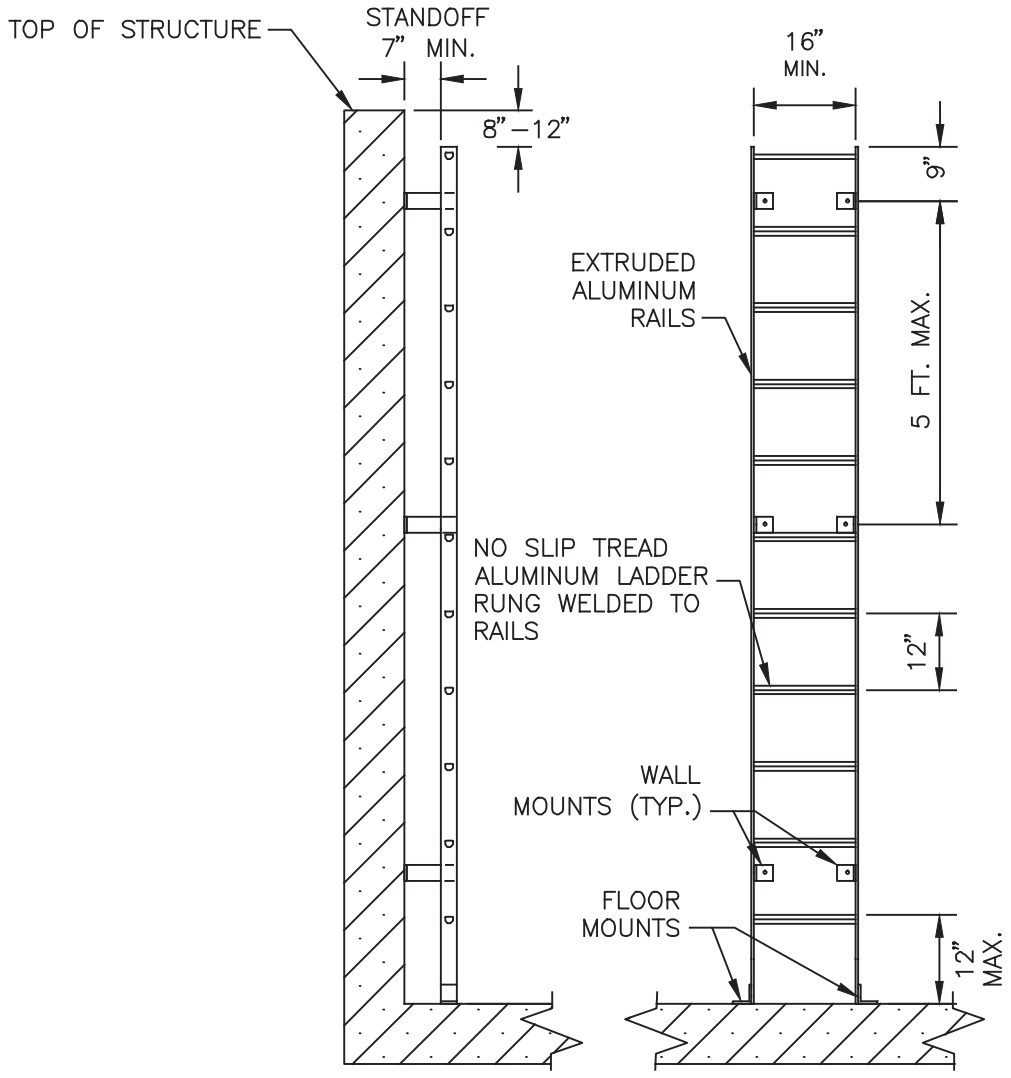
CLARKE COUNTY SANITARY AUTHORITY



APR. 2017	VAULT LADDER	G–22

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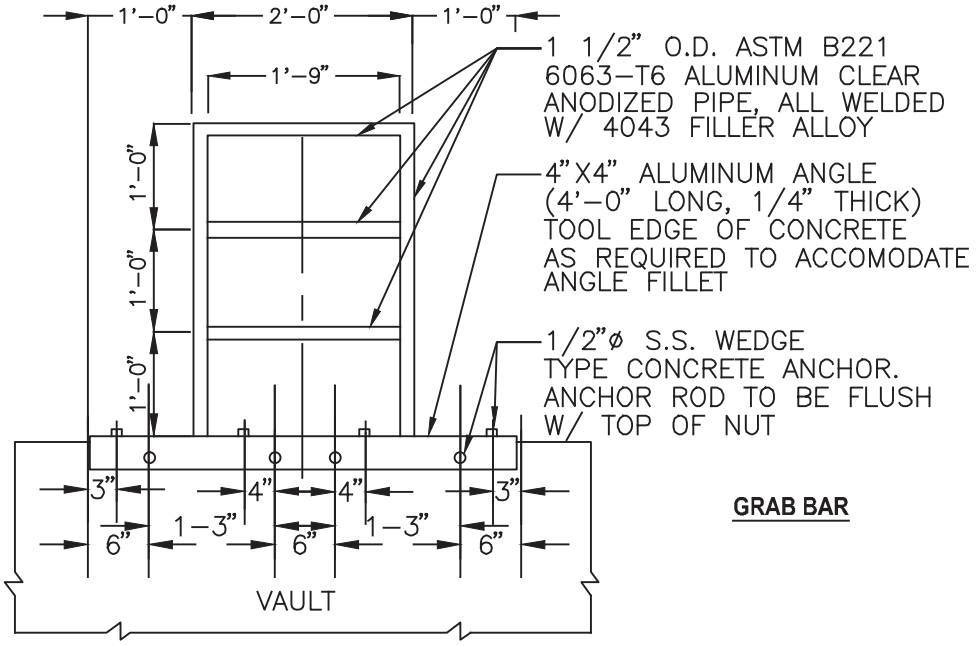
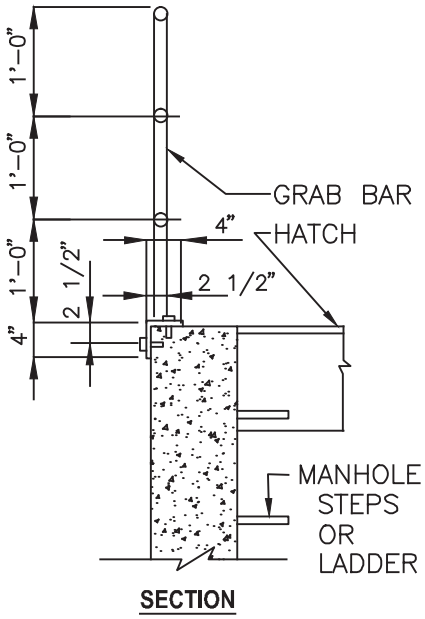
CLARKE COUNTY SANITARY AUTHORITY

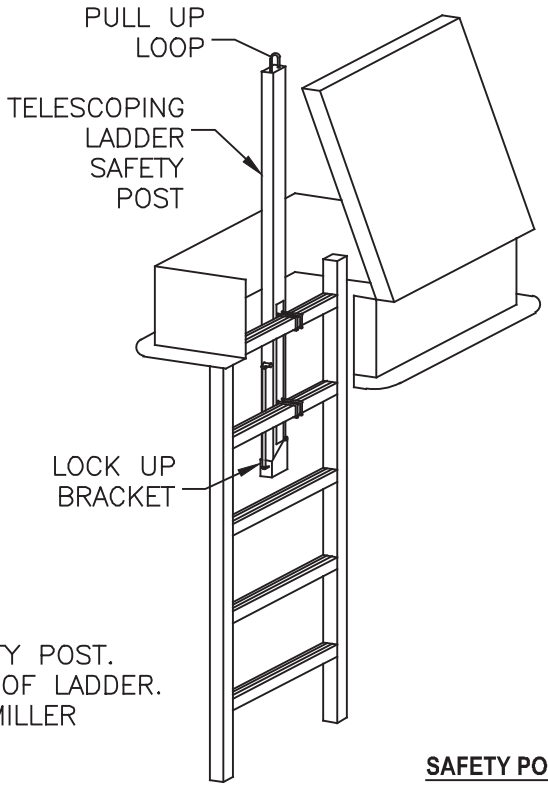


ELEVATION

GRAB BAR



SECTION



SAFETY POST

NOTES:
1. HATCH TO OPEN AWAY FROM GRAB BAR OR SAFETY POST.
2. CENTER GRAB BAR OR SAFETY POST ON CENTER OF LADDER. SAFETY POST MAY BE OFFSET WHEN USED WITH MILLER VI–GO™ SYSTEM.

OCT. 2016	HATCH SAFETY FEATURES	G–23

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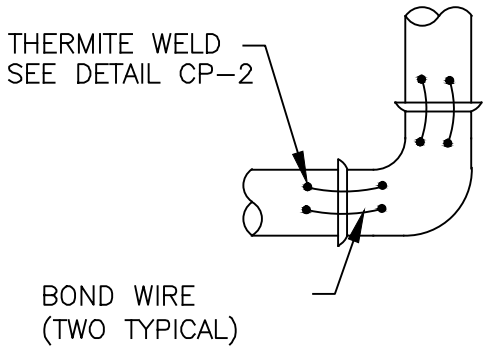
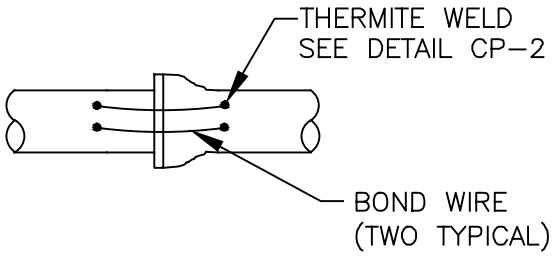
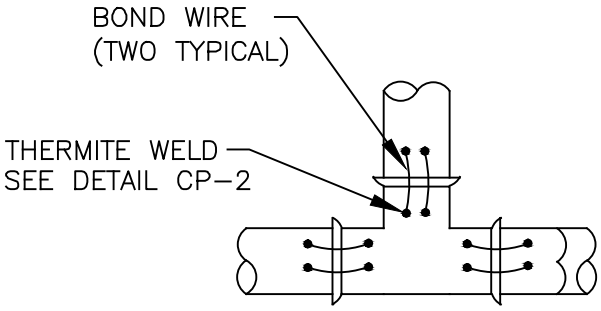


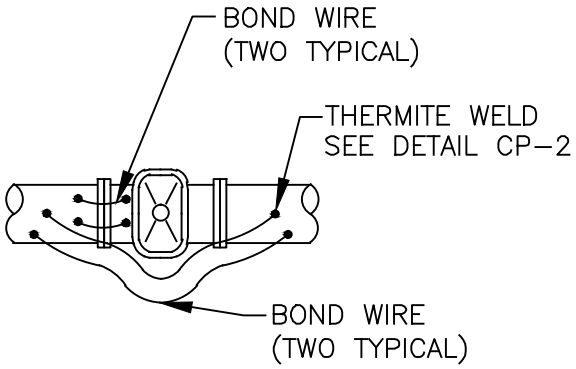
TYPICAL BONDING OF BEND
REDUCER OR SOLID SLEEVE



TYPICAL PIPE JOINT BOND



TYPICAL BONDING OF TEE



TYPICAL BONDING OF VALVE

NOTES:
1. THERMITE WELD BONDING WIRES TO TOP OF PIPE OR FITTING.
2. BOND WIRE LENGTH SHALL BE A MAXIMUM OF 18" UNLESS APPROVED BY THE ENGINEER. LEAVE SLACK IN ALL CABLES.
3. TWO BOND WIRES SHALL BE USED ACROSS EACH PIPE JOINT.
4. COAT ALL THERMITE WELDS AND EXPOSED COPPER IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.
5. WIRE SIZE FOR BONDING WIRES SHALL BE AS FOLLOWS:
   PIPES 36" IN DIAMETER & SMALLER – AWG #4
   PIPES LARGER THAN 36" DIAMETER – AWG #2

OCT. 2016	BONDING OF PIPE AND FITTING	CP–1

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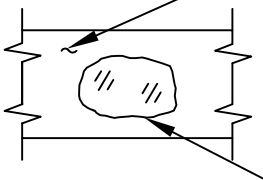
CLARKE COUNTY SANITARY AUTHORITY

STRUCTURE (TOP OF PIPE,FITTING OR STEEL BONDING PLATE)

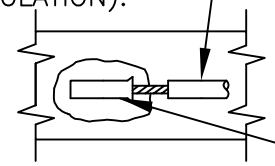


STEP 1

CLEAN SURFACE TO BRIGHT METAL AT WELD LOCATION BY MECHANICAL GRINDER

STRANDED COPPER WIRE (WITH THWN OR HMWPE INSULATION).

STEP 2



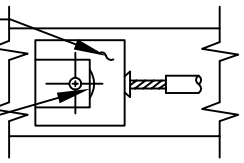
ADAPTER SLEEVE

STRIP INSULATION FROM WIRE AND INSTALL ADAPTER SLEEVE.

TOP

GRAPHITE MOLD

OPENING



HOLD GRAPHITE MOLD FIRMLY OVER ADAPTER SLEEVE WITH OPENING AWAY FROM OPERATOR–IGNITE STARTING POWDER.

HANDLE

GRAPHITE COVER

GRAPHITE MOLD

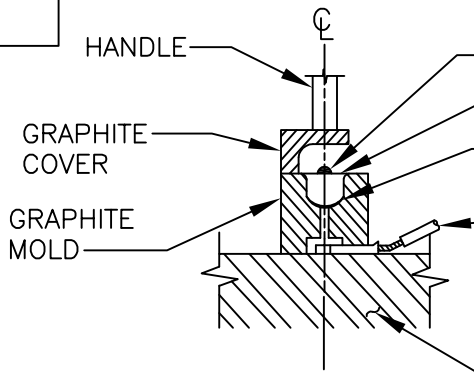
STARTING POWDER

METAL POWDER

METAL DISC

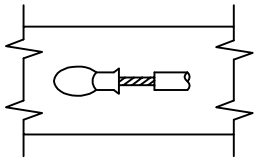
WIRE

STRUCTURE (TOP OF PIPE, FITTING OR STEEL BONDING PLATE)



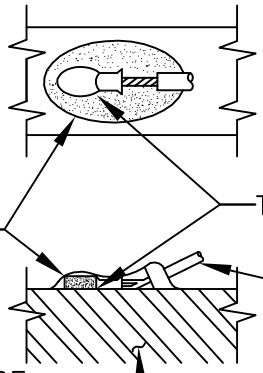
SIDE

STEP 3



REMOVE SLAG FROM CONNECTION. THOROUGHLY CLEAN WELD AREA.

STEP 4



PRIME AND COAT ALL EXPOSED METAL AT WELD AREA.

THERMITE WELD

STRUCTURE (TOP OF PIPE, FITTING OR STEEL BONDING PLATE)

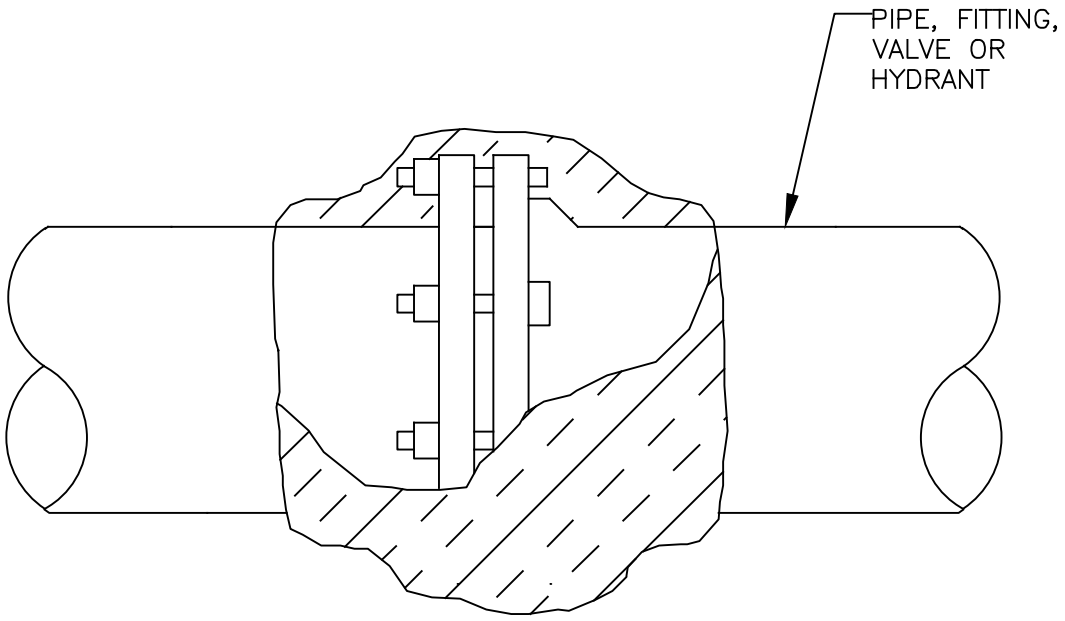
STEP 5

NOTES:

1. THERMITE WELDS MADE TO STEEL OR DUCTILE IRON PIPE SHALL BE COATED IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.

APR. 2010	THERMITE WELD	CP–2

CLARKE COUNTY SANITARY AUTHORITY



MECHANICAL JOINT

NOTES:
1. APPLY PRIMER, WAX TAPE, AND OUTER WRAP IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS. PROFILING MASTIC NOT REQUIRED.

OCT. 2016	COATING OF MECHANICAL JOINTS	CP-3

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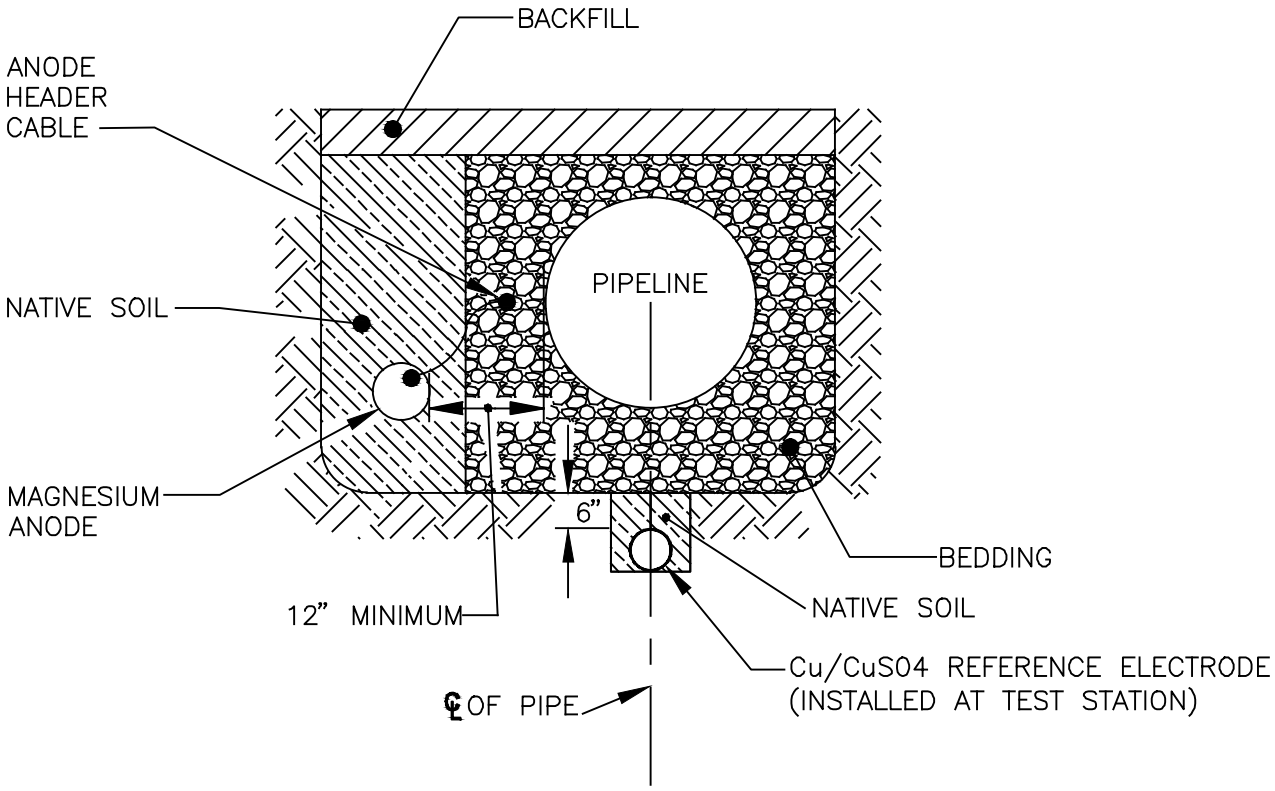
CLARKE COUNTY SANITARY AUTHORITY



INSTALL ANODES AND REFERENCE ELECTRODES IN SOIL BACKFILL. DO NOT BACKFILL ANODES OR REFERENCE ELECTRODES WITH BEDDING MATERIAL.

OCT. 2016	ANODE PLACEMENT	CP–4

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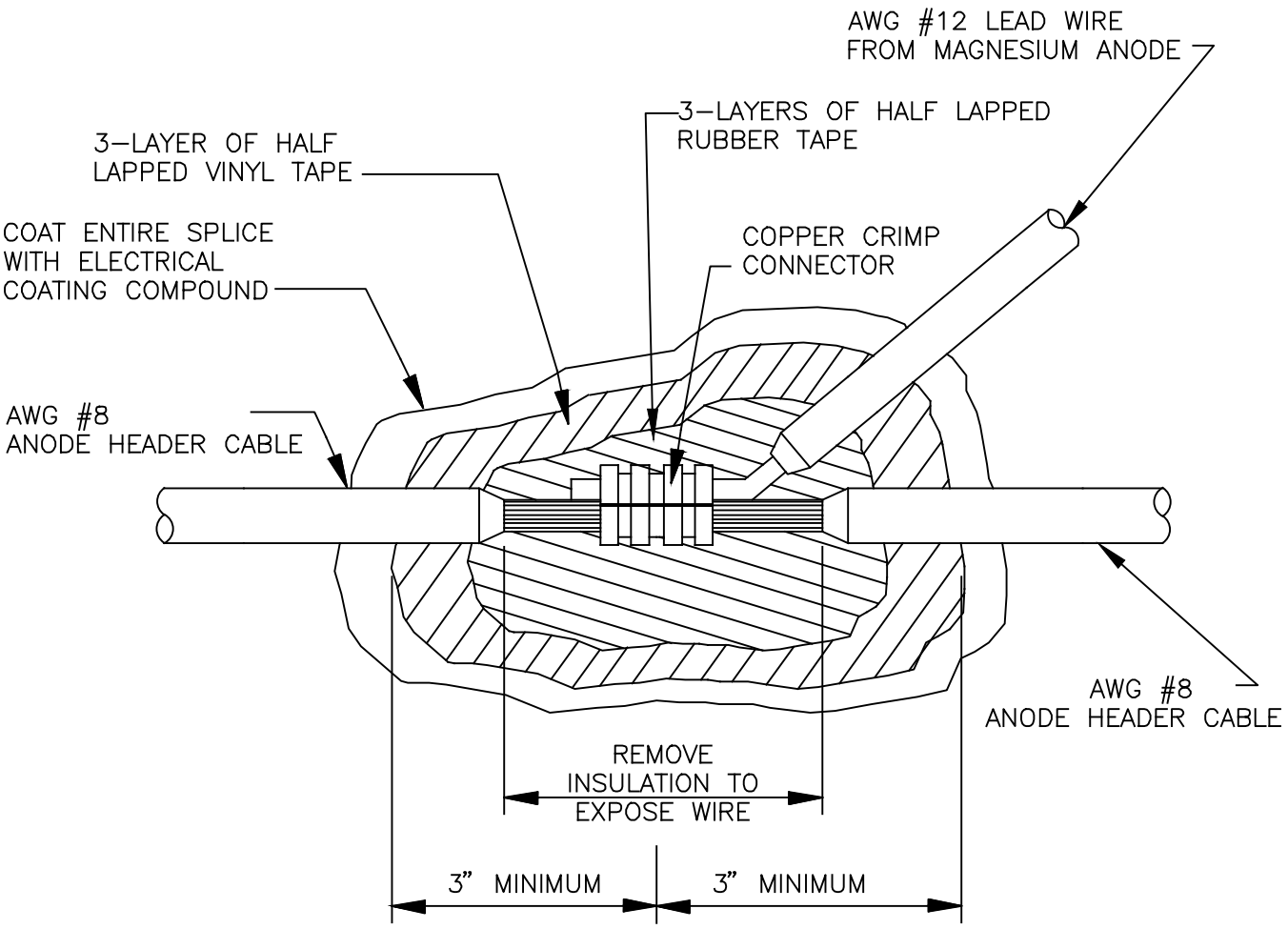
CLARKE COUNTY SANITARY AUTHORITY



OCT. 2016	SPLICE OF ANODE TO HEADER CABLE	CP–5

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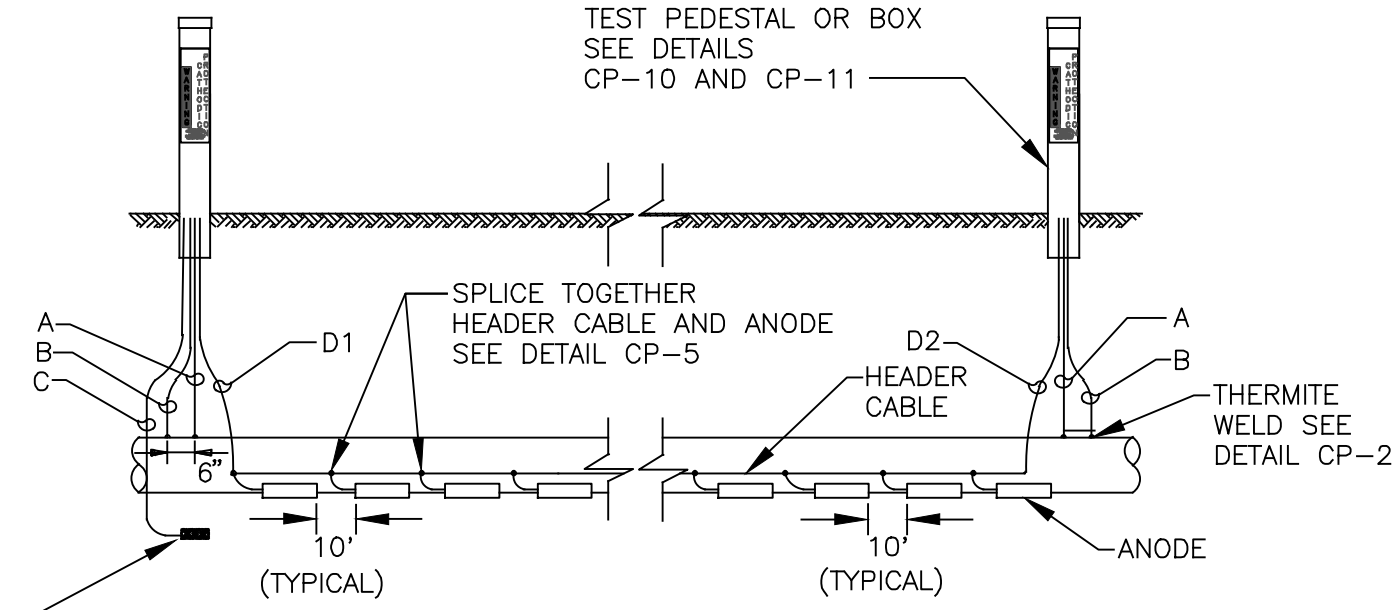
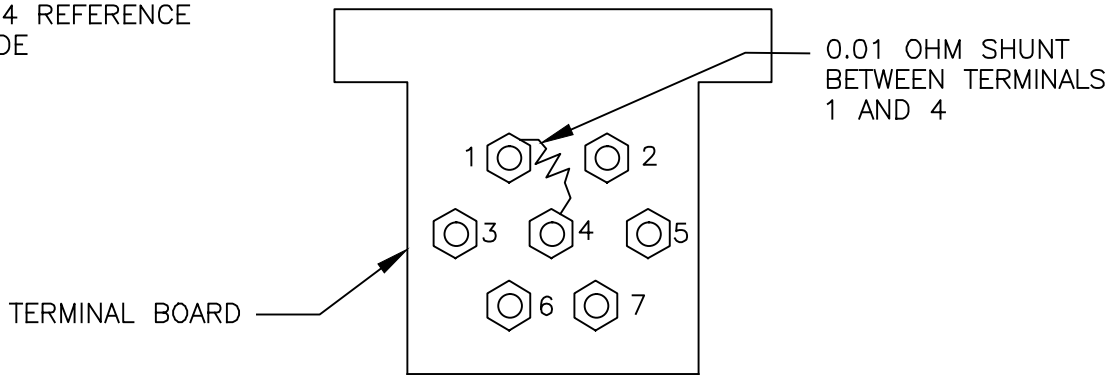
CLARKE COUNTY SANITARY AUTHORITY





WIRING SCHEDULE

DESCRIPTION	WIRE	TEST STATION TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION
NEW PIPE	A B	1 3	#8 #10	THWN THWN	BLUE BLUE
PERMANENT REFERENCE ELECTRODE	C	6	#14	RHW	YELLOW
ANODE HEADER CABLE	D1,D2	4	#8	HMWPE	BLACK

NOTES:
1. INSTALL PREPACKAGED MAGNESIUM ANODES. SEE DETAIL CP–4.

OCT. 2016	ANODE BED AND TEST STATION	CP–6

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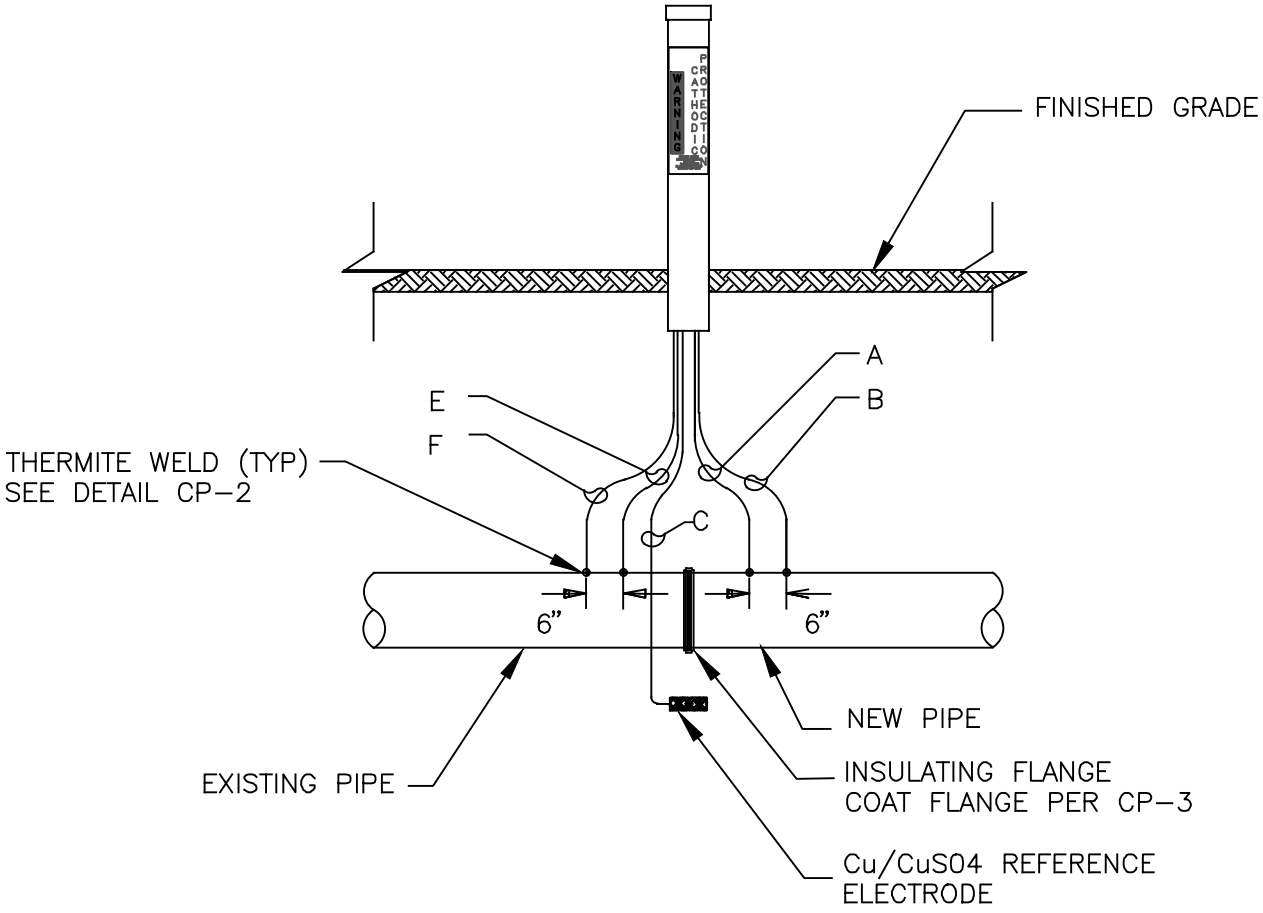
CLARKE COUNTY SANITARY AUTHORITY



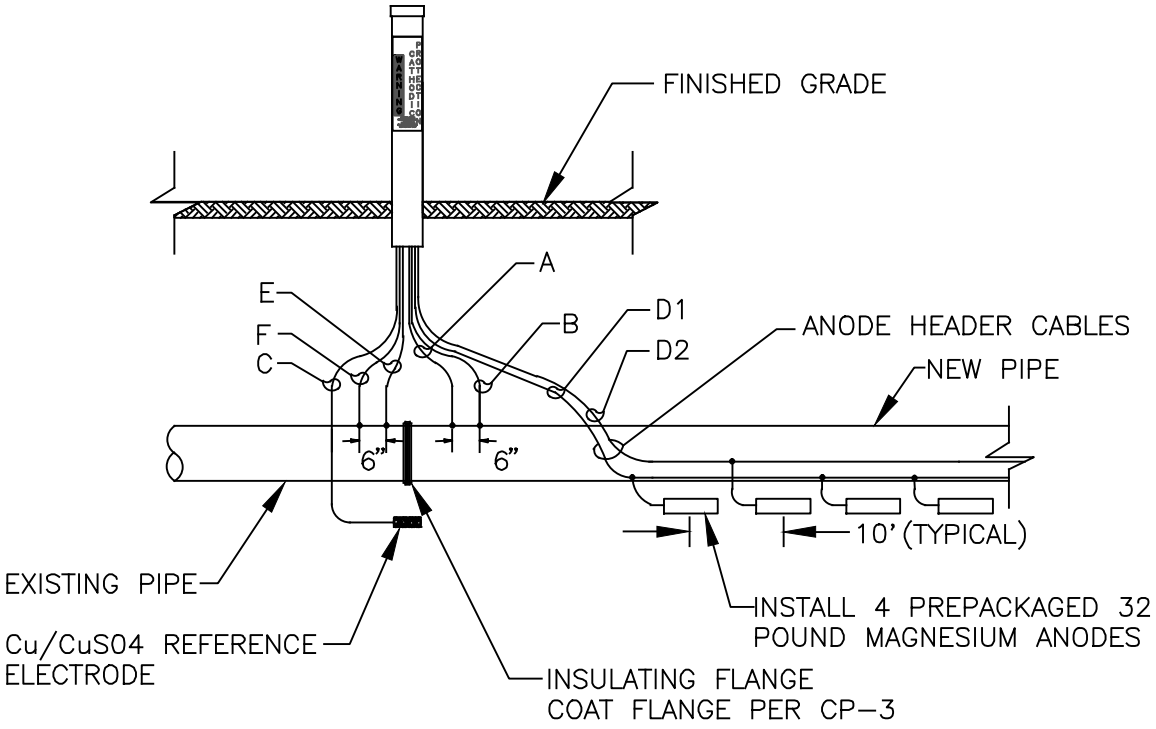
WIRING SCHEDULE

DESCRIPTION	WIRE	TEST STATION TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION
NEW PIPE	A B	1 3	#8 #10	THWN THWN	BLUE BLUE
PERMANENT REFERENCE ELECTRODE	C	6	#14	RHW	YELLOW
EXISTING PIPE	E F	2 5	#8 #10	THWN THWN	WHITE WHITE

OCT. 2016	INSULATING FLANGE TEST STATION	CP-7

Clarke
COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



WIRING SCHEDULE

DESCRIPTION	WIRE	TEST STATION TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION
NEW PIPE	A B	1 3	#8 #10	THWN THWN	BLUE BLUE
PERMANENT REFERENCE ELECTRODE	C	6	#14	RHW	YELLOW
ANODE HEADER CABLE	D1 D2	4 4	#8 #8	HMWPE HMWPE	BLACK BLACK
EXISTING PIPE	E F	2 5	#8 #10	THWN THWN	WHITE WHITE

INSTALL 0.01 OHM SHUNT BETWEEN TERMINALS 1 AND 4.

OCT. 2016	INSULATING FLANGE TEST STATION WITH ANODES	CP-8

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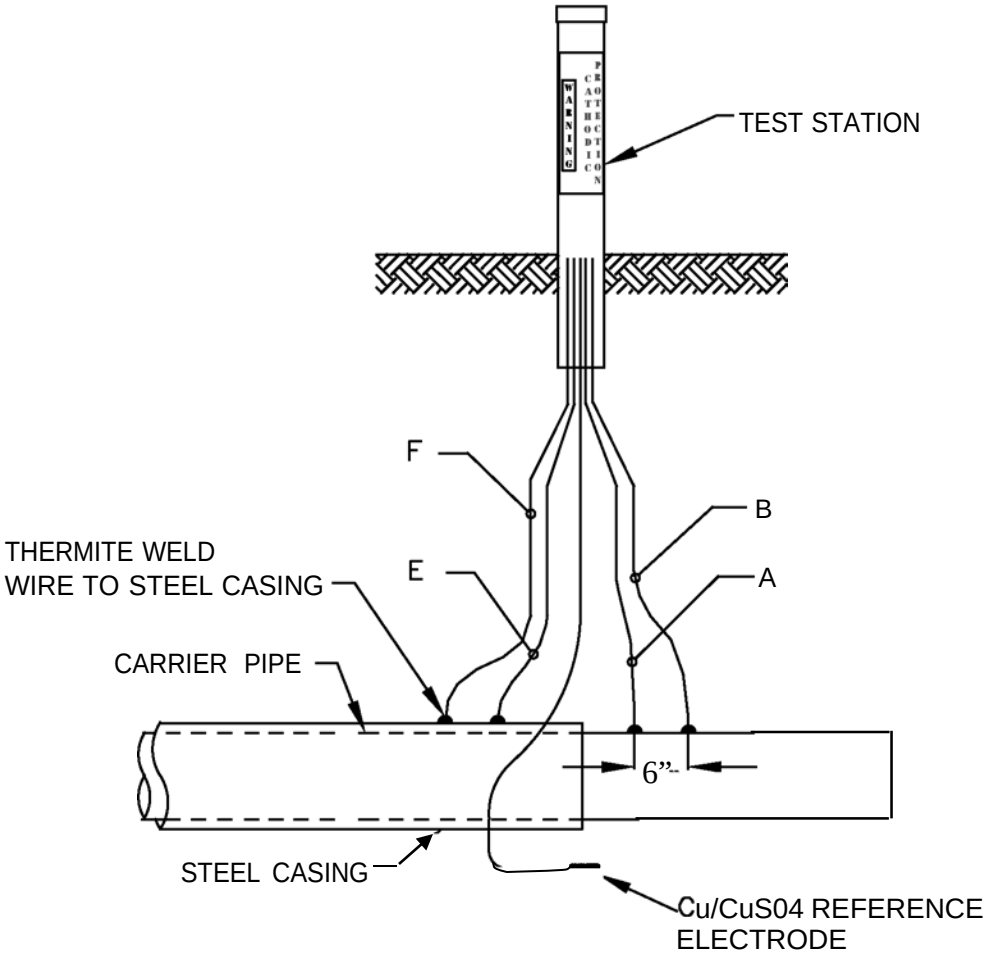
CLARKE COUNTY SANITARY AUTHORITY



WIRING SCHEDULE

DESCRIPTION	WIRE	TEST STATION TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION
NEW PIPE	A B	1 3	#8 #10	THWN THWN	BLUE BLUE
PERMANENT REFERENCE ELECTRODE	C	6	#14	RHW	YELLOW
CASING PIPE	E F	2 5	#8 #10	THWN THWN	WHITE WHITE

NOTES:
1. CARRIER PIPE WITHIN STEEL CASING DOES NOT REQUIRE POLYETHYLENE ENCASEMENT, BUT ALL JOINTS MUST BE BONDED.

