# D

# Engineering

# 1. INTRODUCTORY PROVISIONS

## 1.1 INTRODUCTION

A. **Introduction.** Continued development of the Sumter area and expansion of the utility, drainage, and road systems owned, operated, and maintained by the City of Sumter has resulted in the need for a quality standard for those systems being deeded to or constructed for the City of Sumter. The benefits of standardization for the City include:

1. Reduction in overall cost of operations and maintenance.
2. Reduction in total inventory of spare or replacement components.
3. Familiarity with systems resulting in reduced down time during emergencies.
4. Common standard of design, materials and construction requirements.
5. Reduced design time, review time, and overall process time from project submittal to approval.
6. Reduced installation time, inspection time, and overall process time to reach project construction approval and complete project closeout.

## 2.2 ROLES AND RESPONSIBILITIES

A. The following covers roles and responsibilities of the parties involved in the overall submittal and approval process for new utility, drainage, and road systems and is applicable to all developments requiring water and/or wastewater service from the City.

B. **City Engineering.**

1. Plan Review:
   (1) Determine water and/or wastewater service availability.
   (2) Perform a hydrostatic flow test at the request of the Developer or the Engineer of Record.
   (3) Determine all applicable fees.
   (4) Review project plans and permit applications for conformance with the requirements of these standards.
   (5) Ensure proposed plans are consistent with the City's long-term plans.
   (6) Sign Engineer of Record's prepared SCDOT encroachment permit applications.
   (7) Identify and communicate to the Developer and the Engineer of Record any required changes when plans are not in conformance with the requirements of these standards.
   (8) Provide the following letters:
      a. Willingness to serve letter if the project is outside the City limits
      b. Ability to serve letter
   (9) Upon receipt of a SC DES Permit to Construct, distribute plans stamped "Approved for Installation". This physical set is to remain onside for use during inspections.
2. Construction:
   (1) Observe and document construction related activities to ensure compliance with the requirements of these standards and City approved plans.
   (2) Require work determined not in compliance with these standards and/or approved plans to be promptly corrected to the satisfaction of the City.
   (3) Review and approve project Record Drawings
   (4) Perform a final inspection for acceptance of the constructed water, sewer, drainage, and road systems
3. Closeout:
   (1) Review and approve required project documents to be submitted to City Council for acceptance.

(2) Provide final Operation and Maintenance (O&M) letter(s) to the Engineer of Record for submission to SC DES once City Council has accepted the ownership of the water and sewer system.

C. **Developer.**

1. The Developer shall be considered the following:
   (1) Person or entity initiating the development of a new or improvement to an existing residential or commercial property and is requesting water and/or wastewater service.
   (2) This can be, but is not required to be, the Owner of the property.
   (3) This person or entity shall have legal authority to execute necessary permits, applications, and legal documents which require the Owner's signature.
   (4) This same person or entity will execute all documents throughout the project unless the project is sold and/or this authority is transferred to the new Owner or Owner's agent.
2. The Developer will:
   (1) Provide accurate information as to the person or entity responsible for the development and their contact information.
   (2) Be responsible for payment of all fees required in accordance with these standards.
   (3) Be responsible for the execution of all documents required for project closeout.
   (4) Be financially responsible for future requests for repairs, if any arise, during the maintenance agreement period after takeover of the constructed system(s) by the City.
   (5) The developer is the applicant for SC DES permit(s) to construct. The developer bears all legal and financial burden to ensure the construction of the water and/or sewer system are constructed according to the SC DES regulations.

D. **Developer's Engineer (Engineer of Record).**

1. The Developer's Engineer will be referred to as the Engineer of Record throughout this document.
2. The Engineer of Record is the Engineer hired by the Developer or Property Owner to prepare and design plans for the project.
3. The Engineer of Record will:

(1) Request determination of water and/or wastewater willingness to serve if outside the City limits.
(2) Request determination of water and/or wastewater ability to serve.
(3) Request a hydrostatic flow test for all water projects.
(4) Prepare and submit plans to the City in accordance with the requirements of these standards and will be the engineer of record for the project.
(5) Provide a survey of existing conditions.
(6) Revise the plans in accordance with the City's requirements.
(7) Submit to the City the SC DES permit application package for verification of daily flow rates.
(8) The Engineer of Record is responsible for submitting the permit application package and required documentation to SC DES to obtain permit to construct and permit to operate.
(9) Submit to the City Engineering Department all encroachment permit applications for execution. Engineer of Record is responsible for submission of encroachment permit to appropriate permitting agencies, and ensure all encroachment permits are closed prior to acceptance for ownership by City Council.
(10) Schedule and attend Preconstruction Meeting with the assigned City Engineering and Public Works Department staff prior to beginning construction.
(11) Monitor all phases of the work in progress during construction to ensure all water, sewer, drainage, and road installations are in conformance with the approved plans and these standards. The City accepts no responsibility or liability for work rejected due to non-conformance.
(12) Conduct required testing of systems in the presence of the City Engineering and/or Public Works Staff.
(13) Promptly notify City Engineering and Public Works Staff in writing concerning any changes which may be necessary during the progress of the work. No changes to the approved plans shall be performed without prior written approval from the City Engineering Staff.

(14) Certify in writing that the water, sewer, drainage, and road work was constructed in accordance with the approved plans and these standards.

(15) Coordinate, compile, and submit accurate Record Drawings to the City in accordance with these standards. Record drawings shall be stamped and signed by the engineer of record.

(16) Schedule a Final Inspection with City Engineering Staff to determine conformance with the approved plans.

(17) Provide all information and submittals as required for project closeout and acceptance for ownership by the City as defined in *Section D.9 Inspections and Closeout* of these standards.

# 2. DEVELOPMENT FEES

## 2.1 DEVELOPMENT FEES

A. **General Information.**

1. The Developer shall be responsible for payment of all applicable development fees at the appropriate stages of the process per the fee schedule in place.
2. The City's development fees are subject to review by City Council and may be amended from time to time. Projects will be subject to the most recent fees in effect at the time full payment is received.
3. The engineering services fee will be charged on all projects.
4. All inspection fees are required to be paid prior to scheduling the inspections. Any failed inspections will require a retest fee.

B. **Fees.**

1. Subdivision Tap Fees.
   (1) Tap Fees shall be assessed to the customer for each meter based on its size. Tap fees will be paid 50% at plan approval and 50% at final plat approval.
2. Commercial Tap Fees.
   (1) Tap Fees shall be assessed to the customer for each tap based on its size. Tap fees must be paid at plan approval.
3. Hydrant Flow Test – Payment of this fee and completed application is required to schedule a flow test with the City.
4. Sewer Reinspection fee will be charged if the City is required to reinspect due to failure of the first sewer inspection.
5. Proofroll Reinspection fee will be charged if the City is required to reinspect due to failing a proofroll inspection.
6. Engineering Main Extension Services Fee.
   (1) The City will charge an Engineering Main Extension Services Fee to fund the

cost of reviewing plans, specifications, design documents, sketches, calculations, providing administrative services associated with new development and the installation of new utilities and roadways, and inspections.

7. Engineering Subdivision Services Fee.
   (1) The City will charge an Engineering Subdivision Services Fee which will be charged on a per lot basis.
8. Minimum Water and Sewer Flow Fee.
   (1) Minimum monthly water and sewer flow fees will be charged to a development once they have received their permit to construct from DES.
9. Maintenance Agreement.
   (1) The Maintenance Agreement includes a 15% guarantee based on the installed value of the water, sewer, drainage system and roadways documented in the as-builts submitted by the Engineer of Record at the final inspection package. The guarantee can be either an Irrevocable Standby Letter of Credit from a financial institution or other instrument readily convertible to cash. The guarantee will be held for a period of 2 years from the date of Council approval and will be refunded upon completion of the Maintenance Agreement Final Inspection, provided no deficiencies are found.
   (2) If deficiencies are found and the Developer does not correct these deficiencies, the letter of credit will be used to cover the City's costs to make corrections. In which case, the entire letter of credit amount will then be forfeited.
   (3) The Maintenance Agreement and letter of credit must be received with the Council submission package.
   (4) In some instances, service only projects will be required to provide a Maintenance Agreement.
   (5) In the event the development is transferred to new ownership during the maintenance period, the Maintenance Agreement and letter of credit must be updated to the new ownership.

10. A Performance Agreement for the roads will be required in the amount of 150% of the construction cost of the final surface course.

# 3. SUBMITTALS AND APPROVALS

## 3.1 SUBMITTALS AND APPROVALS

A. **General.**

1. The City will consider for operation and maintenance only those water, sewer, drainage, and road systems which are within the City's service area.
2. Design and construction of water, sewer, drainage, and road systems shall be in accordance with these standards.
3. Phasing of subdivisions will be completed in manner that allows for the long term resiliency and viability of the City owned infrastructure.
   (1) While phases are being constructed the developer is required to have temporary turn around at the end of each road.
   (2) Fire hydrant will be required at the end of the waterline.
4. All connections to the City's existing water and wastewater systems, whether a system extension or new service only connection, must be approved in writing by the City and an open trench inspection performed by a City Engineering Inspector. All taps to be performed by a properly licensed contractor.
5. No water, sewer, drainage, or road system components shall be put into service prior to the receipt of all approved project documents, applicable fees, accepted for ownership by City Council, and the Permit to Operate as issued by the South Carolina Department of Environmental Services (SC DES).

6. The City has specific requirements and specifications for the selection and installation of backflow prevention assemblies. Information regarding The City's backflow prevention requirements can be found in Appendix 2.
7. The City has specific requirements for grease traps. For all services that may require a grease trap (typically all food/beverage serving and/or preparation establishments), a Grease Trap Application must be submitted to the City for review. Additional submittals including drawings/schematics for the proposed grease trap and plumbing connections may be required after initial application review. Grease Trap Applications must be approved by the City in writing prior to installation, and a complete inspection of the installed grease trap and connected kitchen fixtures must be performed by the City prior to service acceptance. See appendix 3 for Grease Trap Application.
8. Those individuals associated with implementing projects are strongly encouraged to meet with the City's Engineering & Public Works Department staff to review plans and coordinate proposed projects.