APR. 2017	TEST STATION AT STEEL CASING	CP-9

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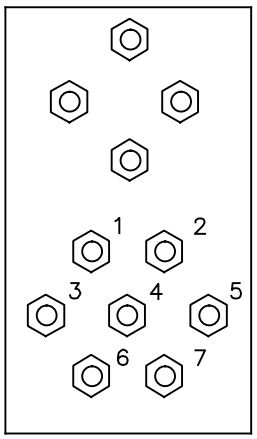
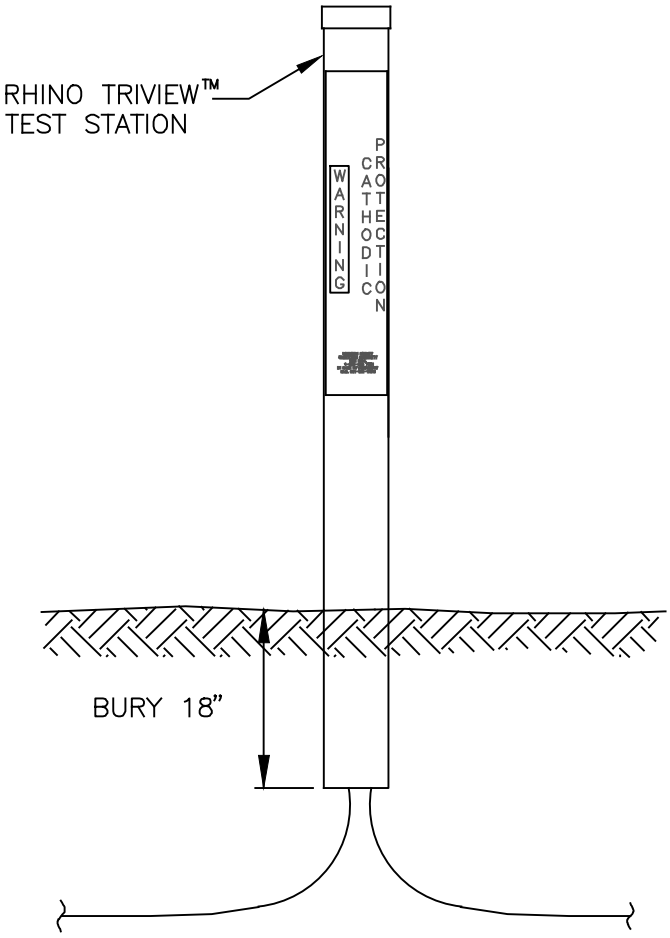
CLARKE COUNTY SANITARY AUTHORITY



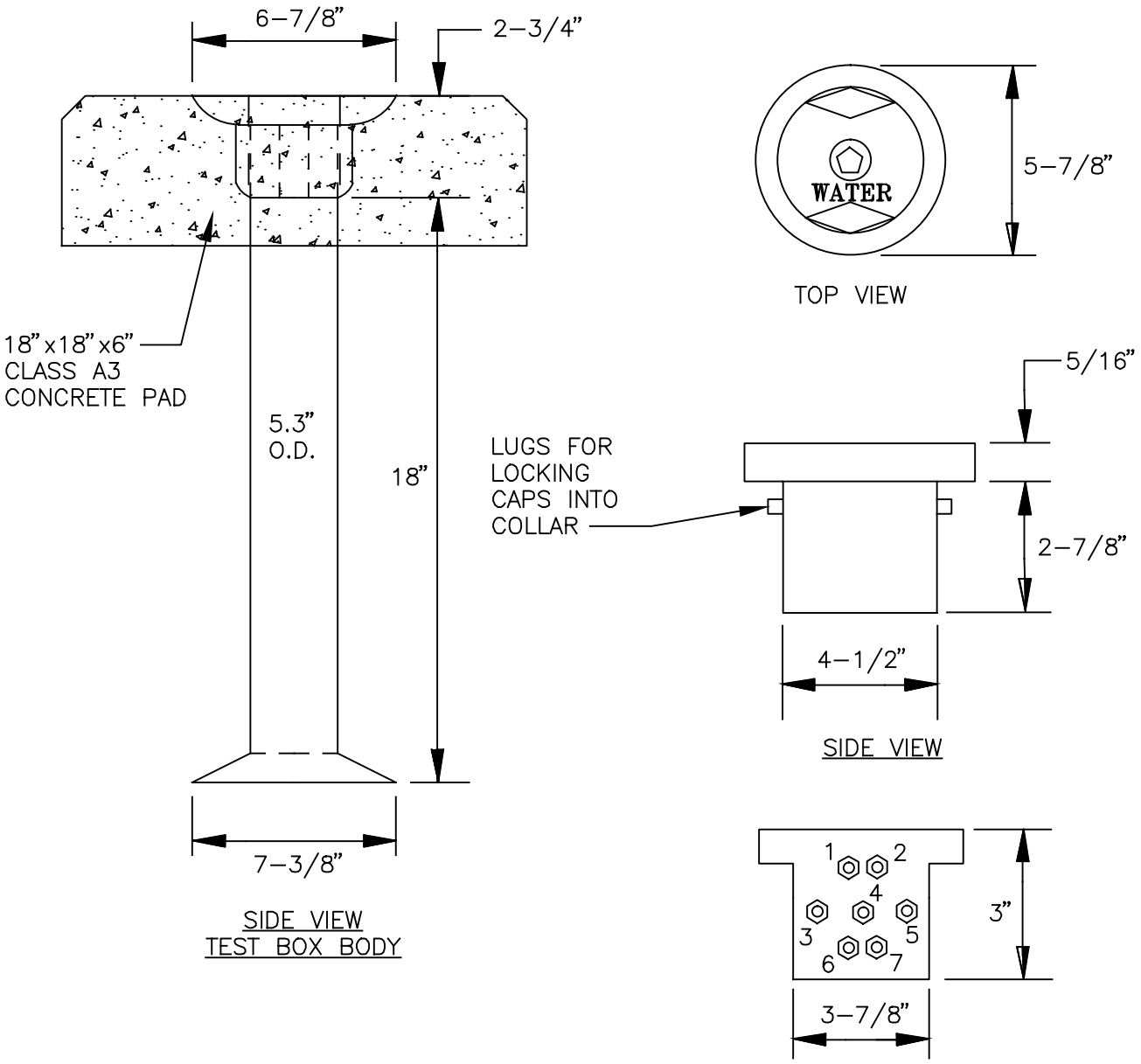
TERMINAL BOARD



NOTES:
1. PROVIDE 54" TRACER PEDESTAL WITH INTERNAL TERMINAL BOARD BY RHINO MARKING AND PROTECTION SYSTEMS. SELECT COLOR ACCORDING TO UTILITY: BLUE (WATER), GREEN (SEWER), PURPLE (REUSE).

OCT. 2016	TEST STATION BY PEDESTAL	CP–10

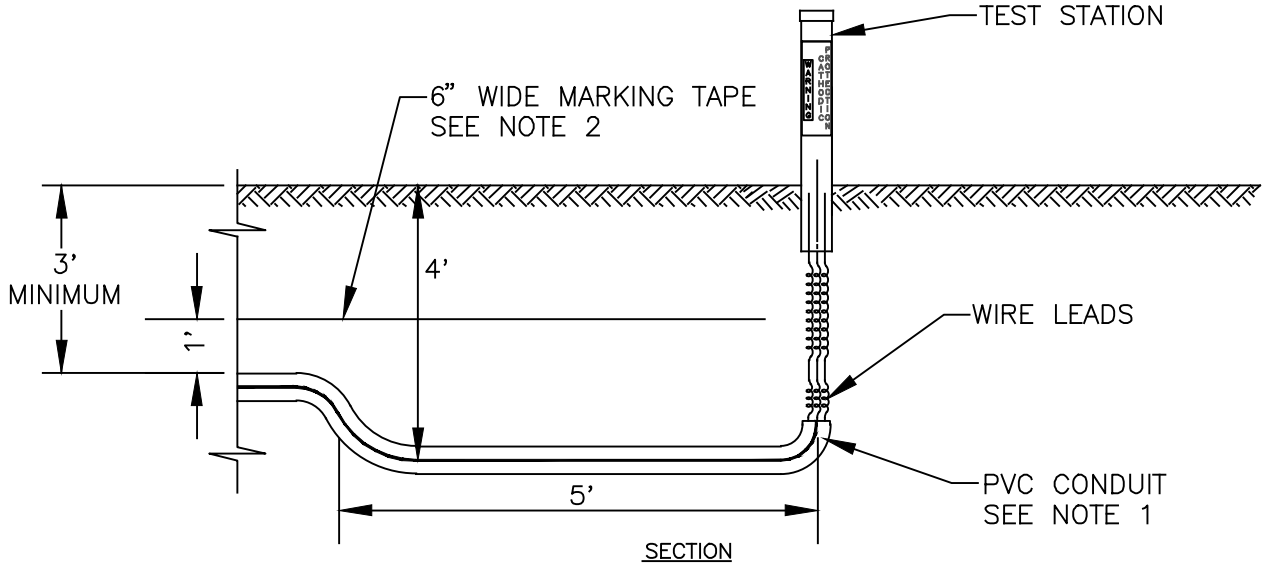
CLARKE COUNTY SANITARY AUTHORITY



NOTES:
1. TO BE USED ONLY WHERE TEST STATION BY PEDESTAL IS NOT FEASIBLE.
2. CONCRETE PAD NOT REQUIRED IN PAVEMENT.

OCT. 2016	TEST STATION BY BOX AT GRADE	CP–11

CLARKE COUNTY SANITARY AUTHORITY

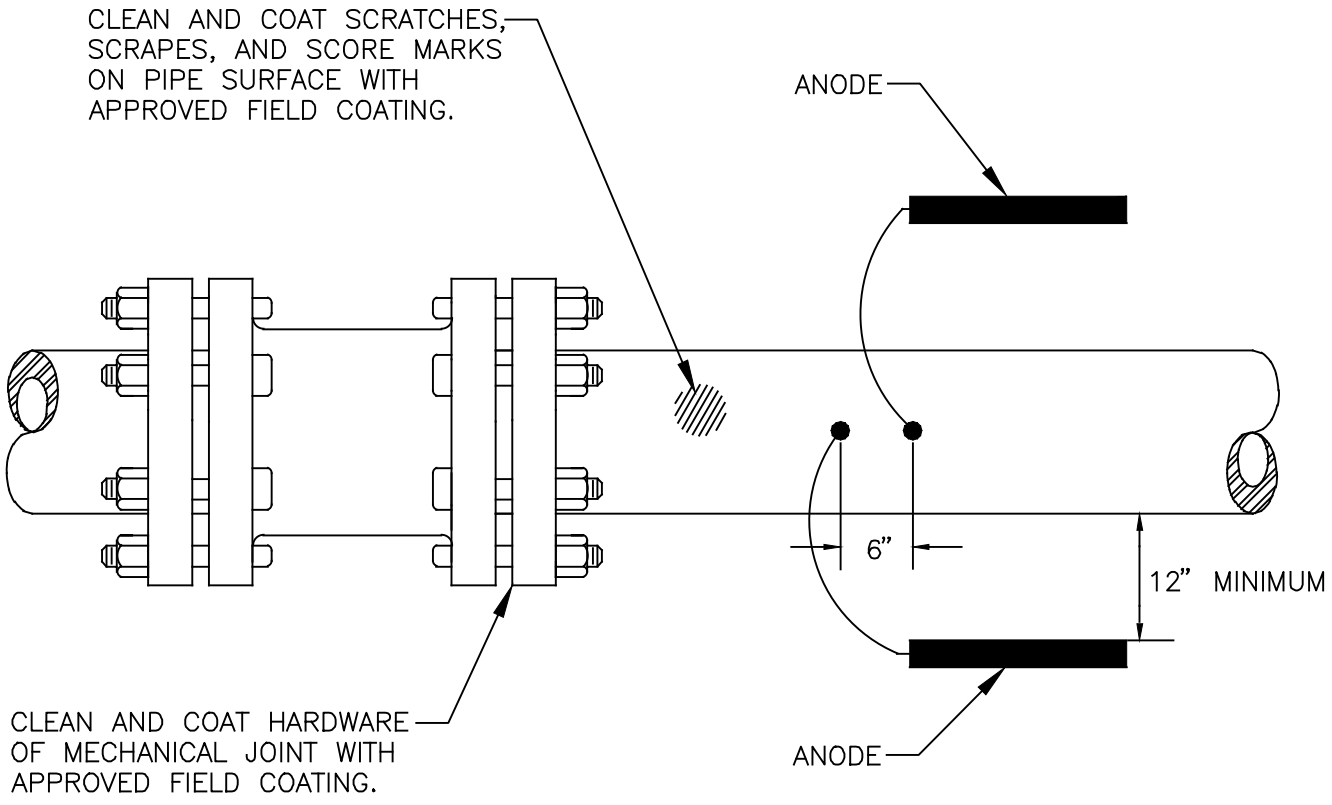


NOTES:
1. IF TEST STATION IS NOT DIRECTLY OVER WATER MAIN, ROUTE WIRES FROM PIPE TRENCH TO STATION THROUGH PVC CONDUIT. CONDUIT IS NOT REQUIRED FOR WIRES IN PIPE TRENCH.
2. MARKING TAPE SHALL READ, "CATHODIC PROTECTION CABLE BURIED BELOW."

OCT. 2016	TEST STATION — OFFSET FROM PIPELINE	CP–12

Clarke COUNTY • VIRGINIA

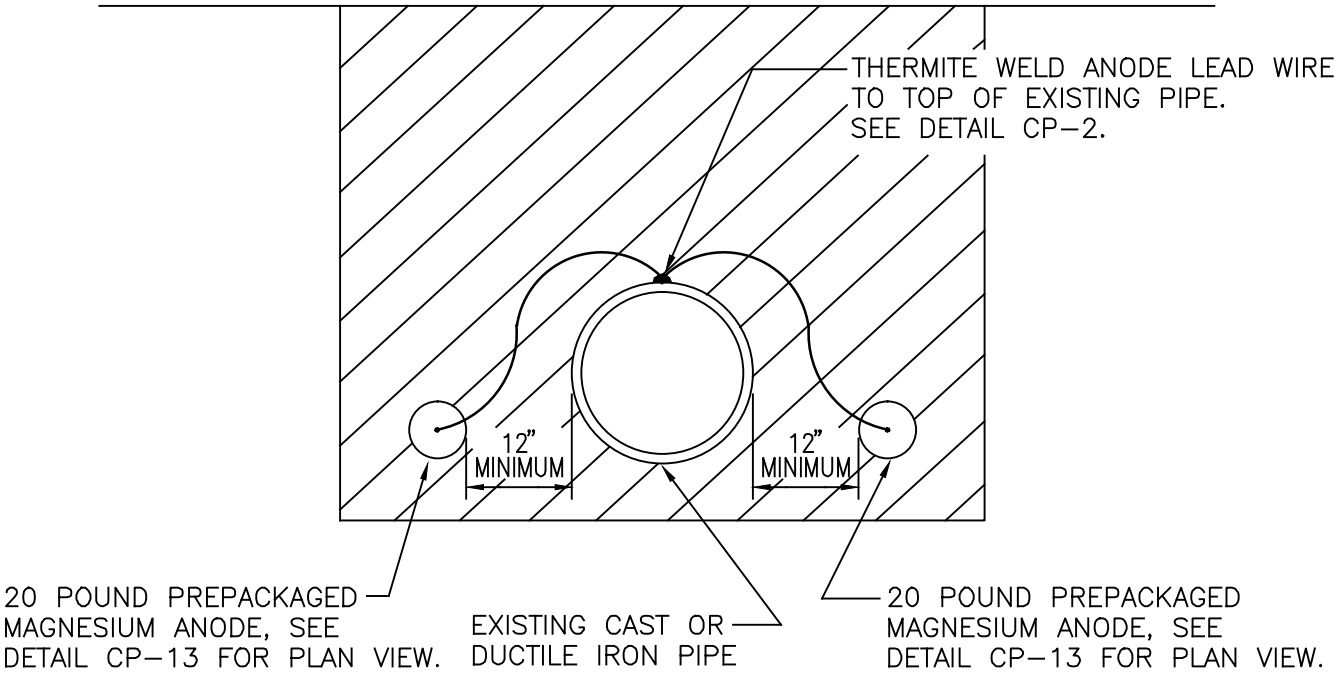
CLARKE COUNTY SANITARY AUTHORITY



NOTES:
1. INSTALL ANODES IN THE VACINITY OF ALL REPAIRED PIPE FAILURES DUE TO CORROSION.
2. ANODES PLACED AT SAME DEPTH AS THE BOTTOM OF THE PIPE AND AT A MINIMUM OF 12" FROM EDGE OF PIPE, SEE DETAIL CP–14.
3. "HOT SPOT" CATHODIC PROTECTION TO BE APPLIED TO CAST AND DUCTILE IRON PIPING. DO NOT INSTALL ON COPPER PIPING.

OCT. 2016	HOT SPOT PROTECTION – COATING AND ANODE	CP–13

CLARKE COUNTY SANITARY AUTHORITY



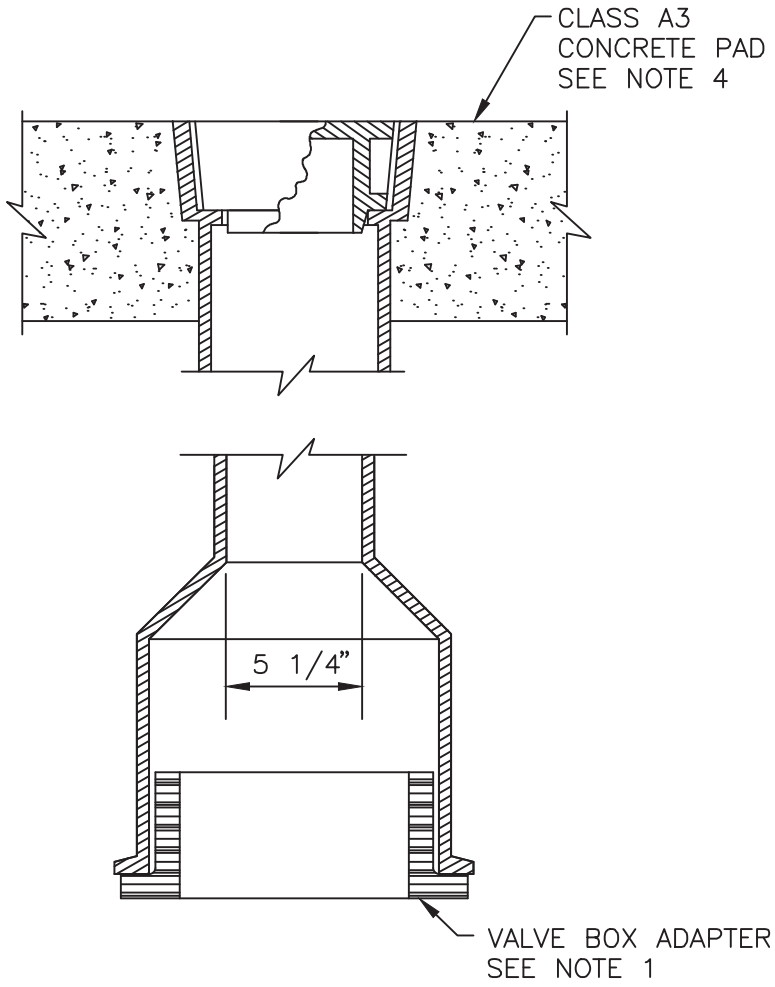
SECTION VIEW

NOTES:
1. INSTALL ANODES ON BOTH SIDES OF PIPE. SEE DETAIL CP–13.
2. INSTALL ANODES IN NATIVE SOIL. DO NOT BACKFILL ANODES WITH SAND OR STONE.
3. PRESOAK ANODE WITH FIVE GALLONS OF WATER AFTER PLACEMENT AND BEFORE BACKFILLING.

OCT. 2016	HOT SPOT PROTECTION – ANODE PLACEMENT	CP–14

Clarke
COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. FOR GATE VALVE INSTALLATIONS, PROVIDE VALVE BOX ADAPTER MADE TO FIT SPECIFIC SIZE AND MANUFACTURE OF VALVE. NOT TO BE USED WITH BUTTERFLY VALVES.
2. PROVIDE EXTENSION OF VALVE STEM WHERE OPERATING NUT IS MORE THAN 5' BELOW GRADE. USE SINGLE, ONE PIECE STEM EXTENSION. TELESCOPING TYPE PROHIBITED.
3. STACKING OF BOTTOM SECTIONS OR EXTENSIONS IS PROHIBITED. FOR DEEPER BURY, USE 5" CAST IRON DWV PIPE AS RISER MATERIAL. TOP ADJUSTMENT BY RISER RINGS PROHIBITED.
4. VALVE BOXES OUTSIDE OF PAVEMENT REQUIRE 18"X18"X6" CONCRETE PAD.
5. REFER TO THE APPROVED MATERIALS LIST FOR APPROVED MANUFACTURERS & PART NUMBERS.

OCT. 2016	VALVE BOX	W–1

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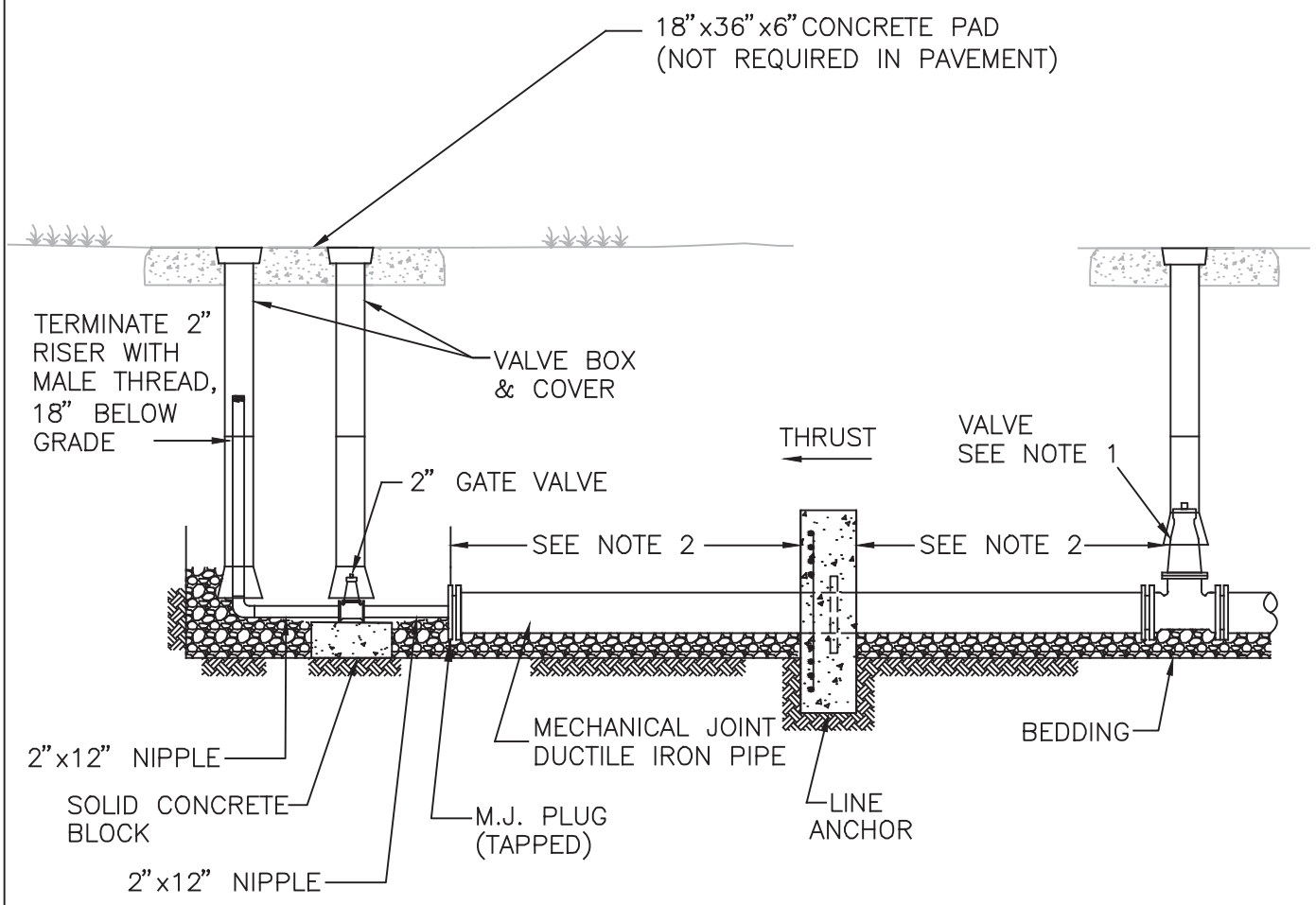
CLARKE COUNTY SANITARY AUTHORITY



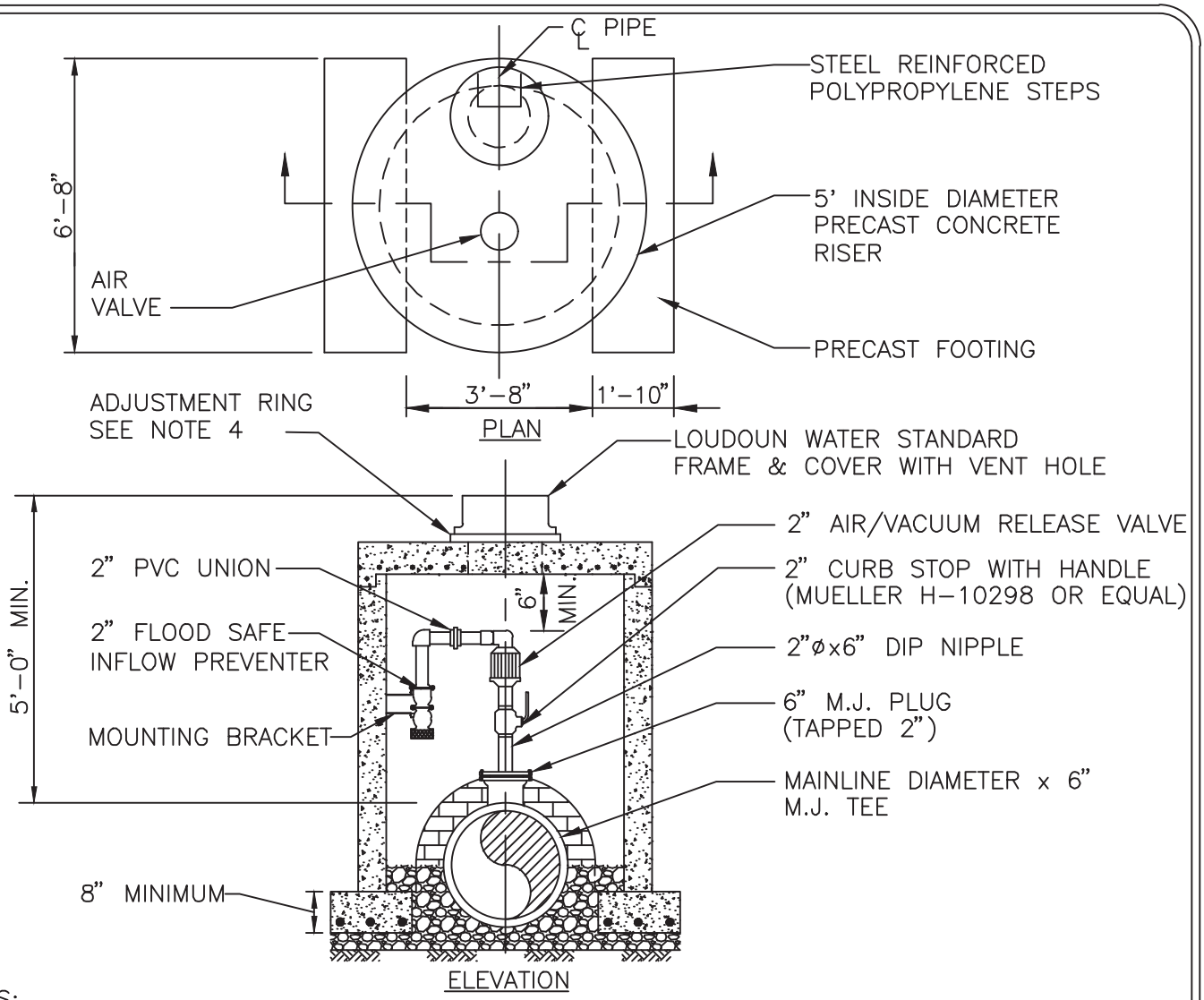
NOTES:

1. WHERE PLANS DO NOT SPECIFY A MAINLINE VALVE WITHIN 50 FEET, OR WHERE A SERVICE CONNECTION OCCURS DOWNSTREAM OF NEAREST MAINLINE VALVE, PROVIDE MAINLINE VALVE UPSTREAM OF LINE ANCHOR.
2. 4' TO ANCHOR ON LINE 12"ø AND SMALLER. 8' TO ANCHOR ON LINE 16"ø AND LARGER.
3. ALL 2" PIPE AND ELBOW TO BE DUCTILE IRON WITH N.P.T. THREADS AND FUSION BONDED EPOXY COATING.
4. ALL MATERIALS MUST CONFORM TO APPLICABLE SECTIONS OF LOUDOUN WATER'S APPROVED MATERIALS LIST.

OCT. 2016	TEMPORARY BLOW-OFF	W-2

Clarke COUNTY · VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. CONFINED SPACE: ATMOSPHERE MUST BE VENTED AND TESTED PRIOR TO ENTRY.
2. PROVIDE 2" FLOOD SAFE INFLOW PREVENTER BY VAL-MATIC WITH MOUNTING BRACKET. MOUNT TO WALL OF STRUCTURE.
3. FROM MAIN TO AIR RELEASE PIPE WITH 2" THREADED DUCTILE IRON PIPE. FROM AIR VALVE TO INFLOW PREVENTER, PIPE IN 2" PVC SCH 80 (ASTM D1785) WITH SOLVENT WELDED JOINTS.
4. MAXIMUM FRAME ADJUSTMENT BY GRADE RINGS IS 12" IN PAVEMENT AND 6" ELSEWHERE.
5. ALL MATERIALS MUST CONFORM TO APPLICABLE SECTIONS OF LOUDOUN WATER'S APPROVED MATERIALS LIST.
6. ALL PRECAST CONCRETE SHALL CONFORM TO AASHTO M199 AND ASTM A615.
7. IF OUTSIDE PAVEMENT BOLT FRAME TO CONE.

AUG. 2018	AIR RELEASE	W-4

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CLARKE COUNTY SANITARY AUTHORITY

WATER LINE TEST

ALLOWABLE LEAKAGE FOR TWO HOUR TEST			
LENGTH OF PIPE (FT)	DIAMETER OF PIPE (IN)	AVG TEST PRESSURE (PSI)	ALLOWABLE LEAKAGE (GAL/2 HR)
1	6	150	0.0010
1	8	150	0.0013
1	10	150	0.0017
1	12	150	0.0020
1	16	150	0.0026
1	20	150	0.0033
1	24	150	0.0040
1	30	150	0.0050
1	36	150	0.0060

OCT. 2016	TABLE OF ALLOWABLE LEAKAGE	W–8

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NOTES:

1. TANGENT TEE REQUIRED WHERE SPECIFIED ON CONSTRUCTION PLANS.
2. TYPICAL HYDRANT HEIGHT IS 5'. INSTALLATION OF SHORTER BARREL REQUIRES APPLICATION SPECIFIC APPROVAL BY CCSA.
3. MAXIMUM HYDRANT HEIGHT IS 7' BURY. FOR DEEPER MAIN, PROVIDE VERTICAL OFFSET IN LEAD.
4. HYDRANT MUST BE AT LEAST 5' FROM DRIVEWAY ENTRANCES.
5. CONCRETE & POLYETHYLENE MUST BE CLEAR OF WEEP HOLES.
6. VERTICAL ADJUSTMENT OF BARREL LIMITED TO ONE EXTENSION.
7. FIELD PAINTING REQUIRED PRIOR TO ACCEPTANCE.
8. LANDSCAPE PLANTINGS ARE PROHIBITED WITHIN 5' OF HYDRANT.

OCT. 2016	HYDRANT NOTES	W–9

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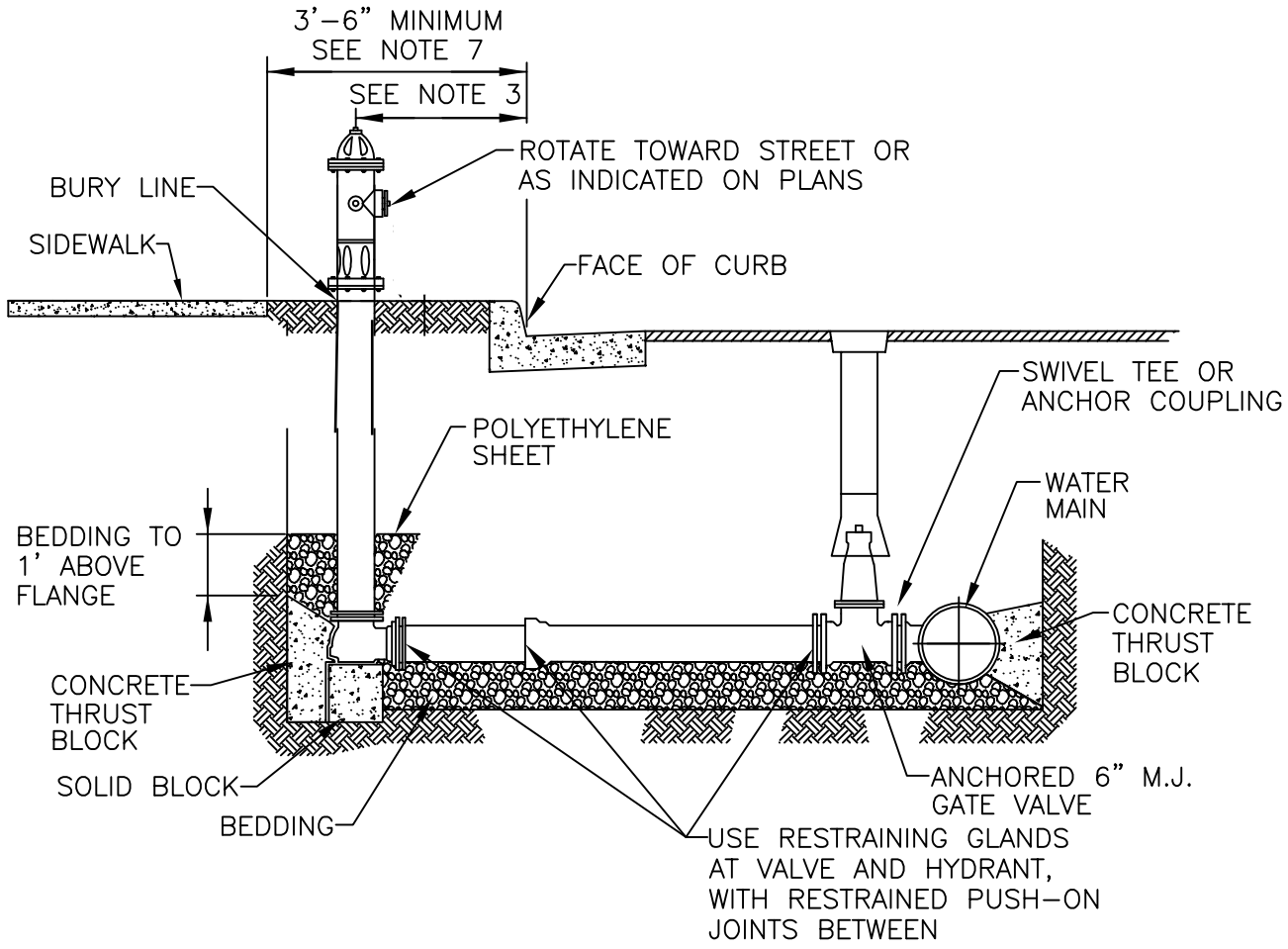
CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. TANGENT TEE REQUIRED WHERE SPECIFIED ON CONSTRUCTION PLANS.
2. MAXIMUM HYDRANT HEIGHT IS 7' BURY. FOR DEEPER MAIN, PROVIDE VERTICAL OFFSET IN LEAD.
3. MINIMUM 2' FROM FACE OF CURB TO CENTER OF HYDRANT.
4. CONCRETE & POLYETHYLENE MUST BE CLEAR OF WEEP HOLES.
5. VERTICAL ADJUSTMENT OF BARREL LIMITED TO ONE EXTENSION. REPLACE ENTIRE STEM WHERE BARREL IS ADJUSTED.
6. FIELD PAINTING REQUIRED PRIOR TO ACCEPTANCE.
7. WHERE LESS THAN 3'–6" IS AVAILABLE BETWEEN FACE OF CURB AND SIDEWALK, CENTER HYDRANT AT LEAST 2' BEHIND SIDEWALK.
8. ALONG STREETS OF DESIGN SPEED 45 MPH AND ABOVE, LOCATE HYDRANT A MINIMUM OF 6' FROM EDGE OF PAVEMENT OR FACE OF CURB.
9. HYDRANT MUST BE AT LEAST 5' FROM DRIVEWAY ENTRANCES.
10. LANDSCAPE PLANTINGS ARE PROHIBITED WITHIN 5' OF HYDRANT.

OCT. 2013	FIRE HYDRANT ALONG STREET	W–10

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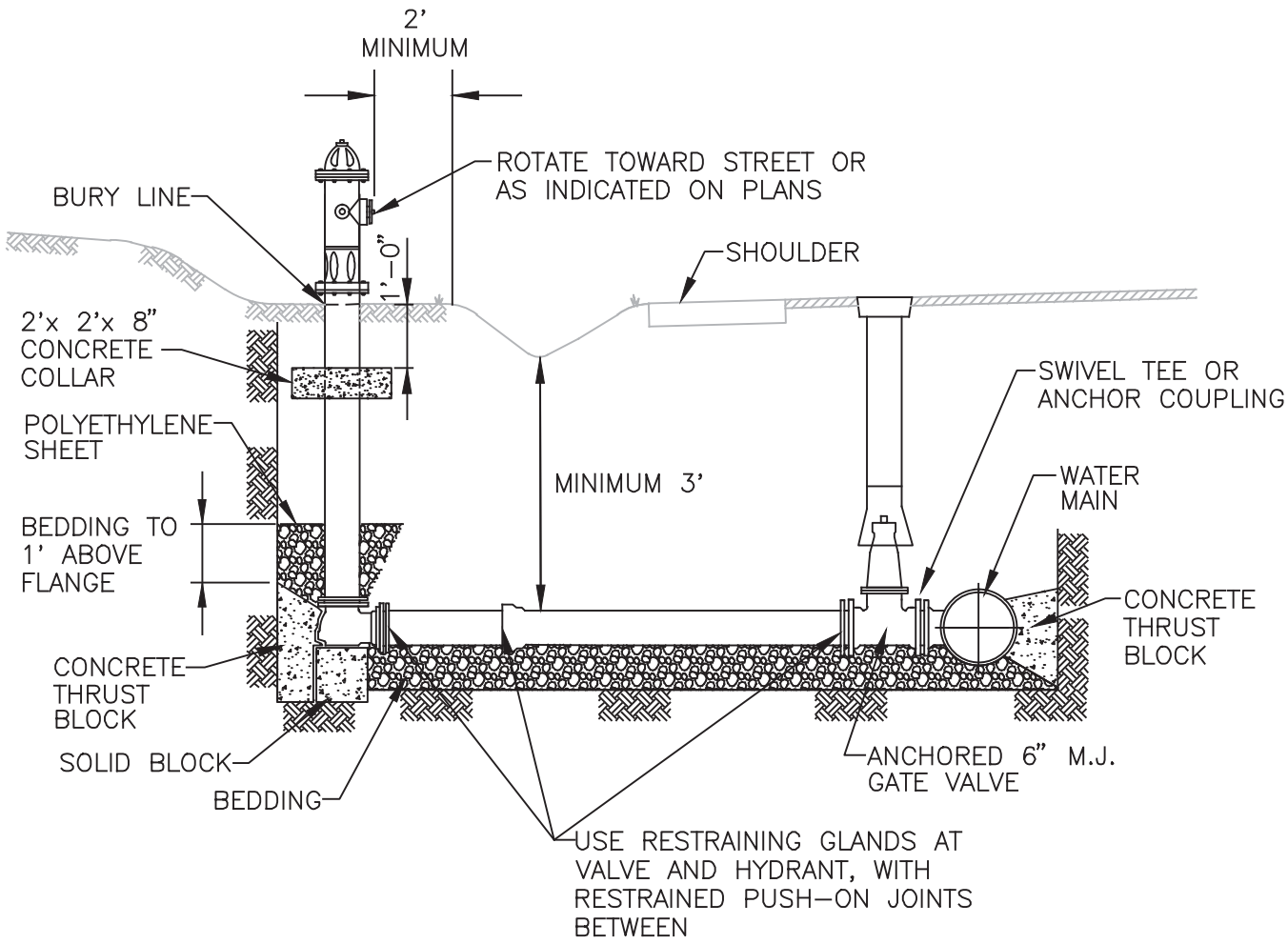
CLARKE COUNTY SANITARY AUTHORITY



NOTES:
1. LOCATE HYDRANT AT LEAST 2' BEHIND DITCH. GRADE TO A MAXIMUM 10% SLOPE WITHIN 2' OF HYDRANT. VALVE MUST NOT BE IN DITCH OR SHOULDER.

OCT. 2016	FIRE HYDRANT BEHIND DITCH	W-11

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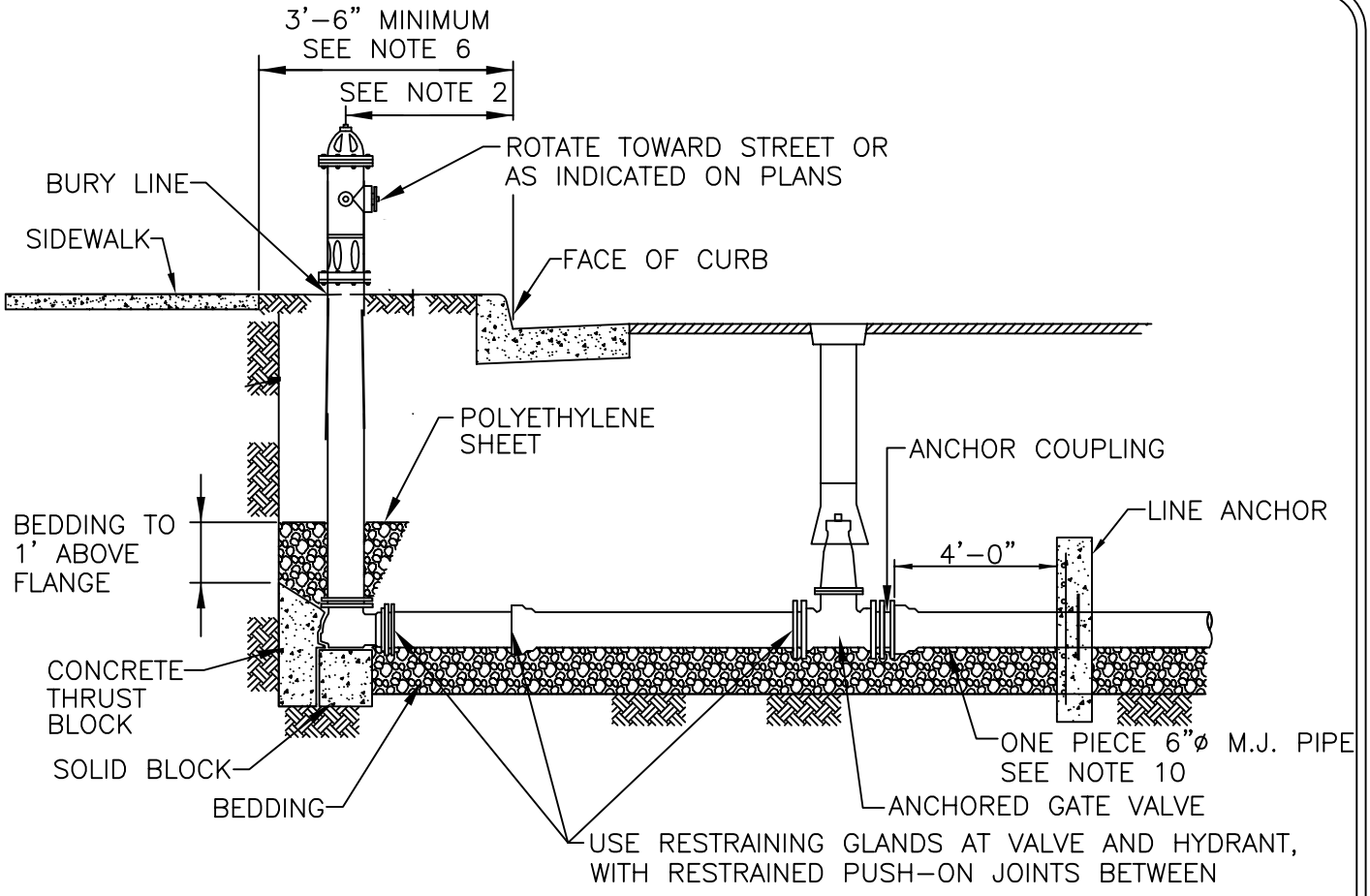
CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. MAXIMUM HYDRANT HEIGHT IS 7' BURY. FOR DEEPER MAIN, PROVIDE VERTICAL OFFSET IN LEAD.
2. MINIMUM 2' FROM FACE OF CURB TO CENTER OF HYDRANT.
3. CONCRETE & POLYETHYLENE MUST BE CLEAR OF WEEP HOLES.
4. VERTICAL ADJUSTMENT OF BARREL LIMITED TO ONE EXTENSION. REPLACE ENTIRE STEM WHERE BARREL IS ADJUSTED.
5. FIELD PAINTING REQUIRED PRIOR TO ACCEPTANCE.
6. WHERE LESS THAN 3'–6" IS AVAILABLE BETWEEN FACE OF CURB AND SIDEWALK, CENTER HYDRANT AT LEAST 2' BEHIND SIDEWALK.
7. ALONG STREETS OF DESIGN SPEED 45 MPH AND ABOVE, LOCATE HYDRANT A MINIMUM OF 6' FROM EDGE OF PAVEMENT OR FACE OF CURB.
8. HYDRANT MUST BE AT LEAST 5' FROM DRIVEWAY ENTRANCES.
9. LANDSCAPE PLANTINGS ARE PROHIBITED WITHIN 5' OF HYDRANT.
10. SERVICE CONNECTIONS PROHIBITED DOWNSTREAM OF LINE ANCHOR.
11. WHERE CCSA DETERMINES THAT LINE ANCHOR IS NOT FEASIBLE, PROVIDE RESTRAINED JOINTS FOR 60' UPSTREAM OF VALVE.

OCT. 2013	DEAD END HYDRANT	W–12

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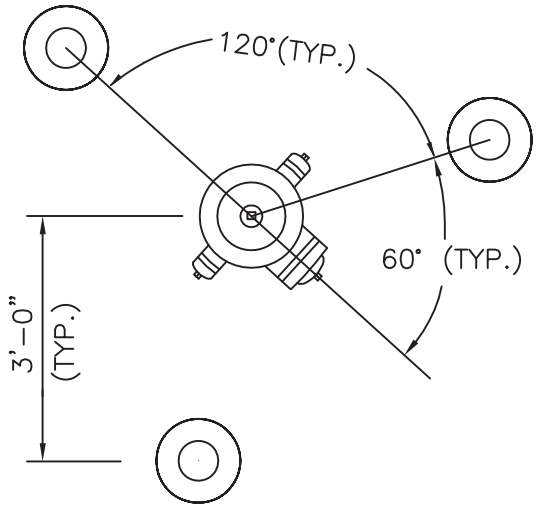
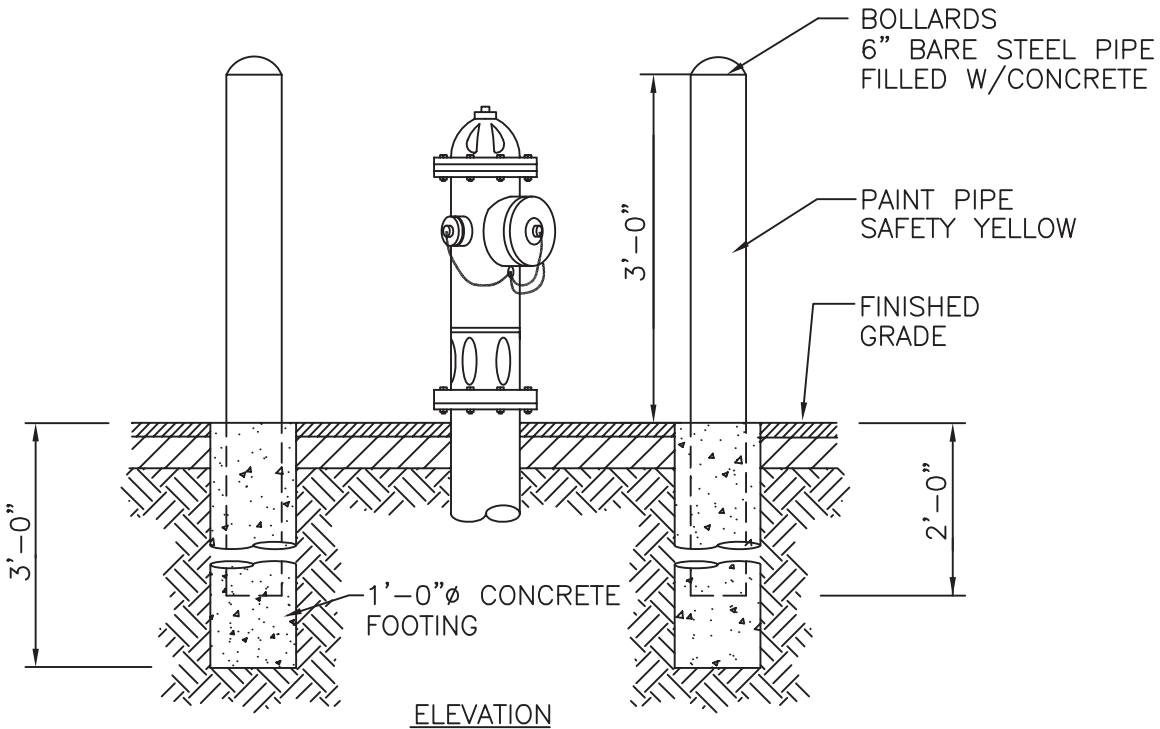
CLARKE COUNTY SANITARY AUTHORITY



TYPICAL 3 BOLLARD PLACEMENT–PLAN

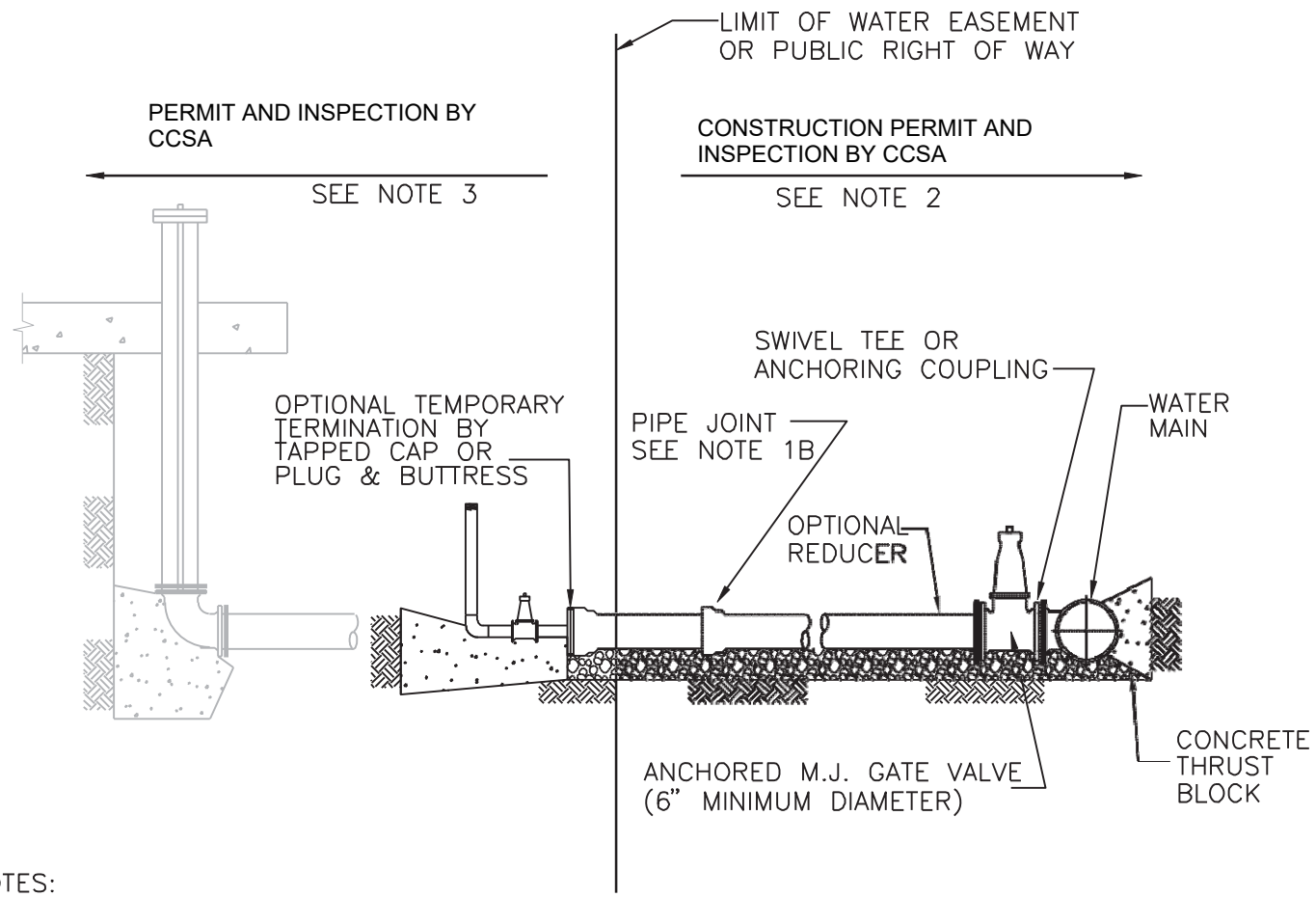


ELEVATION

NOTES:
1. QUANTITY & PLACEMENT OF BOLLARDS TO BE DETERMINED BY PLANS OR FIELD INSPECTION AS WARRANTED.
2. CONCRETE TO BE CLASS A3.

APR. 2010	HYDRANT BOLLARDS	W–13

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. WITHIN WATER EASEMENT OR PUBLIC RIGHT OF WAY:
   A) FIRE LINE TO BE MINIMUM 4" DIAMETER DUCTILE IRON PIPE, CLASS 52 OR BETTER.
   B) USE APPROVED RESTRAINING GLAND AT VALVE. RESTRAIN ALL PIPE JOINTS WITH LOCKING GASKET OR APPROVED RESTRAINED JOINT PIPING SYSTEM.
   C) ALL MATERIALS MUST CONFORM TO APPLICABLE SECTIONS OF LOUDOUN WATER'S APPROVED MATERIALS LIST.
2. CCSA MUST INSPECT AND APPROVE THE INSTALLATION AND HYDROSTATIC TEST AT 200 PSI TO THE LIMIT OF PUBLIC WATER EASEMENT OR RIGHT OF WAY.
3. FOR CONTINUATION TO THE BUILDING, ACQUIRE UNDERGROUND FIRE SERVICE PERMIT AND INSPECTIONS FROM THE CLARKE COUNT BUILDING DEPARTMENT.
4. FOR DRAWS OF WATER FROM THE PUBLIC MAIN, CONTACT CCSA.

OCT. 2019	FIRE SERVICE CONNECTION	W-20

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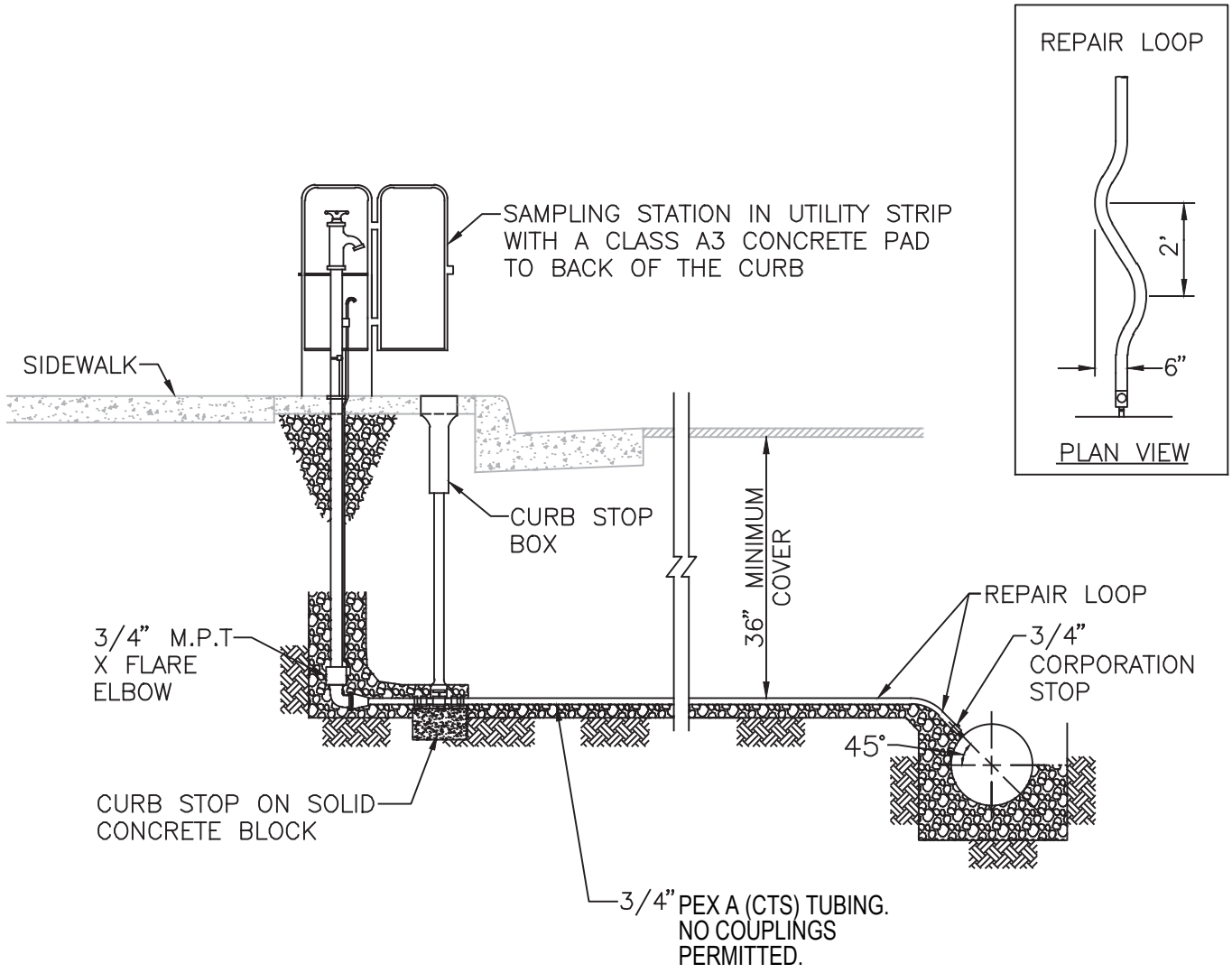

NOTES:
1. EXTEND BEDDING MATERIAL TO BASE OF SAMPLING STATION.
2. ALL MATERIALS MUST CONFORM TO APPLICABLE SECTIONS OF LOUDOUN WATER'S APPROVED MATERIALS LIST. JOIN TO TUBING WITH APPROVED COMPRESSION CONNECTOR.

OCT. 2016	SAMPLING STATION	W–21

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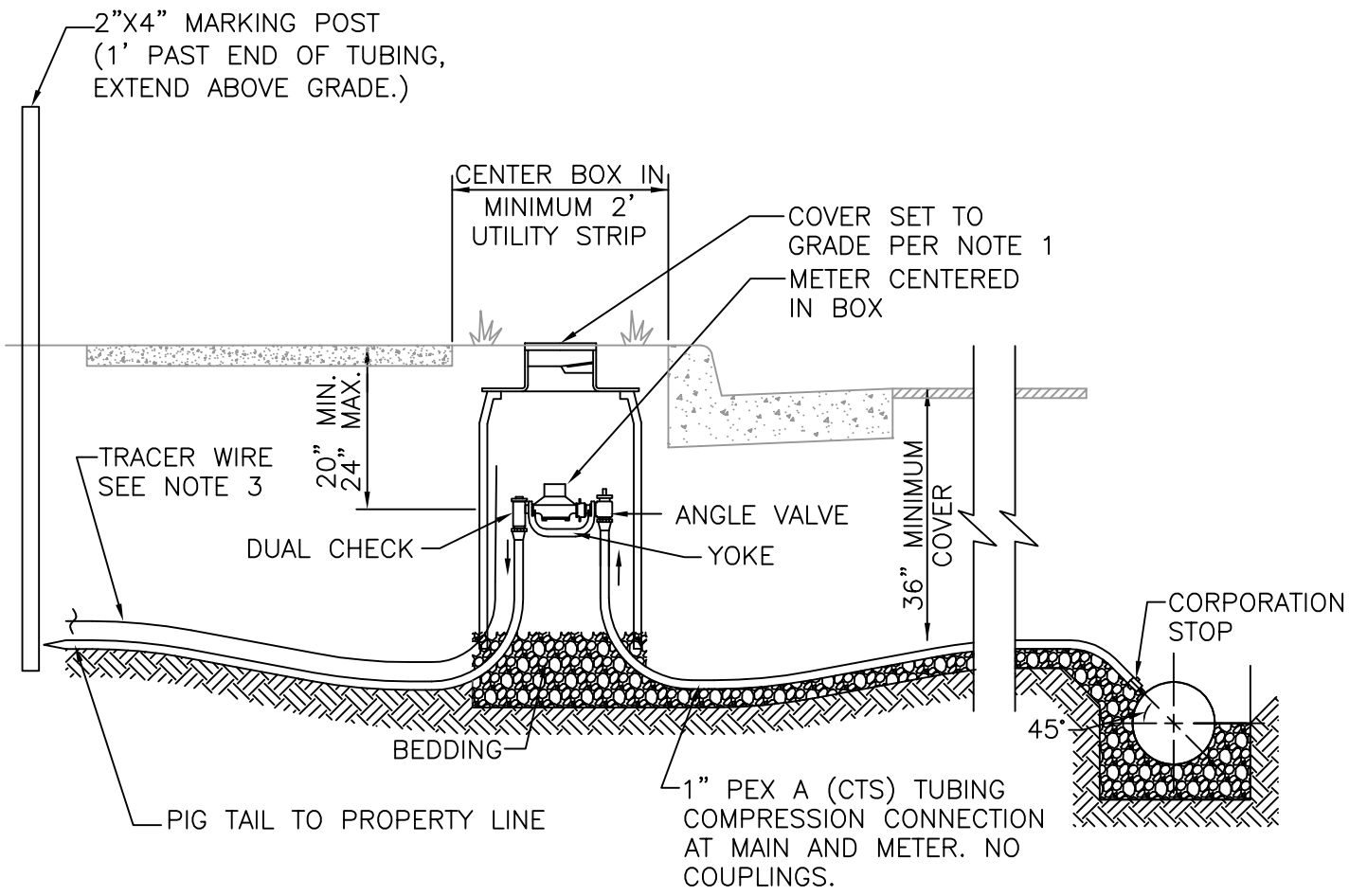
CLARKE COUNTY SANITARY AUTHORITY

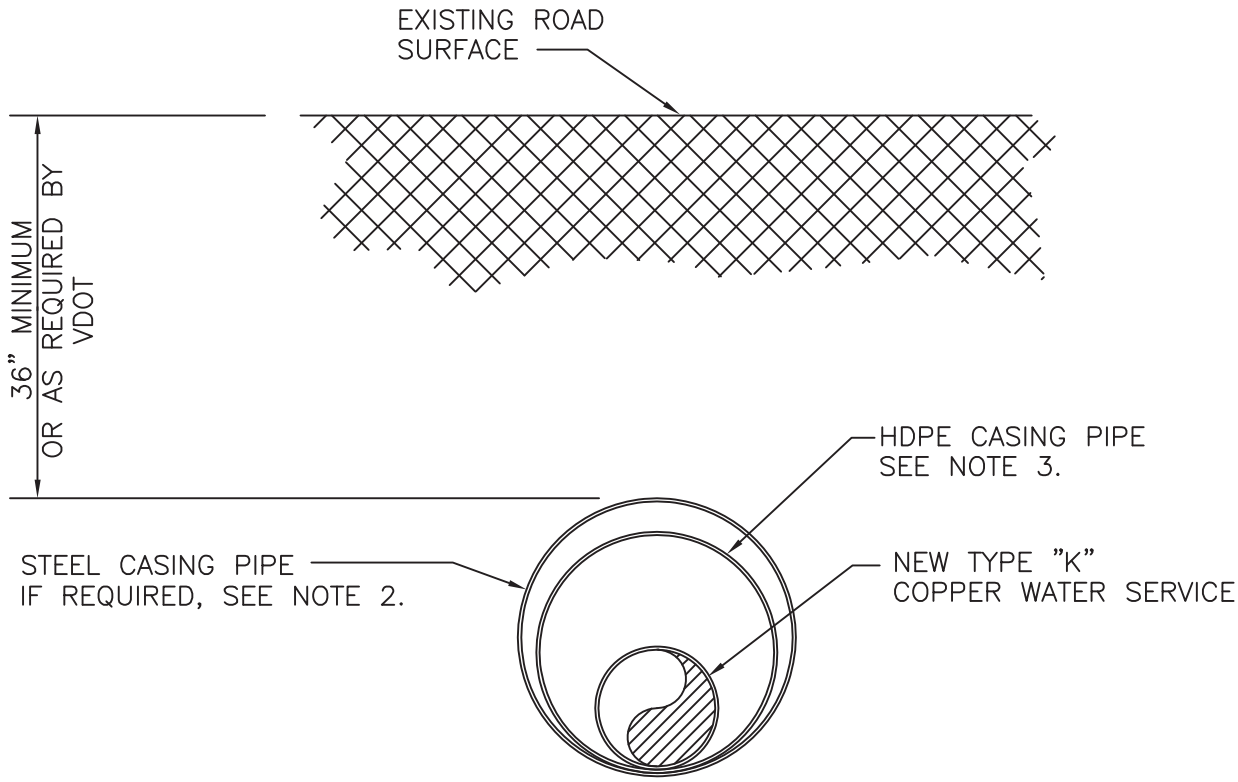


NOTES:

1. A) AT INITIAL INSTALLATION, ROTATIONAL (ADJUSTABLE) FRAME TO BE IN CENTER OF HEIGHT RANGE.
   B) WHERE AT CURB, SET COVER FLUSH TO 1" ABOVE TOP OF CURB.
   C) WHERE NO CURB, SET COVER 1" ABOVE FINAL GRADE.
   D) IN SLOPE, PROVIDE TIMBER RETAINING WALL 3' FROM COVER.
2. WHERE TAP IS ON 4" MAIN, CORPORATION STOP SHALL HAVE 3/4" INLET AND 1" OUTLET.
3. WHERE SERVICE BETWEEN METER AND BUILDING IS PLASTIC TUBING, PROVIDE TRACER WIRE OF AWG #12 SOLID COPPER WITH 45 MIL POLYETHYLENE INSULATION. TURN TRACER WIRE UP INSIDE METER BOX. TERMINATE TRACER WIRE INDOORS OR AT EXTERIOR WALL WITH A BLUE SOIL MARKER.
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.
5. METER FURNISHED AND INSTALLED BY CCSA.

OCT. 2019	SERVICE CONNECTION FOR 3/4" AND 1" METERS	W–22

CLARKE COUNTY SANITARY AUTHORITY



NOTES:
1. A PERMIT FROM THE VIRGINIA DEPARTMENT OF TRANSPORTATION IS REQUIRED FOR ALL WORK WITHIN AN EXISTING PUBLIC RIGHT-OF-WAY.
2. IF ROADWAY OWNER REQUIRES CASING TO BE STEEL, INSERT PLASTIC CASING PIPE INTO STEEL CASING TO INSULATE THE WATER SERVICE FROM STEEL. OTHERWISE USE PLASTIC CASING ONLY.
3. FOR 1" WATER SERVICE USE 3" HIGH DENSITY POLYETHYLENE (HDPE). FOR 1-1/2" SERVICE OR 2" WATER SERVICE USE 4" HDPE. POLYVINYL CHLORIDE (PVC) NOT ACCEPTABLE.
4. SEAL BOTH ENDS OF CASING.

APR. 2010	WATER SERVICE BY JACK AND BORE	W-24

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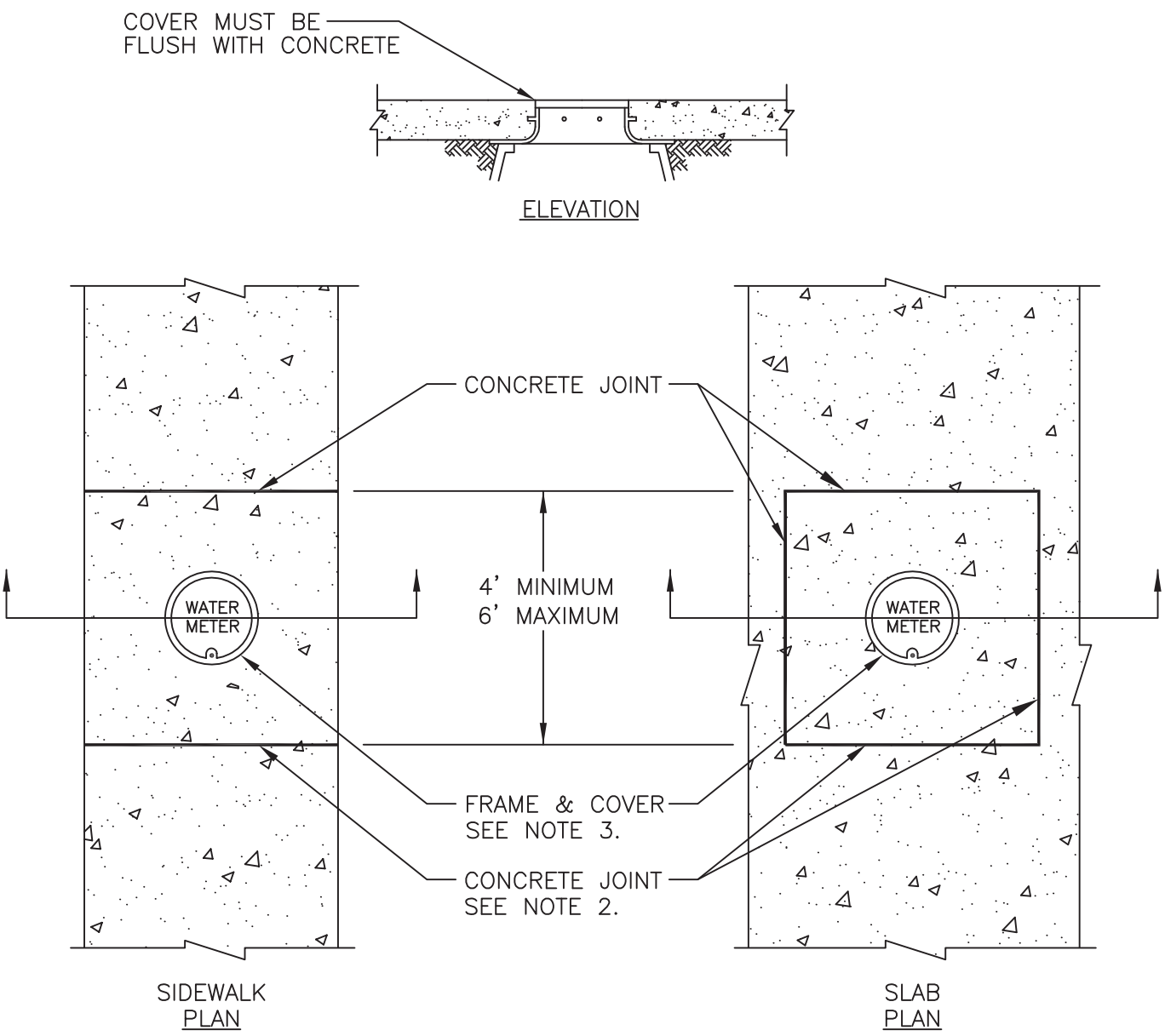
CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. FOR USE ONLY WHERE SPECIFICALLY APPROVED BY CCSA. METER NOT PERMITTED WITHIN DIRECT WHEEL PATH OF VEHICLES.
2. EXTEND JOINTS IN CONCRETE TO A DEPTH OF AT LEAST 1".
3. FRAME AND COVER FOR "SPECIAL APPLICATIONS" REQUIRED. SEE LOUDOUN WATER'S APPROVED MATERIALS LIST FOR MANUFACTURERS AND PART NUMBERS.

SEPT. 2010	WATER METER IN SIDEWALK OR SLAB	W-25

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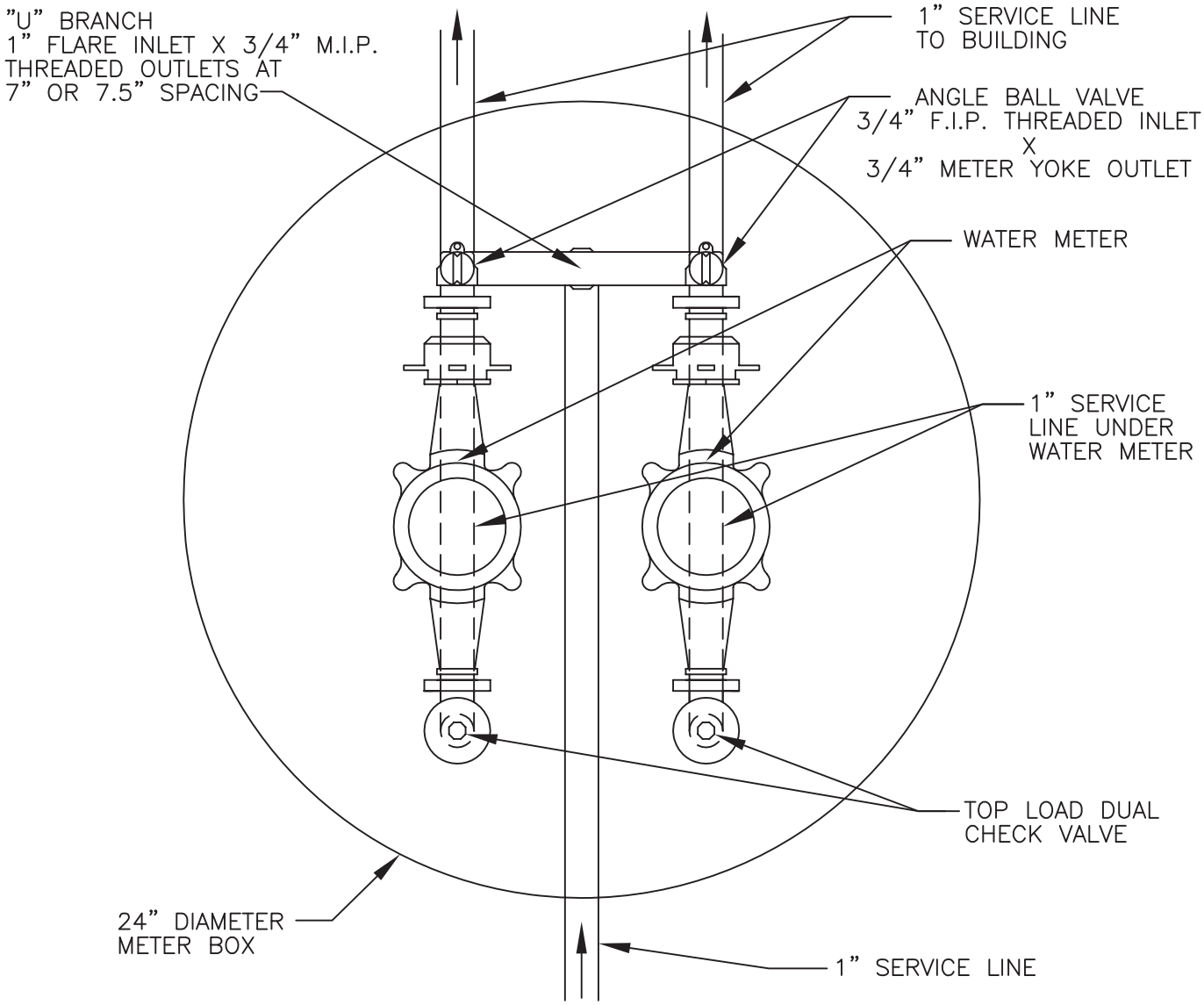
CLARKE COUNTY SANITARY AUTHORITY

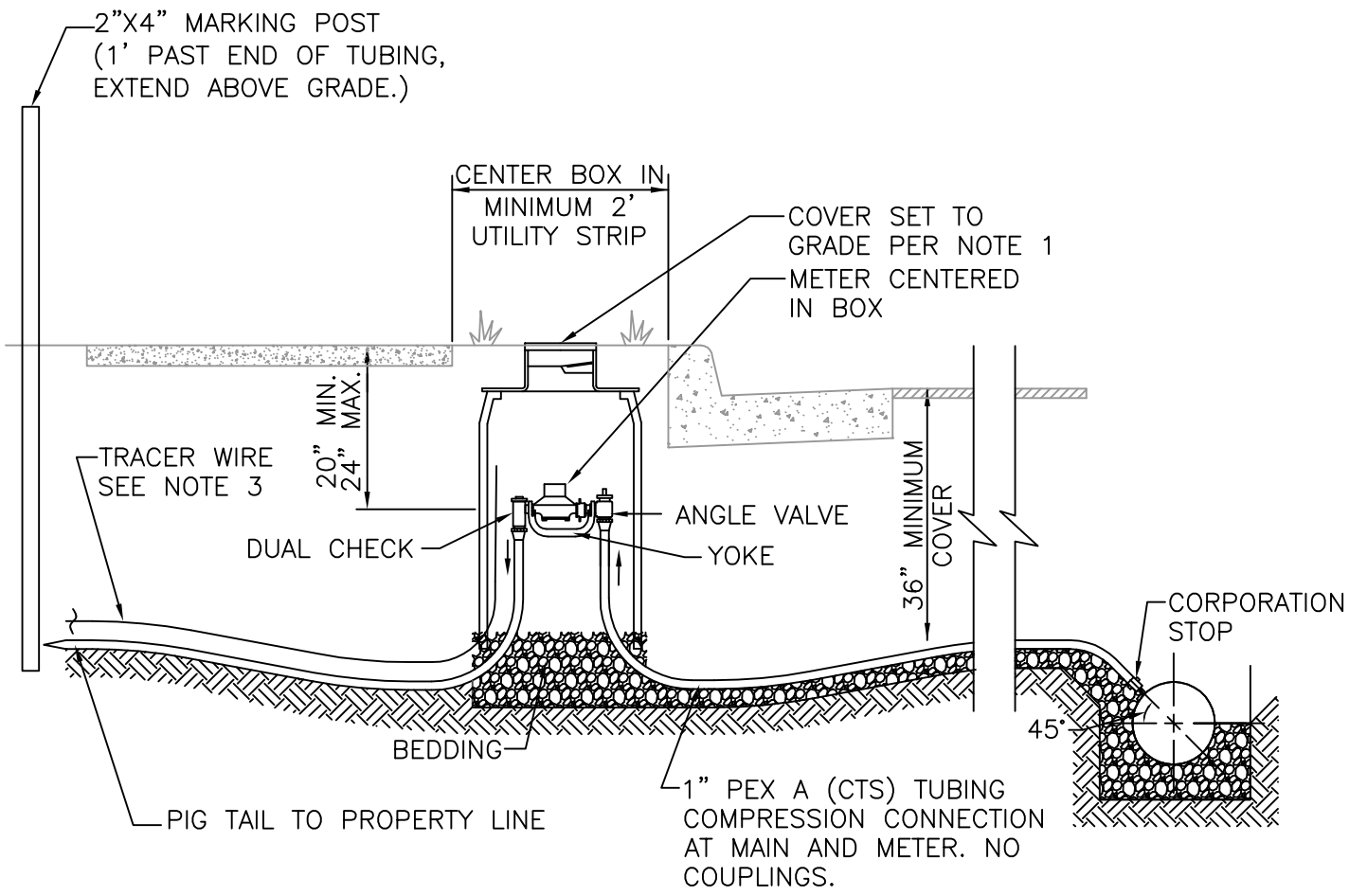


NOTES:
1. FOR USE ONLY WHERE SPECIFICALLY APPROVED BY **CCSA.** CANNOT SUPPLY RESIDENTIAL FIRE SUPPRESSION SYSTEMS.
2. SEE FIGURE W–23 FOR SERVICE LINE AND METER BOX PLACEMENT.
3. SEE LOUDOUN WATER'S APPROVED MATERIALS LIST FOR MANUFACTURERS AND PART NUMBERS.

APR. 2010	DUAL WATER METER SETTING	W–26

Clarke COUNTY · VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. A) AT INITIAL INSTALLATION, ROTATIONAL (ADJUSTABLE) FRAME TO BE IN CENTER OF HEIGHT RANGE.
   B) WHERE AT CURB, SET COVER FLUSH TO 1" ABOVE TOP OF CURB.
   C) WHERE NO CURB, SET COVER 1" ABOVE FINAL GRADE.
   D) IN SLOPE, PROVIDE TIMBER RETAINING WALL 3' FROM COVER.
2. WHERE TAP IS ON 4" MAIN, CORPORATION STOP SHALL HAVE 3/4" INLET AND 1" OUTLET.
3. WHERE SERVICE BETWEEN METER AND BUILDING IS PLASTIC TUBING, PROVIDE TRACER WIRE OF AWG #12 SOLID COPPER WITH 45 MIL POLYETHYLENE INSULATION. TURN TRACER WIRE UP INSIDE METER BOX. TERMINATE TRACER WIRE INDOORS OR AT EXTERIOR WALL WITH A BLUE SOIL MARKER.
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.
5. METER FURNISHED AND INSTALLED BY CCSA.

OCT. 2019	SERVICE CONNECTION FOR 3/4" AND 1" METERS	W-27

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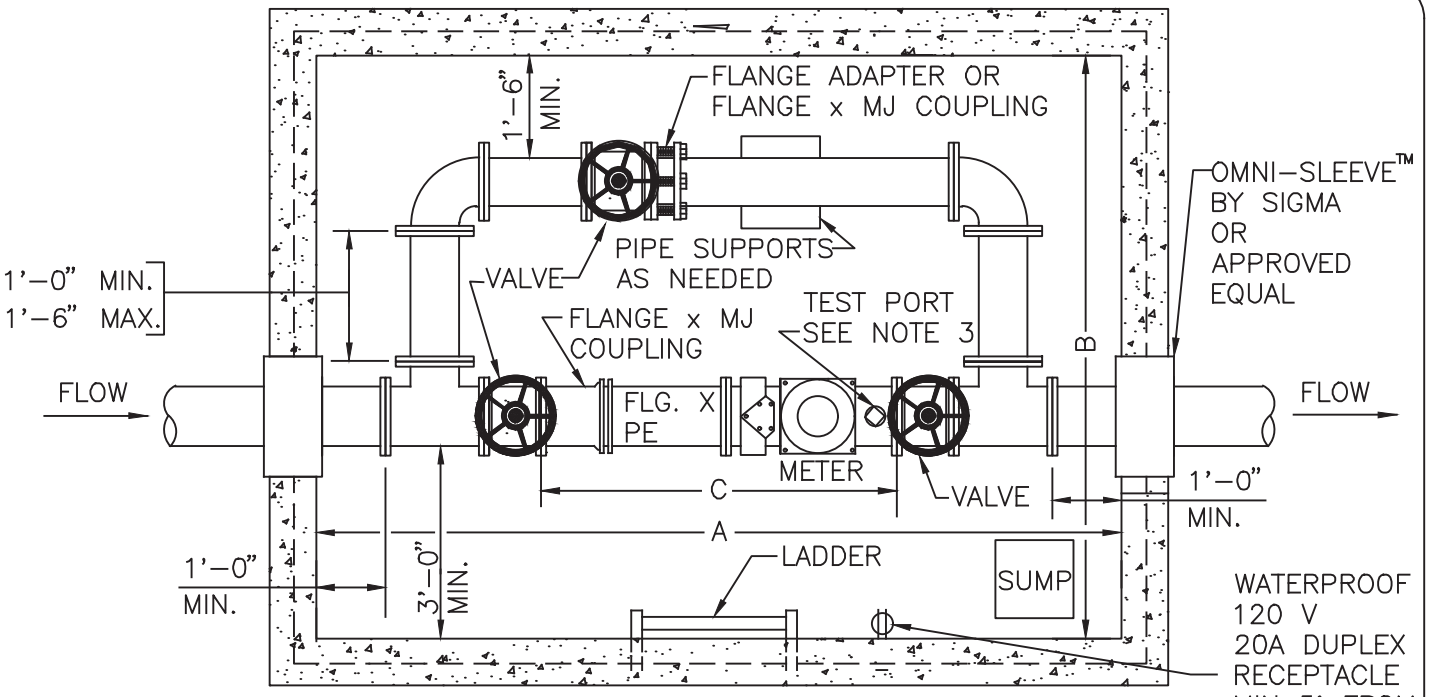
CLARKE COUNTY SANITARY AUTHORITY



METER SIZE	LAY LENGTH*			MINIMUM DIMENSIONS			
	C2	T2	MAGNETIC‡	A	B	C	BYPASS
3"	17.0"	19.0"	13.4"	9'0"	7'0"	3'6"	3" ø
4"	20.0"	23.0"	13.4"	9'0"	7'0"	4'0"	3" ø
6"	24.0"	27.0"	14.6"	12'0"	8'0"	5'0"	4" ø

*ADD TWO GASKETS (⅛" EACH).

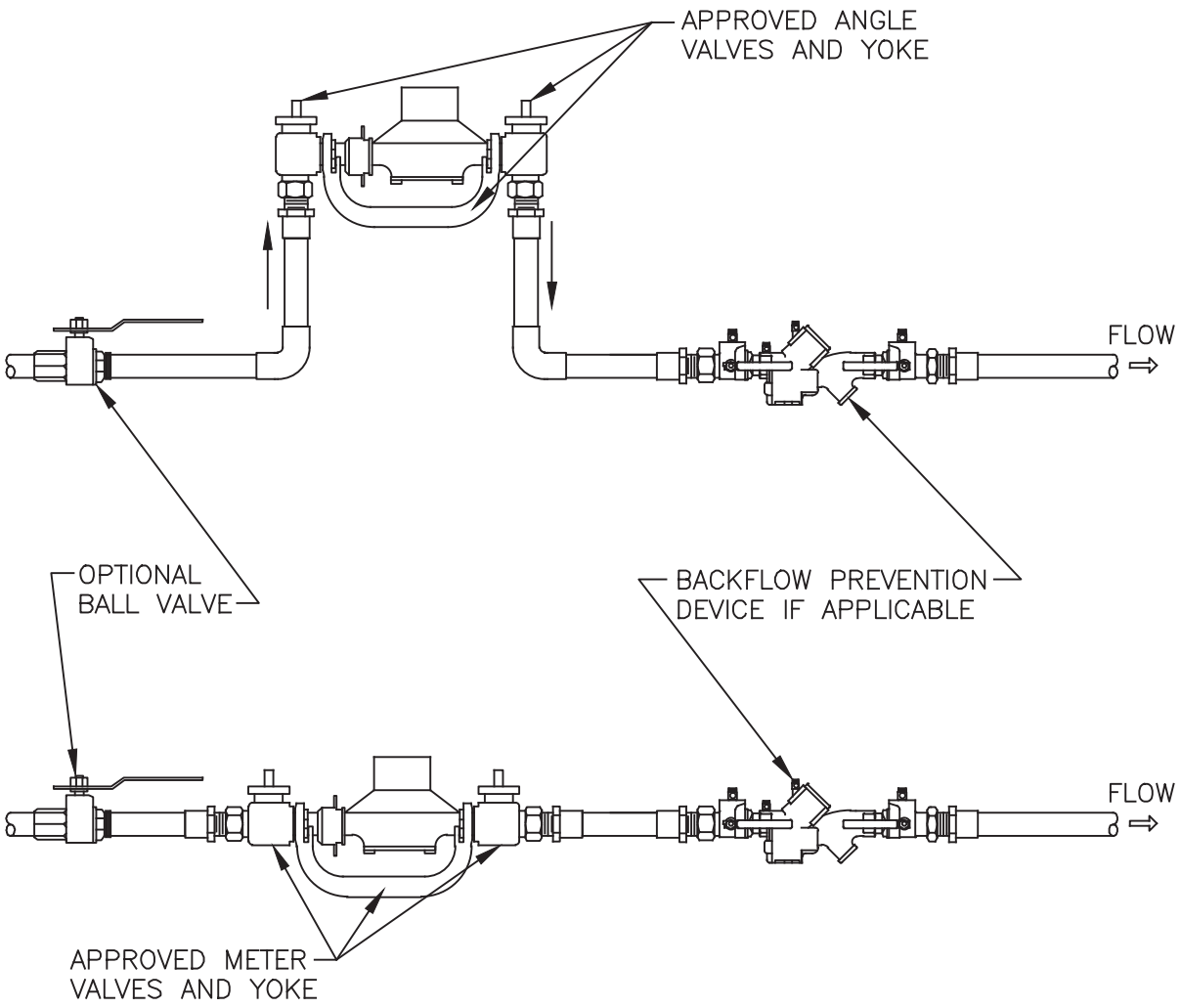
‡ADD FOUR (4) GASKETS AND TWO (2) GROUND RINGS (¾" TOTAL) FOR MAGNETIC METERS.