B. **Water and Wastewater - Ability to Serve**

1. The initial step for any new water or wastewater system being considered by the City is submission of a Request for Ability to Serve to determine service availability for the proposed development.
2. Information required to determine Ability to Serve.
   (1) Property Address
   (2) Tax map number
   (3) Type of proposed development
   (4) Daily water and sewer demand
3. The information provided in the Request for Ability to Serve will be utilized by City Engineering to perform a preliminary hydraulic analysis of the proposed water and/or wastewater system.
4. Based on the results and conclusion determined by the preliminary hydraulic analysis, an Ability to Serve Letter will be issued by City Engineering stating whether service is available or is not available for the proposed development and directives for water and wastewater connection points.

5. An Ability to Serve Letter is valid for 12 months from the date of issuance.
6. Any subsequent changes to the proposed development deemed significant by City Engineering may require submission of a revised Request Ability to Serve and issuance of a revised Ability to Serve letter.
7. No Plan Review will be conducted without a valid Ability to Serve Letter stating the City's ability to provide water and/or wastewater service.

C. **Water and Wastewater- Willingness to Serve**

1. City Administration are the approved personnel that can determine whether the city is willing to serve land parcels water and sewer outside of the City limits. City Engineering staff doesn't have the authority to make this determination.
2. Information required to determine Willingness to Serve.
   (1) Property address.
   (2) Tax map number.
   (3) Type of proposed development.
   (4) Daily water and sewer demand.
3. A Willingness to Serve letter is valid for 12 months from the date of issuance.
4. Any subsequent changes to the proposed development deemed significant by City Engineering may require submission of a revised request Willingness to Serve and issuance of a revised willingness to Serve letter.

D. **Plan Review**

1. Submittal Requirements and Plan Review Process.
   (1) The Developer or the Engineer of Record shall submit a plan review package to the City Planning Department. The package shall include the following items, or Plan Review will not proceed:
      a. Plan Review Application.
      b. Engineering Services Fee.
      c. Valid Water and/or Wastewater Ability to Serve Letter.
      d. Valid Water and/or Wastewater Willingness to Serve Letter if property is outside of the City limits.

e. Water and/or wastewater system plans and drainage and road plans to include all details, drawn to a horizontal scale no smaller than 1-inch equals 50 feet and a vertical scale no smaller than 1 inch equals 5 feet. Plans shall be signed, sealed and dated by an Engineer licensed in the state of South Carolina and shall include the following:

(a) Complete system design.

1. Include the following plan sheets: cover, general development, site plan, building layout, drainage, landscape, demolition, existing conditions survey, water and wastewater system plans, roadway and drainage plan, and applicable City details.
2. Landscape plans shall include any proposed hardscapes (i.e., signage, architectural columns, retaining walls or other types of above ground and underground structures).
3. Demolition plans shall include all existing water and wastewater services, with those proposed for abandonment clearly identified.
4. Existing conditions survey shall include all existing utilities.

(b) Plan and profile view for all water, wastewater, drainage, and road projects.

(c) All fittings and appurtenances shall be clearly labeled with description and stationing. Use of Key notes should be limited.

(d) All vertical and horizontal bends shall be shown and labeled on both the plan and profile view.

(e) Profiles shall show and label (size, type, material, depth) for all utility crossings.

(f) Profile for all water and wastewater mains installed by Jack and Bore or Horizontal Directional Drill or where steel casing is used.

(g) For commercial developments, provide location and size of all proposed water and wastewater services along with addressing plan.

(h) County Tax Map Reference Number of Property.

(i) All public and private rights-of-way. Plans should indicate ownership of existing roadways (City, County, or State), road width and right-of-way width. Indicate the agency to operate and maintain proposed roadways.

(j) Location, type, ownership, and width of all existing and proposed easements to include the City utility easements. In the event a proposed City utility easement encroaches upon or crosses an existing easement owned by another entity, an encroachment permit shall be obtained from the existing easement holder. No plan approval will be issued without an executed copy of the encroachment permit being provided to the City. Please see *Section D.4 Easements* of these standards for additional details and requirements.

f. 1 set of water and/or wastewater calculations signed, sealed and dated by an Engineer licensed in the state of South Carolina. Calculations shall be in accordance with the requirements set forth in the applicable sections of these standards.

(a) Water Mains – *Section D.7.1 Water Distribution System Design Standards*. For commercial developments requesting water for temporary fire protection, provide additional fire flow calculations based on the size of the proposed backflow prevention assembly and fire service meter.

(b) Wastewater Gravity Sewer Mains – *Section D.8.1Wastewater Collection System Gravity Sewer Design Standards.*

(c) Wastewater Force Mains – *Section D.8.4 Wastewater Collection System Force Main Design Standards.*

*(d)* Wastewater Pump Stations – *Section D.8.7 Wastewater Collection System Pump Station Design Standards.*

g. Geotechnical Report indicating thickness of road sections and recommendations for construction materials and construction testing. This report shall be stamped, signed, and dated by an engineer licensed in the State of South Carolina.

h. Completed SC DES Construction Permit Application package for review of daily flow. Engineer of Record is responsible for submission of this package to SC DES.

i. Filled out encroachment permit applications for execution for water and sewer line extension. Engineer of Record is responsible for submission of encroachment permit.

(2) Upon review of the submitted Plan Review items, the City will return to the Engineer of Record:

a. Written design change requirements in the form of a letter or comment log.

b. Request for any other required information pertinent to the proposed project.

E. **Plan Approval**

1. Upon receiving the required design change requirements, the Engineer of Record shall submit to the City Planning Department 1 hard copy set of revised system plans along with the Engineer of Record's responses to the official comment log/letter. Once an acceptable set of plans are approved, the City will notify the Engineer of Record in writing or email.
2. Upon notification of plan approval, the Engineer of Record shall submit to the City the following:

   (1) 2 complete set of approved plans.
3. Fee Determination

   (1) City Engineering Staff will determine the following fees at this time:

   a. Tap Fees.

   (2) 50% are due at plan approval and 50% are due at final plat approval.

F. **Construction Activity**

1. The SCDES Permit to Construct and all applicable approved encroachment permits must be received by the City prior to beginning construction.
2. Plans stamped "Approved for Installation" or "Approved for Construction" will be distributed to the Developer and the Engineer of Record for use by the Contractor. No construction activity shall proceed prior to receipt of stamped approved plans. These stamped approved plans shall remain with the Contractor on site at all times.
3. Prior to construction activities, a Preconstruction Meeting shall be conducted. The Engineer of Record shall schedule and attend the Preconstruction Meeting with the assigned City Engineering Inspector. The Developer (or representative), Contractor (to include any sub-contractors working on the utility, drainage, and road systems shall attend.

   (1) The Preconstruction Meeting shall be held no more than 60 calendar days prior to the start of actual construction.

(2) If construction does not begin within 60 calendar days of the Preconstruction Meeting, another Preconstruction Meeting shall be held.

(3) The Contractor is responsible for the construction of all water, sewer, drainage, and road installations.

4. The Engineer of Record is responsible for monitoring the project as required to ensure construction of the water, sewer, drainage, and road systems meets all design requirements of the approved plans and permits. The Engineer of Record shall provide its project inspection reports to the City Engineering Inspector.
5. If installation per the City approved plans cannot be achieved due to conflicts with other utilities (or sub-grade obstructions), the Contractor shall immediately notify the Engineer of Record and the City Engineering Inspector. No deviation from the City approved plans will be allowed without prior written approval from the City. The Engineer of Record shall make any required modifications to project plans and submit modified plans to the City for approval. The City Engineering office will issue an approval in writing. Construction of the modification should not be constructed until written approval is received by the City
6. If any requirements for carrying out project construction are not met, the City reserves the right to issue a stop work order.

# 4. EASEMENTS

## 4.1 EASEMENTS

A. **General Information.**

1. Easements for all water, wastewater, storm drains and associated appurtenances to be conveyed to the City, shall require the developer or the engineer of record to submit an easement form and drawing illustrating the easement to the City's Engineering Department for approval prior to constructing the utility.
2. Easements shall be clear of trees and debris and grassed unless other treatment is specified and approved by the City.
3. Obstructions within, above, or below any easement such as buildings, building footers, building overhangs, canopy-type trees, overhead structures or other objects or structures which may limit access to or use of the entire easement by the City are not permitted.
4. Asphalt or poured concrete pavement is acceptable within easements. Any asphalt or poured concrete pavement that is damaged by subsequent construction or maintenance by the City will be repaired or replaced with standard, readily available asphalt or concrete materials only. Decorative pavers, pervious pavement or other atypical asphalt or concrete materials utilized over the surface of the City's easement will not be allowed.
5. When applicable, the City utility easements shall be extended to the nearest property line that is shared with the adjoining property owner in a manner that does not conflict with current or future use of the property.
6. In the event a proposed City utility easement encroaches upon or crosses an existing easement owned by another entity, an encroachment permit shall be obtained from the existing easement holder. Such encroachment permit shall be obtained by the Developer or the Engineer of Record and shall be in the name of the City. The City shall have the right to review and accept or reject any terms of the proposed encroachment permit prior to its final approval and acceptance by the City.

B. **Easement Width.**

1. All utility easements to be conveyed to the City shall have a width of 30 feet. The easement will be centered on the centerline of the utility line installed. The edge of easement shall not be less than 10 feet from a permanent structure or foundations.

C. **Final Plat Easement Requirements.**

1. Final Plat shall state the easement is for the City, the type of utility installed in the easement, and the easement width.
2. If a utility easement exists for the use of HOA or other entities the final plat should state, the easement owner and type of utility located in the easement.

D. **Easement Agreement**.

1. As an instrument of conveyance, an easement form completed and signed by developer shall be recorded with the final subdivision plat. The plat and easement form shall list the width of the easement. They shall also indicate the type of utility (water, sewer, or storm drainage). The City will not accept easements for ditches, swales, ponds or other conveyance of stormwater other than pipes. A copy of the recorded easement form shall be sent to the engineering department.