NOTES:

1. CONNECTION AT MAIN TO BE 6" MINIMUM WITH RESTRAINED BRANCH VALVE. RESTRAIN ALL SERVICE LINE BETWEEN MAIN AND BUILDING.
2. ALL PIPE IN VAULT TO BE FLANGED DUCTILE IRON. ALL VALVES TO BE RESILIANT WEDGE WITH HAND WHEEL OPERATOR.
3. DOWNSTREAM OF MAGNETIC METER ADD 3"X3", 4"X4" OR 6"X4" TEE WITH BLIND FLANGE (TAPPED 2") TO SERVE AS TEST PORT.
4. CEILING HEIGHT TO BE 6'–6" MINIMUM. PIPE CENTER LINE 2'–6" ABOVE FLOOR. MANWAY TO BE COVERED WITH 36"X36" HINGED FRAME AND COVER.
5. SUBMITTAL REQUIRED FOR VAULT. STRUCTURAL DESIGN TO BE CERTIFIED BY A VIRGINIA PROFESSIONAL ENGINEER. SEE G–20 THROUGH G–23 FOR ADDITIONAL REQUIREMENTS.
6. THE BUILDING'S INTERNAL PLUMBING SHALL INCLUDE A BACK FLOW PREVENTER (CERTIFIED BY A.S.S.E. OR C.S.A.). INSTALLATION & TESTING SHALL BE IN ACCORDANCE WITH THE INTERNATIONAL PLUMBING CODE (INCLUDING BUT NOT LIMITED TO SECTIONS 312.9.2 & 608.2 & 608.3) & CCSA CROSS CONNECTION / BACKFLOW PREVENTION MANUAL. SYSTEMS THAT REQUIRE AN R.P.Z. BACK FLOW PREVENTER SHALL HAVE, AT MINIMUM, AN EQUIVALENTLY SIZED DRAIN.

AUG. 2018	3", 4" AND 6" OMNI C2, OMNI T2 OR MAGNETIC METER IN VAULT	W–29

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. THIS DETAIL FOR USE WHERE INDOOR METERING HAS BEEN APPROVED. COMMON USES ARE WHERE FLOW QUALIFIES FOR SUBTRACTION METERING OR WHERE SUPPLY TO OR DISCHARGE FROM AN INDUSTRIAL PROCESS IS TO BE METERED.
2. MOUNT METER'S TRANSMITTER ON EXTERIOR OF BUILDING, OREINTED TOWARD READING TOWER. PROVIDE 1"ø PVC CONDUIT FROM METER TO TRANSMITTER. MAXIMUM RUN IS 300'.
3. SEE LOUDOUN WATER'S APPROVED MATERIALS LIST FOR APPROVED MANUFACTURERS AND MODEL NUMBERS. ANGLE VALVES MAY HAVE THREADED OR COMPRESSION CONNECTION TO TUBING.
4. **CCSA WILL PROVIDE METER ONLY.**

OCT. 2016	3/4" OR 1" SUBTRACTION OR INDUSTRIAL PROCESS METER	W–32

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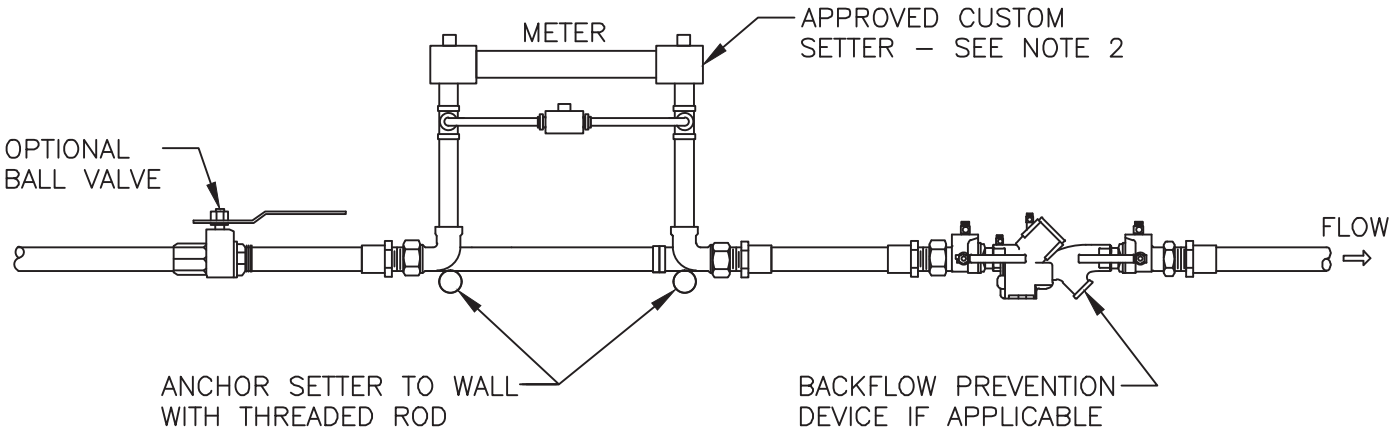
CAUTION: INSTALLER MUST ADJUST SETTER TO EXACT METER DIMENSIONS:

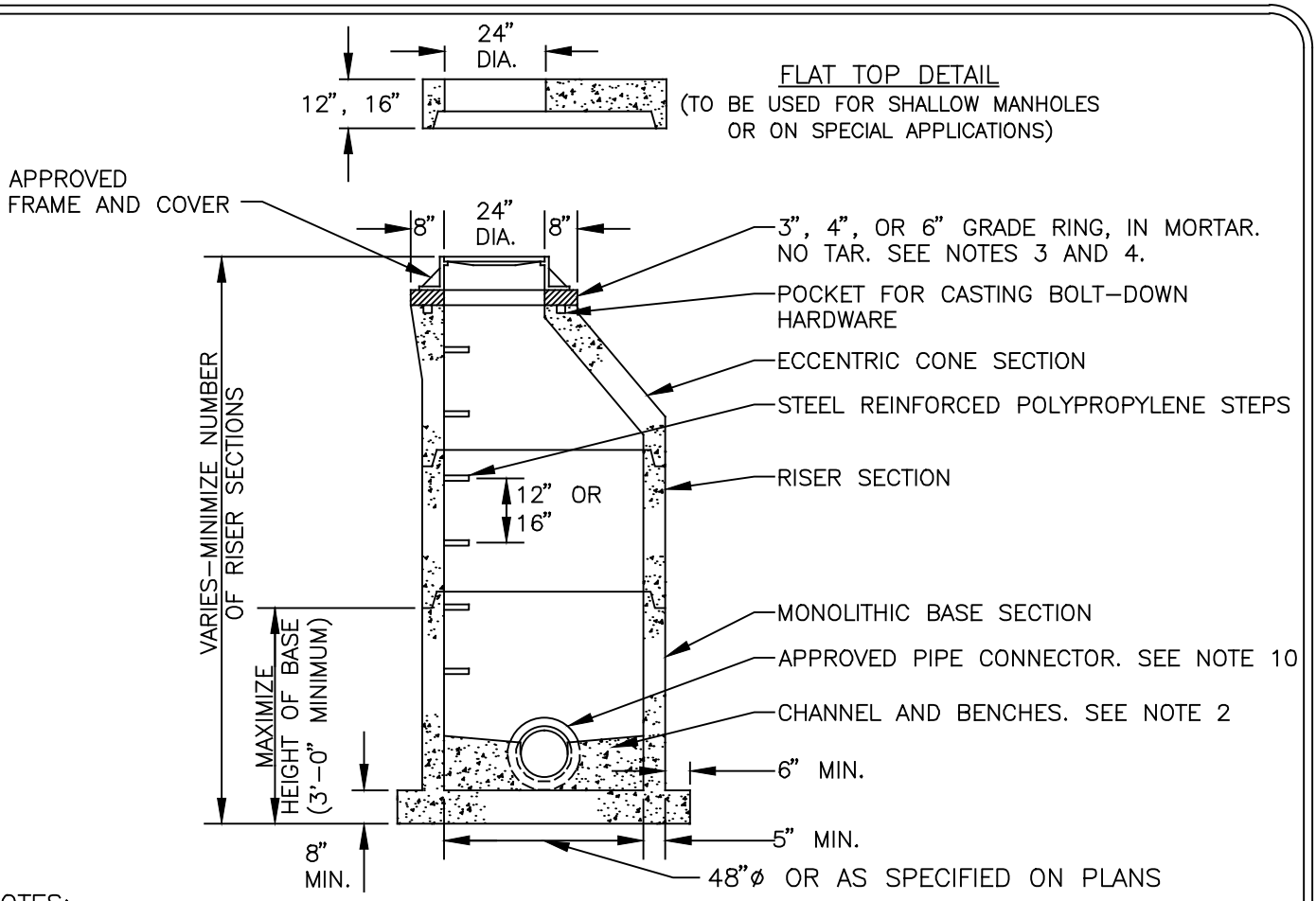
1.5" METER: 13" + 2 GASKETS
2" METER: 17" + 2 GASKETS
GASKETS=1/8" EACH



NOTES:
1. THIS DETAIL FOR USE WHERE INDOOR METERING HAS BEEN APPROVED. COMMON USES ARE WHERE FLOW QUALIFIES FOR SUBTRACTION METERING OR WHERE SUPPLY TO OR DISCHARGE FROM AN INDUSTRIAL PROCESS IS TO BE METERED.
2. MOUNT METER'S TRANSMITTER ON EXTERIOR OF BUILDING, ORIENTED TOWARD READING TOWER. PROVIDE 1"ø PVC CONDUIT FROM METER TO TRANSMITTER. MAXIMUM RUN IS 300'.
3. SEE LOUDOUN WATER'S APPROVED MATERIALS LIST FOR APPROVED MANUFACTURERS AND MODEL NUMBERS. SETTER MAY HAVE THREADED OR COMPRESSION CONNECTION AT INLET AND OUTLET.
4. **CCSA WILL PROVIDE METER ONLY.**

OCT. 2016	1 1/2" OR 2" OMNI C2 SUBTRACTION OR INDUSTRIAL PROCESS METER	W–33

CLARKE COUNTY SANITARY AUTHORITY

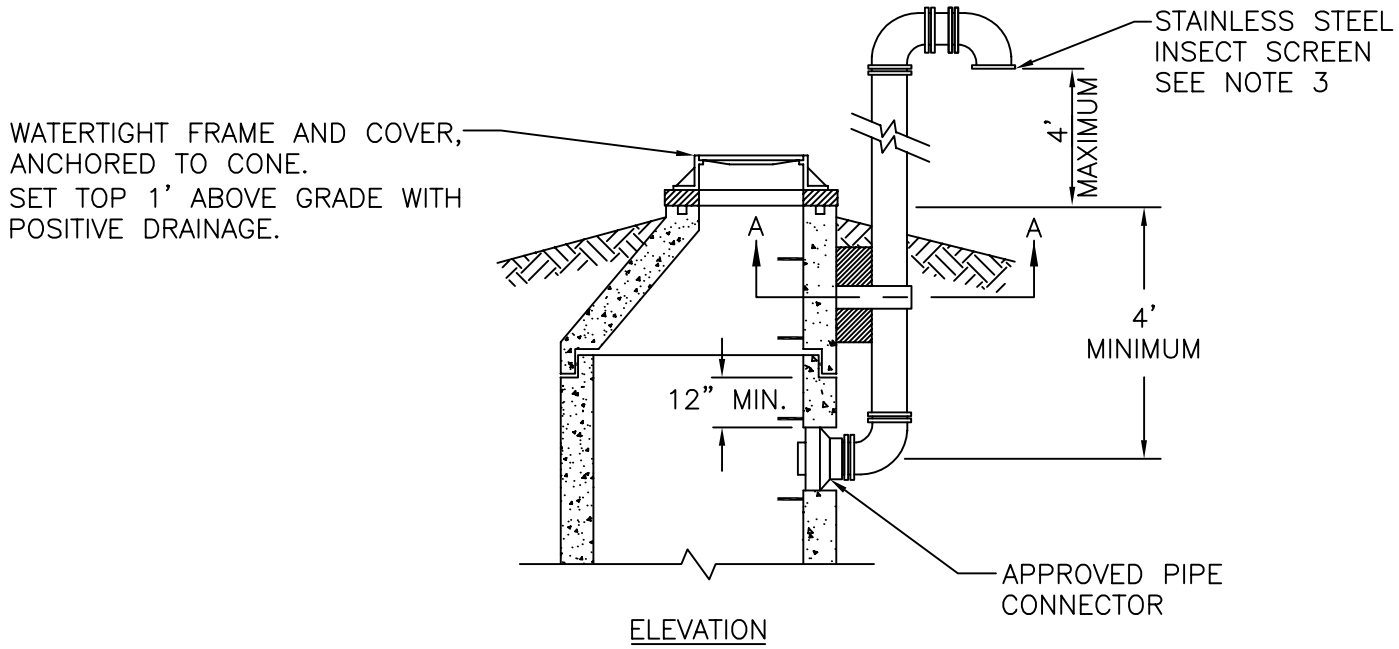


NOTES:

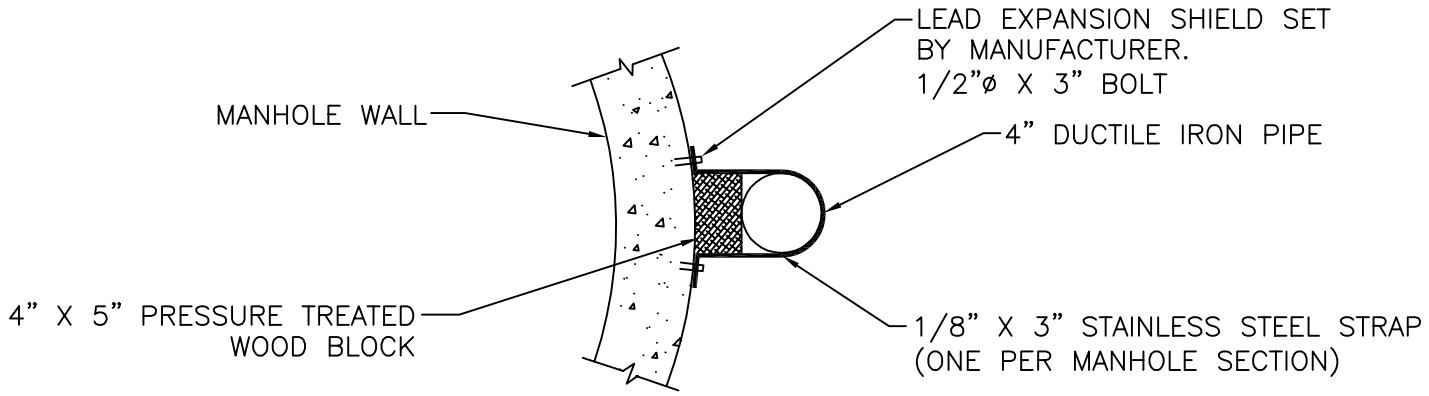
1. INSTALL MANHOLE ON COMPETENT SUBGRADE AND BEDDING MATERIAL PER FIGURE G-6.
2. CHANNEL TO BE CLASS B2 CONCRETE OR BETTER PER LOUDOUN WATER'S APPROVED MATERIALS LIST. DEPTH OF CHANNEL SHALL BE 70% OF THE PIPELINE'S DIAMETER. SLOPE BENCH TO CHANNEL AT 1" PER 1'. APPLY HARD TROWEL FINISH TO CHANNEL AND BRUSH FINISH TO BENCH.
3. MAXIMUM ADJUSTMENT BY GRADE RINGS IS 12" IN PAVEMENT AND 6" ELSEWHERE.
4. WHERE WATERTIGHT COVER IS SPECIFIED, PROVIDE APPROVED CHIMNEY SEAL.
5. OUTSIDE PAVEMENT BOLT FRAME TO CONE.
6. A MINIMUM 6" SEPARATION IS REQUIRED BETWEEN PIPE PENETRATIONS (CORES). CORES MUST BE AT LEAST 6" FROM MANHOLE JOINTS.
7. COMPONENTS SHALL BE REINFORCED TO MEET ASTM 478/AASHTO M199.
8. JOINTS TO BE GASKETED IN ACCORDANCE WITH ASTM C443. APPLY PROPER LUBRICANT FOR ASSEMBLY.
9. APPROVED SHOP DRAWINGS ARE REQUIRED FOR STRUCTURES CONTAINING A REDUCING SLAB.
10. ALL COMPONENTS TO BE PER LOUDOUN WATER'S APPROVED MATERIALS LIST.

APR. 2017	MANHOLE	S-1

CLARKE COUNTY SANITARY AUTHORITY



ELEVATION



SECTION A–A

NOTES:
1. CORE TO BE 12" MINIMUM FROM MANHOLE JOINT.
2. PIPE TO BE 4" DUCTILE IRON WITH FLANGED FITTINGS. ABOVE GRADE APPLY EPOXY PAINT TO VENT PIPING.
3. WHERE VENT IS BELOW THE 100–YEAR FLOOD ELEVATION, INSTALL APPROVED BALL FLOAT CHECK VALVE.
4. ALL COMPONENTS TO BE IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.

APR. 2010	SIDE VENT FOR MANHOLE	S–2

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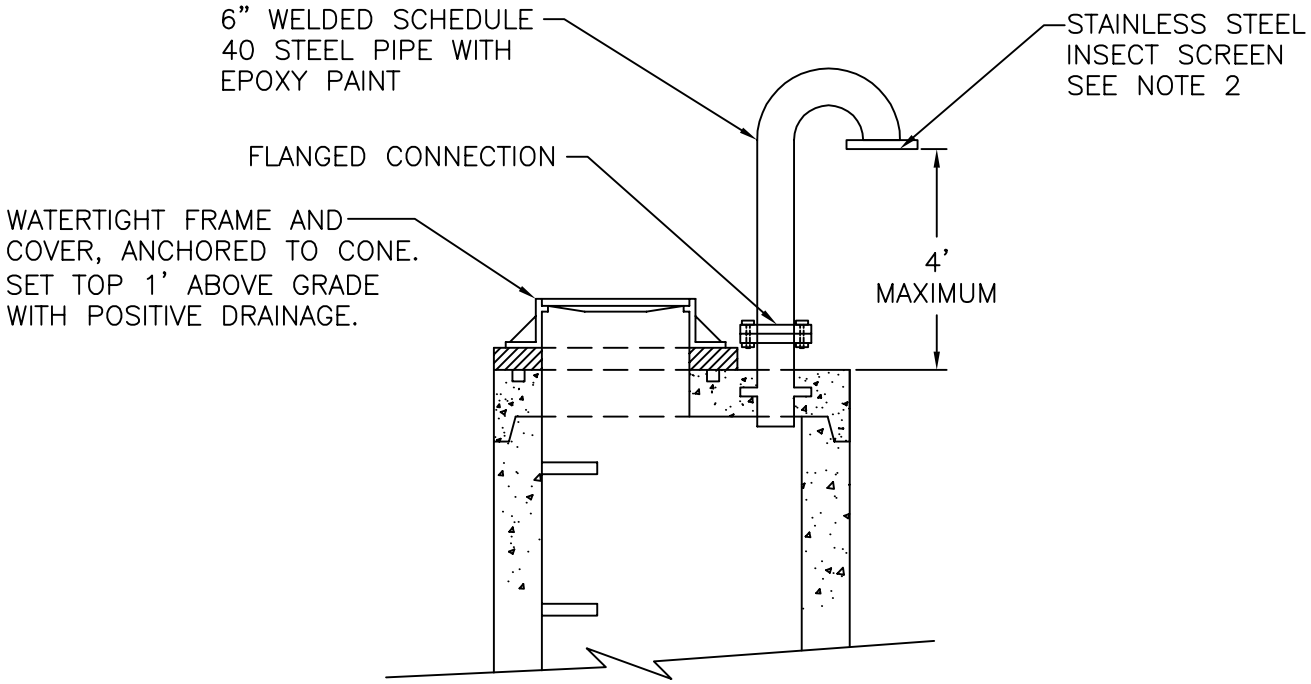

NOTES:

1. PROVIDE FLANGE X PLAIN END 6" STEEL WALL PIPE, CAST INTO MANHOLE TOP.
2. WHERE VENT PIPE IS BELOW THE 100–YEAR FLOOD ELEVATION, INSTALL APPROVED BALL FLOAT CHECK VALVE.
3. ALL COMPONENTS TO BE IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.

APR. 2010	TOP VENT FOR MANHOLE	S–3

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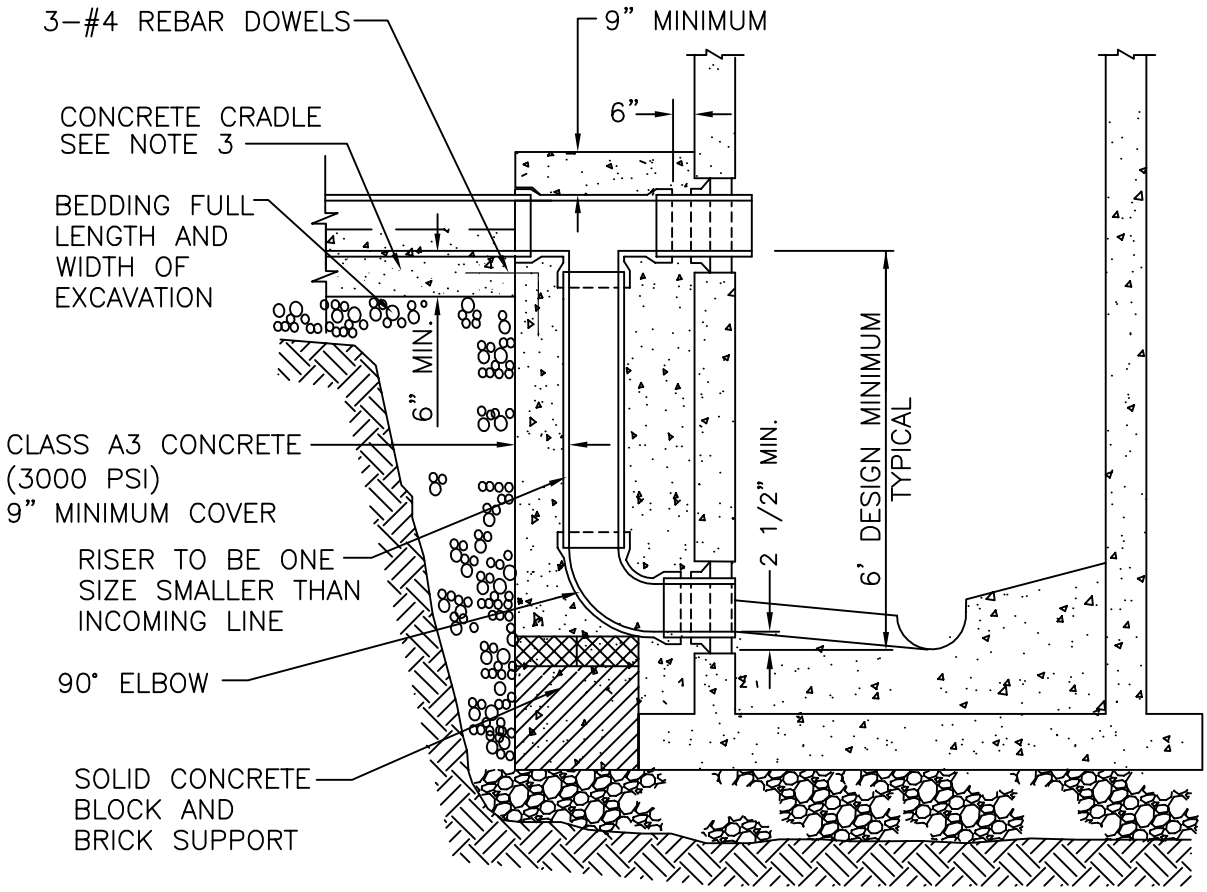
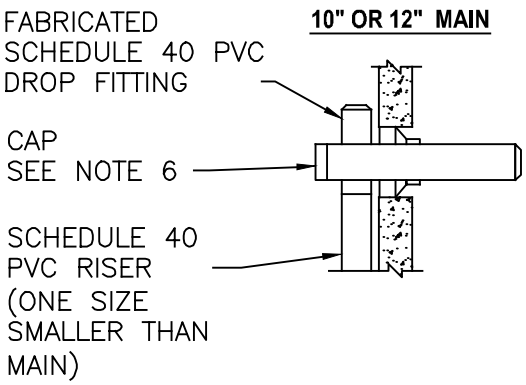


NOTES:
1. INCOMING LINE TO HAVE 2.0% MAXIMUM SLOPE.
2. MANHOLE PENETRATIONS TO BE BY CORE AND APPROVED PIPE CONNECTOR. CORE IS TO BE AT LEAST ONE FOOT CLEAR OF MANHOLE JOINT.
3. EXTEND CONCRETE CRADLE A MINIMUM OF 4' ONTO UNDISTURBED TRENCH BOTTOM.
4. ALL COMPONENTS TO BE IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.

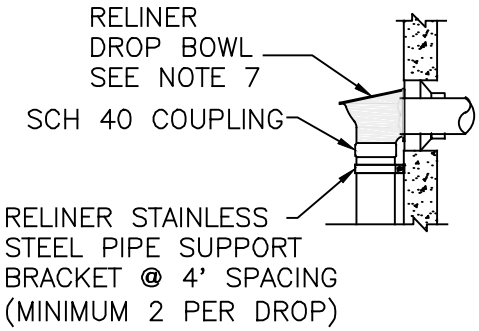
APR. 2010	OUTSIDE DROP CONNECTION	S–4

CLARKE COUNTY SANITARY AUTHORITY

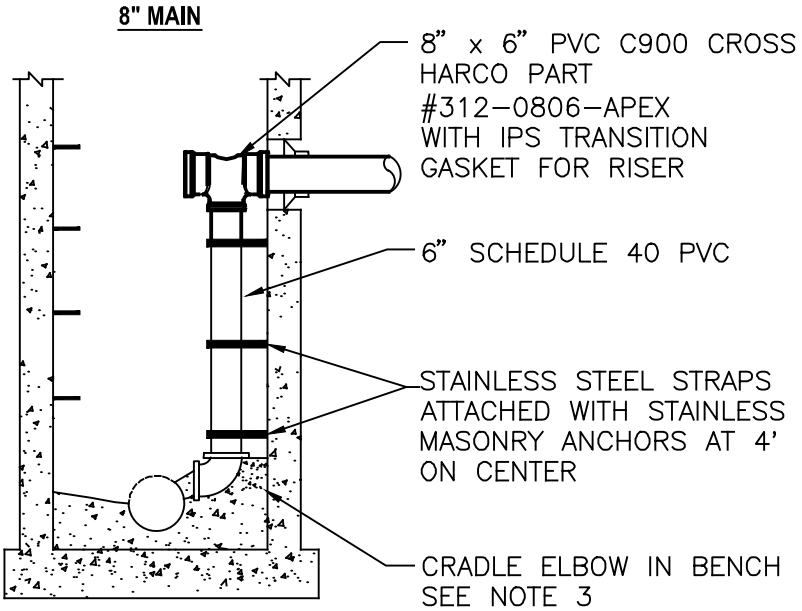
10" OR 12" MAIN



4" OR 6" SERVICE



8" MAIN



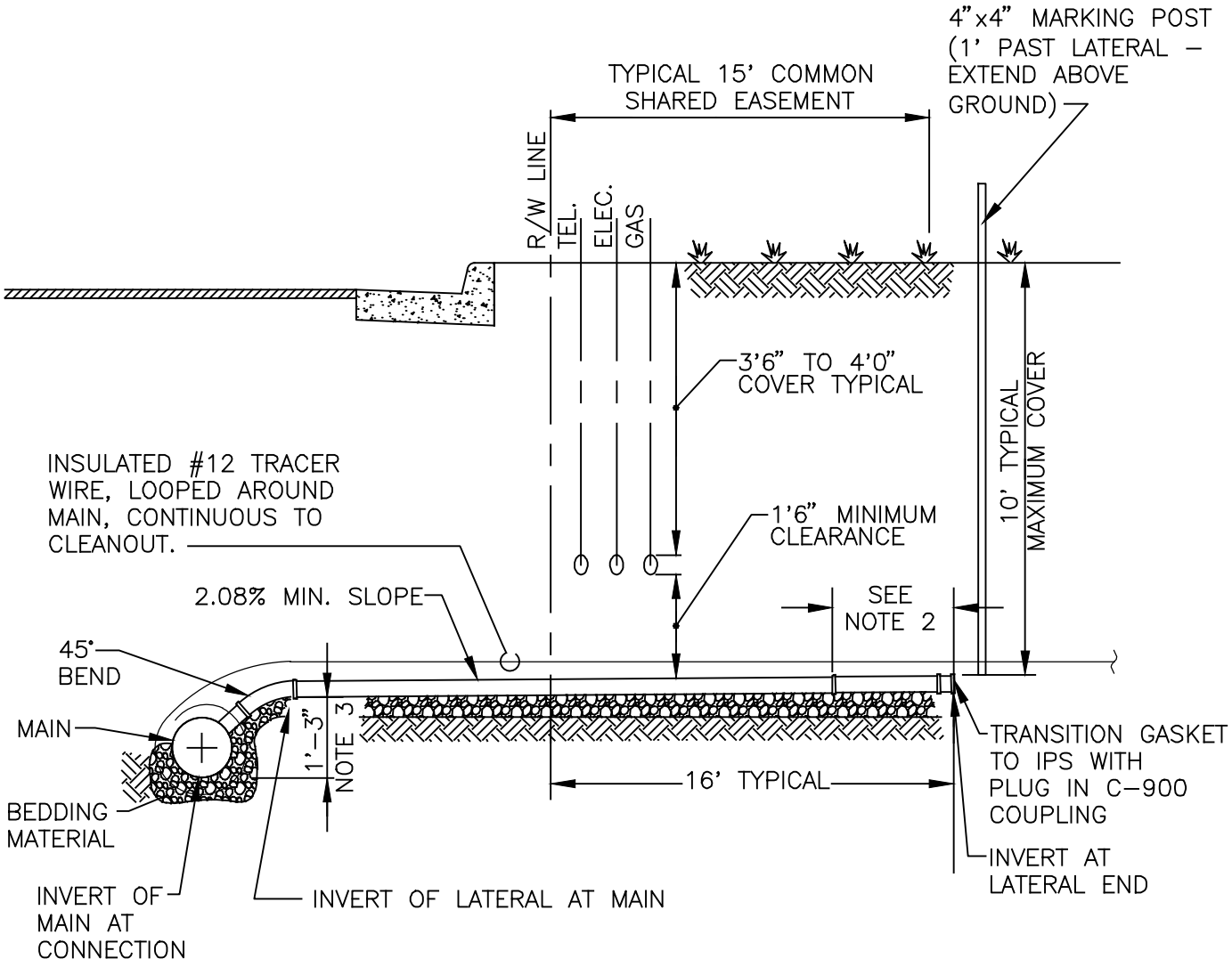
NOTES:

1. INSIDE DROP CONNECTION SHALL NOT BE USED, EXCEPT WHERE APPROVED BY CCSA FOR THE SPECIFIC APPLICATION.
2. MAXIMUM SLOPE OF INCOMING LINE IS 2.0%.
3. THE ELBOW AT THE BOTTOM OF THE STACK MAY BE EITHER A 45 OR 90-DEGREE BEND, TURNED IN THE DIRECTION OF FLOW. CONSTRUCT CHANNEL TO CONFORM TO THE MANHOLE BENCH.
4. MANHOLE PENETRATIONS TO BE BY CORE BORE AND APPROVED PIPE CONNECTOR. CORE IS TO BE AT LEAST 1' CLEAR OF MANHOLE JOINT.
5. ALL COMPONENTS TO BE IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.
6. THE CAP SHALL BE SECURED TO THE DROP CONNECTION FITTING WITH 2' OF STAINLESS STEEL CHAIN, SECURED WITH STAINLESS MACHINE SCREWS, NUTS, AND WASHERS. THE PIPE SHALL BE BEVELED TO ACCEPT THE CAP.
7. WHERE INCOMING LINE IS TO BE UNDER PRESSURE INSTALL OPTIONAL HOOD FROM RELINER.

NOV. 2017	INSIDE DROP CONNECTION	S-5

Clarke
COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



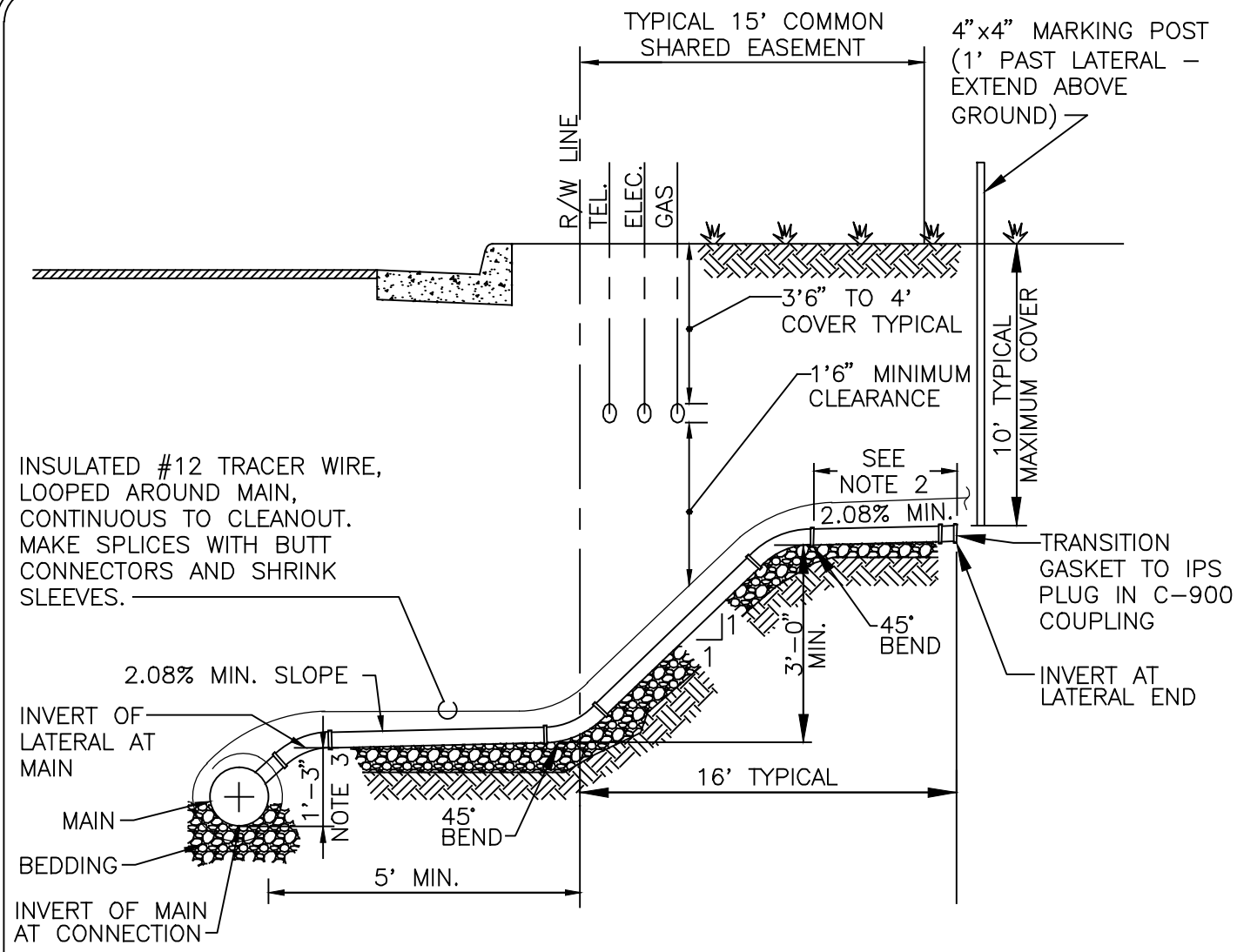
NOTES:

1. LATERAL MUST RECEIVE INSPECTION AND APPROVAL FROM CLARKE COUNTY BUILDING DEPARTMENT PRIOR TO BACKFILL.
2. COUPLING TO BE A MINIMUM OF 5' FROM LAST PIPE JOINT.
3. DIMENSION BASED ON 8" DIAMETER MAIN. ADD FOR LARGER MAINS.
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.

OCT. 2016	LATERAL	S–10

Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



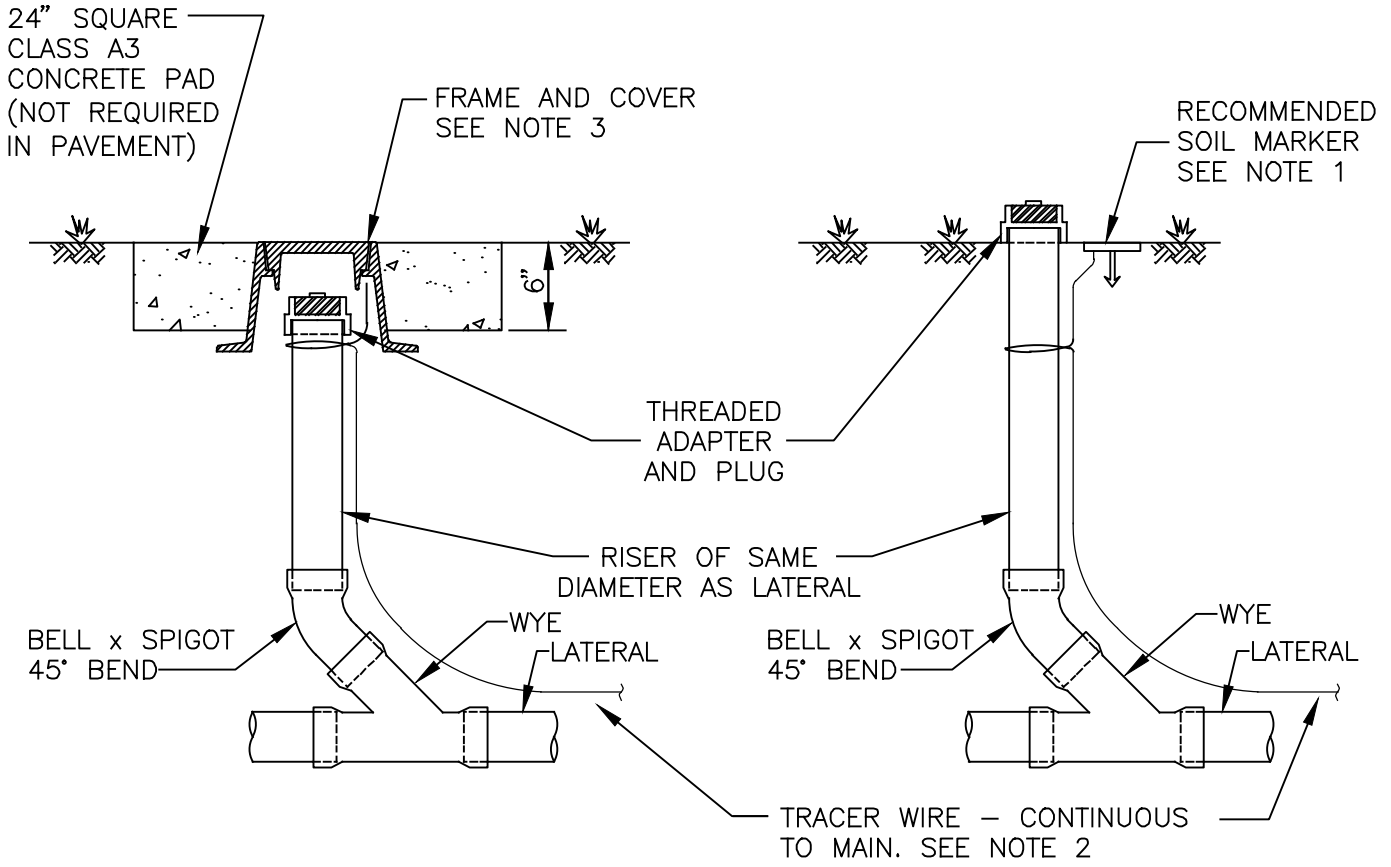
NOTES:

1. LATERAL MUST RECEIVE INSPECTION AND APPROVAL FROM CLARKE COUNTY BUILDING DEPARTMENT PRIOR TO BACKFILL.
2. COUPLING TO BE A MINIMUM OF 5' FROM LAST PIPE JOINT.
3. DIMENSION BASED ON 8" DIAMETER MAIN. ADD FOR LARGER MAINS.
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.

OCT. 2016	LATERAL WITH VERTICAL BENDS	S–11

Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



COMMERCIAL AND MULTIFAMILY APPLICATIONS OR WITHIN PAVEMENT

SINGLE FAMILY RESIDENTIAL APPLICATIONS NOT WITHIN PAVEMENT

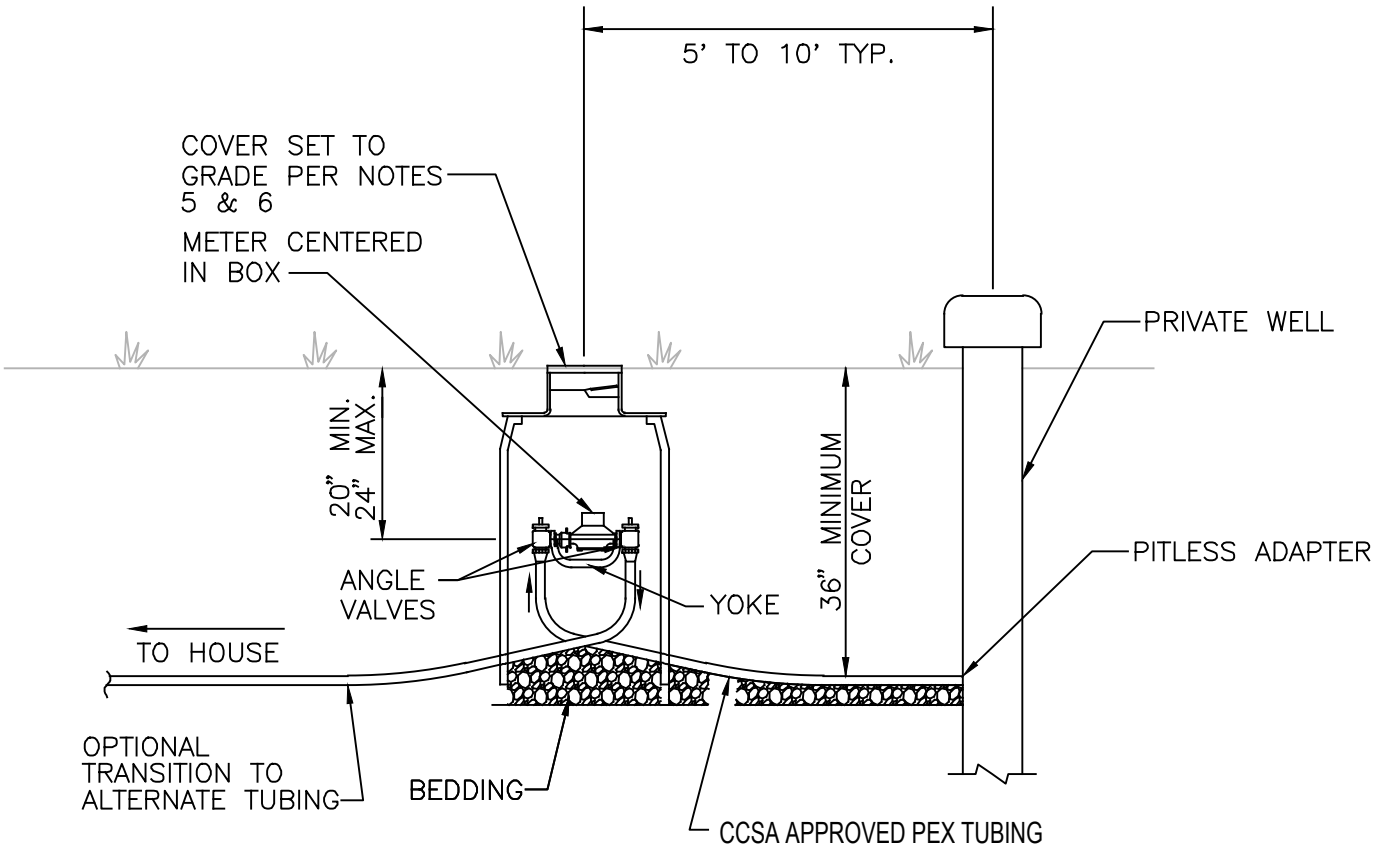
NOTES:

1. TERMINATE TRACER WIRE WITH CLEANOUT THAT IS WITHIN 5' OF BUILDING'S EXTERIOR. TERMINATE TRACER WIRE ABOVE GRADE IN AN ACCESSIBLE LOCATION, WHERE PROTECTED FROM DAMAGE. IF NOT USING IRON FRAME AND COVER, CCSA RECOMMENDS GREEN SOILMARKER™ BY RHINO MARKING AND PROTECTION SYSTEMS OR TRACER WIRE ACCESS BOX BY DRAINAGE AND WATER SOLUTIONS.
2. TRACER WIRE TO BE #12 AWG SOLID COPPER WITH 45 MIL POLYETHYLENE INSULATION. AT TEMPORARY TERMINATION OF LATERAL BY UTILITY CONTRACTOR, MAKE SPLICE WITH BUTT CONNECTOR AND SHRINK SLEEVE. NO OTHER SPLICES PERMITTED.
3. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.

OCT. 2016	SANITARY CLEANOUT	S–12

Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. THIS STANDARD DETAIL FOR USE ON ALL NEW HOME CONSTRUCTION. LOCATE METER AS APPROVED BY CCSA. FOR COMMERCIAL INSTALLATIONS, METER MAY BE LOCATED INDOORS OR OUTDOORS.
2. METER MUST BE INSTALLED BEFORE SANITARY LATERAL IS CONNECTED TO SEWER MAIN.
3. METER FURNISHED AND INSTALLED BY CCSA.
4. CCSA WILL MAINTAIN THE METER ONLY. PIPING FOR MAINTENANCE BY PROPERTY OWNER.
5. AT INITIAL INSTALLATION, ROTATIONAL (ADJUSTABLE) FRAME TO BE IN CENTER OF HEIGHT RANGE.
6. IN SLOPE, PROVIDE TIMBER RETAINING WALL 3' FROM COVER.
7. METER BOX, FRAME & COVER, ANGLE VALVES, AND YOKE MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST. ANGLE VALVES TO HAVE FLARED INLET.

OCT. 2016	WATER METER SETTING – SEWER ONLY ACCOUNTS	S–13

Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY

SANITARY SEWER

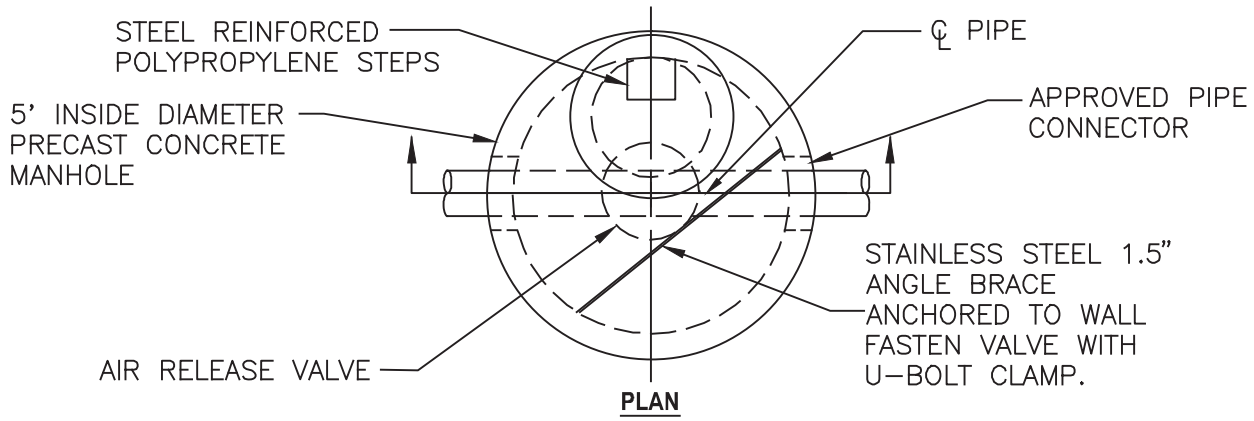
ALLOWABLE LEAKAGE PER TWO HOUR TEST		
LENGTH OF PIPE (FT)	DIAMETER OF PIPE (IN)	ALLOWABLE LEAKAGE (GAL/2 HR)
1	4	0.006
1	6	0.009
1	8	0.013
1	10	0.016
1	12	0.019
1	14	0.022
1	16	0.025
1	18	0.028
1	20	0.032
1	24	0.038
1	30	0.047
1	36	0.057
1	42	0.066
1	48	0.076
1	54	0.085
1	60	0.095
1	66	0.104
1	72	0.114

THE ALLOWABLE LEAKAGES LISTED ABOVE ARE FOR GRAVITY SYSTEMS (PIPE AND MANHOLES). FOR PRESSURIZED WASTEWATER LINES, TEST PER W-8.

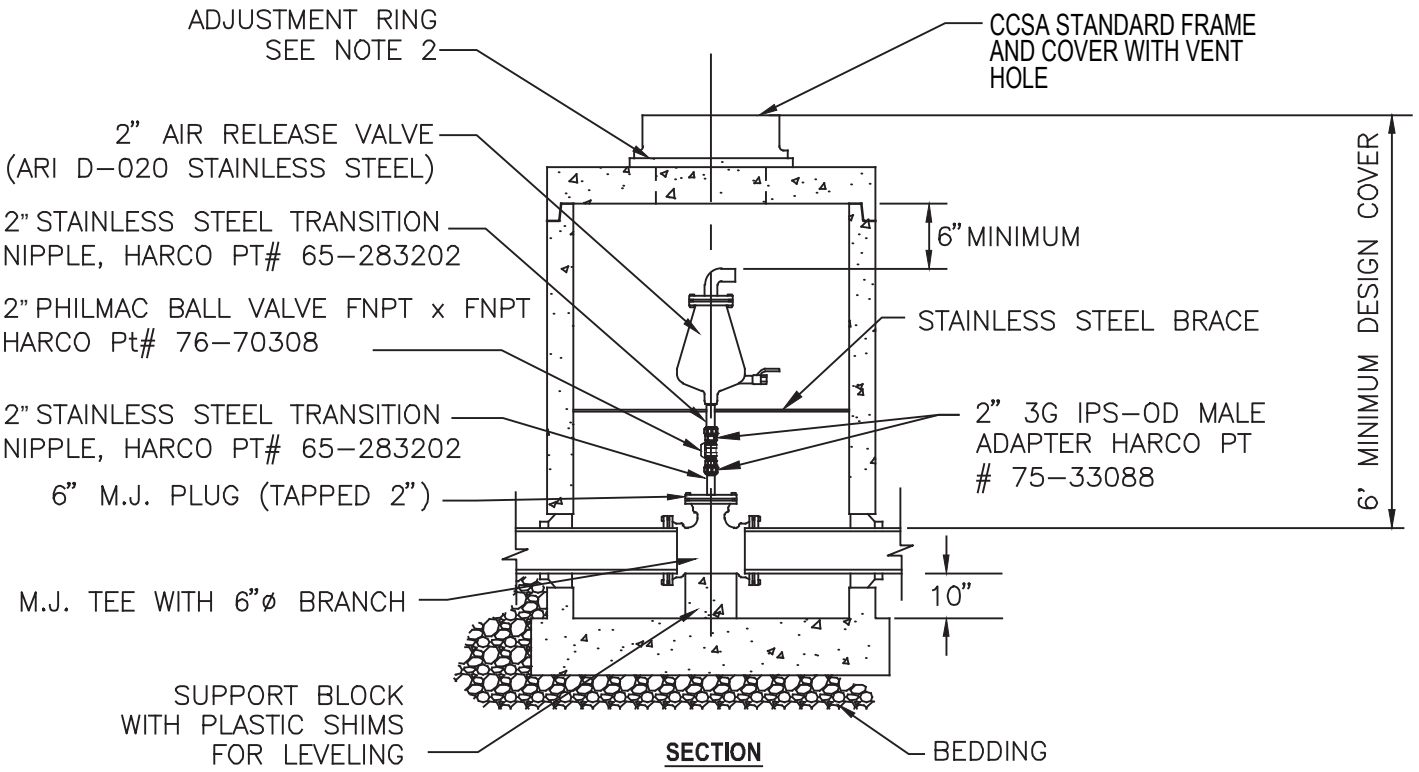
OCT. 2016	TABLE OF ALLOWABLE LEAKAGE	S-20

Clarke
COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



PLAN

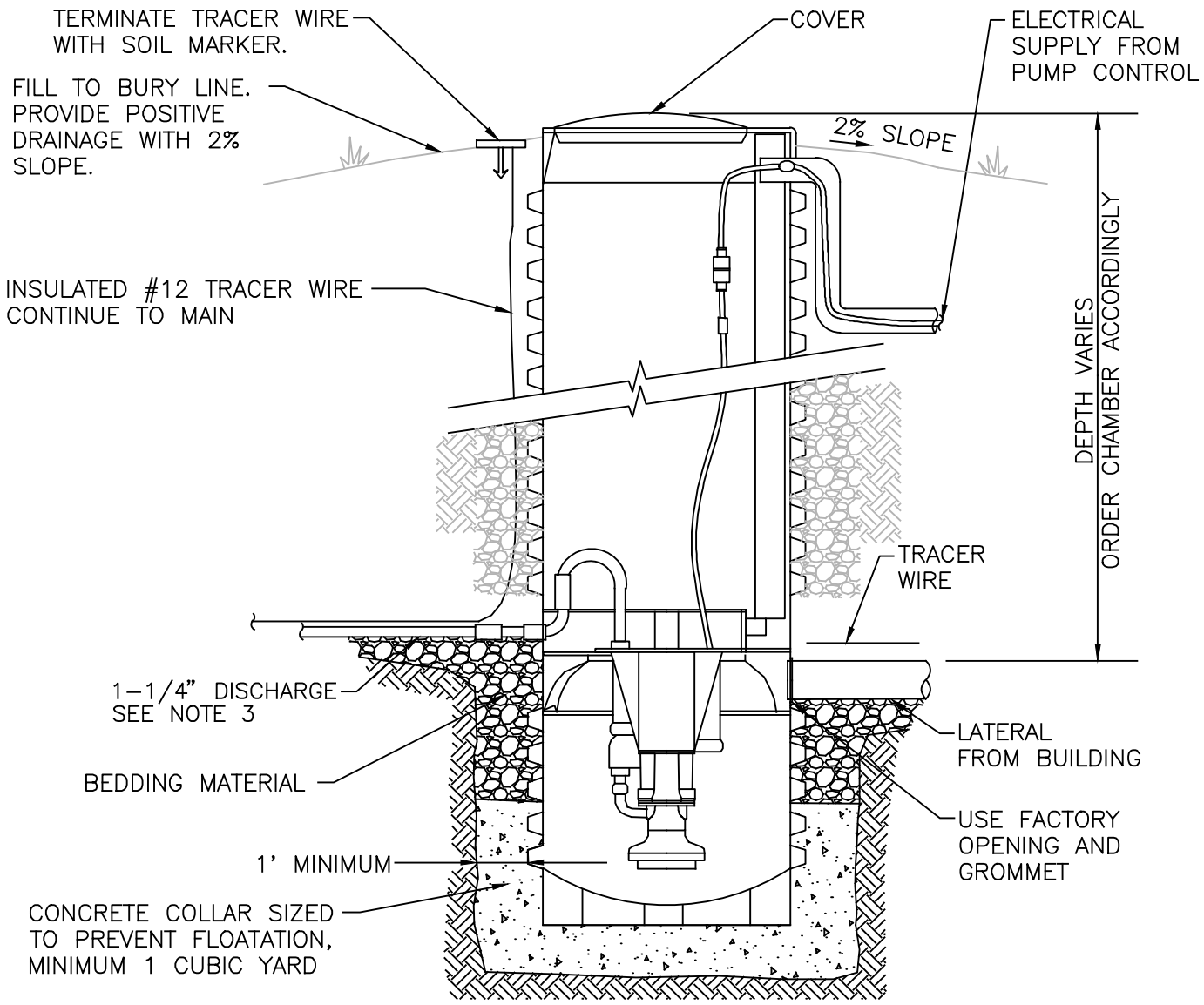


SECTION

NOTES:
1. CONFINED SPACE: ATMOSPHERE MUST BE VENTED AND TESTED PRIOR TO ENTRY.
2. MAXIMUM ADJUSTMENT BY GRADE RINGS IS 12" IN PAVEMENT AND 6" ELSEWHERE.
3. MANHOLE SHALL BE REINFORCED TO MEET ASTM 478/AASHTO M199. JOINTS TO BE GASKETED IN ACCORDANCE WITH ASTM C443. APPLY PROPER LUBRICANT FOR ASSEMBLY.
4. ALL COMPONENTS TO BE IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.

OCT. 2016	FORCE MAIN AIR RELEASE	FM-1

CLARKE COUNTY SANITARY AUTHORITY



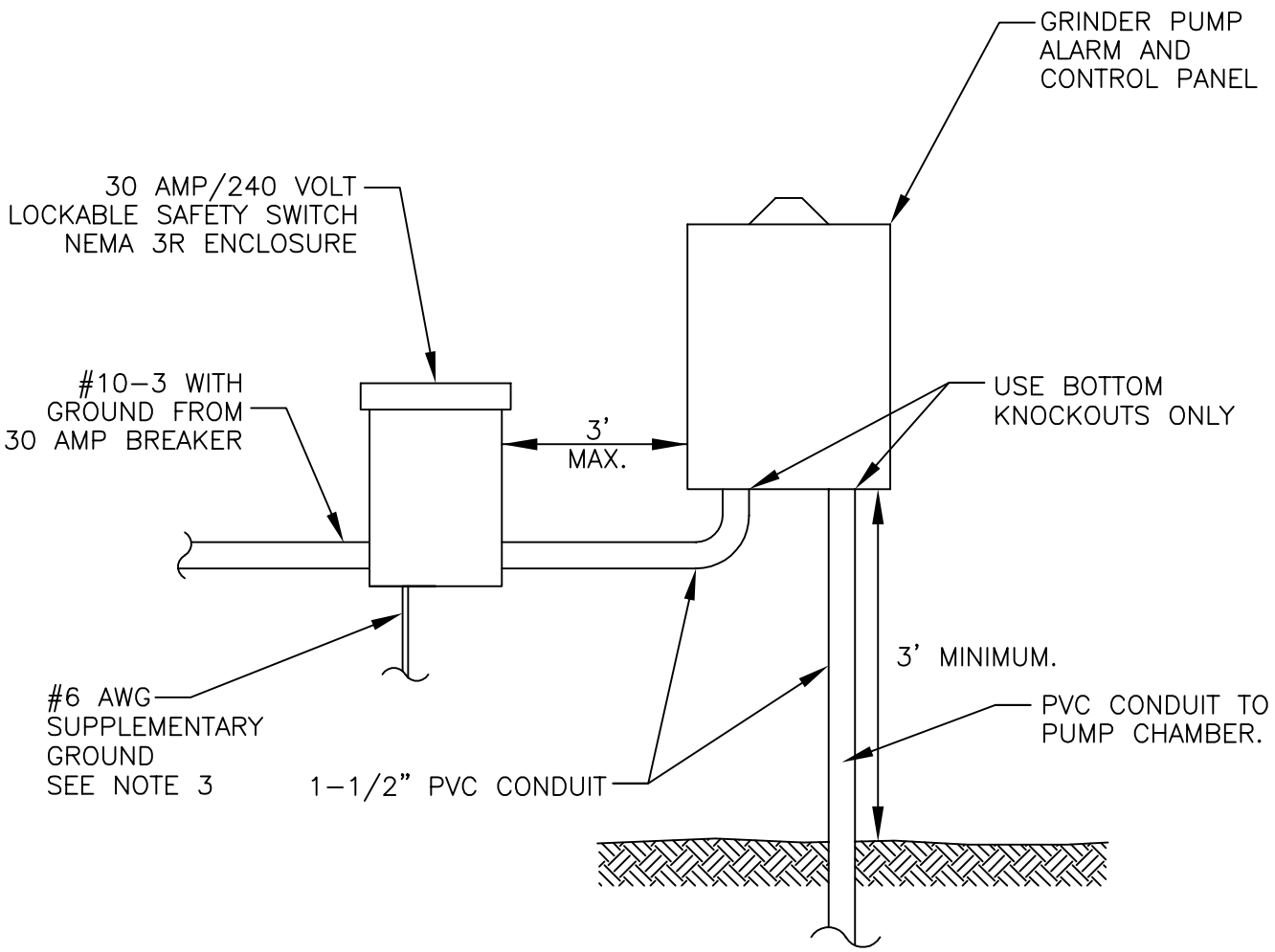
NOTES:

1. PUMP MUST BE LOCATED SO THAT IT IS READILY ACCESSIBLE WITH MAINTENANCE TRUCK.
2. GRINDER PUMP TO RECEIVE SANITARY SEWERAGE ONLY. WATER FROM FOUNDATION DRAINS, STORM DRAINS, SUMP PUMPS, ETC. MUST NOT DRAIN TO THE GRINDER PUMP.
3. 1–1/4" SCHEDULE 40 PVC DISCHARGE SHALL BE BEDDED IN #8 STONE. CONTINUE #8 STONE AS BACKFILL AROUND CHAMBER TO 2' BELOW GRADE.
4. LOW PRESSURE COLLECTION NOT TO BE USED, EXCEPT AT THE SOLE DISCRETION OF CCSA.

OCT. 2016	GRINDER PUMP	LPC–1

Clarke
COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



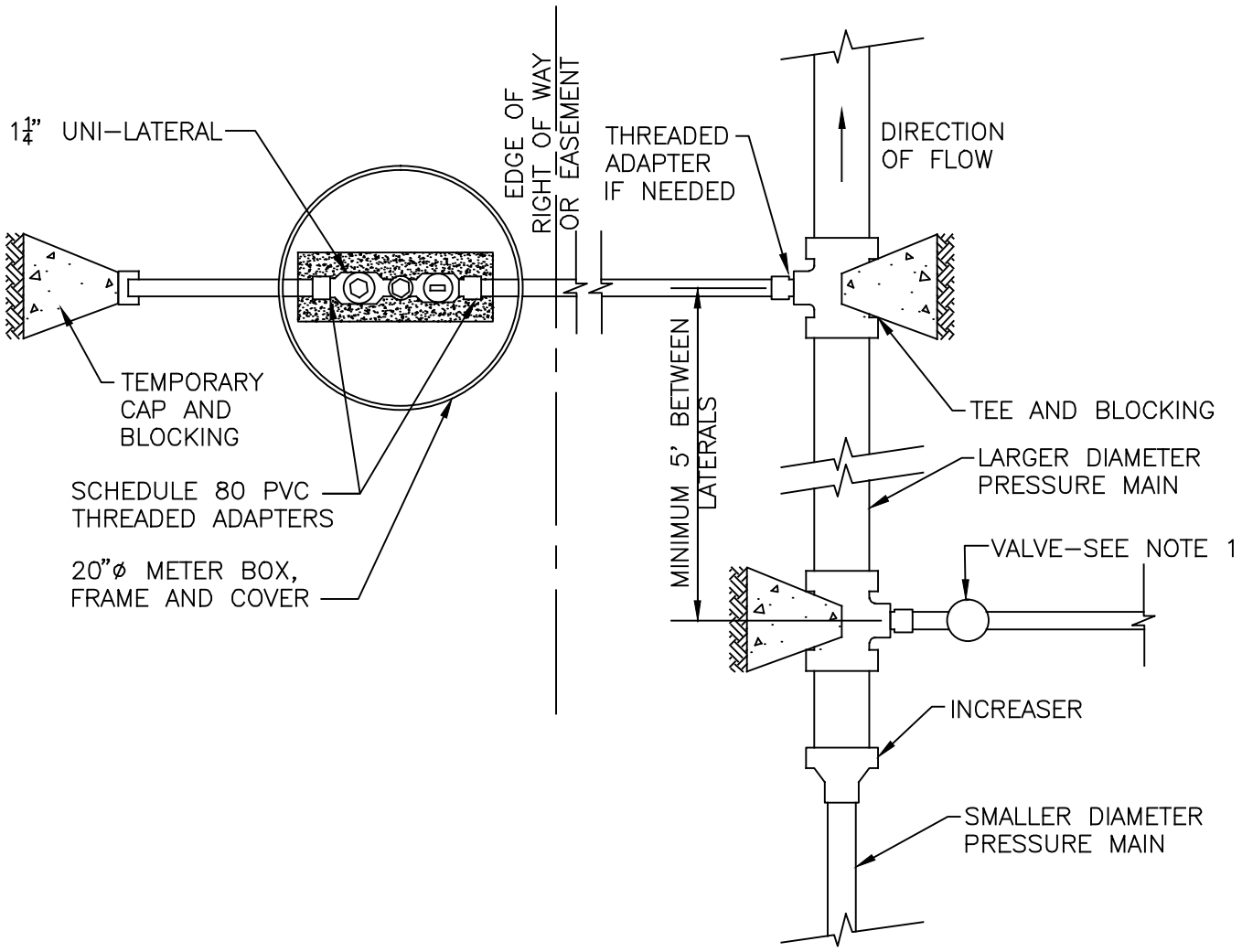
NOTES:

1. ELECTRIC TO MEET ALL CODES. OWNER TO OBTAIN ELECTRICAL PERMIT. A DEDICATED CIRCUIT IS REQUIRED.
2. SAFETY SWITCH AND CONTROL PANEL TO BE WITHIN 30' OF PUMP AND WITHIN CLEAR VIEW OF PUMP.
3. ROUTE SUPPLEMENTARY GROUND CONDUCTOR TO 3/4" X 10' GROUND ROD.
4. DUCT SEAL REQUIRED AT ALL CONDUIT/BOX CONNECTIONS.
5. LOW PRESSURE COLLECTION NOT TO BE USED, EXCEPT AT THE SOLE DISCRETION OF CCSA.

APR. 2010	ELECTRICAL SUPPLY TO PUMP	LPC–2

Clarke COUNTY · VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



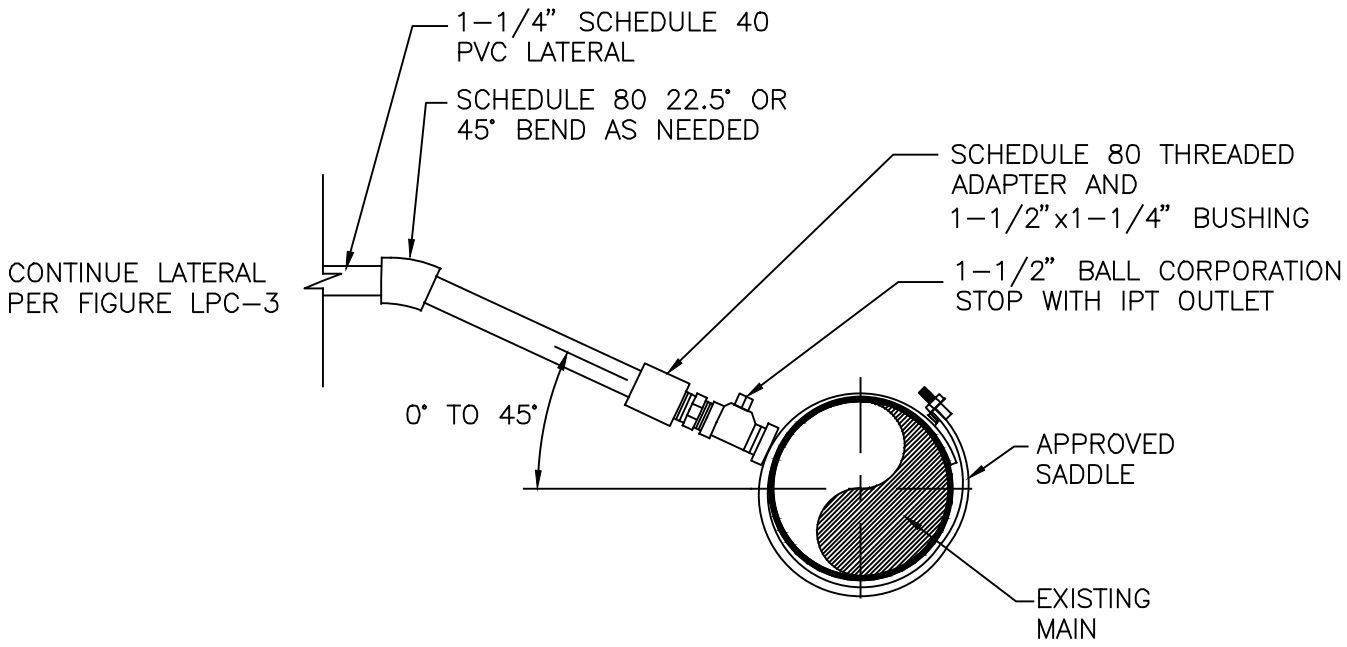
NOTES:

1. WHERE DISTANCE FROM MAIN TO UNI–LATERAL IS MORE THAN 10', ADD BRANCH VALVE AT TEE.
2. LATERAL TO BE 1–1/4" DIAMETER SCHEDULE 40 PVC, CONFORMING TO ASTM 2241, RATED FOR PRESSURE OF 125 PSI OR MORE. FITTINGS WITHIN LATERAL TO BE SCHEDULE 80 PVC, WITH SOLVENT WELD ENDS.
3. PROVIDE 1–1/4" UNI–LATERAL STAINLESS STEEL LATERAL VALVE FROM E/ONE. SET VALVE ON SOLID CONRETE BRICKS. INSTALL 20" DIAMETER X 30" METER BOX FRAME AND COVER.
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.
5. LOW PRESSURE COLLECTION NOT TO BE USED, EXCEPT AT THE SOLE DISCRETION OF CCSA.

OCT. 2016	LOW PRESSURE LATERAL	LPC–3

Clarke COUNTY · VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY

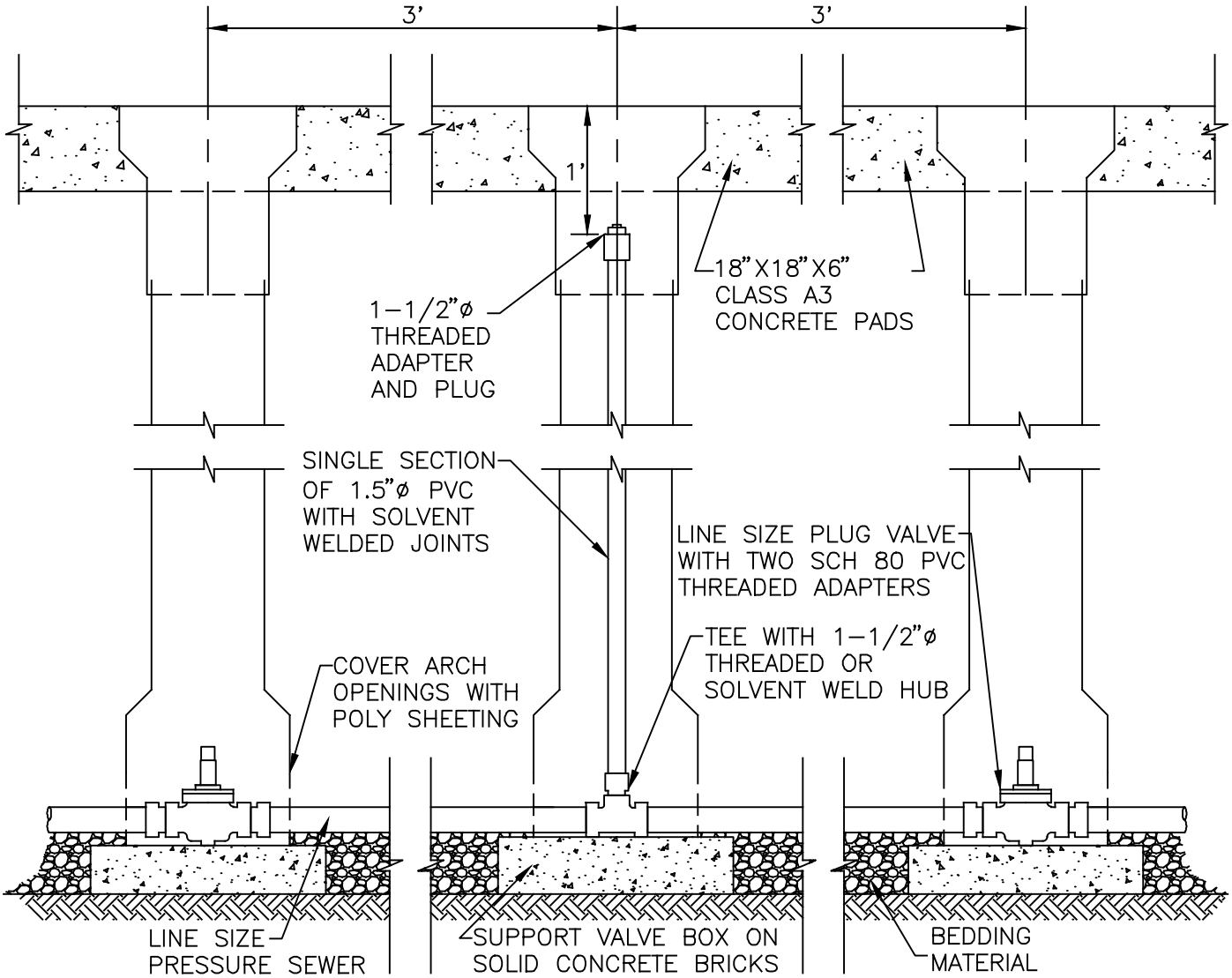


NOTES:
1. SADDLE TO BE STAINLESS STEEL BAND, SIZED FOR EXISTING IPS MAIN.
2. CCSA'S REPRESENTATIVE MUST BE PRESENT DURING THE TAPPING OF THE MAIN.
   THE ENTIRE LATERAL MUST RECEIVE INSPECTION AND APPROVAL FROM CLARKE COUNTY BUILDING DEPARTMENT PRIOR TO BACKFILL.

OCT. 2016	SERVICE BY TAP	LPC–4

Clarke COUNTY · VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



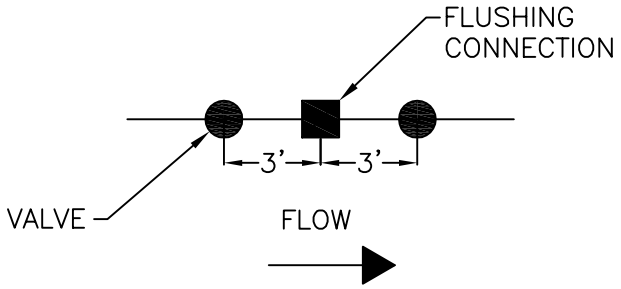
NOTES:

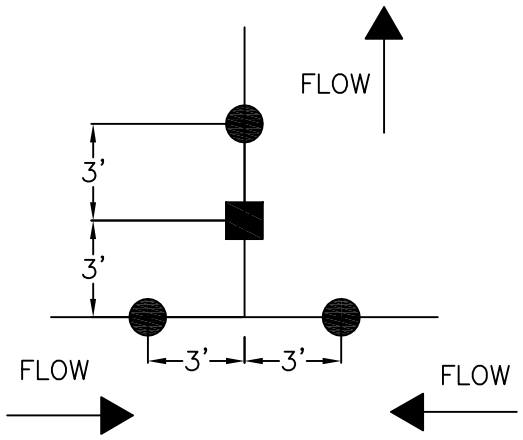
1. RISER TO BE 1–1/2" DIAMETER SCHEDUCLE 40 PVC (ASTM D2241) WITH 125–PSI RATING OR BETTER. FITTINGS IN RISER TO BE SCHEDULE 80 PVC.
2. APPROVED PLUG VALVES ONLY, WITH THREADED ENDS.
3. PROVIDE RISER AND EACH VALVE WITH 5–1/4" IRON VALVE BOX WITH ARCHED BOTTOMS AND COVER LABELED "S".
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.
5. LOCATE FLUSHING CONNECTIONS AT 800' INTERVALS ON LINE.

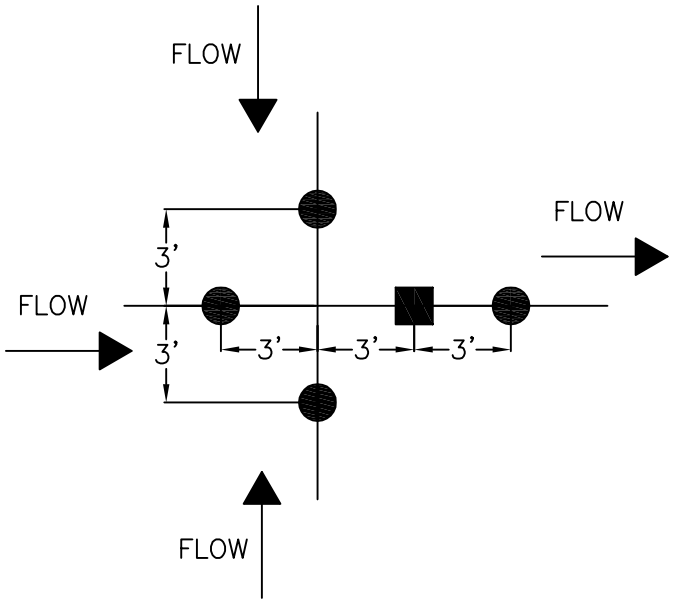
OCT. 2016	FLUSHING CONNECTION	LPC–5

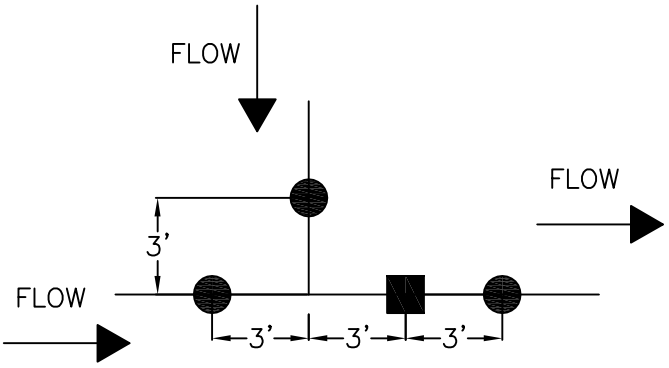
Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY





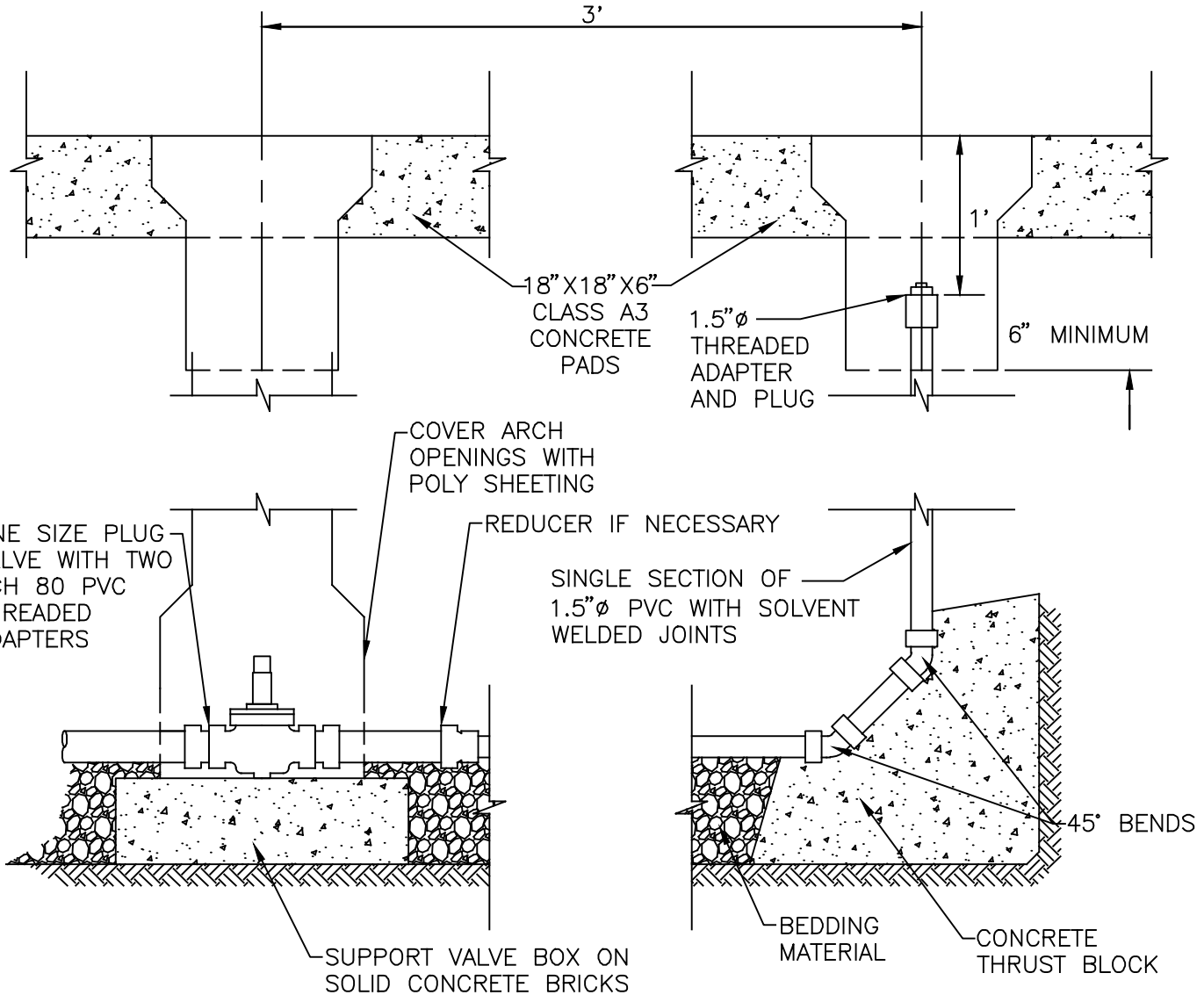




APR. 2010	LOCATION OF VALVES FOR IN-LINE FLUSHING CONNECTION	LPC-6

Clarke
COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



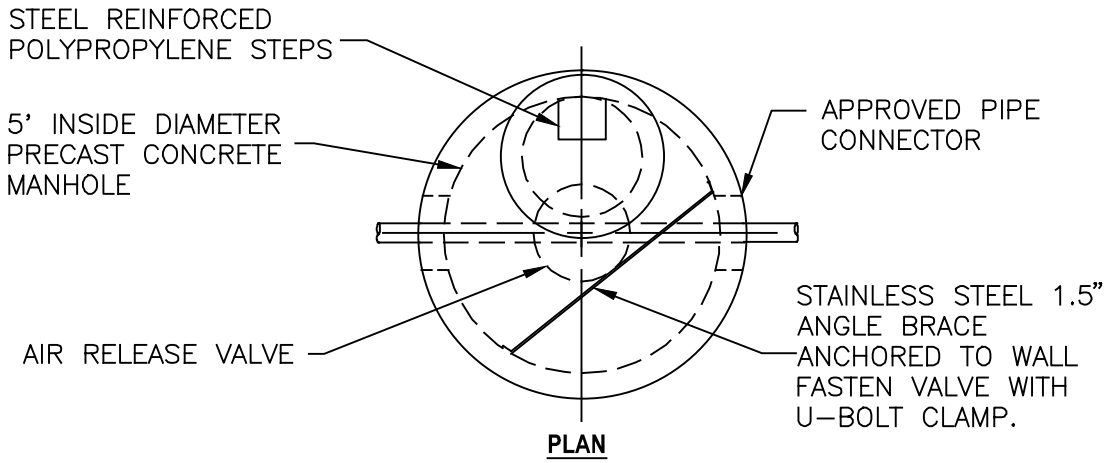
NOTES:

1. RISER TO BE 1–1/2" DIAMETER SCHEDUCLE 40 PVC (ASTM D2241) WITH 125–PSI RATING OR BETTER. FITTINGS IN RISER TO BE SCHEDULE 80 PVC.
2. APPROVED PLUG VALVES ONLY, WITH THREADED ENDS.
3. PROVIDE RISER AND VALVE WITH 5–1/4" IRON VALVE BOX WITH ARCHED BOTTOMS AND COVER LABELED "S".
4. ALL MATERIALS MUST CONFORM TO LOUDOUN WATER'S APPROVED MATERIALS LIST.