# 5. ROADWAY

## 5.1ROADWAY DESIGN REQUIREMENTS

A. **Roadway Design Requirements.**

1. All new roads shall be constructed by the developer at no cost to the City. The developer shall be responsible for obtaining all permits. Required improvements under this Section shall not be installed or constructed until required site plans have been approved by the City in writing.

B. **Road Classification.**

1. Local Street.

(1) Provides direct access to lots. Access streets shall be designed so no road section conveys an ADT greater than 250.

2. Collector (Minor).

(1) Provides direct access to lots and carries traffic from local streets. Designed to carry higher traffic than local streets. Sub-collectors shall be designed so that no road section conveys an ADT greater than 1,000 within residential areas. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required.

3. Collector (Major).

(1) Conducts and distributes traffic between access/sub-collector and arterial streets. Function is to promote free traffic flow; therefore parking and direct access to homes from this level of street shall be prohibited. Collectors shall be designed so that no road section conveys an ADT greater than 2,000. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required.

4. Arterial.

(1) Principal traffic artery that carries relatively high traffic volumes and convey traffic from access and collector streets. Its function is to promote the flow of traffic. Minor arterial shall be designed and constructed according to SCDOT standard specifications.

C. **Road Right-of-Way Widths.**

1. The following sections are descriptions of typical required road right-of-way widths for select categories of road types.

| Table D.5.1 Local Street and Collector (Minor)E | |
|---|---|
| **Width** | |
| A. Right-of-Way Width | 50' |
| B. Back-of-curb to back-of-curb | 27' |
| **Streetscape** | |
| C. Sidewalk (min) | 5' (both sides) |
| **Travelway** | |
| D. Travel lane | 12' (pavement edge to pavement edge) |
| E. Grass verge | 5' (both sides) |
| F. Sidewalk | 5' (both sides) |
| G. Curb & Gutter | 1.5' (both sides) |
| **Engineering Specifications** | |
| H. Design speed (mph) | 25 mph |
| I.Design vehicle | Passenger vehicle |
| J. Driveway spacing | As needed |
| K. Curb radii | 25' |
| L. Lighting | Required on all public streets for new Development |

| Table D.5.2 Collector (Major) & (Minor) | |
|---|---|
| **Width** | |
| A. Right-of-Way Width | 66' |
| B. Back-of-curb to back-of-curb * | 39' |
| **Streetscape** | |
| C. Sidewalk (min) | 5' (both sides) |
| D. Grass verge | 5' (both sides) |
| **Travelway** | |
| E. Travel lane ** | 12' (pavement edge to pavement edge) |
| **Engineering Specifications** | |
| F. Design speed (mph) | 35 mph |
| G. Design vehicle | All vehicles |
| H. Signalized intersection density | As warranted |
| I. Driveway spacing | As needed |
| J. Median opening distance | N/A |
| K. Partial Medians / Island | No |
| L. Curb Radii | 5 -10' |
| M. Lighting | Required on all public streets for new development, pedestrian scale optional and responsibility of developer |
| N. Permitted furniture | Bicycle racks, benches, parking meters |

*Number of travel lanes will be determined by the traffic count

D. **Pavement Width and Curb.**

1. Residential, collector, and arterial roads shall measure pavement width from pavement edge to pavement edge.

2. Curb and gutters shall be installed on all paved roads. The curb shall consist of rolled curbed shown as Figure D.1 Rolled Curb – Ogee Curb Detail or barrier curb shown in Figure D.2 Barrier Curb Detail.

Figure D.1 Rolled Curb – Ogee Curb Detail

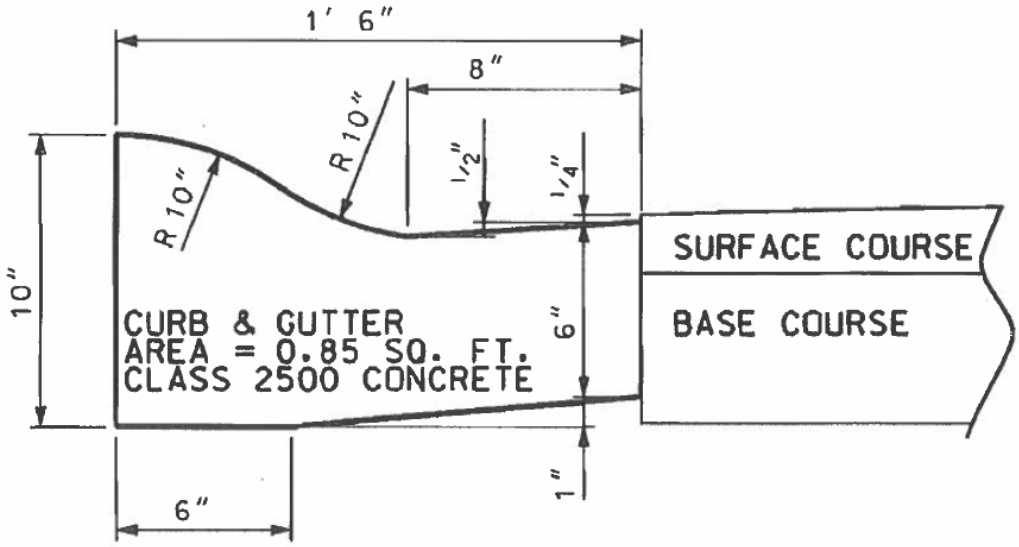
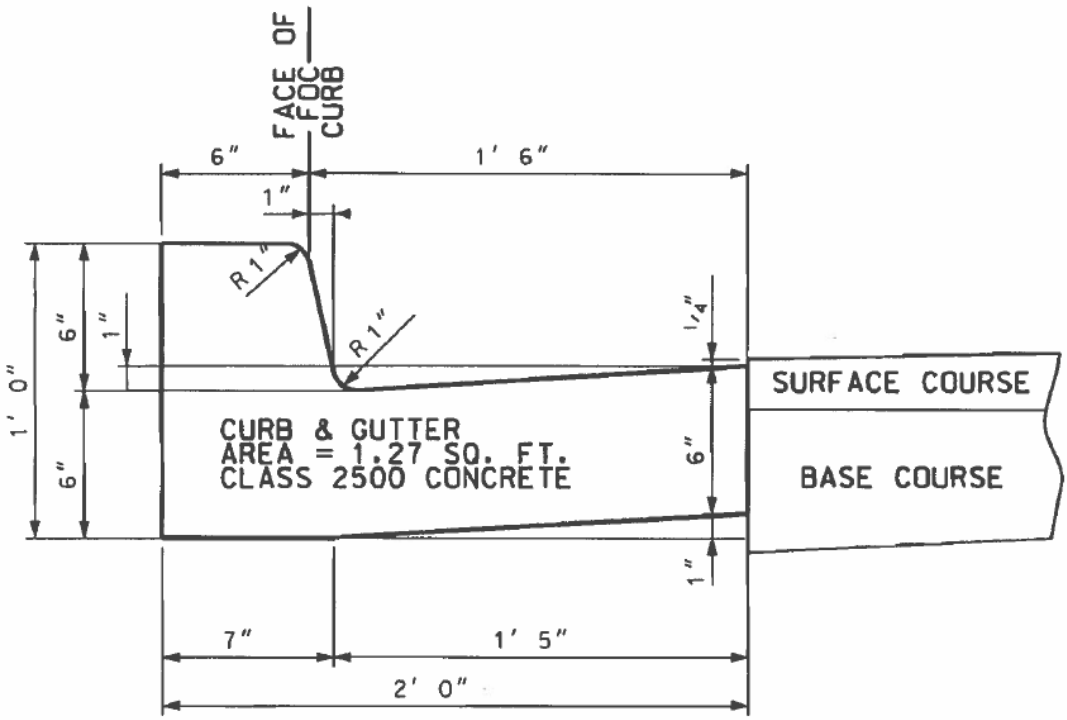


Figure D.2 Barrier Curb Detail




E. **Road Geometric Design.**

1. Unless specifically addressed in these regulations, all geometric elements of roadway design for streets and roads in the City's Road System will be in accordance with the AASHTO Policy on Geometric Design of Highways and Streets and the SCDOT Roadway Design Manual.
2. Horizontal Curves.
   (1) Horizontal curves are to be introduced at all changes of direction on collector, local, and arterial streets. Refer to the SCDOT Roadway Design Manual for further information. The minimum radii of curvature are to be in accordance with Table D.5.3. Refer to the SCDOT Roadway Design Manual for further information.

| Table D.5.3 Street Classification Requirements | | | |
|---|---|---|---|
| **Street Classification** | **Stopping Site Distance (ft)** | **Min. Curve Radius (ft)** | **Max. Grade (%)** |
| Minor Residential | 160 | 150 | 12 |
| Local Residential | 160 | 150 | 12 |
| Collector | 275 | 350 | 12 |
| Arterial | * | * | * |

*Dependent on design speed selected

3. Vertical Curves.
   (1) Crest vertical curves are to be of sufficient length to provide the minimum stopping sight distance at the design speed. Refer to the SCDOT Roadway Design Manual for further information.
4. Intersections.
   (1) The centerlines of no more than two (2) streets shall intersect at any one point. The centerlines of intersecting streets are to be perpendicular. All angles and distances are measured relative to the intersection of a street centerline.
5. Curb Radius.
   (1) The minimum acceptable curb radius at intersections is 25 feet. Larger radii must be provided in accordance with the AASHTO Policy on Geometric Design of Highways and Streets when significant tractor-trailer, or other large vehicle, traffic is expected.
6. Dead End Streets.
   (1) Cul-de-sacs shall not exceed 500 feet in length unless necessitated by topography or property accessibility but are highly discouraged by the City. Measurement shall be from the point where the centerline of the dead-end road intersects with the centerline of a general circulation road to the center of the turnaround of the cul-de-sac. Where one cul-de-sac extends from another cul-de-sac, the end of each cul-de-sac shall be no more than 1,200 feet from a general circulation road as measured by the centerline

of the roads. Cul-de-sacs shall terminate in a circular turnaround having a minimum right-of-way of at least 100 feet in diameter and a paved turnaround with a minimum outside diameter of 80 feet.