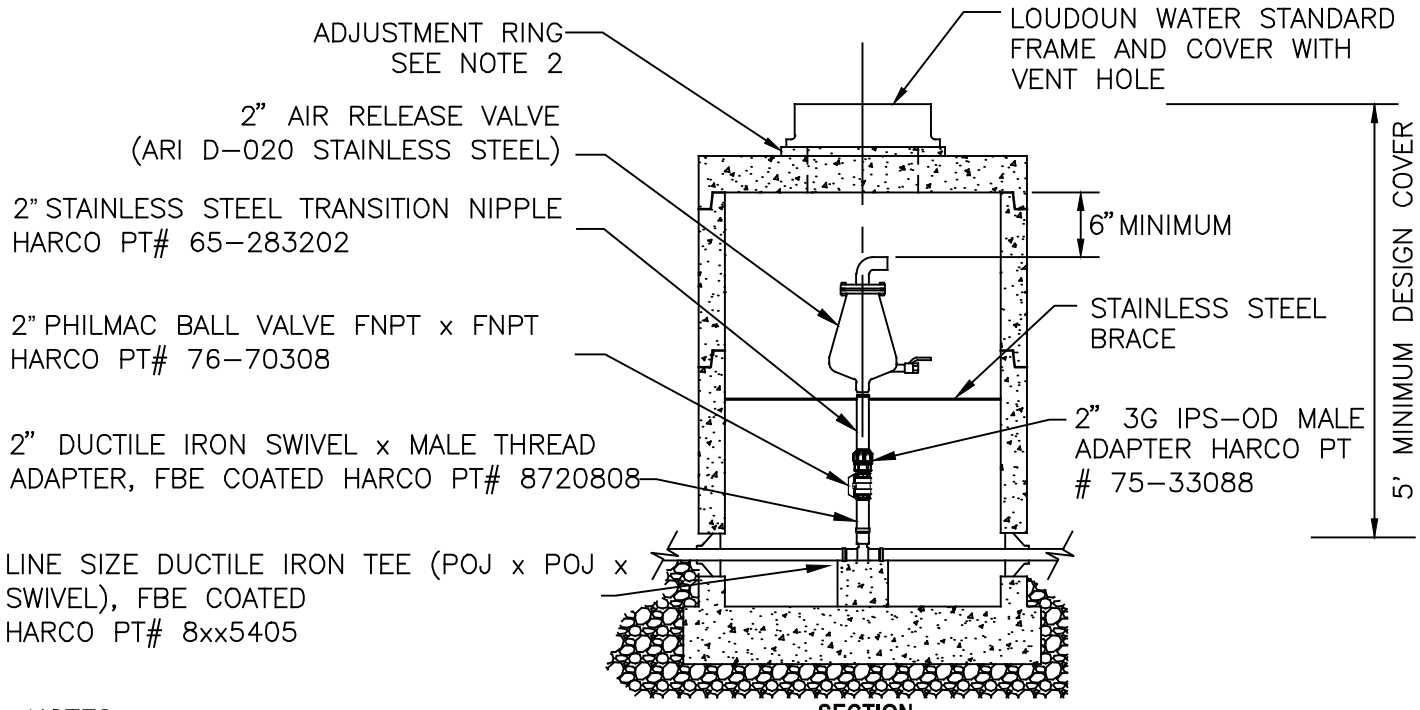
OCT. 2016	TERMINAL FLUSHING CONNECTION	LPC–7

Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



PLAN



SECTION

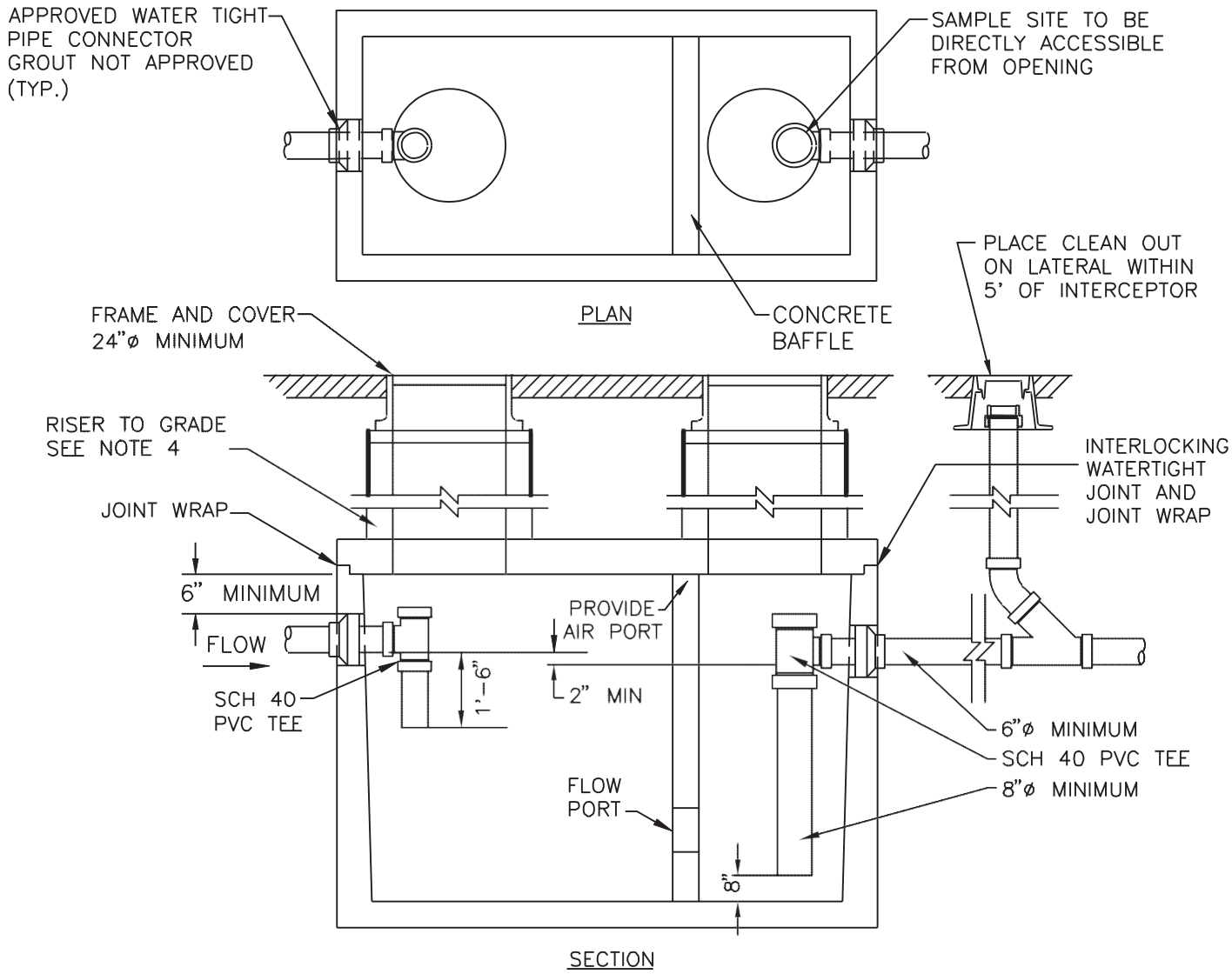
NOTES:

1. CONFINED SPACE: ATMOSPHERE MUST BE VENTED AND TESTED PRIOR TO ENTRY.
2. MAXIMUM ADJUSTMENT BY GRADE RINGS IS 12" IN PAVEMENT AND 6" ELSEWHERE.
3. MANHOLE SHALL BE REINFORCED TO MEET ASTM 478/AASHTO M199. JOINTS TO BE GASKETED IN ACCORDANCE WITH ASTM C443. APPLY PROPER LUBRICANT FOR ASSEMBLY.
4. ALL COMPONENTS TO BE IN ACCORDANCE WITH LOUDOUN WATER'S APPROVED MATERIALS LIST.

OCT. 2016	AIR RELEASE FOR LOW PRESSURE SEWER	LPC-8

Clarke COUNTY • VIRGINIA

CLARKE COUNTY SANITARY AUTHORITY



NOTES:

1. MATERIALS SUBMITTAL FOR EACH DEVICE MUST BE APPROVED BY CCSA; PRIOR TO FABRICATION AND INSTALLATION.
2. EACH DEVICE MUST BE SIZED ACCORDING WITH CHAPTER 5 OF CCSA STANDARD DETAILS AND DESIGNED TO MEET THE REQUIREMENTS CITED IN THE APPROVED MATERIALS LIST.
3. INTERCEPTORS MAY BE MADE OF CONCRETE OR FIBERGLASS REINFORCED PLASTIC.
4. FOR DEVICES WITH MORE THA 4' OF COVER, PROVIDED MINIMUM 3'∅ ACCESS SHAFTS, OF WATERTIGHT CONSTRUCTION, WITH INTERLOCKING JOINTS.

AUG. 2018	GREASE INTERCEPTOR	PT–1

Appendix I: Approved Materials List

44865 Loudoun Water Way
Ashburn, VA 20147
Tel: 571.291.7700 | **Fax:** 571.223.2912
www.loudounwater.org

Approved Materials List

Updated Through September 2018

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INTRODUCTION

Notes

1. Questions or comments regarding the Approved Materials List should be directed to Loudoun Water's Department of Inspections at 571-291-7700.

2. Loudoun Water's Product Review Committee will evaluate, in accordance with established procedures, new products and materials to determine their suitability for use as part of the water and/or sanitary sewer systems.

3. All standards referenced in the Approved Materials List shall be the latest version.

4. Grandfathered Products -- Listing of an approval date of October 1999 or prior indicates that the product was in use by Loudoun Water before publication of the Approved Materials List. Use of these products has been reaffirmed by the Committee during the preparation of this document.

5. Design Changes -- After an item has been approved by the Product Review Committee, the manufacturer, or representative, shall inform the Committee, in writing, of any modifications in design or material. Such changes may require further evaluation resulting in a change to approval status.

6. Withdrawal of Approval -- Loudoun Water may withdraw any approval as a result of design change, field observation, testing, product failure, or other factors which, in the Committee's opinion, warrant such withdrawal.

Product Review Procedures

Making Application

To initiate consideration of a material that is not listed, please follow these procedures.

1. All requests for consideration of new products shall be sent to the Product Review Coordinator, Department of Inspections, at the address on the cover of this document.

2. The applicant will be responsible for providing the Product Review Coordinator with all information and samples needed to evaluate the product. Applications in electronic format are encouraged. Requests shall include all applicable items below, but shall not be limited to:

    - A list of all standards (ANSI/AWWA, ASTM, etc.) to which the product conforms, and any certifications (UL, ASSE, etc.) of the product.

    - Adequate shop drawings and design information.

    - Brochures and/or other product information.

- Location of the manufacturer's plant.
- Location of distribution point and the nearest retail outlet.
- Information about availability of spare parts and service.
- Terms of warranty.
- A 5-year history of the product, documenting its performance.
- User references, with contact persons and telephone numbers.

3. Whenever possible, a committee meeting will be scheduled within 60 days of the receipt of a complete request.

Deliberation

The Product Review Committee makes determinations by consensus, based upon the research and experience of its members, and other staff participating in the deliberation. Sources of information that are often consulted include:

- presentations by manufacturers' representatives
- factory visits
- visits to active installations, or facilities in service
- interviews with contractors, distributors, consulting engineers, and the staff of other utilities
- trial installations in Loudoun Water's system

Factors that are considered include:

- compatibility of the proposed product with materials already in use
- compliance with applicable standards (e.g. AWWA, ANSI, ASTM, VDOT, and Loudoun Water requirements as listed in the Approved Materials List)
- ease or difficulty of installation, including the need for specialized tools
- market availability of spare parts
- optimization of spare parts inventory
- warranties
- susceptibility to corrosion
- history of the product's performance

- quality controls at the factory, and Loudoun Water's access to verify controls
- life cycle cost
- overall benefit to Loudoun Water, stemming from the requested approval

Committee Determinations

After completion of the evaluation, the Product Review Committee may make one of the following determinations:

1. Approval for Use -- Approval allows use of the product throughout the service areas. All use of the product must be in conformance with all State, County, and Loudoun Water standards, regulations, and policies, in accordance with the manufacturer's specifications, and with good engineering practice.

2. Conditional Approval for Use -- Conditional approval allows use of the product throughout the service areas; however, the product will be reviewed periodically to ensure that no unforeseen installation or maintenance problems have arisen. After a suitable period of field observation, the conditional approval may be upgraded to the "Approval for Use" status. The frequency of review and the length of the field observation period will be determined by the Product Review Committee. If, during the field observation period, problems with the installation, operation, or maintenance of the product are observed, the Product Review Committee may downgrade the status of the product to "Disapproval for Use." All use of the product will be in conformance with all State, County, and Loudoun Water standards, regulations, and policies, with the manufacturer's specifications, and with good engineering practice.

3. Limited Approval for Use -- Approval of a product may be limited to use only in certain sites or projects within Loudoun Water's service areas, or for only specific applications. The Product Review Committee will determine where the product can be used. The product will be reviewed periodically to ensure that no unforeseen installation, operation, or maintenance problems have arisen. After a suitable period of field observation, this approval may be upgraded to "Conditional Approval for Use" or "Approval for Use." The frequency of review and the length of the field observation period will be determined by the Product Review Committee. If, during the field observation period, problems with the installation, operation, or maintenance of the product are observed, the Product Review Committee may downgrade the status of the product to "Disapproval for Use." All use of the product will be in conformance with all State, County, and Loudoun Water standards, regulations, and policies, with the manufacturer's specifications, and with good engineering practice.

4. Disapproval for Use -- Should a product not meet the aforementioned criteria; the Product Review Committee shall disapprove it for use anywhere in Loudoun Water's service areas. Once a product has been given a "Disapproval for Use" status, the Committee shall not review the product again unless significant changes have been made to the product, and/or to the manufacturer's process and practices. The Product Review Committee will not reconsider a disapproved product until at least twelve (12) months from the date of disapproval have passed.

5. Insufficient Information -- Should the committee determine that insufficient information about the product has been received, evaluation of the product shall cease until additional information has been submitted. At that time, the Product Review Coordinator will schedule a new evaluation date for the product.

Resolving Disputes

Any questions or appeals by an applicant should be submitted in writing to the Product Review Coordinator. If necessary, the Director of Engineering will review the matter and resolve to final decision.

GENERAL USE ITEMS

Concrete and Mortar

STANDARDS

1. Virginia Department of Transportation Road and Bridge Specification
2. ASTM C33 Concrete Aggregates
3. ASTM C94 Ready-Mix Concrete
4. ASTM C105 Portland Cement

LOUDOUN WATER REQUIREMENTS

1. Class A4 concrete shall be 4,000 psi compressive strength at 28 days. Minimum cement content shall be 6.75 bags per cubic yard. Maximum water content shall be 5.0 gallons per bag. Any VDOT approved supplier and A4 mix design may be used.
2. Class A3 concrete shall be 3,000 psi compressive strength at 28 days. Minimum cement content shall be 6.25 bags per cubic yard. Maximum water content shall be 5.5 gallons per bag. Any VDOT approved supplier and A3 mix design may be used.
3. Class B2 concrete shall be 2,200 psi compressive strength at 28 days. Minimum cement content shall be 5.25 bags per cubic yard. Maximum water content shall be 6.5 gallons per bag. Any VDOT approved supplier and B2 mix design may be used.
4. Use mix with air entraining agent for applications exposed to freeze-thaw cycle.
5. Maximum slump, air content, temperature and mix duration to be within range specified for the selected mix, as specified by the VDOT Road and Bridge Specification.
6. Forms shall be mortar tight, made of wood or other approved materials. Forms shall be smooth and free of holes, dents, or other irregularities.
7. Mortar shall be one part cement to two parts sand (one bag cement to 1.8 cubic feet sand). Add minimum water necessary to create a workable mix.
8. Concrete, grout, and mortar for use in sanitary sewer system is to be made of Type II Portland Cement for sulfate resistance.

Casing and Liner Plate

STANDARDS

1. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs
4. ASTM A569 Electric-Fusion (Arc) Welded Steel Pipe
5. Virginia Department of Transportation Road and Bridge Specifications

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal must be reviewed and approved by Loudoun Water.**
2. Design of tunnel liner shall be sealed by a Professional Engineer licensed in the Commonwealth of Virginia. Liner plate shall be hot-dipped galvanized, with bituminous coating and 2-inch grout holes every 3 rings minimum. Liner plate thickness shall be 8 gauge minimum.
3. Casing shall be smooth wall steel pipe, conforming to ASTM A 139 Grade B with a minimum wall thickness of ½ inch, or ASTM A53 Standard Weight Class. Hydrostatic testing is waived. Casing shall be exterior prime coated and have beveled edges suitable for field welding.

MANUFACTURERS AND MODELS

Company Name	Approval Date	Model Name/Number
American Commercial	10/1999	Liner Plate
Contech Construction Products	10/1999	Liner Plate
Mittal Steel	10/1999	Liner Plate
Permaloc		Bell and Spigot Casing
Pittsburgh Pipe/TDI	10/1999	Casing
Costal Pipe, Inc.	9/2010	Casing

Continued on Next Page

Company Name	Approval Date	Model Name/Number
OPS Sales Company (Oilfield Pipeline Services)	8/2011	Casing
Arntzen Steel Pipe	11/2015	Casing
Trinity	4/2016	Casing

Casing Spacers

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal must be reviewed and approved by Loudoun Water. Dimensions of casing spacers must be coordinated with the inside diameter of the selected casing. Design will typically require that the carrier pipe be supported in the centered and restrained position.**
2. 8-inch width for 12-inch diameter pipe or smaller.
3. 12-inch width for 16-inch diameter or larger.
4. Minimum of three (3) casing insulators required per length of pipe.
5. Bolts and nuts shall be T304 stainless steel.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Cascade Waterworks Manufacturing	10/1999	
Pipeline Seal & Insulator, Inc.	10/1999	
Power Seal	4/1998	Casing Chock Model 4810
The BWM Company	10/2002	BWM SS
RACI Spacers North America, Inc.	7/2006	
Advance Products & Systems, Inc.	7/2006	Model SSI
CCI	11/2015	Models CSS8 and CSS12

Vaults

STANDARDS

1. ACI 301 Specifications for Structural Concrete for Buildings
2. ACI 318 Building Code Requirements for Reinforced Concrete
3. ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement
4. ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
5. ASTM C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
6. ASTM C858 Standard Specification for Underground Precast Concrete Utility Structures
7. ASTM C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water or Wastewater Structures

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal must be reviewed and approved by Loudoun Water.**
2. Design to be sealed by Professional Engineer licensed in the Commonwealth of Virginia. Design shall meet AASHTO H-20 loading criteria.
3. Concrete to be minimum 4,000 psi compressive strength at 28 days.
4. Joints to be interlocking type, waterproofed with butyl rubber. In addition, joint exteriors shall be waterproofed with one of the wraps listed below. Vertical joints prohibited, except where construction by panels has been specifically approved by Loudoun water.
5. Access door shall be 36 inches by 36 inches minimum with hinged frame and cover and shall meet AASHTO H-20 loading criteria.
6. Access door shall be aluminum with stainless steel hardware and shall contain an automatic hold open arm, slam lack with removable key, safety grate and have a drainable frame.
7. Ladder shall be heavy-duty aluminum, 16 inches wide with non-skid treads, securely fastened to wall with stainless steel bolts. Provide safety features in accordance with Loudoun Water Standard Details G-21 VAULT NOTES, G-22 VAULT LADDER, and G-23 HATCH SAFETY FEATURES.
8. All penetrations for pressure pipes shall incorporate Omni Sleeve by Sigma or Loudoun Water approved equal. For gravity sewer connections, use approved pipe to structure connector as listed in SEWER, Section3.

9. Pressure pipe shall be flanged, supported as necessary, with flange adapter(s), flange by mechanical joint coupling(s), and/or dismantling joint(s) to enable disassembly. See construction plans for placement and specific type of fitting.

VAULT MANUFACTURERS

Company	Approval Date
A. C. Miller Concrete Products	10/1999
Clear Flow by CP&P	10/1999
Rotondo Penn-Cast	10/1999
Smith-Midland	10/1999

HATCH MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Bilco	10/1999	Series J Access Door – H20
Halliday Products	9/2018	Series H1R Access Door
USF Fabrications	9/2018	THD, THS

JOINT WRAPMANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Canusa	10/1999	Wrapid Seal joint wrap
Press-Seal Gasket Corporation	6/2008	E-Z Wrap joint wrap
Cretex	7/2003	Cretex Wrap Joint Wrap

Marking Tape

STANDARD

1. ASTM-D-2103
2. ASTM-D-882 Method A

LOUDOUN WATER REQUIREMENTS

1. Thickness, tensile strength, longitudinal elongation and transverse elongation must meet the above standards. Colors shall not deteriorate with long-term exposure to soil. Tape shall be 6 inches wide, polyethylene, 4 mils minimum thickness. Text must be at intervals of 36 inches or less.
2. Tape installed with water piping shall have APWA blue background with "CAUTION BURIED WATER LINE" in black letters.
3. Tape installed with reclaimed water piping shall have APWA purple background with caution statement "CAUTION: RECLAIMED WATER—DO NOT DRINK" in black letters.
4. Tape installed with sanitary sewer shall have APWA green background with "CAUTION BURIED SEWER LINE" in black letters.
5. Tape installed with cathodic protection systems shall have APWA red or yellow background with "CAUTION CATHODIC PROTECTION CABLE BURRIED BELOW" in black letters.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Brady	10/1999	Identoline
Empire	10/1999	ShieldTec
Marking Services Incorporated	6/2004	
Pro-Line Safety Products	4/2009	
Allen Systems	11/2005	Detectatape
Lineguard, Inc.	11/2005	Lineguard Super Tuff III
Harris Industries	1/2010	
Mutual Industries	2/2012	
Christy's	2/2012	
Presco	11/2015	

Tracer Wire

LOUDOUN WATER REQUIREMENTS

1. Tracer wire required only with nonmetallic (e.g. PVC, HDPE or PEX) pipeline.

2. Wire to be #12 AWG solid copper with low density polyethylene insulation of minimum thickness 45 mils.

3. Along mains, use Rhino TriView™ tracer pedestals to terminate wire. Pedestals shall be at maximum 1000' intervals along the pipeline. Wire must not be spliced between pedestals.

4. For gravity sewers, wire is not required with mainline of manhole to manhole construction.

5. Tracer wire is required with sanitary laterals, from main to structure served. Terminate tracer wire on sanitary lateral at building's exterior, beside cleanout. If iron frame and cover is not to be used on cleanout, Loudoun Water recommends terminating tracer wire with green Soilmarker™ by Rhino Marking and Protection Systems, or Tracer Wire Access Box by Drainage and Water Solutions, Inc.

MANUFACTURERS AND MODELS

Company	Approval Date
Kris-Tech Wire Company	10/1999
Paige Electric Company	10/1999
Pro-Line Safety Products	4/2009

Marker Posts and Tracer Pedestals

LOUDOUN WATER REQUIREMENTS

UTILITY	TYPE OF PIPE	POST	DECALS (3 PER POST)
WATER	IRON	78" BLUE MARKER	SD-7443K
	NON-METALIC	54" BLUE TRACER PEDESTAL AND 78" BLUE MARKER	SD-7443K
RECLAIMED WATER	IRON	78" PURPLE MARKER	SD-7617K
	NON-METALIC	54" PURPLE TRACER PEDESTAL AND 78" PURPLE MARKER	SD-7617K
GRAVITY SEWER	ALL TYPES	78" GREEN MARKER	SD-7442K
PRESSURIZED SEWER	IRON	78" GREEN MARKER	SD-7441K
	NON-METALIC	54" GREEN TRACER PEDESTAL AND 78" GREEN MARKER	SD-7441K

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Numbers
Rhino Markings and Protection Systems	10/2006	see table above

Lock for Entry Doors to Above Grade Structures

LOUDOUN WATER REQUIREMENTS

1. Lock to be type listed for authorized duplication only. During construction, lock may be keyed for contractor's key, and for Loudoun Water's "landlord" key.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Schlage	10/2012	
Weiser	10/2012	
Baldwin	10/2012	

CATHODIC PROTECTION

Magnesium Anodes

STANDARDS

1. ASTM B 843

LOUDOUN WATER REQUIREMENTS

1. Each anode shall have the following nominal weights and dimensions:

Anode Nominal Weight (lbs.)*	Dimensions (inches)
17	25 long and D-shaped (2.5 inches by 3.5 inches by 3.5 inches)
20	58.75 long and D-shaped (2.5 inches by 2.5 inches by 2.375 inches)
32	21 long and D-shaped (5 inches by 6 inches by 4.5 inches)

* excluding backfill

2. Composition of anodes shall be as follows:
   - Aluminum 0.010% Maximum
   - Manganese 0.50 to 1.3%
   - Copper 0.02% Maximum
   - Nickel 0.001% Maximum
   - Zinc 0.05% Maximum
   - Iron 0.03% Maximum
   - Silicon 0.05% Maximum
   - Other 0.05% Each or 0.030% Maximum Total
   - Magnesium Remainder
3. Each anode and backfill shall be vibratory packaged in a permeable cardboard box or cloth bag with the following dimensions:

Anode Nominal Weight (lbs.)	Boxed Dimensions (inches)	Cloth Bag -Packaged Dimensions (inches)	Backfill Weight (lbs.)
17	minimum 32 long by 5.5 on each side	minimum of 29 long by 6.5 on each side	28
20	minimum 71 long by 4.5 on each side	minimum of 56 long by 5.0 on each side	45
32	minimum 24 long by 7.5 on each side	minimum of 28 long by 8.0 on each side	38

4. Anode backfill shall have the following composition:
    - Hydrated Gypsum 75%
    - Bentonite 20%
    - Sodium Sulfate 5%
5. A minimum of 10 feet of AWG # 12 stranded copper wire with TW insulation (black) shall be attached to the anode. Wire anode attachment shall be by silver solder and sealed to prevent a moisture penetration.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Stuart Steel Protection Company	11/2005	Viboxed Maxmag
Piping & Corrosion Specialties, Inc.	11/2005	Galvomag
3N International, Inc.	1/2010	High Potential
Corrpro Companies, Inc.	4/2012	High Potential Cast Magnesium

Current Measuring Shunt

LOUDOUN WATER REQUIREMENTS

1. Test station shunts shall be manufactured with a mounting board to fit the terminal posts for the specified test station.

2. The resistance shall be 0.01 OHM with a current capacity of 8 amperes.

MANUFACTURES AND MODELS

Company	Approval Date	Model Name/Number
COTT Manufacturing Company	11/2005	Yellow
Pro-Mark Utility Supply, Inc.	1/2010	Yellow

Test Station

LOUDOUN WATER REQUIREMENTS

1. Flush mount test stations shall consist of a nonconductive terminal board mounted in a locking cover, suitable for placement in heavy traffic areas. Covers shall be lettered as indicated in Figure CP-11 TEST STATION BY BOX AT GRADE of the Standard Details.

2. The test station shall consist of a cast iron lid with a cast iron collar. The body of the test station shall be 5 inches inner diameter with a length of 18 inches.

3. The mounting board shall be nonconductive material and shall have a minimum of seven terminal posts.

4. Test station terminal lugs shall be one-hole, compression terminal lugs for 0.25 inch bolt size

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
Rhino Marking and Protection Systems	4/2013	54" TriView Test Station	
Bingham & Taylor	1/2010	NM-5	
Thomas and Betts Corporation	11/2005	Series 54100 and Model c-10-14; one hole, compression terminal legs for 0.25 inch bolt size.	Terminal lugs only

Permanent Reference Electrode

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Borin Manufacturing, Inc.	6/2016	Stelth®2 Cu-CuSO4 Reference Electrode

Wire

STANDARDS

1. ASTM B-8

2. ASTM D-1248, Type 1, Class A, Category 4, Grade E-5

LOUDOUN WATER REQUIREMENTS

1. All wiring, excluding wire provided with the anodes, shall be copper wire of the specified AWG wire size and color, as shown in the Standard Details.

2. Wire for the bonding of joints shall be #4 AWG stranded copper with high molecular weight polyethylene (HMWPE) insulation conforming to ASTM D-1248 as listed above. For pipes larger than 36" in diameter, #2 AWG is required.

3. Anode header cable to be #8 AWG with HMWPE insulation conforming to ASTM D-1248 as listed above.

4. Wire for test stations leads shall be #8 or #10 AWG stranded copper wire, 600-volt, with THWN insulation, in colors as specified by construction plans and the Standard Details.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Kalas Manufacturing Inc.	11/2005	HMWPE Cathodic Protection Cable

Splicing Tape

LOUDOUN WATER REQUIREMENTS

1. Electric tape shall be applied over splicing compound for underground splicing of anode cables and test wire connections.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
3M Company	11/2005	Scotch® Linerless Rubber Splicing Tape 130C
	11/2005	Scotch® Vinyl Electrical Tape Super 88
	1/2010	33+Vinyl Electrical Tape

Splice Coating Compound

LOUDOUN WATER REQUIREMENTS

1. Electric coating compound shall be applied for underground splicing of anode cables and test wire connections.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
3M Company	11/2005	Scotchkote™ Electrical Coating FD

Thermite Weld Equipment

LOUDOUN WATER REQUIREMENTS

1. Thermite weld molds and charges shall be suitable for the sizes and types of materials and shapes encountered.

2. Adapter sleeves shall be utilized for all thermite welds.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Erico, Inc	11/2005	Cadweld
Continental Industries	11/2005	thermOweld®

Coating for Thermite Welds

LOUDOUN WATER REQUIREMENTS

1. Thermite welds are to be coated with prefabricated one piece elastometric filled, plastic cap (Royston handy-cap or approved equal).

2. The appropriate primer as required by the elastometric cap manufacturer shall be used.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Royston	11/2005	Roybond 747 primer with Royston Handy Cap
Continental Industries	1/2010	ThermOcap PC - Primerless
		ThermOcaps with Polyken 1027 Primer
Amcorr Products & Services	6/2016	VISCOTAQ® Coating Patch

Insulating Flange

LOUDOUN WATER REQUIREMENTS

1. The following dielectric materials shall be used for the fabrication of the flange insulator.
   - Insulating Gasket: Type "E" G10 Epoxy/Glass with Nitrile Seal, machined to match particular pipe material being used. Inside diameter to be 3/32 inch less than net inside diameter of pipe and any internal coating or lining.
   - Insulating Sleeves: G-10 Epoxy/Glass
   - Insulating Washers: G-10 Epoxy/Glass. Provide two washers for each bolt.
   - Zinc plated Steel Washers: 1/8 inch thick plated hot rolled steel. Provide two washers for each bolt.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
PSI Industries, Inc.	11/2005	
Advance Products & Systems, Inc.	11/2005	

Coating for Mechanical Joints and Insulating Flanges

STANDARDS

1. AWWA C217
2. AWWA C209

LOUDOUN WATER REQUIREMENTS

1. All mechanical joints shall be field coated with a petrolatum system (wax and tape), in accordance with manufacturer's recommended installation procedures. The mechanical joints shall be fully coated. The remainder of the fitting need not be wrapped in the wax and tape.
2. Insulating flanges shall be field coated with a petrolatum system (wax and tape) in accordance with manufacturer's recommended installation procedures.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Raychem Inc.	11/2005	wax and tape system
Denso North America Inc.	11/2005	wax and tape system
Trenton Wax Tape	11/2005	#1 Wax-Tape Coating System

Bonded Coating for Ductile Iron Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Where pipe with a bonded coating is being installed, fittings shall be wrapped in a tape coating with polyethylene backing.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
Liberty Coating Company, LLC	10/2016	PRITEC®	for use on ductile iron pipe
Berry Plastics Corporation	10/2016	Polyken #930 polyethylene backed tape wrap with Polyken #939 filler mastic and #1027 liquid adhesive	for use on iron fittings and pipe joints
Canusa-CPS	4/2017	Aqua-Shield™ AQW	for use on pipe joints

Polyethylene Encasement

STANDARDS

1. ANSI/AWWA C105/A21.5

LOUDOUN WATER REQUIREMENTS

1. Polyethylene encasement shall comply with ANSI/AWWA C105/A21.5. Material may be 4 mil thick cross-laminated high density polyethylene, or 8 mil linear low density polyethylene. Seamless flat tube form must comply with the minimum widths based on nominal pipe diameter in accordance with above standard.

2. Where polyethylene encasement of pipe is specified, fittings and valve bodies are to be included within the encasement.

3. In reclaimed water installations, polyethylene wrap must be purple and printed with the statement "CAUTION: RECLAIMED WATER—DO NOT DRINK" in text size and spacing cited in the Virginia Water Reclamation and Reuse Regulation.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Sigma	6/2009	
Trumbull Industries	2/2012	
Flexsol	2/2012	

Miscellaneous Products

Insulating Unions:	Mueller Company
Field Applied Dielectric:	Royston Company; R28 Rubberized Mastic Carboline; Bitumastic No. 50
Steel Hand Stamp:	C.H Hanson Company; Model Nos. 24450/22981 with 3/8 inch letter
Solder:	0.062 inch diameter 60/40 Solder with 3.5 percent type RMA rosin core
Glass Mesh:	various thicknesses based on electrical isolation requirements
Separator Mesh:	Tuff-N-Nuff Industries, Inc.; Tuff-N-Nuff Rock Shield

WATER, SECTION 1 – PIPE

Ductile Iron Pipe

STANDARDS

1. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast
2. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile Iron Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. In addition to conforming to all applicable sections of the above standards, pipe shall:
   - be Thickness Class 52 or higher.
   - have cement lining with seal coat, in accordance with ANSI/AWWA C104/A21.4.
2. Acceptable diameters are 4, 6, 8, 10, 12, 16, 20, 24, 30, 36, 42, 48 and 54 inches.

MANUFACTURERS AND MODELS

Company	Approval Date
American Ductile Iron Pipe	10/1999
Atlantic States/Clow/McWane	10/1999
U. S. Pipe	10/1999

Push-On Joints

STANDARD

1. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Pipe joints shall conform to the above referenced standard, and shall be push-on type, unless otherwise specified on construction plans.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
American Ductile Iron Pipe	10/1999	Fastite®
Atlantic States/Clow/McWane	10/1999	Tyton®(4”-24”) Fastite®(30”-36”)
U. S. Pipe	10/1999	Tyton®

Mechanical Joints

STANDARD

1. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Mechanical joints, including nuts and bolts, shall conform to the above referenced standard.
2. **Mechanical joint pipe shall be used only where specified on approved construction plans or detail (typically at blow-off and in dead end hydrant assembly).**

MANUFACTURERS AND MODELS

Company	Approval Date
American Ductile Iron Pipe	10/1999
Atlantic States/Clow/McWane	10/1999
U. S. Pipe	10/1999

Flanged Joints

STANDARD

1. ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges

LOUDOUN WATER REQUIREMENTS

1. Flanged joints shall conform to the above referenced standard.

2. **Flanged joints may be used only in buildings, in vaults, or where specified on construction plans.**

3. Bolt circle and holes shall conform to Class 125 standard template in accordance with ANSI B16.1.

4. Gaskets 12-inches in diameter and smaller shall be full-faced 1/8-inch thick, and shall conform to the dimensions of Table A1 of AWWA C115 Section A2. For pipe sizes 16-inch and larger, use ring gasket.

5. Gaskets shall extend to inside of bolt holes, and to the inside diameter of the pipe, thereby protecting the threads that join the flange from corrosion.

6. Drop-in type gaskets may be used only upon specific approval.

7. Bolts and nuts shall be low-carbon steel, ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi tensile strength, Grade B.

MANUFACTURERS AND MODELS

Company	Approval Date
American Ductile Iron Pipe	10/1999
Atlantic States/Clow/McWane	10/1999
U. S. Pipe Fabrication, LLC	10/1999
Fast Fabricators, Inc.	10/1999
Higgins Engineering	2/2012

Restrained Joint Piping Systems

STANDARD

1. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Restrained joints shall conform to the above referenced standard.
2. Restrained joint piping systems shall be used where specified on construction plans.
3. Restrained joint piping systems are required for installations through casings or tunnels, in conformance with Standard Detail G-12 CASING INSTALLATION.
4. Contractor shall submit project specific proposal for restrained joint piping system to Loudoun Water for review and approval. Loudoun Water reserves the right to select from the list of joints below, based upon the characteristics of the specific application.
5. Field welding of restraining components is not permitted.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name
American Ductile Iron Pipe	10/1999	Flex-Ring®
Atlantic States/Clow/McWane	9/2010	TR Flex®
U. S. Pipe	10/1999	TR Flex® HP Lok® Mech-lok™ Bolt-lok™

Locking Gaskets

STANDARD

1. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Locking gaskets shall conform to the above referenced standard.
2. **Locking gaskets may be used in conformance with the Standard Details listed below. Use in other applications is prohibited, except where application specific approval is granted by Loudoun Water.**

   G-11 RESTRAINT OF VERTICAL OFFSET

   W-10 FIRE HYDRANT ALONG STREET / W-11 FIRE HYDRANT BEHIND DITCH / W-12 DEAD END HYDRANT

   W-20 FIRE SERVICE CONNECTION

   W-28 2" OMNI C2, OMNI T2, OR MAGNETIC METER

   W-29 3", 4" AND 6" OMNI C2, OMNI T2 OR MAGNETICMETER IN VAULT

   W-31 SERVICE ENTRANCE WITH INDOOR METER

   R-3 TERMINUS BY FLUSHING HYDRANT / R-5 REUSE FLUSHING HYDRANT BELOW GRADE / R-6 REUSE FLUSHING HYDRANT ABOVE GRADE

   R-12 2" MAGNETIC REUSE METER

   R-13 3", 4" OR 6" MAGNETIC REUSE METER IN VAULT

   R-14 REUSE SERVICE ENTRANCE WITH INDOOR METER

MANUFACTURERS AND MODELS

Company	Model	Conditions of Approval
U. S. Pipe	FieldLok 350® Gasket	Must be used with Tyton® joint pipe, conforming to latest joint design issued by U. S. Pipe.
American Ductile Iron Pipe	Fast-Grip Gasket	Must be used in a Fastite® joint.

Threaded Nipples

LOUDOUN WATER REQUIREMENTS

1. Made of ductile iron conforming to ASTM A-536, Grade 65-45-12.
2. Minimum wall thickness equal to 0.25” and outside diameters equal to IPS pipe sizes.
3. Threads per ANSI B.120-1-1983.
4. Fusion bonded epoxy coating and lining required.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Harrington Corporation (HARCO)	6/2002	

Plastic Pipe

STANDARDS

1. ANSI/AWWA C900-16 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 12 In. (100 mm Through 1,500 mm), For Water Distribution

LOUDOUN WATER REQUIREMENTS

1. Plastic pipe will be specified only for special applications, typically for limited segments where nearby utility may result in stray electrical current.

2. Pipe shall conform to one of the above standards.

3. See construction plans for required dimension ratio (DR). Typically DR14 will be specified.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Diamond Plastics Corporation	10/1999	
IPEX, Inc.	10/1999	
National Pipe & Plastics, Inc.	10/1999	
Rehau	10/1999	AQUALOC
Royal Pipe Systems	10/1999	
North American Pipe Corporation	10/1999	PVC C900-16
		Certa-Lok™ C900RJ

WATER, SECTION 2 – CAST AND DUCTILE FITTINGS

Compact Ductile Iron Mechanical Joint Fittings

STANDARDS

1. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings
2. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Gray-Iron Fittings
3. ANSI/AWWA C116/A21.16 Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings

LOUDOUN WATER REQUIREMENTS

1. Fittings shall conform to ANSA/AWWA C153/A21.53, and have lining and coating in accordance with either the second or third standard listed above.
2. Minimum Pressure Class 350 in diameters 3”-24”, and Class 250 in diameters 30”-48”.
3. Bolts and nuts shall be in accordance with AWWA C111.
4. Fitting design shall prevent T-head bolts from rotating.
5. **All sleeves shall be long pattern unless otherwise approved by Loudoun Water.**

MANUFACTURERS AND MODELS

Company	Approval Date	Conditions of Approval
American Cast Iron Pipe Co.	10/1999	
SIP Industries	7/2014	
Sigma	6/1995 2/2001	
Star Pipe Products, Inc.	6/1996	
Tyler Pipe/ Union Foundry	10/1999	
U. S. Pipe	10/1999 6/2001	mortar lined or Permafuse® epoxy

Flanged Fittings

STANDARDS

1. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings
2. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile Iron Pipe and Fittings
3. ANSI/AWWA C116/A21.16 Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings

LOUDOUN WATER REQUIREMENTS

1. Fittings shall conform to ANSA/AWWA C110/A21.10, and have lining and coating in accordance with either the second or third standard listed above.
2. Flange dimensions shall conform with ASME B16.1 class 125.
3. Minimum pressure rating of 250 psi (all sizes).
4. Bolts and nuts shall be low-carbon steel, ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi tensile strength, Grade B.

MANUFACTURERS AND MODELS

Company	Approval Date	Conditions of Approval
American Cast Iron Pipe Co.	10/1999	
SIP Industries	7/2014	
Sigma	6/1995 2/2001	
Star Pipe Products, Inc.	6/1996	
Tyler Pipe/ Union Foundry	10/1999	
U. S. Pipe	10/1999 6/2001	mortar lined or Permafuse® epoxy

Tangent (Offset) Tee

STANDARDS

1. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings
2. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings
3. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile Iron Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Tangent tees shall conform to either standard 1 or 2 listed above, and shall have cement mortar lining. Ends are to be mechanical joint.
2. Tangent tees are required on mains of diameter 16" and larger, where specified on construction plans.

MANUFACTURERS AND MODELS

Company	Approval Date
Star Pipe Products	2/2007
SIP Industries	7/2014
Horizon Metals, Inc.	4/2017

PLEASE NOTE: TANGENT TEES MUST BE ORDERED WELL IN ADVANCE OF THE INSTALLATION TO ENSURE ADEQUATE LEAD TIME FOR DELIVERY.

Anchoring (Swivel) Fittings

STANDARDS

1. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings
2. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
3. ANSI/AWWA C116/A21.16 Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings

LOUDOUN WATER REQUIREMENTS

1. Cement mortar lining required, except where lined with fusion bonded epoxy per AWWA C116.
2. Ends shall be mechanical joint.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Assured Flow Sales, Inc.	4/1997	GradeLok
American Cast Iron Pipe Co.	10/1999	anchoring tees and anchoring couplings
SIP Industries	7/2014	anchoring tees and anchoring couplings
Tyler Pipe/ Union Foundry	10/1999	anchoring tees and anchoring couplings
Star Pipe Products	6/1996	anchoring tees and anchoring couplings
Sigma	10/1999	anchoring tees and anchoring couplings
U. S. Pipe & Foundry Co.	10/1999	anchoring tees and anchoring couplings
Infact Corporation	6/2008	Foster Adaptor with epoxy coating and stainless steel accessory pack, in sizes 10” and larger. **Not to be substituted for an anchoring coupling**.