F. **Sidewalks.**

1. Sidewalks in residential developments shall be constructed on both sides of the road to meet the following standards:
   (1) The minimum width of all sidewalks shall be five feet.
   (2) Sidewalks shall match the grade or elevation of adjacent sidewalk at the property lines; if there is no adjacent sidewalk, the sidewalk shall be six inches above the adjacent edge of the pavement grade at the property line.
   (3) Sidewalk shall have a maximum cross slope of 2%.
   (4) Sidewalks shall be constructed to meet the minimum requirements of the Americans with Disabilities Act (ADA).
   (5) All sidewalks will be owned and maintained by homeowners.

G. **Temporary Dead-End Roads and Half Roads.**

1. Temporary dead-end roads shall be provided with a temporary turnaround having a roadway surface diameter of 80 feet.
   (1) Dead end roads and turn around shall drain stormwater runoff and not detain runoff.
   (2) This is only allowed for one (1) year and must be permitted with the City.
   (3) If for any reason the next phase of construction does not move forward within one year from the date of the maintenance agreement execution, the Developer is required to pave the turnaround.

H. **Lateral Clearance**.

1. A minimum lateral clearance as shown below shall be from the back of curb.
   (1) Rolled curb and gutter: 6.0 ft.
   (2) Barrier type curb 4.0 ft.
2. No entrance gates or other obstructions, with the exception of traffic control, street name signs, and mailboxes, are to be placed within these distances from the edge of the street.
3. Trees are allowed at the right-of-way line only and must utilize a root barrier on the sidewalk and/or roadway side.

4. It should be noted that the above setbacks are minimums based on the obstruction being located on a tangent. When an obstruction is located within a horizontal curve, the setback must be calculated using the equation:

$$R = \frac{s2}{8M}$$

Where:

*R* = Radius of curvature at the centerline of the lane closest to the obstruction (feet)

*M* = Distance from the centerline of the lane to the obstruction (feet)

*S* = Stopping sight distance (feet)

Provided the above setbacks and sight distances requirements are met, trees may be retained or planted within the right-of-way for aesthetic or environmental purposes. Homeowners will own trees located in the right of way. The City will not maintain trees, shrubs, or plants located in the road right of way.

I. **Road Subgrade and Pavement Structure Requirements**

1. A geotechnical report shall be submitted for the design of the roadway section based on subgrade soils, traffic design loads, and other factors that will affect the structural integrity of the roads. The traffic loads should include all house construction traffic as well as daily traffic of the proposed development. The roads shall have a 20-year design life. All roads to be dedicated to the City shall have a 1.5 inch surface type "C" course placed once 80% of all houses are constructed or upon request by the City. A minimum road section of 3 inches of asphalt surface with 6 inches of macadam base course shall be used with 12 inches of sub compacted subbase soils. The surface course shall be placed in two (2) 1.5 inch lifts. The surface course shall be type "C" asphalt as defined in the SCDOT Standard Specification. The surface course, base course, and sub base shall all be constructed in accordance with SCDOT Standard Specification. The geotechnical report shall include all testing methods and requirements of the road section materials and testing of the installed materials.
2. The geotechnical engineer shall provide a letter to the City stating the roads are constructed in general accordance with the project report. Any deviations from the report

shall be noted in this letter. The City will not accept any roads for ownership without the geotechnical engineer's letter. A performance agreement will be required for the 1.5" surface course that will be required once 80% of home construction is completed. The performance agreement will require a letter of credit in the amount of 150% of construction cost of the final surface course.

## 5.2 PAVEMENT SUBMITTAL REQUIREMENTS

A. **Pavement Submittal Requirements.**

1. Plan and profile sheets for each road. Include all horizontal & vertical curve information. Include station numbers.
2. Plan and profile should be at no smaller scale than 1inch = 50 feet horizontal scale and 1 inch = 5 feet vertical scale.
3. Show water, sewer, and storm drain utility's horizontal and vertical locations to include depths below road surface course. All utilities should be 12 inches below the base course. If utilities cannot be located 12 inches below the base course, a geotechnical engineer can design a road section allowing for the reduced subbase section with approval from City Engineering.
4. Provide typical roadway cross sections indicating thickness and material of each roadway course (subgrade, base and surface course).
5. The surface course shall consist of lanes that are 12 feet wide from edge of asphalt to centerline of road or to the beginning of the next lane on roads with more than two lanes. The road shall have a 1 inch in 48 feet of slope from the center line of the road to the edge of pavement.
6. The centerline slope of the road should not exceed 8 percent and should be a minimum of 0.5 percent. All roads designed with centerline slopes between 0.5 percent and 1 percent will require as built surveys of the roads verifying the roads are constructed with the minimum slope. The engineer of record will need to stamp and sign the as built road survey.

7. All roads shall have curbs and gutters at the edge of pavement. The curbing shall consist of roll curbing as illustrated on Figure D.1 Rolled Curb – Ogee Curb Detail or barrier curb shown in Figure D.2 Barrier Curb Detail.
8. The road shoulder including the remaining road right of way should be graded to a maximum slope of 2 percent from the back of curb to the road right of way line and should provide for positive drainage. The shoulder should be seeded with grass prior to City Council accepting roads for ownership.

## 5.3 ROADWAY CONSTRUCTION AND TESTING

A. **Clearing and Grubbing.**

1. All work associated with clearing and grubbing of all debris, vegetative matter, trees, stumps, and obstructions within the limits of disturbance such as roadway, right-of-way, easement areas, ditches, etc., unless otherwise stated to remain in accordance with the approved set of plans. All clearing and grubbing work shall be authorized under a City land disturbance permit. The contractor shall confirm all organic, vegetative matter (roots, stumps, logs, etc.) have been removed from the roadway right-of-way and document any unsuitable soil conditions with the right-of-way.

B. **Road Embankment**

1. All stumps and large roots must be removed from the roadbed prior to placement of fill for embankments regardless of fill height. All roadway sub base and embankment fill must be approved and signed off on by the geotechnical engineer. Roadway embankment fill is to be placed and compacted in lifts not exceeding eight (8) inches. The contractor is responsible for providing geotechnical testing and documentation that the sub base and fill material has been compacted to 95 percent of maximum dry density, as determined by ASTM 1557. At a minimum, density testing of embankment fill is to be performed every 16 inches of fill or the fill limits, whichever is less. Spacing of density testing is to be every 250 feet of road, alternating lanes. Density testing shall be performed in accordance with the geotechnical report, however a minimum of two (2) tests per road per 16 inches of fill (or the fill limit, whichever is less). No proof-roll of the sub grade will be scheduled until the compaction has been documented and submitted to the City Engineering Department.

2. Any roadway embankment modifications (extra stone, soil cement, lime treatment, geo grid, etc.) must be approved by the geotechnical engineer and the City Engineering Department.

C. **Materials and Equipment.**

1. Materials and equipment used for all roadway courses shall be in accordance with the latest edition of the SCDOT Standard Specifications and in working condition necessary for the construction, application, placement, and maintenance.
2. Any geotechnical firm that is to conduct work in the City shall hold at least one lab certification from the following agencies, and is responsible for providing their credentials when the initial proof roll is requested:
   (1) SCDOT
   (2) AASHTO
   (3) CMEC
   (4) USACE

D. **Road Construction Requirements.**

1. The typical flexible pavement structure consists of subgrade (subbase) course, base course, and surface course and shall be in conformance with lines, grades, dimensions, and cross-sections shown on approved construction plans.
2. Subgrade Course. The following subgrade course types are acceptable to the City.
   (1) Native Soils Subgrade can be used as a subgrade and must be properly prepared for construction and pavement structure.
   (2) Cement Modified Subgrade can be used in the modification of an existing subgrade by adding Portland cement, pulverizing the in-place soil, mixing, shaping, compacting, curing, and finishing the mixed material to form a subbase for a pavement structure. This subgrade material shall be prepared in accordance with SCDOT Standard Specifications.
3. Base Course.
   (1) The following base course types are acceptable to the City: Macadam Base Course or type "B" Asphalt Base Course.

4. Maintenance of Base Courses.
   (1) Base courses shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the base.
5. Binder or Intermediate Course.
   (1) The following Binder or Intermediate Course types are acceptable to the City.
      a. Asphalt Concrete Intermediate Course, Type "C".
6. Maintenance of Intermediate Course.
   (1) Intermediate Course shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the intermediate course.
   (2) If intermediate course is in place for nine (9) months without surface course, the binder course is subject to an inspection. A proof roll inspection and geotechnical engineering evaluation will be required to assess the condition of the course. If the proof roll fails, then a geotechnical recommendation must be submitted for review within 10 days of the proof roll. Repairs, according to the approved geotechnical evaluation, must be completed within 30 days of the approval by the City.
7. Surface Course.
   (1) The following Surface Course types are acceptable to the City.
      a. Asphalt Surface Course Type C.
      b. All roads will require 1.5 inches of surface course once 80% of the homes are constructed. The road section design shall be designed to support all construction traffic without the 1.5 inches of surface course.
8. Construction of Surface Course.
      a. Compacting, rolling, finishing, and opening to traffic shall be in accordance with the latest edition of the SCDOT Standard Specifications.
9. Maintenance of Surface Course.

(1) Asphalt Surface Course shall be maintained in good condition until all work is complete and accepted by City council. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the surface course.

10. Weather Restrictions.
    (1) Asphalt Surface Course Type C cannot be applied on a wet surface or when the ambient temperature is below 45°F.
11. Asphalt Mixture Placement Quality Control Verifications.
    (1) During all asphalt mixture placement and compaction operations, a density gauge shall be in use. Asphalt roadway quality control verifications shall be documented by a certified Asphalt Roadway Technician. The rolling and compacting roadway verification shall include the following:
        a. Proper number and type of rolling and compacting equipment.
        b. Identify asphalt type, depth thickness, mixture placement, and compaction during production.
        c. Document ambient air temperature.
    (2) If the City Engineering Department determines that the asphalt course has areas of non- uniformity between coarse and fine aggregate particles within the compacted surface course pavement, the contractor and developer are responsible for correcting all segregated areas. These areas are to be removed and replaced for the full depth of the surface course within 10 feet on either side of the segregated areas for the full width of the paving lane.
    (3) Road shoulders should be graded to final grade and establish grass prior to being dedicated to the City.
    (4) Road shoulders shall be compacted to 95% of the maximum dry density as determined by the standard proctor ASTM 1557.

E. **Proof Rolling.**
    1. A proof roll inspection involves the following components: the specifications for equipment, construction and requirements of testing the roadway embankment and subgrade for compaction uniformity and stability through a proof roll inspection.
    2. Failed proof roll inspection will require a retest fee.

3. Equipment.
   (1) The contractor shall ensure that the equipment used is in acceptable working condition necessary for the construction and testing in areas subject to proof roll inspections. A fully loaded tri-axle dump truck with a minimum 50,000 lbs is accepted for proof rolling. The approved equipment shall only have air-filled pneumatic tires with a pressure between 70 and 90 psi while proof rolling.
4. Proof Rolling Method.
   (1) Prior to scheduling any proof roll inspections, all density testing data must be submitted to and approved by the City.
   (2) All proof rolls are to be performed in the presence of the City Engineering representative, geotechnical engineer, and contractor.
5. Proof Roll Types.
   (1) The following proof roll types are described in the sub-sections that follow:
      a. Concrete curb and gutter
      b. Cement Stabilized Earth (soil cement)
      c. Subgrade
      d. Embankment (Road Shoulders)
      e. Base course
6. Concrete Curb and Gutter Proof Roll and Soil Cement.
   (1) Proof rolls may be performed for concrete curb and gutter and soil cement at the request of the contractor. No proof roll inspection can be conducted without prior City approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a fully loaded tri-axle dump truck.
   (2) The contractor shall schedule this inspection with the Engineering Department. The geotechnical engineer, City Engineering Inspector, and contractor shall be represented and in attendance for the proof roll inspection. The City Engineering Inspector reserves the right to conduct or require additional testing at any time.
1. Road Shoulders, Subgrade, and Base Course Proof Rolls.
   (3) Proof rolls may be performed for the road shoulders, subgrade, and base course at the request of the contractor. No proof roll inspection can be conducted without prior City

approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a loaded tandem axle dump truck only. The contractor shall schedule this inspection with the Engineering Department. The geotechnical engineer, City Engineering Inspector, and contractor shall be represented and in attendance for the proof roll inspection. The Engineering Inspector reserves the right to conduct or require additional testing at any time.

(4) The geotechnical engineer shall submit their inspection/observation report to the City Engineering Department.

F. **Roadway Signs/Traffic Control Devices.**

1. Road signs, in conformance with the requirements of the Federal Highway Administration's Manual on Uniform Traffic Control Devices latest edition.
2. Roadway Signs.
   (1) Shall be installed by the Developer in accordance with an approved sign plan developed by the Design Engineer.
   (2) Custom road signs that do not follow the MUTCD guidelines will not be maintained or owner by the City.

## 5.4 DRAINAGE PIPE AND BASIN STANDARD

A. **Drainage Pipe and Basin Standard.**

1. All regulations, procedures, fees, and penalties listed in City Ordinance 2469 Stormwater Management and Sediment Control Regulations are applicable when designing drainage systems. See Appendix 1 for Ordinance 2469.
2. The minimum size storm drainage pipe allowable shall be 18 inches in diameter. All storm drainage to be owned by the City shall be reinforced concrete pipe (RCP).
3. The minimum allowable slope for storm drainage pipe shall be one-half of 1% (0.005 ft/ft) or a minimum flow velocity of 3 feet per second at all flow levels. Maximum allowable slope for storm drainage pipe is 20 % (0.20 ft/ft).
4. At pipe outfalls, the use of a rip-rap apron, placed on filter fabric, for a minimum distance equal to or greater than 6 pipe diameters. Use type A riprap as defined by *SCDOT Standard Specification Section 804*. Fabric shall be from SCDOT Qualified Product List.

5. Type and class of storm drainage pipe, as well as the construction of pipe culverts, shall be in accordance with SCDOT's *Supplemental Technical Specifications, Sections 714.* RCP is the only type of drainage pipe the City will accept for ownership.
6. A minimum of 1 foot of cover shall be provided for RCP storm drainage pipe. Storm drainage pipe shall be placed to minimize the length running under pavement. Where it is necessary for a pipe to cross the roadway, the preferred placement shall be at a 90 degree angle. All cross lines in the roadway shall be compacted in 8" lifts to 95% Standard Proctor maximum density and to 100% on the last 8" inches.
7. Any "open" storm drainage cross line pipe shall extend out of the toe of the roadway embankment; in no case will the end of the pipe be within 5 feet of the roadway shoulder.
8. Storm drainage pipe discharging into a drainage channel shall intersect the channel in a manner such that the interior angle measured from its centerline of flow, is at least 90 degrees. Rip-rap, or other suitable protection, is required from the outlet point to the bottom of the channel and on the opposite channel bank to prevent scour and erosion.
9. Storm drainage pipes discharging into a wet pond below the permanent pool shall be analyzed to ensure that the tailwater conditions do not adversely impact storm drainage capacity or increase the potential for flooding. Where storm drainage pipes discharge above the permanent pool, rip-rap or other energy dissipation structures shall be designed and installed to ensure non- erosive velocities and discourage resuspension of solids in the pond.
10. An access point to allow maintenance shall be available within every 300 feet for 18" diameter pipe, every 400 feet for 24" pipe, and every 500 feet for larger storm drainage pipes.
11. The 100-year, 24-hour storm event shall be used to check all drainage designs for local flooding and, most notably, potential flood hazards to adjacent structures and/or property.
12. Hydraulic grade line and head loss calculations for determining water surface elevations shall be performed for connections to existing systems.
13. Calculations should be performed for the appropriate design storm event

14. For storm drainage systems with less than 10 connections, Manning's Equation shall be acceptable for sizing the capacity of drain pipes for non- submerged conditions where the free water surface elevation is below the crown of the pipes.
15. Storm drain profile plots should be included in the set of construction plans.
16. Storm drainage systems shall be designed to convey stormwater runoff by gravity flow.
17. CCTV inspection is required on all storm drain piping and apparatuses .

B. **Culverts.**

1. Proper consideration of inlet and outlet control shall be given in the design of culverts and outlets.
2. The pipe, appurtenant entrance, and outlet structure should properly account for water, bed-load, and floating debris at all stages of flow.
3. The outlet should be designed to resist undermining and wash-out. Rip-rap aprons, flared end sections, wing walls, or other means shall be sized and specified, as necessary.
4. Culvert section techniques can range from solving empirical formulas, to using nomographs and charts, to comprehensive mathematical analysis for specific hydraulic conditions. Other widely accepted models may be used, but must be approved by the City Engineering Department. Designs shall be based upon SCDOT requirements where applicable.
5. Additional hydraulic capacity shall be required as necessary to prevent backwater effects that may adversely impact upstream property or structures.

C. **Headwalls and Outlets.**

1. All exposed ends of pipes shall be protected by a flared end section or one of the following type headwalls:
   (1) A concrete or brick headwall plastered with grout is preferred.
   (2) A rip-rap headwall is acceptable for pipes 24" or less in a number of situations. Note that this technique requires the use of both filter fabric and grout. For pipes greater than 24", a concrete headwall with wings is required.
   (3) Where feasible, outfalls that convey newly-concentrated runoff from new development and discharge to an area without an existing channel must discharge through a natural buffer area a minimum of 50 feet in width from the property line. The

discharge shall enter an energy dissipater to slow the velocity of water and convert the discharge back to sheet flow, or one that is below an erosive velocity for the site conditions before entering the buffer area. Where the concentrated runoff from the new development discharges into a channel, a stabilized outlet must be provided such that the discharge does not cause erosion of the receiving channel.

(4) Outlets will not be allowed to discharge on fill slopes.

D. **Energy Dissipation.**

1. All concentrated discharge points shall be sufficiently stabilized, or have energy dissipating devices added, to mitigate the potential for long-term erosion of the areas receiving the stormwater flows. Calculations shall be provided justifying the design and material used. The use of energy dissipating devices shall be considered in all applications, and an explanation shall be provided for all instances where they are excluded from the design (e.g. flows enter directly into a stable, natural swale/channel).
2. Where concentrated runoff does not discharge to a channel, level spreaders, rip-rap aprons, plunge pools, etc. shall be properly designed and installed to ensure that concentrated flows are converted into sheet flow. The use of level spreaders shall be considered in all applications, and an explanation shall be provided for all instances where they are excluded from the design (e.g. flows enter directly into a natural swale/channel).

E. **Catch Basins, Yard Inlets, Manholes, Piping, and Junction Boxes.**

1. Materials and construction shall be prefabricated concrete box.
2. Materials and construction shall be as specified in Section 719 of the SCDOT Standard Drawings.
3. Side inlet catch basins or junction boxes with concrete covers shall have a metal ring and manhole lid cast within the top for easy access (e.g. pull holes in lid).
4. When the depth of a catch basin or junction box exceeds 4 feet, rungs/steps shall be provided for ascent and descent (Steps are to be ASTM-C-478, or equivalent).
5. The box top shall be a minimum of 3 feet by 3 feet. Sides shall be plastered with grout.
6. All pipes entering or leaving shall not protrude more than 4 inches into the box.
7. All roadway catch basins be Modified Florida Type Catch Basins.