Compact Gland (M.J. Accessory Kit)

STANDARD

1. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

LOUDOUN WATER REQUIREMENTS

1. Glands of all sizes must be of ductile iron.
2. Bolts and nuts shall be in accordance with AWWA C111.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
American Cast Iron Pipe Co.	10/1999	
SIP Industries	7/2014	
Sigma	6/1995	
Star Pipe Products	6/1996	
Tyler Pipe/ Union Foundry	10/1999	
U. S. Pipe & Foundry Co.	10/1999	

Restraining Gland

STANDARDS

1. ANSI/AWWA C111/A21.11 Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1,219 mm) for Water

LOUDOUN WATER REQUIREMENTS

1. Pressure rating of 350 psi for sizes 4" through 16". Pressure rating of 250 psi for sizes 20" through 48".

2. Bolts and nuts shall be in accordance with ANSI/AWWA C111/A21.11.

3. Where casting a line anchor, or otherwise installing around an existing pipe without connecting MJ bell, use gland designed for mid-span installation.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
EBAA, Inc.	10/1999	1100 MEGALUG®	for use on DIP
	9/2016	2000 PV MEGALUG®	for use on PVC
	5/2018	1100SDB Series	Mid-span restraint
Star Pipe Products	12/2008	Stargrip® Series 3000	for use on DIP
	9/2016	PVC Stargrip® Series 4000	for use on PVC
Sigma	6/2009	ONE-LOK™ SLDE	for use on DIP
	9/2016	ONE-LOK™ SLCE	for use on PVC
SIP Industries	7/2014	EZ Grip™ Series EZD	for use on DIP
	9/2016	EZ Grip™ Series EZP	for use on PVC
Ford Meter Box Company	8/2000	Uni-Flange, Series 1400	for use on DIP
	5/2018	Uni-Flange, Series 1495	Mid-span restraint

Flange by Mechanical Joint Coupling

STANDARD

1. ANSI/AWWA C115/A 21.11
2. ANSI/AWWA C111/A 21.11

LOUDOUN WATER REQUIREMENTS

1. Coupling, bolts and gaskets shall conform to the above standards.
2. Body shall be ductile iron per ASTM A536 Grade 65-45-12.
3. Couplings listed below are for use in buildings and vaults to enable components such as meters or valves to be removed from the line for maintenance. Use only where approved to enable the system to be dismantled. **Flanged couplings may not be substituted for fabricated sections of flanged pipe.**

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Star Pipe Products	12/2008	Starflange Series 3200
Smith-Blair	12/2012	911 Flange Lock
Romac	10/2013	RFCA Series

Flange Adapter

STANDARD

1. ANSI/AWWA C115/A 21.11

LOUDOUN WATER REQUIREMENTS

1. Flange adapters, bolts and gaskets shall conform to the above standards.
2. Body shall be ductile iron per ASTM A536 Grade 65-45-12.
3. Adapters listed below are for use in buildings and vaults to enable components such as meters or valves to be removed from the line. Use only where approved to enable the system to be dismantled. **Flange adapters may not be substituted for fabricated sections of flanged pipe.**

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
EBAA, Inc	10/2016	2100 Megaflange®

Dismantling Joint (Flange x Flange)

STANDARD

1. ANSI/AWWA C115/A 21.11

LOUDOUN WATER REQUIREMENTS

1. Dismantling joint, bolts and gaskets shall conform to the above standards.
2. Body shall be ductile iron per ASTM A536 Grade 65-45-12.
3. Dismantling joints listed below are for use in buildings and vaults to enable components such as meters or valves to be removed from the line for maintenance. Use only where approved to enable the system to be dismantled.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Smith-Blair	10/2016	SB 971 Series

WATER, SECTION 3 – VALVES AND HYDRANTS

Resilient Wedge Gate Valve

STANDARDS

1. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
2. ANSI/AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
3. ANSI/AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
4. ASTM D 6284 Standard Test Method for Rubber Property-Effects of Aqueous Solutions with Available Chlorine and Chloramines

LOUDOUN WATER REQUIREMENTS

1. Gate valves shall conform to either standard 1 or 2 above. All gate valves shall be lined and coated per standard 3 above.
2. In buried applications, maximum size of 12", except where construction plans specify a larger gate valve. Butterfly valves are typically employed in buried applications 16" and larger.
3. Unless otherwise specified on construction plans, ends shall be mechanical joint for buried applications. Flanged ends shall be used in buildings, in vaults, and where joining to a tapping sleeve. Threaded ends used for 2" valve of blow-off assembly.
4. Fasteners exposed to backfill (not including those of the mechanical joint ends) must be T304 Stainless Steel.
5. Synthetic rubber compound must be resilient to continuous exposure to concentrations of chlorine and chloramines found in drinking water. Manufacturer of valve must evaluate rubber per Standard 4 above, and provide test results to Loudoun Water upon request.
6. Non-rising stem and O-ring seals.
7. Counter-clockwise rotation of operator to open. Operator to be 2-inch square nut for underground installations; with hand wheel in all buildings and vaults.

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MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
American Flow Control	7/2000	Series 2500	
Clow/Kennedy/M & H	10/1999		EPDM rubber required
Mueller Company	3/1999 Updated 10/24/2017	A-2361 Series A-2362 Series	
U. S. Pipe (by Mueller)	2008	A-USPO	
J&S Valve	6/2011		Limited Approval for Use May be included in specifications throughout all service areas, where in plant, station and vault applications.

Butterfly Valve

STANDARD

1. ANSI/AWWA C504 Rubber-Seated Butterfly Valves
2. ASTM D 6284 Standard Test Method for Rubber Property-Effects of Aqueous Solutions with Available Chlorine and Chloramines

LOUDOUN WATER REQUIREMENTS

1. Butterfly valves and actuators shall conform to the above standard.
2. Minimum size of 16", unless otherwise specified on construction plans.
3. Epoxy coated, inside and outside.
4. Fasteners exposed to backfill (not including those of the mechanical joint ends) must be T304 Stainless Steel.
5. Synthetic rubber compound must be resilient to continuous exposure to concentrations of chlorine and chloramines found in drinking water. Manufacturer of valve must evaluate rubber per Standard 2 above, and provide test results to Loudoun Water upon request.
6. Unless otherwise specified, valves with flanged ends shall be short-body, Class 250B, per ANSI/AWWA C504.
7. Valves for bury below grade shall have mechanical joint ends, and shall be Class 250B per ANSI/AWWA C504.
8. Actuators shall rotate counter-clockwise to open.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Clow/Kennedy/M & H	10/1999	
Mueller Company	10/1999	Lineseal III
Pratt	10/1999	Groundhog
Val-Matic	4/2010	Series 2000
DeZurik	4/2010	
VAG USA LLC (formerly GA Industries)	1/2014	

Insert Valve

STANDARD

1. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
2. ANSI/AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal for each insert valve must be reviewed and approved by Loudoun Water.**
2. Insert valves shall conform to either standard 1 above. Insert valves may be lined and coated per standard 2 above.
3. Insert valve shall have mechanical joint ends, and shall provide positive shut-off by means of a rubber wedge.
4. Fasteners exposed to backfill must be T304 Stainless Steel.

Company	Approval Date	Model Name/Number
Team Industrial Services, Inc.	10/2012	InsertValve™ RW-Gate

Fire Hydrant

STANDARD

1. ANSI/AWWA C502 Dry-Barrel Fire Hydrants

2. ANSI/AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

LOUDOUN WATER REQUIREMENTS

1. Hydrants shall conform to the standard referenced above.

2. Fire hydrants shall be of 3-way class, with one 4½-inch pumper outlet and two 2½-inch hose outlets, all with National Standard fire hose threads. The hydrant shoe shall have at least two all bronze drain outlets. The complete interior of the shoe shall be epoxy-coated if the O-ring is in contact with cast iron. If the bottom O-ring is in contact with brass, no epoxy coating of the interior of the shoe is required. Hydrants shall be furnished with a breakaway feature that will break cleanly on the underside of the flange upon impact. This shall consist of a break flange with a breakable stem coupling. Breakable bolts will not be accepted. This break flange shall also permit 360-degree rotation of the upper barrel to orient nozzles in any desired direction.

3. **Permissible bury depths are 5', 6' and 7'. Bury depth of 4' requires installation specific approval from Loudoun Water. Bury depths in excess of 7' are strictly prohibited**.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
Kennedy Valve Manufacturing Co.	2/1998	K81D Guardian, 5-1/4"	
Mueller Company	5/1999	Super Centurion 250, 5-1/4	
American Flow Control	2/1998	B-84B, 5-1/4"	
Clow Valve	8/2015	Medallion	Conditional Approval

Post Hydrant for Community Water System

STANDARD

1. ANSI/AWWA C502 Dry-Barrel Fire Hydrants
2. ANSI/AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

LOUDOUN WATER REQUIREMENTS

1. Hydrants shall conform to the standard referenced above.
2. Fire hydrants shall be 1-way, with one 2½-inch hose outlet, with National Standard fire hose threads. The hydrant shoe shall have at least two all bronze drain outlets. The complete interior of the shoe shall be epoxy-coated if the O-ring is in contact with cast iron. If the bottom O-ring is in contact with brass, no epoxy coating of the interior of the shoe is required. Hydrants shall be furnished with a breakaway feature that will break cleanly on the underside of the flange upon impact. This shall consist of a break flange with a breakable stem coupling. Breakable bolts will not be accepted. This break flange shall also permit 360-degree rotation of the upper barrel to orient nozzles in any desired direction.
3. **Permissible bury depths are 5', 6' and 7'. Bury depth of 4' requires installation specific approval from Loudoun Water. Bury depths in excess of 7' are strictly prohibited**.
4. Provide post hydrant where specified on construction plans. This will typically be in a community water system, where main is designed to deliver 500 gallons per minute or less.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Mueller Company	8/2013	A-411

Hydrant Paint

LOUDOUN WATER REQUIREMENTS

1. Where hydrant manufacturer's coating is fusion bonded epoxy or high performance urethane, typically no recoating in the field is required.

2. Where coating or touch-up in the field is required, paint body and caps RED. Paint bonnet with reflective WHITE.

3. Use Safety Yellow for all hydrant bollards and for any hydrant approved for sale of water through a hydrant meter.

4. In COMMUNITY WATER SYSTEMS ONLY, see construction plans for specification of flow rate. Paint hydrant body WHITE. Paint bonnet and caps RED for flow rate less than 500 gallons per minute, or ORANGE for flow rate of 500-1000 gallons per minute.

MANUFACTURERS AND MODELS

Color	Company	Approval Date	Model Name/Number
RED	Rustoleum	10/1999	#7765 Regal Red or #7564 Safety Red
WHITE	Axon Products, Inc.	11/1998	1460 Alert, Bright White Light Reflective Coating
SAFETY YELLOW	Rustoleum	1/2010	
ORANGE	Rustoleum	8/2013	

Valve Box

STANDARD

1. ASTM A 48 Standard Specification for Gray Iron Castings
2. Virginia Department of Transportation Road and Bridge Specifications
3. AASHTO M 105, Class 35B

LOUDOUN WATER REQUIREMENTS

1. Boxes shall be of gray iron meeting the requirements of ASTM A48, Class 35B.
2. Two piece sliding type, unless otherwise specified on construction plans.
3. Shaft to be 5" nominal diameter. All boxes shall have on exterior a ledge under the ring that houses the cover. This is to allow the top section to be pulled upward. The upper section shall not have a flange at the bottom.
4. Manufacturer or supplier must be listed by the Virginia Department of Transportation as participating in the Department's Gray Iron Casting Manufacturers/Distributors QA/QC Program.
5. For gate valve installations, provide valve box adapter, made to specific size and manufacture of valve and valve box manufacturer. No adapter is required with butterfly valves.
6. Stacking of multiple bottom sections or extensions is prohibited. A maximum of one bottom section and one extension is permitted, below the top section. For deeper bury, use 5-inch cast iron DWV pipe as riser material.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Bingham & Taylor	10/1999	5664
Capitol Foundry of VA, Inc.	10/1999	664A*MWW
East Jordan Iron Works, Inc.	6/2008	8555 Sections 6800 Cover
Adaptor, Inc.	1/2008	Valve Box Adaptor II (VBAII) (see Requirement 5 above)

Air Release Valve

LOUDOUN WATER REQUIREMENTS

1. Device must be combination air release and vacuum breaker.
2. Pressure rating of 150 psi or better. Must remain closed to water pressures as little as 2 psi, while allowing air to be released.
3. 2-inch NPT threaded inlet and outlet.
4. All working parts shall be constructed of non-corroding material.
5. With each air release valve, furnish 2-inch Flood Safe inflow preventer and mounting bracket by Val-Matic, in accordance with Standard Detail W-4 AIR RELEASE.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Bermad	1/2014	2" C30 with threaded inlet and outlet Part Number C30022PSNP00000-WD

Swing Type Check Valve

STANDARD

1. ANSI/AWWA C508 Swing-Check Valves for Waterworks Service, 2-In. Through 24-In.

LOUDOUN WATER REQUIREMENTS

1. Iron body and cover with epoxy coating. Clapper to be rubber faced disc.
2. Lever and weight or cushioning mechanism as per project's plans and specifications. A project specific materials submittal must be reviewed and approved by Loudoun Water.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Mueller Company	4/2009	A-2600 Series
VAG USA LLC (formerly GA Industries Inc.)	8/2013	200 Series

Control Valve

LOUDOUN WATER REQUIREMENTS

1. See project's plans and specifications for applicable sizes, models and options.
2. A project specific materials submittal must be reviewed and approved by Loudoun Water.
3. Rubber parts to be EPDM.
4. Trim to be stainless steel.

MANUFACTURERS AND MODELS

Company	Approval Date
CLA-VAL	10/1999

WATER, SECTION 4 – TAPPING SLEEVES AND SADDLES

Tapping Sleeve for Cast or Ductile Iron Pipe

STANDARD

1. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings

LOUDOUN WATER REQUIREMENTS

1. Sleeve shall be made of ductile iron. Mechanical joint ends on all sizes.
2. Sizes up to 36" x 24". Diameter of tap may be as large as that of pipe being tapped, unless otherwise limited by Loudoun Water.
3. Bolts and nuts shall be low-alloy steel, ASTM A307 Standard Specification Carbon Steel Bolts and Studs, 60,000 psi tensile strength, Grade B.
4. Minimum pressure rating of 200 psi.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
American Flow Control	3/8/2001	Series 2800 Compact Ductile Tapping Sleeve	
Mueller Company	10/1999	H-615	
Tyler Pipe	10/1999	Ductile Iron MJ Tapping Sleeve	
JCM Industries	9/2012	414 Steel Tapping Sleeve	approved in diameters 30" and larger; stainless steel fasteners required
Smith-Blair	12/2012	624 MJ Tapping Sleeve	approved in diameters 30" and larger; stainless steel fasteners required

Tapping Saddle

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Saddle shall conform to the above referenced standard, and be all brass with double brass strap and rubber seal gasket.

2. Maximum tap size of 1 inch. Maximum pipe size of 12 inches, unless otherwise specified on construction plans.

3. Except as specified in item 4 below, service connections shall be by direct tap (no saddle). Use of saddle may be approved on a case-by-case basis, where direct tap has been unsuccessful.

4. Saddle required on tap of 3-inch main (where a ¾ inch tap shall be made).

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Ford Meter Box Co.	10/1999	202-B Series
Mueller Company	10/1999	BR2B Series Bronze Service Saddle

WATER, SECTION 5 – SERVICE HARDWARE

Copper Tubing

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Type "K" soft copper, sizes ¾"-2".
2. Packaging of pancake coils through 1½"; regular coil for 2".

MANUFACTURERS AND MODELS

Company	Approval Date
Cambridge Lee Industries	10/1999
Cerro Flow Products, Inc.	10/1999
CMC Howell Metal	10/1999
Kessler Industries	10/1999
Mueller Company	10/1999
Wieland Copper Products, LLC	10/2012

Corporation Stop

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Ball type with rating of 300 psi.

2. Must have flare outlet of same size as specified tubing.

3. Typical service connection is 1-inch tap. The ¾-inch tap is for reserved for specific applications, such as at sampling station. Where making service connection on 3-inch or 4-inch main, use corporation stop with ¾-inch inlet and 1-inch flare outlet. On 3-inch main, use an approved saddle.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
A. Y. McDonald	8/1994	74701B
Ford Meter Box Company	7/1992	FB600-4 Where tapping 3” or 4” main, use FB600-34.
Mueller Company	7/1992	B-25000
Cambridge Brass	8/2016	301NL

Meter Box

LOUDOUN WATER REQUIREMENTS

1. Meter boxes to be molded plastic with white interior.

MANUFACTURERS AND MODELS

Company	Approval Date	Meter Size/Type	Model Number
Bingham & Taylor	10/2016	3/4" Short iPERL	PMP 202430 MMP 202430
	7/2014	1" iPERL	PMP 202430
	4/2017		MMP202430
DFW Plastics, Inc.	10/1999	3/4" Short iPERL	DFW 242030
		1" iPERL	DFW 242030
		1-1/2" or 2" Omni C2	DFW 3636
		Double Meter	DFW 2430
Oldcastle®/Carson Industries LLC	12/2006	3/4" Short iPERL	Carson 0020-MAX
		1" iPERL	Carson 0020-MAX
	10/1999	1-1/2" or 2" Omni C2	36" x 36" straight sided
		Double Meter	24" x 30" straight sided
	10/2016	2" Omni C2, Omni T2 , or magnetic meter, installed per Standard Detail W-28	4367-60 Vault with Aluminum Cover*
Sigma Corporation	7/25/2017	3/4" Short iPERL	20" x 24" RMP 202430-FB-W full barrel
		1" iPERL	20" x 24" RMP 202430-FB-W full barrel

		1-1/2” or 2” Omni C2	36” x 36” RMP 3636-SW-W straight sided
		Double Meter	24” x 30” RMP2430-SW-W straight sided

* With this vault and aluminum cover provide 30 inch x 30 inch access door, Bilco SM-2 or Halliday F1R3030. Access door shall be bolted to aluminum cover with stainless steel bolts.

Meter Box Frame and Cover

STANDARD

1. ASTM A 48 Standard Specification for Gray Iron Castings

LOUDOUN WATER REQUIREMENTS

1. All frames shall conform to the above referenced standard, and be of iron meeting requirements of Class 25, or better. Country of origin must be cast into the product.

2. All covers shall be of plastic so as to enhance reading of meter by radio frequency, and feature recess with 2" hole to accommodate the meter's transponder.

3. Frame and cover for "**Special Applications"** to be used wherever cover has been approved to be located in concrete or asphalt pavement. Such approvals are limited to areas not subject to vehicular traffic, due to the plastic cover and meter's transponder.

MANUFACTURERS AND MODELS

Frames and Covers by A. Y. McDonald Manufacturing Company

Approval Date	Meter Size/Type	Frame	Frame for Special Applications
10/2012	3/4" Short iPERL	74R32ACRTC x800 frame and cover	74M32AC frame
10/2012	1" iPERL	74R32ACRTC x800 frame and cover	74M32AC frame
11/2001	1-1/2" Omni C2	74M36H flange and ring	74M36H flange and ring
11/2001	2" Omni C2	74M36H flange and ring	74M36H flange and ring
11/2001	Double Meter	74M24H flange and ring	74M24H flange and ring

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Frames by Bingham & Taylor

Approval Date	Meter Size/Type	Frame	Frame for Special Applications
12/2013	3/4" Short iPERL	CULF 18018ACT with CULF 18018ACB	BT-A-32C frame
	1" iPERL		
8/2002	1-1/2" Omni C2	BT 2036 MFCH flange and ring	BT 2036 MFCH flange and ring
8/2002	2" Omni C2	BT 2036 MFCH flange and ring	BT 2036 MFCH flange and ring
8/2002	Double Meter	BT 2024 MFCH flange and ring	BT 2024 MFCH flange and ring

Frames by Ford Meter Box Company

Approval Date	Meter Size/Type	Frame	Frame for Special Applications
10/1999	3/4" Short iPERL	32B frame	A32C frame
	1" iPERL		
	1-1/2" Omni C2	MC36HH flange and ring	MC36HH flange and ring
	2" Omni C2	MC36HH flange and ring	MC36HH flange and ring
	Double Meter	MC24H flange and ring	MC24H flange and ring

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Frames by Vestal Manufacturing Company

Approval Date	Meter Size/Type	Frame	Frame for Special Applications
7/2003	3/4" Short iPERL		32-086 RMRC-18L frame
	1" iPERL		
7/2003	1-1/2" Omni C2	32-090 Ex-Heavy flange and ring	32-090 Ex-Heavy flange and ring
7/2003	2" Omni C2	32-090 Ex-Heavy flange and ring	32-090 Ex-Heavy flange and ring

Frames by Sigma

Approval Date	Meter Size/Type	Frame	Frame for Special Applications
7/2014	3/4" Short iPERL	MB 12725C0	

Covers by Nicor, Inc. / Bingham & Taylor

Approval Date	Nominal Cover Size	Part Number	Cover for Special Applications
2/2012	12"	NCUL-12.25 PL OUSTH-CX	NCUL-12.25 PL OUSTH-CX
10/2012	21"	NCULM021DP	NCULM021DP

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Underground Meter Settings

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Connections to copper tubing by flare (except for indoor installations).

2. For double meter setting, provide U-Branch with 1" flare inlet and two ¾" M.I.P. outlets (at 7" or 7.5" spacing). Use ball angle valves with F.I.P. inlets.

3. Inlet valve and bypass valve shall have padlock wings.

4. Angle dual check valves shall meet the following:
   - Valve should be full 1-inch, with both ¾-inch and 1-inch inlets available.
   - Outlet shall be integral to the body of the device and must be for 1-inch flare connection.
   - Total height of body shall not exceed 5½ inches, as measured from bottom of outlet (not including flare nut) to center of inlet.
   - Checks shall be two 1-inch poppets, assembled in the vertical cartridge. Access must be through the top of the device.
   - Check valve must be approved under requirements of ASSE Standard 1024.

5. Vertical risers to be no lead solder joints. No pack-joints are permitted in risers. By-pass may be compression fitting.

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MANUFACTURERS AND MODELS

A. Y. McDonald Manufacturing Company

Meter Size	Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	14-2	714-2EHG	74602BY (1" x ¾" x 02)	7112-4YR 34
1"	iPERL	14-4	714-4EHG	74602BY (1" x 1" x 04)	7112-4YR44
1"	iPERL (Fire Service)	14-4	714-4EHG	74602BY (1" x 1" x 04)	7112-4YR44
1½"	Omni C2	Setter 720R615WWFF665			
2"	Omni C2 installed per Standard Detail W-27	Setter 720R715WWFF775			
2"	Omni C2 or Omni T2 installed per Standard Detail W-28	720R700WWFF 777X441 FNPT x FNPT			
2"	Magnetic meter installed per Standard Detail W-28	720R700WWFF 777X402X442X8.12 FNPT x FNPT			

Ford Meter Box Company

Meter Size	Sensus Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	Y502	EC-23	BA92-324W	HHCA92-424
1"	iPERL	Y504	EC-4	BA92-444W	HHCA92-424
1"	iPERL(Fire Service)	Y504	EC-4	BA92-444W	HHCA92-424
1½"	Omni C2	Coppersetter VBB76-15HB-11-66			
2"	Omni C2	Coppersetter VBB77-15HB-11-77			

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Mueller Company

Meter Size	Sensus Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	H-5020	H-14234N 3/4	B24264N 5/8x3/4x1	H14465-AN, M-98
1"	iPERL	H-5040	H-14234N 1	B24264N 1	H14465-AN, M-98
1"	iPERL(Fire Service)	H-5040	H-14234N 1	B24264N 1	H14465-AN, M-98
1½"	Omni C2	Copper Meter Yoke B-2423-99000N			
2"	Omni C2	Copper Meter Yoke B-2423-99000N			

Cambridge Brass

Meter Size	Sensus Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	460-2	430NL-3	210NL	500NLSR
1"	iPERL	460-4	430NL-4	210NL	500NLSR
1"	iPERL (Fire Service)	460-4	430NL-4	210NL	500NLSR
1½"	Omni C2	Meter Setter 6020NL-615F6F6-UUHB with idler			
2"	Omni C2	Meter Setter 6020NL-715F7F7-UUHB5 with idler			

Indoor Meter Settings

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. This section lists components required for meter settings approved by Loudoun Water to be made in accordance with these Standard Details:

   W-32 3/4" OR 1" SUBTRACTION OR INDUSTRIALPROCESS METER

   W-33 1 ½" OR 2" OMNI C2 SUBTRACTION OR INDUSTRIAL PROCESS METER

   R-15 ¾"OR 1" REUSE METER INDOORS

2. For ¾-inch or 1-inch meter, the inlet and outlet meter valves may be straight through or angle configuration.

3. Connections to customer's plumbing may be by threads, pack joint, or compression. Valves listed below with pack joint or compression inlets are for use on copper tubing (CTS outside dimensions). For connections to other pipe types, consult distributor.

4. Custom setters for 1 ½-inch and 2-inch meters come with threaded inlet and outlet.

5. Inlet valve and bypass valve (if any) shall have padlock wings.

Continued on Next Page

A. Y. McDonald Manufacturing Company

Meter Size	Meter Type	Yoke	Straight Valve	Angle Valve
3/4" Short	iPERL	14-2	Threaded Connections: 76101WY 1 x ¾ X 02	Threaded Connections: 74604BY 1 x ¾ X 02
			Pack Joint Connections: 76102WY-22 1 x ¾ X 02	Pack Joint Connections: 76102BY-22 ¾ x ¾ X 02
			McDonald Q Compression Connections: 76102WYQ ¾ x ¾ X 02	McDonald Q Compression Connections: 74602BYQ ¾ x ¾ X 02
1"	iPERL	14-4	Threaded Connections: 76101WY 1 x ¾ X 02	Threaded Connections: 74604BY 1 x 1 X 02
			Pack Joint Connections: 76102WY-22 1 x ¾ X 02	Pack Joint Connections: 76102BY-22 1 x 1 X 02
			McDonald Q Compression Connections: 76102WYQ ¾ x ¾ X 02	McDonald Q Compression Connections: 74602BYQ 1 x 1 X 02
1 ½"	Omni C2	Copper Meter Setter 720R615WWFF665		
2"	Omni C2	Copper Meter Setter 720R715WWFF775		

Continued on Next Page

Mueller Company

Meter Size	Meter Type	Yoke	Straight Valve	Angle Valve
3/4” Short	iPERL	H-5020	Threaded Connections: B-24360N 5/8 x ¾ x ¾	Threaded Connections: B-24278N 5/8 x ¾ x ¾
			Mueller Pack Joint Connections: P-24359N 5/8 x ¾ x ¾	Mueller Pack Joint Connections: P-24273N 5/8 x ¾ x ¾
			Mueller 110 Compression Connections: B-24359N 5/8 x ¾ x ¾	Mueller 110 Compression Connections: B-24273N 5/8 x ¾ x ¾
1”	iPERL	H-5040	Threaded Connections: B-24360N 1	Threaded Connections: B-24278N 1
			Mueller Pack Joint Connections: P-24359N 1	Mueller Pack Joint Connections: P-24273N 1
			Mueller 110 Compression Connections: B-24359N 1	Mueller 110 Compression Connections: B-24273N 1
1 ½”	Omni C2	Copper Meter Yoke B-2423-99000N		
2”	Omni C2	Copper Meter Yoke B-2423-99000N		

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Cambridge Brass

Meter Size	Meter Type	Yoke	Straight Valve	Angle Valve
3/4" Short	iPERL	460-2	Threaded Connections: 212NLF4SR3	Threaded Connections: 210NLF4SR3
			Pack Joint Connections: 212NLB4SR3	Pack Joint Connections: 210NLB4SR3
			Compression Connections: 212NLH3SR3	Compression Connections: 210NLH3SR3
1"	iPERL	460-4	Threaded Connections: 212NLF4SR3	Threaded Connections: 210NLF4SR3
			Pack Joint Connections: 212NLB4SR3	Pack Joint Connections: 210NLB4SR3
			Compression Connections: 212NLH3SR3	Compression Connections: 210NLH3SR3
1 ½"	Omni C2	Meter Setter 6020NL-615F6F6-UUHB with idler		
2"	Omni C2	Meter Setter 6020NL-715F7F7-UUHB5 with idler		

Double Check Backflow Prevention Assembly for Service Line Protection

STANDARD

1. ASSE 1015 Double Check Backflow Prevention Assembly

LOUDOUN WATER REQUIREMENTS

1. Any double check assembly meeting ASSE 1015 is acceptable. A partial list of examples is provided for reference.

2. For services using a 1-1/2" or larger meter and for fire lines, a backflow prevention assembly must be provided where the service line enters the structure. A reduced pressure zone device may be required in applications with fixtures of higher risk. Consult Loudoun Water's Backflow Prevention Specialist to determine the required type of device for specific applications.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Sizes
FEBCO	10/99	856	2½" - 10"
Watts	10/99	007	¾" – 3"
Watts	10/99	709	¾" – 10"
Zurn Wilkins	10/99	950 XLT 950, 950L	¾" – 2" 2½" – 10"
Zurn Wilkins	10/99	350	4" – 6"

Reduced Pressure Backflow Prevention Assembly for Service Line Protection

STANDARD

1. ASSE 1013 Reduced Pressure Backflow Prevention Assembly.

LOUDOUN WATER REQUIREMENTS

1. Any reduced pressure backflow prevention device meeting ASSE 1013 is acceptable. A partial list of examples is provided for reference.

2. For services using a 1-1/2" or larger meter and for fire lines, a backflow prevention assembly must be provided where the service line enters the structure. A reduced pressure zone device may be required in applications with fixtures of higher risk. Consult Loudoun Water's Backflow Prevention Specialist to determine the required type of device for specific applications.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Sizes
FEBCO	10/99	860	2½" - 10"
Watts	10/99	Series 909	¾" – 3"
Watts	10/99	Series 009	½" – 3"
Zurn Wilkins	10/99	975MS & 975BMS	2½" – 10"
Zurn Wilkins	10/99	975	2½" – 10"

Curb Stop

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Curb stop to be ball style, full port, with quarter turn operation.
2. Where in buried service, connections to be flare.
3. In air release assembly, use threaded connections and provide handle.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
A. Y. McDonald	10/99	76100 in buried service
		76101 FH 2 in air release (includes handle)
Mueller Co.	10/99	B-25204N in buried service
		2” B-20283N in air release with handle 1” H-10298
Cambridge Brass	8/2016	202NL in buried service
		202NLHF7F7 with handle in air release

Curb Stop Box

LOUDOUN WATER REQUIREMENTS

1. Locking lid and foot piece required.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Mueller Company	10/99	H-10316 with optional foot piece and locking lid

Sampling Station

LOUDOUN WATER REQUIREMENTS

1. Connect to main with ¾-inch tap, service line, and curb stop.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
Kupferle Foundry/Eclipse	10/99	No. 88

Ball Valve

STANDARDS

1. ASTM B-16
2. ASTM B-145

LOUDOUN WATER REQUIREMENTS

1. Ball valves listed below are for use in indoor piping, typically in association with indoor meter settings. See construction plans and Loudoun Water's standard details for applicable placement of ball valves.
2. Valves shall be solid ball type, with 100% full port configuration and straight through flow pattern. Valve shall be one-quarter (1/4) turn operation with handle.
3. Materials of construction shall be as follows.

   valve body/bonnet: brass per ASTM B-16, bronze per ASTM B-145, or steel with epoxy coating

   ball: brass or stainless steel

   seats and packing: Teflon® or nylon

   stem: brass

   handle: steel

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MANUFACTURERS AND MODELS

Company	Approval Date	Model Numbers
American Valve	1/2010	M100 and M100S Series T200 Series 2A Series
TIPCO	6/2011	
Apollo	10/2012	

WATER, SECTION 6 – MISCELLANEOUS

Manhole Frame and Cover

STANDARD

1. ASTM A 48 Standard Specification for Gray Iron Castings
2. Virginia Department of Transportation Road and Bridge Specifications
3. AASHTO M306

LOUDOUN WATER REQUIREMENTS

1. Typical application is on manhole containing an air release valve. In this application, the cover must have a vent hole. Use Standard cover where in unpaved area. Use Heavy-duty cover in pavement.
2. Dimensions and pattern shall be the same as approved for sanitary sewer. However, lettering shall be “LOUDOUN”, “LOUDOUN CO”, or “LOUDOUN COUNTY”; and “WATER”.
3. Frame and cover shall conform to AASHTO M 306 and be of gray iron meeting the requirements of ASTM A48, Class 35B.
4. Manufacturer or supplier must be listed by the Virginia Department of Transportation as participating in the Department's Gray Iron Casting Manufacturers/Distributors QA/QC Program.

MANUFACTURERS AND MODELS

Company	Approval Date
Chesapeake Foundries, Inc.	10/2005
East Jordan Iron Works, Inc.	10/99
Capitol Foundry of Virginia, Inc. (made by U.S. Foundry)	6/2009
U.S. Foundry and Manufacturing Corporation	6/2009

RECLAIMED WATER, SECTION 1 – PIPE

Plastic Pipe

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS listed for Plastic Pipe in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Plastic Pipe in WATER, SECTION 1.

3. Plastic pipe will typically be specified for general use throughout the reuse distribution.

4. See construction plans for required dimension ratio (DR). Typically DR18 or better will be specified for reclaim applications.

5. Pipe is to be purple and carry the marking "CAUTION: RECLAIMED WATER-- DO NOT DRINK" in two- to three-inch letters. Caution statement must be on opposite sides of the pipe and at intervals of three feet or less. If this caution statement is not stamped on the pipe, then apply vinyl adhesive tape with required caution statement, in accordance with the Virginia Water Reclamation and Reuse Regulation.

Ductile Iron Pipe

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS listed for Ductile Iron Pipe in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Ductile Iron Pipe in WATER, SECTION 1.

3. Pipe shall be Thickness Class 52 or higher, and have cement mortar lining.

4. Ductile iron pipe will be specified only for limited segments of the reuse distribution, typically for segments where restrained joints are needed. Typically such segments will include temporary terminus by blow-off, flushing hydrant assemblies, blow-off, through casings and vertical offsets.

5. Acceptable diameters are 4, 6, 8, 10, 12, and 16 inches.

6. In reclaim installations of ductile iron, pipe must be painted purple with approved Loudoun Water 522 Coating or wrapped with purple polyethylene encasement. Pipe must carry the marking "CAUTION: RECLAIMED WATER-- DO NOT DRINK" in two- to three-inch letters. Caution statement must be on opposite sides of the pipe at intervals of three feet or less. If

pipe is painted, or this caution statement is not stamped on the polyethylene encasement, then apply vinyl adhesive tape with required caution statement, in accordance with the Virginia Water Reclamation and Reuse Regulation.

Ductile Push-On Joints

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS listed for Ductile Push-On Joints in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Ductile Push-On Joints in WATER, SECTION 1.

Ductile Mechanical Joints

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS listed for Ductile Mechanical Joints in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Ductile Mechanical Joints in WATER, SECTION 1.

Ductile Flanged Joints

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Ductile Flanged Joints in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Ductile Flanged Joints in WATER, SECTION 1.

Restrained Joint Piping Systems

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Restrained Joint Piping Systems in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Restrained Joint Piping Systems in WATER, SECTION 1.

3. Restrained joint piping systems shall be used where specified on construction plans.

4. Restrained joint piping systems are required for installations through casings or tunnels, in conformance with Standard Detail G-12 CASING INSTALLATION.

5. Contractor shall submit project specific proposal for restrained joint piping system to Loudoun Water for review and approval. Loudoun Water reserves the right to select from the list of joints below, based upon the characteristics of the specific application.

6. Field welding of restraining components is not permitted.

Locking Gaskets

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Locking Gaskets in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Locking Gaskets in WATER, SECTION 1.

3. Locking gaskets may be used in conformance with these Standard Details:

   G-11 RESTRAINT OF VERTICAL OFFSET

   R-3 TERMINUS BY FLUSHING HYDRANT

   R-5 REUSE FLUSHING HYDRANT BELOW GRADE / R-6 REUSE FLUSHING HYDRANT ABOVE GRADE

   R-12 2” MAGNETIC METER REUSE METER

   R-13 3’, 4” OR 6”MAGNETIC METER REUSE METER IN VAULT

   R-14 REUSE SERVICE ENTRANCE WITH INDOOR METER

Threaded Nipples

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Threaded Nipples in WATER, SECTION 1 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Threaded Nipples in WATER, SECTION 1.

RECLAIMED WATER, SECTION 2 – CAST AND DUCTILE FITTINGS

Compact Ductile Iron Mechanical Joint Fittings

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Compact Ductile Mechanical Joint Fittings in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Compact Ductile Mechanical Joint Fittings in WATER, SECTION 2.

Flanged Fittings

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Flanged Fittings in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Flanged Fittings in WATER, SECTION 2.

Tangent (Offset) Tee

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Flanged Fittings in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Flanged Fittings in WATER, SECTION 2.

3. Tangent tees are required on mains of diameter 16” and larger, where blow-off flushing hydrant is specified.

Anchoring (Swivel) Fittings

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Anchoring Fittings in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Anchoring Fittings in WATER, SECTION 2.

Compact Gland (M.J. Accessory Kit)

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Compact Gland in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Compact Gland in WATER, SECTION 2.

Restraining Gland

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Restraining Gland in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Restraining Gland in WATER, SECTION 2.

Flange by Mechanical Joint Restrained Coupling

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Flange by Mechanical Joint Restrained Coupling in WATER, SECTION 2 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Flange by Mechanical Joint Restrained Coupling in WATER, SECTION 2.

RECLAIMED WATER, SECTION 3 – VALVES AND FLUSHING HYDRANTS

Resilient Wedge Gate Valve

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Resilient Wedge Gate Valve in WATER, SECTION 3 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Resilient Wedge Gate Valve in WATER, SECTION 3.

3. In buried applications, maximum size of 12", unless construction plans specify a larger gate valve. Butterfly valves are typically employed in buried applications 16" and larger.

4. Unless otherwise specified on construction plans, ends shall be mechanical joint for buried applications. Flanged ends shall be used in buildings, in vaults, and where joining to a tapping sleeve. Threaded ends used for 2" valve of blow-off assembly.

Butterfly Valve

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Butterfly Valve in WATER, SECTION 3 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Butterfly Valve in WATER, SECTION 3.

3. Minimum size of 16", unless otherwise specified on construction plans.

4. Unless otherwise specified, valves with flanged ends shall be short-body, Class 250B, per ANSI/AWWA C504.

5. Valves for bury below grade shall have mechanical joint ends, and shall be Class 250B per ANSI/AWWA C504.

6. Actuators shall rotate counter-clockwise to open.

Above Grade Flushing Hydrant

STANDARD

1. ANSI/AWWA C502 Dry-Barrel Fire Hydrants

2. ANSI/AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

LOUDOUN WATER REQUIREMENTS

1. Flushing hydrants shall conform to the standards referenced above.

2. Flushing hydrants shall be of 3-way class, with one 4½-inch pumper outlet and two 2½-inch hose outlets, all with National Standard fire hose threads. The hydrant shoe shall have at least two all bronze drain outlets. The complete interior of the shoe shall be epoxy-coated if the O-ring is in contact with cast iron. If the bottom O-ring is in contact with brass, no epoxy coating of the interior of the shoe is required. Hydrants shall be furnished with a breakaway feature that will break cleanly on the underside of the flange upon impact. This shall consist of a break flange with a breakable stem coupling. Breakable bolts will not be accepted. This break flange shall also permit 360-degree rotation of the upper barrel to orient nozzles in any desired direction.

3. **Permissible bury depths are 5', 6' and 7'. Bury depth of 4' requires installation specific approval from Loudoun Water. Bury depths in excess of 7' are strictly prohibited**.

4. Approved MANUFACTURERS AND MODELS are those listed for Fire Hydrant in WATER, SECTION 3.

Below Grade Flushing Hydrant

STANDARD

1. ANSI/AWWA C502 Dry-Barrel Fire Hydrants

LOUDOUN WATER REQUIREMENTS

1. Flushing hydrants shall conform to the standard referenced above.

2. Below grade flushing hydrants shall be of 3-way class, with one 4½-inch pumper outlet and two 2½-inch hose outlets, all with National Standard fire hose threads. The hydrant shoe shall have at least two all bronze drain outlets. The complete interior of the shoe shall be epoxy-coated if the O-ring is in contact with cast iron. If the bottom O-ring is in contact with brass, no epoxy coating of the interior of the shoe is required.

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MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Mueller Company	1/2008	A-415

Valve Box

STANDARD

1. ASTM A 48 Standard Specification for Gray Iron Castings
2. Virginia Department of Transportation Road and Bridge Specifications
3. AASHTO M 105, Class 35B

LOUDOUN WATER REQUIREMENTS

1. Boxes shall be of gray iron meeting the requirements of ASTM A48, Class 35B.
2. Two piece sliding type, unless otherwise specified on construction plans.
3. Shaft to be 5" to 5-1/4" in diameter. All boxes shall have on exterior a ledge under the ring that houses the cover. This is to allow the top section to be pulled upward. The upper section shall not have a flange at the bottom.
4. All valve boxes in reuse distribution to have square frame and cover. Cover to have raised lettering "RECLAIMED WATER".
5. For gate valve installations, provide valve box adapter, made to specific size and manufacture of valve. No adapter is required with butterfly valves.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Bingham & Taylor	10/2013	5-1/4" Heavy Weight Square Lid with 4" Skirt #56 Square Top Section, #64 Sliding Bottom Section
Adaptor, Inc.	1/2008	V-Guard Valve Box Adaptor (see Requirement 5 above)
Capitol Foundry of Virginia, Inc	1/2017	#664-RW

Air Release Valve

LOUDOUN WATER REQUIREMENTS

1. Device must be combination air release and vacuum breaker.
2. Pressure rating of 150 psi or better. Must remain closed to water pressures as little as 2 psi, while allowing air to be released.
3. 2-inch NPT threaded inlet.
4. All working parts shall be constructed of non-corroding material.
5. Approved MANUFACTURERS AND MODELS are those listed for Air Release Valve in WATER, SECTION 3.

RECLAIMED WATER, SECTION 4 – SERVICE HARDWARE

Crosslinked polyethylene (PEXa) Municipal Water Service Pipe

STANDARD

1. AWWA C904 Crosslinked polyethylene pressure pipe

LOUDOUN WATER REQUIREMENTS

1. Material shall be MUNICIPEX PEXa tubing. Approved sizes are ¾", 1", 1-1/2" and 2" diameters.

2. PEXa tubing to be used where specified by Loudoun Water.

3. Connections to pipe shall be by means of one of the following compression connectors: Mueller: 110 Type, A.Y McDonald: 'T' compression, Ford: Quick Joint or Cambridge: CB Style.

4. A plastic insert stiffener shall be used at each connection for ¾" and 1" pipe.

5. A stainless steel insert stiffener shall be used at each connection for 1-1/2" and 2" pipe.

Corporation Stop

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Corporation Stop in WATER, SECTION 5 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Corporation Stop in WATER, SECTION 5.

3. Typical service connection is 1-inch tap. The ¾-inch size is listed below for special applications, such as at sampling stations.