8. Yard inlets shall be designed to accommodate a given flow such that ponded water is removed within 72 hours, and does not cause flooding to adjacent buildings or other interests. As long as these criteria are met, the depth of ponded water is allowed to exceed the top of the manhole lid by no more than six (6) inches for the appropriate design storm.
9. It is desirable to locate catch basins outside curve radii. If this is not reasonably possible, the catch basin shall be set back an extra foot and the face of the catch basin shall be parallel to a chord joining the two points on the curve radius located by projecting lines from the sides of the catch basin box.
10. Catch basins shall contain a minimum drop of 0.2 feet from invert in to invert out.
11. Floors are to be concrete with raised corners. Concrete must tie in at invert in and continue to invert out with raised corners to prevent water and sediment from collecting in the bottom of the catch basin.
12. Within a catch basin, the elevation at the crown of any inlet pipe shall be equal to or greater than the crown of the outlet pipe.
13. Catch basins shall be field staked to ensure proper catch basin inlet alignment with the street gutter line.
14. Are around all catch basins shall be backfilled in 12" lifts, compacted to 95% Standard Proctor maximum density.
15. Inlet protection shall be provided at all inlets into the stormwater system during construction and until project closure procedures have been completed or notification from the City's Engineering Department has been given stating that an acceptable level of stabilization has been achieved. Guidance on design, installation and maintenance of inlet protection can be found in the *SCDES Storm Water Management BMP Field Manual (2005)*. The City does not allow inlet protection devices that are installed inside an inlet or pipe. All inlet protection devices must be located at the surface/entrance of the inlet.
16. Maximum depth in which the water may pond above or around an inlet must not threaten surrounding permanent structures or facilities and ponded water shall not extend into travel lanes.

17. Catch basins, yard inlets, and junction boxes shall be constructed large enough to accept the pipes entering and exiting the box. Also, when necessary, an offset lid or other means shall be provided for safe access into the box for maintenance purposes. A detail shall be provided that clearly depicts these requirements.
18. Stormwater RCP - piping joints must have two complete wraps of geotextile material. Geotextile wrap to be 1' long on both sides from the center line of the pipe joint and must include 18" overlap.

F. **Detention/Retention Structures.**

1. A 50 foot minimum undisturbed buffer is required between the property line and drainage outfall. Where the pond discharges into a new or existing channel, the 50 foot setback applies, and the channel must be stabilized against erosion.
2. All ponds shall have an emergency spillway designed to safely pass the 100- year storm event. Earthen emergency spillways shall be designed so as not to overtop during the 25-year storm event. Larger ponds that fall under the purview of the Dams and Reservoirs Safety Act must comply with those regulations.
3. All sloped surfaces are to be roughened using the horizontal tracking method and seeded with a mulch covering to provide protection from weather.
4. Corrugated metal pipe (CMP) is not allowed through pond dams; only RCP shall be allowed.
5. Any development that uses a parking area or other feature for detention storage capacity shall clearly identify the limits and depths of the expected detention pool. Travel lanes cannot be used as detention storage.
6. Basin configurations which create stagnant water conditions shall be avoided.

G. **Open Channel Hydraulics.**

1. Open Channels shall include all permanent storm drainage channels including swales and diversions. These storm drainage systems shall be designed based upon the following criteria:

(1) Each swale design configuration (i.e. width, depth, side-slopes, and longitudinal slopes) used for a site must be provided- no "typical details" shall be allowed for sites that have multiple swale design configurations.

(2) All open channels are to be uniform and shall be stabilized to prevent erosion. A number of acceptable techniques are shown in the current version of the *SCDES Storm Water Management BMP Field Manual (2025)*.

(3) The design of open channels shall be based on Manning's Formula where backwater effects from obstructions and/or tailwater are not present. Flow velocities must be non-erosive to soils present or the channel surfaces must be adequately lined (e.g. rolled erosion control product, rip-rap, concrete). All channels in clayey soils shall be limited to a maximum flow velocity of 5 feet per second. All channels in sandy soils shall be limited to a maximum flow velocity of 2.5 feet per second.

(4) The minimum channel grade shall be 0.005 ft/ft, there will be no pools or standing water areas formed in the channels at smaller slopes.

(5) Design conditions can be assumed to be steady, uniform flow.

(6) Except for roadside ditches, the side slopes of grassed lined channels without rolled erosion control products or turf reinforcement matting shall be no steeper than 3H:1V.

(7) Channels may be designed with multiple stage levels with a low flow section to carry the 2-year storm event and a high flow section to carry storms of larger frequencies.

(8) The City will not accept ownership or maintenance of any open channels or ponds.

2. Construction Safety.

(1) The contractor is responsible for work site safety. Although the City will visit the construction site to observe construction, the City shall not be held liable for work site safety.

# 6. DRAINAGE

## 6.1 DRAINAGE PIPE AND BASIN STANDARD

A. **Drainage Pipe and Basin Standard**

1. All regulations, procedures, fees, and penalties listed in City Ordinance 2469 Stormwater Management and Sediment Control Regulations are applicable when designing drainage systems. See Appendix 1 for Ordinance 2469.
2. The minimum size storm drainage pipe allowable shall be 18 inches in diameter. All storm drainage to be owned by the City shall be reinforced concrete pipe (RCP).
3. The minimum allowable slope for storm drainage pipe shall be one-half of 1% (0.005 ft/ft) or a minimum flow velocity of 3 feet per second at all flow levels. Maximum allowable slope for storm drainage pipe is 20 % (0.20 ft/ft).
4. At pipe outfalls, the use of a rip-rap apron, placed on filter fabric, for a minimum distance equal to or greater than 6 pipe diameters. Use type A riprap as defined by *SCDOT Standard Specification Section 804*. Fabric shall be from SCDOT Qualified Product List.
5. Type and class of storm drainage pipe, as well as the construction of pipe culverts, shall be in accordance with SCDOT's *Supplemental Technical Specifications, Sections 714.* RCP is the only type of drainage pipe the City will accept for ownership.
6. A minimum of 1 foot of cover shall be provided for RCP storm drainage pipe. Storm drainage pipe shall be placed to minimize the length running under pavement. Where it is necessary for a pipe to cross the roadway, the preferred placement shall be at a 90 degree angle. All cross lines in the roadway shall be compacted in 8" lifts to 95% Standard Proctor maximum density and to 100% on the last 8" inches.
7. Any "open" storm drainage cross line pipe shall extend out of the toe of the roadway embankment; in no case will the end of the pipe be within 5 feet of the roadway shoulder.

8. Storm drainage pipe discharging into a drainage channel shall intersect the channel in a manner such that the interior angle measured from its centerline of flow, is at least 90 degrees. Rip-rap, or other suitable protection, is required from the outlet point to the bottom of the channel and on the opposite channel bank to prevent scour and erosion.
9. Storm drainage pipes discharging into a wet pond below the permanent pool shall be analyzed to ensure that the tailwater conditions do not adversely impact storm drainage capacity or increase the potential for flooding. Where storm drainage pipes discharge above the permanent pool, rip-rap or other energy dissipation structures shall be designed and installed to ensure non- erosive velocities and discourage resuspension of solids in the pond.
10. An access point to allow maintenance shall be available within every 300 feet for 18" diameter pipe, every 400 feet for 24" pipe, and every 500 feet for larger storm drainage pipes.
11. The 100-year, 24-hour storm event shall be used to check all drainage designs for local flooding and, most notably, potential flood hazards to adjacent structures and/or property.
12. Hydraulic grade line and head loss calculations for determining water surface elevations shall be performed for connections to existing systems.
13. Calculations should be performed for the appropriate design storm event.
14. For storm drainage systems with less than 10 connections, Manning's Equation shall be acceptable for sizing the capacity of drain pipes for non- submerged conditions where the free water surface elevation is below the crown of the pipes.
15. Storm drain profile plots should be included in the set of construction plans.
16. Storm drainage systems shall be designed to convey stormwater runoff by gravity flow.
17. CCTV inspection is required on all storm drain piping and apparatuses.

B. **Culverts.**

1. Proper consideration of inlet and outlet control shall be given in the design of culverts and outlets.
2. The pipe, appurtenant entrance, and outlet structure should properly account for water, bed-load, and floating debris at all stages of flow.

3. The outlet should be designed to resist undermining and wash-out. Rip-rap aprons, flared end sections, wing walls, or other means shall be sized and specified, as necessary.
4. Culvert section techniques can range from solving empirical formulas, to using nomographs and charts, to comprehensive mathematical analysis for specific hydraulic conditions. Other widely accepted models may be used, but must be approved by the City Engineering Department. Designs shall be based upon SCDOT requirements where applicable.
5. Additional hydraulic capacity shall be required as necessary to prevent backwater effects that may adversely impact upstream property or structures.

C. **Headwalls and Outlets.**

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   (1) A concrete or brick headwall plastered with grout is preferred.
   (2) A rip-rap headwall is acceptable for pipes 24" or less in a number of situations. Note that this technique requires the use of both filter fabric and grout. For pipes greater than 24", a concrete headwall with wings is required.
   (3) Where feasible, outfalls that convey newly-concentrated runoff from new development and discharge to an area without an existing channel must discharge through a natural buffer area a minimum of 50 feet in width from the property line. The discharge shall enter an energy dissipater to slow the velocity of water and convert the discharge back to sheet flow, or one that is below an erosive velocity for the site conditions before entering the buffer area. Where the concentrated runoff from the new development discharges into a channel, a stabilized outlet must be provided such that the discharge does not cause erosion of the receiving channel.
   (4) Outlets will not be allowed to discharge on fill slopes.

D. **Energy Dissipation.**

1. All concentrated discharge points shall be sufficiently stabilized, or have energy dissipating devices added, to mitigate the potential for long-term erosion of the areas receiving the stormwater flows. Calculations shall be provided justifying the design and material used. The use of energy dissipating devices shall be considered in all applications, and an

explanation shall be provided for all instances where they are excluded from the design (e.g. flows enter directly into a stable, natural swale/channel).