Meter Box

LOUDOUN WATER REQUIREMENTS

1. Where commercially available, meter boxes to be molded plastic with white or purple interior.

2. Approved MANUFACTURERS AND MODELS are those listed for Meter Box in WATER, SECTION 5.

Meter Box Frame and Cover

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Meter Box Frame and Cover in WATER, SECTION 5 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Meter Box Frame and Cover in WATER, SECTION 5.

3. All covers shall be of plastic so as to enhance reading of meter by radio frequency.

4. Frame and cover for **"Special Applications"** to be used wherever cover has been approved to be located in concrete or asphalt pavement.

Underground Meter Settings

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Connections to copper tubing by flare (except for indoor installations).

2. Inlet valve and bypass valve shall have padlock wings.

3. Angle dual check valves shall meet the following:
   - Valve should be full 1-inch, with both ¾-inch and 1-inch inlets available.
   - Outlet shall be integral to the body of the device and must be for 1-inch flare connection.
   - Total height of body shall not exceed 5½ inches, as measured from bottom of outlet (not including flare nut) to center of inlet.
   - Checks shall be two 1-inch poppets, assembled in the vertical cartridge. Access must be through the top of the device.
   - Check valve must be approved under requirements of ASSE Standard 1024.

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MANUFACTURERS AND MODELS

A. Y. McDonald Manufacturing Company

Meter Size	Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	14-2	714-2EHG	74602BY (1" x ¾" x 02)	7112-4YR 34
1"	iPERL	14-4	714-4EHG	74602BY (1" x 1" x 04)	7112-4YR44
2"	Ultrasonic installed per Standard Detail R-11	Setter 720R715WWFF775			
2"	Magnetic meter installed per Standard Detail R-12	No Rise Setter 720R700WWFF 777x402x442x8.12			

Ford Meter Box Company

Meter Size	Sensus Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	Y502	EC-23	BA92-324W	HHCA92-424
1"	iPERL	Y504	EC-4	BA92-444W	HHCA92-424
2"	Ultrasonic installed per Standard Detail R-11	Coppersetter VBB77-12HB-11-77			

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Mueller Company

Meter Size	Sensus Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	H-5020	H-14234N 3/4	B24264N 5/8x3/4x1	H14465-AN, M-98
1"	iPERL	H-5040	H-14234N 1	B24264N 1	H14465-AN, M-98
2"	Ultrasonic installed per Standard Detail R-11	Copper Meter Yoke B-2423-99000N			

Cambridge Brass

Meter Size	Sensus Meter	Yoke	Expansion Connector	Angle Valve	Dual Check
3/4" Short	iPERL	460-2	430NL-3	210NL	500NLSR
1"	iPERL	460-4	430NL-4	210NL	500NLSR
2"	Ultrasonic installed per Standard Detail R-11	Meter Setter 6020NL-715F7F7-UUHB5 with idler			

Indoor Meter Settings

STANDARD

1. ANSI/AWWA C800 Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. This section lists components required for meter settings approved by Loudoun Water to be made in accordance with these Standard Details:

   R-15 3/4" OR 1" REUSE METER INDOORS

2. For ¾-inch or 1-inch meter, the inlet and outlet meter valves may be straight through or angle configuration.

3. Connections to customer's plumbing may be by threads, pack joint, or compression. Valves listed below with pack joint or compression inlets are for use on copper tubing (CTS outside dimensions). For connections to other pipe types, consult distributor.

4. Inlet valve and bypass valve (if any) shall have padlock wings.

5. Approved MANUFACTURERS AND MODELS are those listed for Indoor Meter Settings in WATER, SECTION 5.

Double Check Backflow Prevention Assembly for Service Line Protection

STANDARD

1. ASSE 1015 Double Check Backflow Prevention Assembly

LOUDOUN WATER REQUIREMENTS

1. Any double check assembly meeting ASSE 1015 is acceptable. A partial list of examples is provided for reference.

2. For services using a 1-1/2" or larger meter and for fire lines, a backflow prevention assembly must be provided where the service line enters the structure. A reduced pressure zone device may be required in applications with fixtures of higher risk. Consult Loudoun Water's Backflow Prevention Specialist to determine the required type of device for specific applications.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Sizes
FEBCO	10/99	856	2½" - 10"
Watts	10/99	007	¾" – 3"
Watts	10/99	709	¾" – 10"
Zurn Wilkins	10/99	950 XLT 950, 950L	¾" – 2" 2½" – 10"
Zurn Wilkins	10/99	350	4" – 6"

Reduced Pressure Backflow Prevention Assembly for Service Line Protection

STANDARD

1. ASSE 1013 Reduced Pressure Backflow Prevention Assembly.

LOUDOUN WATER REQUIREMENTS

1. Any reduced pressure backflow prevention device meeting ASSE 1013 is acceptable. A partial list of examples is provided for reference.

2. For services using a 1-1/2" or larger meter and for fire lines, a backflow prevention assembly must be provided where the service line enters the structure. A reduced pressure zone device may be required in applications with fixtures of higher risk. Consult Loudoun Water's Backflow Prevention Specialist to determine the required type of device for specific applications.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Sizes
FEBCO	10/99	860	2½" - 10"
Watts	10/99	Series 909	¾" – 3"
Watts	10/99	Series 009	½" – 3"
Zurn Wilkins	10/99	975MS & 975BMS	2½" – 10"
Zurn Wilkins	10/99	975	2½" – 10"

Curb Stop

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Curb Stop in WATER, SECTION 5 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Curb Stop in WATER, SECTION 5.

3. In air release assembly, use threaded connections and provide handle.

Curb Stop Box

LOUDOUN WATER REQUIREMENTS

1. Material shall conform to the STANDARDS and all applicable REQUIREMENTS, listed for Curb Stop Box in WATER, SECTION 5 of this list.

2. Approved MANUFACTURERS AND MODELS are those listed for Curb Stop Box in WATER, SECTION 5.

Sampling Station

LOUDOUN WATER REQUIREMENTS

1. Sampling station components to be stainless steel.

2. Enclosure of sampling station to be purple.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
Kupferle Foundry	10/99	Eclipse #88-SS

RECLAIMED WATER, SECTION 5 – MISCELLANEOUS

Manhole Frame and Cover

STANDARD

1. ASTM A 48 Standard Specification for Gray Iron Castings
2. Virginia Department of Transportation Road and Bridge Specifications
3. AASHTO M306

LOUDOUN WATER REQUIREMENTS

1. Typical application is on manhole containing an air release valve. In this application, the cover must have a vent hole. Use Standard cover where in unpaved area. Use Heavy-duty cover in pavement.
2. Dimensions and pattern shall be the same as approved for sanitary sewer. However, lettering shall be "LOUDOUN", "LOUDOUN CO", or "LOUDOUN COUNTY"; and "REUSE", "RECLAIM", or "RECLAIMED".
3. Frame and cover shall conform to AASHTO M 306 and be of gray iron meeting the requirements of ASTM A48, Class 35B.
4. Manufacturer or supplier must be listed by the Virginia Department of Transportation as participating in the Department's Gray Iron Casting Manufacturers/Distributors QA/QC Program.

MANUFACTURERS AND MODELS

Company	Approval Date
Chesapeake Foundries, Inc.	10/2005
East Jordan Iron Works, Inc.	10/99
Capitol Foundry of Virginia, Inc. (made by U.S. Foundry)	6/2009
U.S. Foundry and Manufacturing Corporation	6/2009

Purple Coating

LOUDOUN WATER REQUIREMENTS

1. Paint must be tinted to Pantone 522 (purple) color.
2. Use only paints listed below.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Rustoleum	10/2016	Safety Purple

Dye for Testing

LOUDOUN WATER REQUIREMENTS

1. Dye for testing must be red in color, fluorescent and NSF certified as non-toxic.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Presto Dye Chemical	10/2012	
Bright Dyes	10/2012	FWT Red; 200 intensity 1 pint/2500 gallons of pipe volume

SEWER, SECTION 1 - PIPE

Plastic Pipe

STANDARDS

1. ANSI/AWWA C900-16 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 12 In. (100 mm Through 1,500 mm), For Water Distribution

2. ANSI/AWWA C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), For Water Distribution

LOUDOUN WATER REQUIREMENTS

1. Pipe shall conform to one of the above standards.

2. Pipe subject to gravity flow shall have a dimension ratio (DR) of 25 or better. DR 18 may be specified on construction plans for deep or shallow installations. For diameters larger than 36 inch, dimension ratios higher than 25 will be considered on a project specific basis.

3. For pressure applications, see construction plans for dimension ratio (DR).

4. Acceptable diameters are 4, 6, 8, 10, 12, 16, 20, 24, 30, 36, 42, and 48 inches.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
IPEX, Inc.	10/1999	
National Pipe & Plastics, Inc.	10/1999	
Rehau	10/1999	AQUALOC
Royal Pipe Systems	10/1999	
Diamond Plastics Corporation	10/1999	
North American Pipe Corporation	10/1999	

Ductile Iron Pipe

STANDARDS

1. ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.

2. ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

LOUDOUN WATER REQUIREMENTS

1. Ductile iron is not used for Loudoun Water's gravity sewer installations. Ductile may be specified for sanitary force main and in pumping stations or treatment works. Consideration of ductile iron will be on a project specific basis.

2. Pipe shall conform to the above standards, and be Thickness Class 52 or higher. Pipe shall be clearly marked for "SEWER USE".

3. Lining to be ceramic epoxy, PROTECTO 401.

4. Joint shall be push-on bell and spigot type.

5. Acceptable diameters shall be 4, 6, 8, 10, 12, 16, 20, 24, 30, 36, 42, 48 and 54 inches.

MANUFACTURERS AND MODELS

Company	Approval Date
American Ductile Iron Pipe Co.	10/1999
Atlantic States/Clow/McWane	10/1999
U. S. Pipe	10/1999

Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe

STANDARDS

1. ASTM D 3262

LOUDOUN WATER REQUIREMENTS

1. May be specified for gravity sewers in large diameters. Consideration to specifying this type of pipe will be given on a project specific basis.

2. Manholes are to be concrete with circular, square, rectangular, or trapezoidal bases.

MANUFACTURERS AND MODELS

Company	Approval Date
Hobas Pipe USA	10/2012

Service Pipe and Fittings

STANDARDS

1. See preceding pages of SEWER, SECTION 1 for standards applied to Plastic Pipe, Ductile Iron Pipe, and Ductile Iron Pipe Joints. See the following SEWER, SECTION 2 for standards applied to Plastic Fittings and Ductile Iron Fittings.

2. ASTM D3034, Type PSM Polyvinyl Chloride Sewer Pipe and Fittings, 4" through 15"

LOUDOUN WATER REQUIREMENTS

1. Lateral spurs shall be PVC conforming to AWWA C900-16 and of same dimension ratio (DR) as associated main, except where otherwise specified on construction plans.

2. Where cover is insufficient (typically less than four feet), lateral spurs may be specified as Ductile Iron, Class 52, lined for sewer service.

3. Building sewers (upstream of lateral spurs) shall be as follows:

4. In all multi-family residential, commercial, institutional, and industrial applications, building sewers to be PVC DR 25 conforming to AWWA C900-16.

5. Beyond easement, public right-of-way and pavement, building sewers serving single family residences may transition to PVC SDR35, conforming to ASTM D3034.

MANUFACTURERS AND MODELS

Refer to preceding pages in SEWER, SECTION 1 for approved manufacturers of Plastic and Ductile Iron Pipe; and SEWER, SECTION 2 for approved manufacturers of Plastic and Ductile Iron Fittings.

Pipe conforming to ASTM D 3034 SDR 35 and corresponding fittings are not for Loudoun Water's ownership, and manufacturers are not listed.

Pipe and Fittings for Low Pressure Collection

STANDARDS

1. ASTM D1785, Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120
2. ASTM D2241, Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
3. ASTM D2564, Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems
4. ASTM D3139, Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

LOUDOUN WATER REQUIREMENTS

1. Pipes and fittings of 4 inch diameter shall be polyvinyl chloride, per ASTM D2241 (Class 12454-B PVC), with integral bell end and steel pipe (IPS) outside dimensions. Dimension ratio shall be SDR 17 or better.
2. Pipe and fittings 2 inches through 3 inches shall be polyvinyl chloride, per ASTM D2241 (Class 12454-B PVC), with integral bell end and steel pipe (IPS) outside dimensions. Dimension ratio shall be SDR 17 or SDR 21.
3. Pipe joints 4 inch through 2 inches shall be push-on, per ASTM D3139, and pipe/fitting joints shall be push-on or compression/mechanical type, per ASTM D3139, except where solvent cement joints are required.
4. Sizes 1½ inches and 1-1/4 inches shall meet requirements of ASTM D1785. Pipe shall be Schedule 40 (Class 12454-B PVC), and fittings shall be Schedule 80. Joints shall be for solvent cement.
5. Solvent cement joints shall meet the requirements of ASTM D2564, and shall be appropriate solvent for the pipe materials.

MANUFACTURERS AND MODELS

Refer to preceding pages in SEWER, SECTION 1 for approved manufacturers of Plastic Pipe, and to SEWER, SECTION 2 for approved manufacturers of fittings.

SEWER, SECTION 2 – FITTINGS

Plastic Fittings for Gravity Collection Systems

STANDARDS

1. ANSI/AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In., for Water Transmission and Distribution

2. ANSI/AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. through 12 In., for Water, Wastewater, and Reclaimed Water Service

LOUDOUN WATER REQUIREMENTS

1. Injection molded fittings shall be used in lieu of fabricated fittings wherever commercially available (presently for all applications 12-inch and smaller).

2. Molded fittings shall conform to ANSI/AWWA C907 and have moderate insertion force required for assembly, such that installation by hand with block and bar is practical.

3. Fabricated Fittings for use with C905 pipe in gravity sewer applications shall be manufactured for pressure use, conforming fully to AWWA C905.

MANUFACTURERS AND MODELS

Company	Approval Date	Conditions of Approval
HARCO	9/1998	
IPEX, Inc./Multi Fittings	3/2001	
Specified Fittings	11/2000	

Inside Drop Connection

LOUDOUN WATER REQUIREMENTS

1. Inside drop connection for use only where specified and approved by Loudoun Water. For mainline drop, use drop connection filling. Drop bowls limited to service connections, unless otherwise specified by Loudoun Water.

MANUFACTURERS AND MODELS

Company	Approval Date	Model	Conditions of Approval
HARCO	9/1998	C900-16 Drop Fitting	
RELINER/ Duran Inc.	1/2010	Inside Drop Bowl	Use on service connections only

Compact Ductile Iron Flanged and Mechanical Joint Fittings

STANDARDS

1. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings for Water Service

LOUDOUN WATER REQUIREMENTS

1. Ductile iron fittings are not used for Loudoun Water's gravity sewer installations. Ductile may be specified for sanitary force main, in pumping stations, or in treatment works. Consideration of ductile iron will be on a project specific basis.
2. Fittings shall conform to the standard listed above.
3. Lining to be ceramic epoxy, PROTECTO 401.
4. Minimum Pressure Class 350 in diameters 3"-24", and Class 250 in diameters 30"-48".
5. Bolts and nuts shall be in accordance with AWWA C111.
6. Fitting design shall prevent T-head bolts from rotating.
7. All sleeves shall be long pattern unless otherwise approved by Loudoun Water.
8. Approved MANUFACTURERS AND MODELS are those listed for Compact Ductile Mechanical Joint Fittings and for Flanged Fittings in WATER, SECTION 2.

Bell Harness for Restraint of PVC through Casing

LOUDOUN WATER REQUIREMENTS

1. Harness must consist of two serrated clamps, joined with threaded rods. Clamps must provide a two-directional grip on the outside of the pipe, and must no rely on the pipe bell to accomplish the restraint. Eyes receiving bolts must allow for rods have **nuts on both sides of eye**, so as to prevent both joint separation and over insertion.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
EBAA, Inc.	10/2016	1500 Series (sizes 4" to 12") 1100HV Series (sizes 14" to 30")
Star Pipe Products	10/2016	Series 1100
Sigma	10/2016	PV-LOK™ Model PWP

Tapping Saddles for Gravity Service Connection

LOUDOUN WATER REQUIREMENTS

1. Saddle shall have cast iron body with watertight gasket sealing to existing main. Saddle must incorporate an alignment flange that protrudes into the tapping hole. Saddle to clamp to existing main with a stainless steel band and stainless steel fasteners. Saddle must incorporate a PVC hub to receive C900-16 PVC pipe. Hub to be joined to cast iron with two part urethane adhesive.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
General Engineering Company (GENECO)	10/99	SEALTITE TEE® F-90

Tapping Saddles for Low Pressure Collection

LOUDOUN WATER REQUIREMENTS

1. Saddle to be stainless steel band.
2. Nuts and bolts shall be stainless steel.
3. Use with applicable ball corporation stop. See WATER, SECTION 5-SERVICE HARDWARE for approved manufacturers of corporation stops.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
Smith Blair	1/2010	372 Service Saddles
Romac	1/2010	Style 306 Service Saddle

Transition Coupling for PVC to ACP (Asbestos Cement Pipe)

LOUDOUN WATER REQUIREMENTS

1. Coupling to have ductile iron body with epoxy coating. Body to be long pattern. Nuts and bolts shall be stainless steel.

2. Make field measurement of outside diameter of existing pipe as basis for ordering coupling.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
Smith Blair	1/2013	442 Series with stainless bolts

Transition Coupling for Cast Iron Soil Pipe to PVC

LOUDOUN WATER REQUIREMENTS

1. Coupling to have ductile iron body with epoxy coating. Body to be long pattern. Nuts and bolts shall be stainless steel.

2. Make field measurement of outside diameter of existing pipe as basis for ordering coupling.

3. Prior to the introduction of PVC with C900-16 cast iron outside dimensions as Loudoun Water's preferred material for gravity sewer, service spurs were typically made of Extra Heavy Cast Iron (XHCI). Older services of 4-inch, 5-inch and 6-inch diameters may be encountered. At point of connection to new work, transition will typically be to PVC with IPS outside dimensions (Schedule 40), to start with a Schedule 40 test tee. Where 5-inch XHCI is encountered, recommended transition is by means of XHCI 5"x4" reducer, followed by a section of 4-inch XHCI. Then transition to PVC can be made using the coupling listed below.

4. Prior to the introduction of PVC as the typical material for private building sewer, services were typically made of Service Weight Cast Iron. At point of connection to new work, transition will typically be to PVC with IPS outside dimensions (Schedule 40), to start with a Schedule 40 test tee. In residential applications, transition from PVC Schedule 40 to PVC SDR 35 may be made by means of a glue bushing in Schedule 40 bell.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
Smith Blair	1/2013	442 Series with stainless bolts

SEWER, SECTION 3 – PRE-CAST STRUCTURES

Manhole

STANDARDS

1. ASTM C478/AASHTO M199 Precast Reinforce Concrete Manhole Sections.
2. ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement.
3. ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
4. VDOT Road and Bridge Specifications, Sections 105 and 302.
5. ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets

LOUDOUN WATER REQUIREMENTS

1. Design to be sealed by Professional Engineer licensed in the Commonwealth of Virginia. Upon request, provide buoyancy calculations for review and approval by Loudoun Water.
2. **For all manholes greater than 5' in diameter, any manhole containing a reducing slab, all vaults, junction boxes, wet wells and structures with protective linings, provide project specific materials submittal for review and approval by Loudoun Water.**
3. Manholes to be in accordance with applicable Standard Details. Approved protective linings to be included where specified on the project's construction plans.
4. Concrete to be minimum 4,000 psi compressive strength at 28 days. Each component must be monolithic. No cold joints permitted within a piece. Base must be wet cast.
5. Unless otherwise specified, inside diameter of manhole to be 4 feet for pipes less than or equal to 24-inch; 5 feet for pipes larger that 24-inch.
6. Joints shall be made watertight with a gasket in accordance with ASTM C443.
7. Base section to be 3 feet high minimum, unless overall height of structure requires use of shorter base. Minimize number of riser sections.
8. Provide a minimum of 6 inches between pipe penetrations. Provide a minimum of 6 inches between pipe penetrations and manhole joints.
9. Rungs shall be polypropylene reinforced with steel bar. Treads are to be a minimum width of ten and three quarter inches, with no slip surface and side lugs. Rungs are to be vertically aligned at 12 inch or 16 inch spacing.
10. Pipe penetrations to be provided with approved connectors.

MANUFACTURERS AND MODELS

Company	Approval Date
Concrete Pipe & Precast, LLC (formerly Americast and Hanson Pipe & Precast, Ltd.)	10/1999
Contractors Precast Corporation	10/1999
Winchester Building Supply	8/2013

Pipe/Structure Connector

STANDARDS

1. ASTM C-923 Resilient Connectors between Concrete Manhole Structures and Pipes.

LOUDOUN WATER REQUIREMENTS

1. Connectors must conform to the above standard.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number	Conditions of Approval
A-Lok Products, Inc.	10/1999	A-LOK® PREMIUM	>12-inch pipe
International Precast Supply	11/2000	Adjustable Style, Toggle Style	
NPC, Inc.	10/1999	Kor-N-Seal I and II	
Press-Seal Gasket Corporation	10/1999	PSX: Positive Seal & Series 6, Press Boot	
	6/2008	PSX Direct Drive	

Concrete Protective Linings and Coatings

LOUDOUN WATER REQUIREMENTS

1. Loudoun Water will specify the acceptable lining or coating system for the specific application. Linings will be specified in new manhole installations. Coatings will be specified to protect existing structures. Coatings may also be specified in a new wet well, grinder chamber, or similar wastewater structure.

2. System shall be resistant to deterioration due to hydrogen sulfide (H2S) and its by-products. System shall include provisions to protect concrete at all discontinuities, including joints, pipe penetrations, seams, and entryways. System shall not rely on weep holes to relieve hydraulic pressure from the exterior of the structure.

3. Protective linings shall:

   - have extensions to provide for mechanical bond to concrete through positive embedment.

   - have minimum thickness of 2 mm.

4. Protective coatings to be applied in accordance with manufacturer's recommendations, including surface preparation as specified.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Protective Linings		
Agru		Sure Grip
Protective Coatings		
Raven Lining Systems	4/2000	Epoxy Coatings
TNEMEC Series 436 Perma-Shield FR	9/2018	Epoxy Coatings
Belzona	12/1999	Polymer Coating
Poly Coating Solutions	1/2017	Versaflex 50 DM Polyurea Coating System

Manhole Chimney

LOUDOUN WATER REQUIREMENTS

1. Chimney seals:
    - Shall be furnished where watertight cover is specified on plans.
    - Shall be constructed of corrosion resistant materials.
    - May be installed on interior or exterior.
    - Shall accommodate initial height adjustment.
    - Shall be installed per manufacturer's recommendations.
2. Adjustment rings:
    - Shall be constructed of precast concrete, HDPE or rubber.
    - On site brick, block, and mortar construction shall not be permitted in lieu of rings.
3. Chimney seals may not be used to compensate for deficient or damaged masonry or grade rings.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
A-Lok Products		GNR Road Maximizer
Canusa		Wrapid Seal
Cretex Specialty Products		Chimney Seal
Ladtech, Inc.		HDPE Adjusting Ring

Precast Concrete Above-Ground Structures

STANDARDS

1. ACI 318 Building Code Requirements for Reinforced Concrete
2. CRSI Manual of Standard Practice
3. ANSI Building Code Requirements for Minimum Design Loads in Buildings and Other Structures

LOUDOUN WATER REQUIREMENTS

1. Building size, configuration, and accessories will be project specific. A materials submittal for each structure must be reviewed and approved by Loudoun Water.
2. Walls, floor, and roof shall be concrete, with architectural treatment.
3. Concrete to be 4000 psi minimum, steel reinforced.
4. Roof shall have a 3-inch overhang, sloped, with drip edge.
5. Doors shall be 1-3/4 inches thick, 18-gauge steel, painted, with locking hardware keyed to Loudoun Water standard.
6. Vents shall be 8 inches by 16 inches, with screen, all of aluminum. A minimum of two vents are required.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Americast/The Clear Flow Company	10/1999	Stonewall
Smith Midland	10/1999	Easi-Set Precast Building

SEWER, SECTION 4 – FRAMES AND COVERS

Manhole Frame and Cover

STANDARDS

1. ASTM A 48, Gray Iron
2. AASHTO M306, Standard Specifications for Drainage Structure Castings
3. Virginia Department of Transportation Road and Bridge Specification

LOUDOUN WATER REQUIREMENTS

1. Manufacturer or supplier must be listed by the Virginia Department of Transportation as participating in the Department's Gray Iron Casting Manufacturers/Distributors QA/QC Program.
2. All frames and covers shall conform to AASHTO M306 including proof load test, and shall be cast of Class 35 iron per ASTM A 48.
3. Manufacturer's name, date, heat number, place of origin, and applicable AASHTO and ASTM standards shall show on flange of frame and on underside of cover. All frames and covers shall be shipped clean and unpainted and shall have machined bearing surfaces.
4. The approved patterns listed below incorporate the following features and dimensions:
    - All frames provide a 24-inch diameter clear opening. Each cover is 25-3/4 inches in diameter, and rests in a seat of 26 inches in diameter.
    - All frames are 8 inches high, have a flange of 36-inch outside diameter, have four (4) 7/8-inch-diameter holes (for fastening to manhole), and have two (2) tapped holes to receive 5/8"-11 bolts (for fastening cover). Patterns with minor variations in height and flange diameter may be approved.
    - All covers are 1-inch thick and have diamond, non-skid surface. Covers feature 1½-inch high lettering with text "LOUDOUN", "LOUDOUN CO", or "LOUDOUN COUNTY"; and "SEWER". If construction plans call for private sewer, text to be "PRIVATE SEWER".
    - Standard cover includes two (2) 5/8-inch recessed hex head stainless steel bolts (with rubber gaskets and stainless steel washers), and have one (1) 1-inch vent hole.
    - Heavy-duty cover weighs 150 pounds minimum, and includes two (2) closed pick holes and one 1-inch vent hole.

- Watertight cover includes ¼-inch O-ring gasket, bonded to frame; two (2) 5/8-inch recessed hex head stainless steel bolts (with rubber gasket and stainless steel washers); and two (2) stainless steel lift bar slots.

MANUFACTURERS AND MODELS

Furnish Heavy-duty cover for all manholes in streets and other pavements. Furnish Standard cover for manholes in unpaved areas. Furnish watertight cover on all manholes in floodplain, or where so specified on construction plans.

Company	Approval Date	Style of Cover	Model Numbers
Chesapeake Foundries, Inc.	new patterns 12/2013 10/2005	Heavy-duty	LD24
		Standard	LD24E
		Watertight	LD24WT
East Jordan Ironworks, Inc.	10/1999	Heavy-duty	2028C
		Standard	2028CPT
		Watertight	2028APT
Capitol Foundry of Virginia, Inc. (made by U.S. Foundry)	6/2009	Heavy-duty	MH-247*
		Standard	MH-247*VP
		Watertight	MH-247*WT
U.S. Foundry and Manufacturing Corporation	6/2009	Heavy-duty	215 PU
		Standard	215 PV

		Watertight	215 PW

Cleanout Frame and Cover

STANDARDS

1. ASTM A48 Gray Iron

LOUDOUN WATER REQUIREMENTS

1. Frame and cover shall be Class 30 or better iron per ASTM A 48. Frame to be 8 inches high and designed with cover to withstand H-20 truck load without damage to plastic cleanout.
2. Covers shall have a non-skid surface, lettering of "S" or "Sewer", and two closed pick holes.
3. Manufacturer's name and date shall appear on both frame and cover.
4. Frame and cover shall comply with Loudoun Water's Standard Details.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
Bingham & Taylor	10/2013	
Capitol Foundry of Virginia, Inc.	10/1999	VB-9S
Geneco Products	10/1999	CC-6
Drainage & Water Solutions	8/2013	SC40 for 4" pipe
		SC60 for 6" pipe
Sigma	2/2017	MBX3491 cover in MBX3492 frame

SEWER, SECTION 5 – VALVES

Resilient Wedge Gate Valve

STANDARDS

1. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
2. ANSI/AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
3. ANSI/AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

LOUDOUN WATER REQUIREMENTS

1. Gate valves shall conform to either standard 1 or 2 above. All gate valves shall be lined and coated per standard 3 above.
2. In buried applications, gate valves are to be specified, unless height of bonnet cannot be accommodated. Plug valves may be necessary for buried applications where cover on pipeline cannot accommodate a gate valve's bonnet.
3. Unless otherwise specified on construction plans, ends shall be mechanical joint for buried applications. Flanged ends shall be used in buildings and vaults.
4. Fasteners exposed to backfill (not including those of the mechanical joint ends) must be T304 Stainless Steel.
5. Valve shall have non-rising stem with O-ring seals.
6. Counter-clockwise rotation of operating nut to open. Operator to be 2-inch square nut for underground installations; with hand wheel in all buildings and vaults.

Continued on Next Page

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
American Flow Control	7/2000	Series 2500
Clow/Kennedy/M &H	10/1999	
Mueller Co.	3/1999	A-2360 Series A-2361 Series
	3/2005	Aqua-Grip™ System
U. S. Pipe (by Mueller Co.)	2008	A-USPO
J&S Valve	6/2011	Limited Approval for Use May be included in specifications throughout all service areas, where in plant, station and vault applications.

Plug Valve

STANDARDS

LOUDOUN WATER REQUIREMENTS

1. Plug valves shall be specified primarily for applications in buildings and vaults, where special considerations preclude the accommodation of gate valves. Plug valves may be specified in underground applications, where cover on pipeline cannot accommodate a gate valve's bonnet.

2. Plug valves are also for use in low pressure collection systems in sizes 2-inch and larger.

3. Valve ends for buried applications shall be mechanical joint, in sizes 3-inch and larger, and threaded in 2-inch. Flanged ends shall be used in buildings and vaults.

4. Fasteners exposed to backfill (not including those of the mechanical joint ends) must be T304 Stainless Steel.

5. Eccentric plug valves shall be suitable for raw sewage, with full port configuration and straight through flow pattern.

6. Design working pressure shall be 150 psi.

7. Materials of construction shall be as follows:
   - Valve Body: Ductile Iron or Gray Iron
   - Plug: Resilient Faced
   - Valve Seats: Nickel
   - Bearings: Stainless Steel

MANUFACTURERS AND MODELS

Company	Approval Date	Model Name/Number
DeZurik	10/99	
Mueller/Pratt	10/99	
Clow	11/2003	
Val-Matic	4/2010	
VAG USA LLC (formerly GA Industries)	1/2014	

Ball Valve for Low Pressure Collection

STANDARDS

1. AWWA C800, Underground Service Line Valves and Fittings

LOUDOUN WATER REQUIREMENTS

1. Ball valves in size 1-1/2 inch are specified in low pressure wastewater collection systems.
2. With each valve, furnish 5-1/4" cast iron roadway box with arched bottom, model number CUL5B64SARC by Bingham & Taylor or approved equal. Cover to be marked "SEWER".
3. Valves shall be ball type, with full port configuration and straight through flow pattern. Valve shall be for buried service, one-quarter (1/4) turn operation through valve box. Valve ends shall be threaded.
4. Materials of construction shall be as follows:
   - Valve Body: Bronze
   - Ball: Brass, Fluorocarbon-Coated
   - Seals: Buna-N O-Rings

MANUFACTURERS AND MODELS

Company	Approval Date	Model Numbers
Ford Meter Box Company	10/99	Series B11
Mueller Company	10/99	B-20200
A.Y. McDonald	10/99	6101 Series

In-Line Check Valve for Low Pressure Collection

LOUDOUN WATER REQUIREMENTS

1. For use in service branch of low pressure wastewater collection systems.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Numbers
Environment One	10/2012	1-1/4" Uni-Lateral Stainless Steel Lateral Valve: NA0330P04 --includes ball valve, check valve, access port, and SCH 80 adapters

Combination Air Valve

STANDARDS

LOUDOUN WATER REQUIREMENTS

1. Valve to have stainless steel body.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Numbers
A.R.I.	10/99	D-020 Stainless Steel comparable valve by A.R.I to be specified where a combination device is not appropriate

Ball Float Check Valve

STANDARDS

LOUDOUN WATER REQUIREMENTS

1. For use in vents of manholes where below 100-year water surface elevation.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Numbers	Conditions
JOSAM	10/99	67100A Series	
J R Smith	1/2010	Model #7080	
Wager	7/2015		Conditional Approval

SEWER, SECTION 6 – PRE-TREATMENT DEVICES

Concrete Grease Interceptors

STANDARDS

1. ACI 318 Building Code Requirements for Reinforced Concrete.
2. ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement.
3. ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
4. ASTM C858 Standard Specification for Underground Precast Concrete Utility Structures.
5. ASTM C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water or Wastewater Structures.

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal must be reviewed and approved by Loudoun Water for each installation**.
2. Shop drawings and design calculations to be sealed by a Professional Engineer licensed in the Commonwealth of Virginia. Design shall meet AASHTO H-20 loading criteria.
3. Concrete mix shall provide minimum 4,000 psi compressive strength at 28 days.
4. Joints not permitted below liquid level, except in units of 3,500 gallons and larger.
5. Joints to be interlocking type, made watertight by means of O-ring gasket or butyl rubber. Additionally, joints below liquid level to be provided with approved joint wrap on exterior.
6. Pipe penetrations must employ approved connectors (see SEWER, SECTION 3, PIPE/STRUCTURE CONNECTOR). Provide a minimum separation of 6 inches between pipe penetrations and joints.
7. The interceptor shall be partitioned and piped to provide at least two (2) skimming chambers.
8. The interceptor shall be vented to allow for air flow through the unit.
9. An effluent sampling port of 8 inch diameter shall be provided at the exit pipe of each interceptor, where effluent can be collected prior to combining with untreated flows.

10. Each compartment must have sufficient access for cleaning and maintenance. Access risers to be of watertight construction, and have minimum 24 inch diameter for shallow bury. Where top of unit will have more four feet of cover, access riser to be minimum 30 inches in diameter, with interlocking joints. Provide cast iron frames and covers labeled "S" or "SEWER".

MANUFACTURERS AND MODELS

Grease interceptors are owned and maintained by the owner of the building served. The owner is responsible for selecting an interceptor suited to the volume of flow and concentration of fats, oil and grease that the building will generate.

In accordance with Chapter 1064 of Loudoun County Ordinance, the building's owner is responsible for conducting routine cleaning and maintenance of the interceptor, and must ensure that discharges to the public collection system do not contain fats, grease and oils in concentrations above 100 parts per million.

Shop drawings and basis for sizing of each device must be submitted for review and approval by Loudoun Water, to ensure that it is appropriate for the intended application.

Among interceptors that are routinely specified are those listed below. Where the building's owner requests a device that is suited to the application, but is not listed below, Loudoun Water will consider the owner's selected interceptor.

Company	Approval Date	Model Name/Number
Clear Flow by CP&P	10/99	
Mayer Bros., Inc.	9/2007	1000 TRLCSA 1500 TRLCSA 2000 TRLCSA 2500 TRLCSA 3000 TRLCSA
Hanover Precast	7/2013	1000, 1500, 2000, 2500 and 3000 gallon H20 Top Load Rating, Loudoun Grease Trap Offset Baffle Limited to a maximum cover of 4 feet.

Fiberglass, Polyethylene, or Steel Grease Interceptors

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal must be reviewed and approved by Loudoun Water for each installation**.

2. All interceptor installations shall meet AASHTO H-20 loading criteria, regardless of the interceptor's location on the site. Where a concrete slab and/or specific bedding and backfill are needed to attain this load rating, the manufacturer of the interceptor shall provide such specifications. Shop drawings and design calculations, sealed by a licensed Professional Engineer and demonstrating adequacy under traffic loading, shall be furnished to Loudoun Water upon request.

3. Pipe penetrations must be watertight, and allow joining to pipe with fittings, and without the use of rubber coupling or no-hub band.

4. The interceptor shall be partitioned and piped to provide at least two (2) skimming chambers.

5. The interceptor shall be vented to allow for air flow through the unit.

6. An effluent sampling port of 8 inch diameter or larger shall be provided at the exit pipe of each interceptor, where effluent can be collected prior to combining with untreated flows.

7. Each compartment must have sufficient access for cleaning and maintenance. Access risers to be of watertight construction, and have minimum 24 inch diameter for shallow bury. Where top of unit will have more four feet of cover, access riser to be minimum 30 inches in diameter, with interlocking joints. Provide cast iron frames and covers labeled "S" or "SEWER".

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MANUFACTURERS AND MODELS

Grease interceptors are owned and maintained by the owner of the building served. The owner is responsible for selecting an interceptor suited to the volume of flow and concentration of fats, oil and grease that the building will generate.

In accordance with Chapter 1064 of Loudoun County Ordinance, the building's owner is responsible for conducting routine cleaning and maintenance of the interceptor, and must ensure that discharges to the public collection system do not contain fats, grease and oils in concentrations above 100 parts per million.

Shop drawings and basis for sizing of each device must be submitted for review and approval by Loudoun Water, to ensure that it is appropriate for the intended application.

Among interceptors that are routinely specified are those listed below. Where the building's owner requests a device that is suited to the application, but is not listed below, Loudoun Water will consider the owner's selected interceptor.

Company	Approval Date	Model Name/Number
Green Turtle Americas Ltd./ Proceptor™	11/2002	GMC 500-LCSA, GMC 1000-LCSA, GMC 1500(1)-LCSA, GMC 1500(2)-LCSA, GMC 2000-LCSA
Containment Solutions	10/99	
Highland Tank	10/2013	

Oil-Water-Grit Interceptors

STANDARDS

1. ACI 318 Building Code Requirements for Reinforced Concrete.
2. ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement.
3. ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
4. ASTM C858 Standard Specification for Underground Precast Concrete Utility Structures.
5. ASTM C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water or Wastewater Structures.

LOUDOUN WATER REQUIREMENTS

1. **A project specific materials submittal must be reviewed and approved by Loudoun Water for each installation**.
2. Oil-water separator design shall incorporate coalescing plates or similar technology. Devices shall be designed and proven to produce effluent with 15 parts per million or less free oil, under normal operating conditions. Normal operating conditions consist of influents containing oils of 0.90 or lighter specific gravity, up to 20 percent (200,000 ppm) oil content in the water, and temperatures of 40° to 140° F.
3. Grit collectors shall be designed to remove sand, gravel, cinders, or other heavy solid materials that have specific gravities substantially greater than typical organic solids in wastewater. Grit collectors shall be designed with adequate access for maintenance/cleaning.
4. Shop drawings and design calculations to be sealed by Professional Engineer licensed in the Commonwealth of Virginia. Design shall meet AASHTO H-20 loading criteria.
5. Pipe penetrations must employ approved connectors.
6. The interceptor shall be vented to allow for air flow through the unit.
7. An effluent sampling port of 8 inch diameter or larger shall be provided at the exit pipe of each interceptor, where effluent can be collected prior to combining with untreated flows.
8. Joints to be interlocking type, made watertight by means of O-ring gasket or butyl rubber. Joints not permitted below liquid level.
9. If made of concrete, mix shall provide minimum 4,000 psi compressive strength at 28 days.

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10. If made of steel, provide coating and galvanic protection against corrosion.

11. Each compartment must have sufficient access for cleaning and maintenance. Access risers to be of watertight construction, and have minimum 24 inch diameter for shallow bury. Where top of unit will have more four feet of cover, access riser to be minimum 30 inches in diameter, with interlocking joints.

MANUFACTURERS AND MODELS

Oil and grit interceptors are owned and maintained by the owner of the building served. The owner is responsible for selecting an interceptor suited to the volume of flow and concentration of oil and grit that the building will generate. The owner is responsible for conducting routine cleaning and maintenance of the interceptor.

Project specific shop drawings and basis for sizing of each device must be submitted for review and approval by Loudoun Water.

Among interceptors that are routinely specified are those listed below. Where the building's owner requests a device that is suited to the application, but is not listed below, Loudoun Water will consider the owner's selected interceptor.

Company	Approval Date	Model Name/Number
Green Turtle Americas Ltd./ Proceptor™	11/2002	OMC 500-LCSA, OMC 1000-LCSA, OMC 1500(1)-LCSA, OMC 1500(2)-LCSA, and OMC 2000-LCSA
Containment Solutions	10/99	
Clear Flow by CP&P	10/99	incorporates ecoLine-b coalescing media
Schier Products/ Striem	1/2016	OS-50 OS-75 OS-100

SEWER, SECTION 7 – PUMPS

Grinder Pumps for Public, Low Pressure Systems

LOUDOUN WATER REQUIREMENTS

1. Grinder pump to be complete unit, ready for connection to inlet and outlet piping, and electric power supply, including the following.

    - All components to be corrosion resistant, with accessory/wet well to be fiberglass reinforced polyester or high density polyethylene, double-wall construction.
    - Pump shall be removable, semi-positive displacement type rated at 9 gpm at 138 feet TDH, 1HP, 120- or 240-Volt, 1 phase, 1725 RPM, including a grinder suitable for domestic sewage.
    - Inlet shall be for connection to 4-inch PVC pipe.
    - Discharge shall be 1¼-inch threaded stainless steel, including a check valve, a disconnect, and a ball valve.
    - Wet well shall be 60- or 120-gallon capacity, with 2-inch PVC vent.
    - Cover shall be secured with a locking mechanism or bolts.
    - Control shall be via pressure switches.
    - Audio and visual warnings shall activate when liquid level rises above alarm level.

MANUFACTURERS AND MODELS

Company	Approval Date	Model Number
Environment One Corporation	11/2013	Extreme Series DH071

Privately Owned Grinder Pumps

LOUDOUN WATER REQUIREMENTS

1. Private grinder pumps are installed outdoors on lots receiving public gravity sewer service, but where topography of the lot requires sewage pumping to reach the gravity service. These pumping systems are owned and maintained by the property owner.

2. Installations shall be in accordance with manufacturer's recommendations and shall include provisions to prevent flotation.

3. Grinder pump to be complete water-tight unit, ready for connection to inlet and outlet piping, and electric power supply, including the following:

   - All components to be corrosion resistant, with accessory/wet well to be fiberglass or high density polyethylene.

   - Pump shall be removable via a quick disconnect system, with head and flow characteristics suitable for the application and a grinder suitable for domestic sewage.

   - Inlet shall be for connection to 4-inch or larger PVC pipe.

   - Discharge force main shall include a check valve and a ball valve.

   - Wet well shall be vented and sized in accordance with the application, but not less than 24 inches in diameter by 36 inches deep.

   - Cover shall be fiberglass or polypropylene and shall be secured to the wet well with a locking mechanism or bolts.

   - Pump control shall be via floats or pressure switch. Electric wiring between control panel and grinder pump unit shall be installed in conduit. Control panel to have audio and visual warnings activated when liquid level rises above alarm level. Control panel shall be NEMA 4 mounted on the outside of the building. Electrical conduit shall enter the bottom of the panel with a sealed connection.

MANUFACTURERS AND MODELS

Systems meeting the requirements listed above are acceptable. Examples of suitable systems for residences are listed below. For commercial or industrial applications consult manufacturer's representative for suitable package.

Environment One	Zoeller "Shark"	Myers "Grizzly"
Interon Little Giant Pump Company "Powersewer"	Barnes Pump "EcoTRAN"	Liberty Pump