2. Where concentrated runoff does not discharge to a channel, level spreaders, rip-rap aprons, plunge pools, etc. shall be properly designed and installed to ensure that concentrated flows are converted into sheet flow. The use of level spreaders shall be considered in all applications, and an explanation shall be provided for all instances where they are excluded from the design (e.g. flows enter directly into a natural swale/channel).

E. **Catch Basins, Yard Inlets, Manholes, Piping, and Junction Boxes.**

1. Materials and construction shall be prefabricated concrete box.
2. Materials and construction shall be as specified in Section 719 of the SCDOT Standard Drawings.
3. Side inlet catch basins or junction boxes with concrete covers shall have a metal ring and manhole lid cast within the top for easy access (e.g. pull holes in lid).
4. When the depth of a catch basin or junction box exceeds 4 feet, rungs/steps shall be provided for ascent and descent (Steps are to be ASTM-C-478, or equivalent).
5. The box top shall be a minimum of 3 feet by 3 feet. Sides shall be plastered with grout.
6. All pipes entering or leaving shall not protrude more than 4 inches into the box.
7. All roadway catch basins be Modified Florida Type Catch Basins.
8. Yard inlets shall be designed to accommodate a given flow such that ponded water is removed within 72 hours, and does not cause flooding to adjacent buildings or other interests. As long as these criteria are met, the depth of ponded water is allowed to exceed the top of the manhole lid by no more than six (6) inches for the appropriate design storm.
9. It is desirable to locate catch basins outside curve radii. If this is not reasonably possible, the catch basin shall be set back an extra foot and the face of the catch basin shall be parallel to a chord joining the two points on the curve radius located by projecting lines from the sides of the catch basin box.
10. Catch basins shall contain a minimum drop of 0.2 feet from invert in to invert out.

11. Floors are to be concrete with raised corners. Concrete must tie in at invert in and continue to invert out with raised corners to prevent water and sediment from collecting in the bottom of the catch basin.
12. Within a catch basin, the elevation at the crown of any inlet pipe shall be equal to or greater than the crown of the outlet pipe.
13. Catch basins shall be field staked to ensure proper catch basin inlet alignment with the street gutter line.
14. Are around all catch basins shall be backfilled in 12" lifts, compacted to 95% Standard Proctor maximum density.
15. Inlet protection shall be provided at all inlets into the stormwater system during construction and until project closure procedures have been completed or notification from the City's Engineering Department has been given stating that an acceptable level of stabilization has been achieved. Guidance on design, installation and maintenance of inlet protection can be found in the *SCDES Storm Water Management BMP Field Manual (2005)*. The City does not allow inlet protection devices that are installed inside an inlet or pipe. All inlet protection devices must be located at the surface/entrance of the inlet.
16. Maximum depth in which the water may pond above or around an inlet must not threaten surrounding permanent structures or facilities and ponded water shall not extend into travel lanes.
17. Catch basins, yard inlets, and junction boxes shall be constructed large enough to accept the pipes entering and exiting the box. Also, when necessary, an offset lid or other means shall be provided for safe access into the box for maintenance purposes. A detail shall be provided that clearly depicts these requirements.
18. Stormwater RCP - piping joints must have two complete wraps of geotextile material. Geotextile wrap to be 1' long on both sides from the center line of the pipe joint and must include 18" overlap.

F. **Detention/Retention Structures:**

1. A 50 foot minimum undisturbed buffer is required between the property line and drainage outfall. Where the pond discharges into a new or existing channel, the 50 foot setback applies, and the channel must be stabilized against erosion.

2. All ponds shall have an emergency spillway designed to safely pass the 100- year storm event. Earthen emergency spillways shall be designed so as not to overtop during the 25-year storm event. Larger ponds that fall under the purview of the Dams and Reservoirs Safety Act must comply with those regulations.
3. All sloped surfaces are to be roughened using the horizontal tracking method and seeded with a mulch covering to provide protection from weather.
4. Corrugated metal pipe (CMP) is not allowed through pond dams; only RCP shall be allowed.
5. Any development that uses a parking area or other feature for detention storage capacity shall clearly identify the limits and depths of the expected detention pool. Travel lanes cannot be used as detention storage.
6. Basin configurations which create stagnant water conditions shall be avoided.

G. **Open Channel Hydraulics.**

1. Open Channels shall include all permanent storm drainage channels including swales and diversions. These storm drainage systems shall be designed based upon the following criteria.
   (1) Each swale design configuration (i.e. width, depth, side-slopes, and longitudinal slopes) used for a site must be provided- no "typical details" shall be allowed for sites that have multiple swale design configurations.
   (2) All open channels are to be uniform and shall be stabilized to prevent erosion. A number of acceptable techniques are shown in the current version of the *SCDES Storm Water Management BMP Field Manual (2025)*.
   (3) The design of open channels shall be based on Manning's Formula where backwater effects from obstructions and/or tailwater are not present. Flow velocities must be non-erosive to soils present or the channel surfaces must be adequately lined (e.g. rolled erosion control product, rip-rap, concrete). All channels in clayey soils shall be limited to a maximum flow velocity of 5 feet per second. All channels in sandy soils shall be limited to a maximum flow velocity of 2.5 feet per second.
   (4) The minimum channel grade shall be 0.005 ft/ft, there will be no pools or standing water areas formed in the channels at smaller slopes.

(5) Design conditions can be assumed to be steady, uniform flow.

(6) Except for roadside ditches, the side slopes of grassed lined channels without rolled erosion control products or turf reinforcement matting shall be no steeper than 3H:1V.

(7) Channels may be designed with multiple stage levels with a low flow section to carry the 2-year storm event and a high flow section to carry storms of larger frequencies.

(8) The City will not accept ownership or maintenance of any open channels or ponds.

2. Construction Safety.

(1) The contractor is responsible for work site safety. Although the City will visit the construction site to observe construction, the City shall not be held liable for work site safety.

# 7. WATER

## 7.1 WATER DISTRIBUTION SYSTEM DESIGN STANDARDS

A. **General.**

1. The following water system design standards are based on Federal, State, and the requirements of the City.
2. These design standards are applicable to all development requiring water service from the City.
3. As a general rule, the City does not allow aerial water main crossings. Examples of aerial crossings include, but are not limited to, water mains constructed on piers or pilings, and water mains attached to structures such as roadways, bridges or piers.
4. Where it is necessary for water mains to cross surface water or wetlands, the preferred method of installation is by Horizontal Directional Drill or Jack and Bore. In either case, the Engineer of Record is encouraged to meet with the City to discuss method of installation prior to submitting development plans for plan review.

B. **Design Criteria.**

1. Design water mains in accordance with the requirements of the South Carolina Department of Environmental Services (SCDES*) State Primary Drinking Water Regulation R.61-58* and the requirements of these standards.
2. Plan and Profile.
   (1) Provide plan view for all water mains drawn to a horizontal scale no smaller than 1-inch equals 50-feet.
   (2) Provide water main profile drawn to a vertical scale no smaller than 1-inch equals 5-feet.
   (3) Provide plan and profile at each location where water main crosses over or under a storm drainage pipe or structure, or sewer lines.

(4) Provide plan and profile for all water mains installed by jack and bore or horizontal directional drill.

3. Water mains shall not be closer than 25-feet horizontally from any portion of a wastewater tile field or spray field. If this separation is not possible, the water mains shall be protected by an acceptable method approved by SCDES and the City.
4. Water mains shall be located outside of contaminated areas. Where it is necessary for water mains to cross contaminated areas, the Engineer of Record shall submit proposed method of construction to the City for review and approval prior to submitting development plans for plan review.
5. There shall be no connection between the water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the system.
6. Locate water mains, valves and meters outside of paved roadway, if possible. Do not locate water mains, valves, meters or hydrants under or behind parking spaces or in any other areas that could inhibit access for operations and maintenance
7. Minimize dead ends by looping of all water mains. Arrange water mains so they are looped and interconnected at intersections without using crosses.
8. Where dead-ends occur, provide a fire hydrant on water mains 6-inch and larger and a yard hydrant on water mains less than 6-inch. Size flushing devices to provide flows with a velocity of at least 2.5 fps in the water main being flushed.
9. All water mains installed by direct bury or jack and bore shall be ductile iron pipe or C900 DR14 PVC.
10. All water mains installed by horizontal directional drill shall be High Density Polyethylene (HDPE).
11. Provide restrained joint pipe and fittings on all piping at each fitting, valve, and fire hydrant connection. The location and length of restrained joint pipe will be clearly marked on the plans.
12. Provide minimum 36-inch to maximum 48-inch cover at finished grade. Justification for deviation must be approved by the City.
13. Water Main Size.

(1) Minimum water main size shall be 6-inch. 4-inch mains may be allowed on dead-end lines provided the main cannot be extended and the main does not provide fire protection. The use of 4-inch mains requires prior approval from City Engineering.

(2) Maximum water main size shall be no larger than the water main from which it is being extended from or, in the case of a looped water main, no larger than the water main to which it is being extended to, whichever being the larger.

(3) The City reserves the right to stipulate the maximum water main size for any water main extension

C. **Capacity Design.**

1. Size mains based on either 1/5 the maximum instantaneous demand plus fire flow or maximum instantaneous demand, whichever is greater. The minimum pressure under conditions of maximum instantaneous demand shall be 30 psi at every service tap. 30 psi will be acceptable at any service tap when fire flows or flushing flows are provided in excess of maximum peak hourly flow.
2. Minimum design fire flow shall be 500 GPM.
3. Hydraulic calculations shall be based on the available static and residual pressure in the main to be extended. These pressures will be from a fire hydrant flow test performed by the City.
4. Use Hazen and Williams design coefficient, for cement lined DIP 120 and for PVC pipe 150.
5. The maximum instantaneous demand is to be calculated using the tables provided below, as published in the *Community Water System Source Book* by Joseph S. Ameen.

| Table D.7.1 Maximum Instantaneous Flows for Residential Areas | |
|---|---|
| **Number of Residences Served** | **Flow per Residence in GPM** |
| 1 (First) | 15.0 |
| 2 – 10* | 5.0 |
| 11 – 20** | 4.0 |
| 21 – 30 | 3.8 |
| 31 – 40 | 3.4 |
| 41 – 50 | 3.2 |
| 51 – 60 | 2.7 |
| 61 – 70 | 2.5 |
| 71 – 80 | 2.2 |
| 81 – 90 | 2.1 |
| 91 – 100 | 2.0 |
| 101 – 125 | 1.8 |
| 126 – 150 | 1.6 |
| 151 – 175 | 1.4 |
| 176 – 200 | 1.3 |
| 201 – 300 | 1.2 |
| 301 – 400 | 1.0 |
| 401 – 500 | 0.8 |
| 501 – 750 | 0.7 |
| 751 – 1,000 | 0.5 |

* Second, third, etc. through tenth residence served

** Eleventh, twelfth, etc., through twentieth residence served

| Table D.7.2 Maximum Instantaneous Flows for Commercial Areas | |
|---|---|
| **Type of Business** | **GPM on Basis Shown** |
| Barber Shop | 3.0 gpm per chair |
| Beauty Shop | 3.0 gpm per chair |
| Dentist Office | 4.0 gpm per chair |
| Department Store* | 1.0 – 2.0 – 3.0 gpm per employee |
| Drug Store | 5.0 gpm |
| with fountain service | add 6.0 gpm per fountain area |
| serving meals | add 2.0 gpm per seat |
| Industrial Plants** | 4.0 gpm plus 1.0 gpm per employee |
| Laundry | 30.0 gpm per 1,000 pounds of clothes |
| Launderette | 8.0 gpm per unit |
| Meat Market, Super Market | 6.0 gpm per 2,500 sq ft floor area |
| Motel, Hotel | 4.0 gpm per unit |
| Office Building | 0.5 gpm per 100 sq ft floor area or 2.0 gpm per employee |
| Physician's Office | 3.0 gpm per examining room |
| Restaurant | 2.0 gpm per seat |
| single service | 6.0 to 20.0 gpm total |
| drive-in | 2.0 to 7.0 gpm total |
| Service Station | 10.0 gpm per wash rack |
| Theater | 0.2 gpm per seat |
| drive-in | 0.2 gpm per car space |
| Other Establishments*** | Estimate at 4.0 gpm each |

* Including customer service

** Not including process water

*** Non-water using establishments

| Table D.7.3 Maximum Instantaneous Flows for Institutions | |
|---|---|
| **Type of Institution** | **Basis of Flow, GPM** |
| Boarding Schools, Colleges | 2.0 gpm per student |
| Churches | 0.4 gpm per member |
| Clubs: Country, Civic | 0.6 gpm per member |
| Hospitals | 4.0 gpm per bed |
| Nursing Homes | 2.0 gpm per bed |
| Prisons | 3.0 gpm per inmate |
| Rooming House | Same as Residential* |
| **Schools: Day, Elementary, Junior High, Senior High** | |
| **Number of Students** | **GPM Per Student** |
| 0 – 50 | 2.00 |
| 100 | 1.90 |
| 200 | 1.88 |
| 300 | 1.80 |
| 400 | 1.72 |
| 500 | 1.64 |
| 600 | 1.56 |
| 700 | 1.44 |
| 800 | 1.38 |
| 900 | 1.32 |
| 1,000 | 1.20 |
| 1,200 | 1.04 |
| 1,400 | 0.86 |
| 1,600 | 0.70 |
| 1,800 | 0.54 |
| 2,000 | 0.40 |

* Each unit of an apartment building should be considered as an individual residence.

D. **Relation to Sewer Mains.**

1. There shall be no physical connection between a public potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a gravity sewer manhole.
2. Horizontal and Vertical Separation:
   (1) Water mains shall be laid at least 10-feet horizontally from any existing or proposed sewer main. The distance shall be measured edge to edge. For water mains where it is not practical to maintain 10-foot separation, deviation may be allowed provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer main and at an elevation so the bottom of the water main is at least 18- inches above the top of the sewer main.
   (2) Crossings.
      a. Water mains crossing sewer mains shall be laid to provide a minimum vertical distance of 18-inches between the outside of the water main and the outside of the sewer main. This shall be the case whether the water main is either above or below the sewer main. Whenever possible, the water main shall be located above the sewer main. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the sewer main joints. Where a water main crosses under a gravity sewer main, adequate structural support shall be provided for the gravity sewer main to maintain line and grade.
      b. Where it is not practical to obtain proper horizontal and vertical separation as stipulated above, both the water main or the gravity sewer main shall be installed in a watertight steel casing that extends 10-feet either side of the crossing, measured perpendicular to the outside of the water main.

E. **Relation to Storm Drains.**

1. General.
   (1) No water main shall pass through or come into contact with any part of a storm drain pipe or structure.
2. Horizontal Separation.
   (1) Water mains shall be laid at least 5-feet horizontally from any existing or proposed storm drain pipe or structure. The distance shall be measured edge to edge.

3. Crossings Above.
   (1) Water mains crossing above storm drains shall be laid to provide a minimum vertical separation of 12-inches between the outside of the storm drain and the outside of the water main.
4. Crossings Below.
   (1) Single Barrel, 18-inch Diameter or Less.
      a. Water mains crossing below a single barrel storm drain pipe 18-inch diameter or less shall be laid to provide a minimum vertical separation of 18-inches between the outside of the storm drain and the outside of the water main.
      b. Where vertical separation is between 18-inches and 42- inches, one full length of ductile iron water main shall be centered under the storm drain crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far away as possible from the storm drain crossing.
   (2) Single Barrel, 30-inch Diameter or Greater.
      a. Water mains crossing below a single barrel storm drain pipe 30-inch diameter or greater shall be laid to provide a minimum vertical separation of 18-inches between the outside of the storm drain and the outside of the water main and shall be installed in a steel casing, regardless of the depth of vertical separation, that extends 5-feet on both sides of the crossing, measured perpendicular to the outside of the storm drain. A longer length may be required, as determined by the City, based on the depth and location of the crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the storm drain crossing.
   (3) Multiple Barrel.
      a. Water mains crossing below 2 or more adjacent storm drain pipes, regardless of diameter, shall be laid to provide a minimum vertical separation of 18-inches between the outside of the storm drain and the outside of the water main and shall be installed in a steel casing, regardless of the depth of vertical separation, that extends 5-feet on both sides of the crossing, measured perpendicular to the outside of the storm drain. A longer length may be required, as determined by the City, based on the depth and location of the crossing. The crossing shall be

arranged so that the water main joints will be equidistant and as far as possible from the storm drain crossing.

(4) Box Culverts.

a. Water mains crossing below box culverts shall be laid to provide a minimum vertical separation of 18-inches between the outside of the box culvert and the outside of the water main and shall be installed in a steel casing, regardless of the depth of vertical separation, that extends 5-feet on both sides of the crossing, measured perpendicular to the outside of the box culvert. A longer length may be required, as determined by the City, based on the depth or location of the crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the storm drain crossing.

F. **Services.**

1. Location.

(1) All water services and fire lines will require a meter.

(2) All meter boxes and meter vaults to be installed within road right-of- way, outside of the paved roadway, or in a City easement dedicated for the water system.

(3) Install all service lines, meter boxes and meter vaults perpendicular to the road right-of-way.

(4) Locate a minimum of 1-inch services and meter boxes for residential properties so services and meters are not located in concrete.

(5) Do not locate meter box or meter vault in driveways, under or behind parking spaces, or in any other areas that could inhibit access for operations and maintenance.

(6) Maximum length of service line, from the water main to the meter, shall not exceed 150-feet.

(7) All water service lines shall have tracer wire attached.

2. Tap Size.

(1) General.

a. The service line, including any branch lines, from the tap to the customer's point of connection, may be the same size as the tap, but may not be any larger.

b. All residential services are required to be a minimum 1-inch tap.

c. The City reserves the right to stipulate the minimum or maximum size service tap available off of any water main regardless of the water main size.

(2) Services, 2-inch and smaller.

a. Tap size shall be, at a minimum, one size smaller than the water main being tapped.

G. **Joint Restraint.**

1. General.

(1) Design restrained joints in accordance with the Ductile Iron Pipe Research Association (DIPRA) standards for all fittings, valves, hydrants and pipe joints as required to resist forces during testing and normal operating pressures within the distribution system.

(2) Retainer glands shall be used on all mechanical joint fittings. All tees, plugs, caps, and bends equal to or exceeding 11-1/4 degrees, and at other locations where unbalanced forces exist, must have acceptable thrust restraint.

H. **Valves.**

1. Gate Valves.

(1) Water mains 4-inch through 12-inch: Use resilient wedge gate valves.

(2) Provide valves at maximum 500-foot intervals. Requests for spacing greater than 500-foot will be reviewed on a case-by-case basis.

(3) Provide three (3) valves for a tee intersection and four (4) valves for two- offset tee intersections. The use of crosses is not acceptable.

(4) Valves should be placed to minimize the number of City customers out of service due to a water main break and/or any maintenance operation.

(5) If a water line crosses at a bridge, a valve will be required on either side of the bridge.

(6) The City reserves the right to require additional valves if it is deemed in the best interest of current and future customers.

I. **Fire Hydrants.**

1. General.

(1) Minimum main size for water mains serving fire hydrants shall be 6- inch.

(2) Minimum size for hydrant lead shall be 6-inch

(3) Provide hydrant control valve on all hydrant leads

(4) Fire hydrants shall be flush to finish grade

2. Location.
   (1) Fire hydrants will be generally spaced at intervals of 1,000-feet in rural areas and at intervals of 500-feet in urban areas.
   (2) The City reserves the right to require the installation of additional fire hydrants, solely at its discretion.
   (3) When practical, locate fire hydrants at road intersections or at property corners.
   (4) Do not locate fire hydrants in driveways, ditches, wetlands or in areas not easily accessible for operation and maintenance.
   (5) No portion of a fire hydrant shall be inside an ADA sidewalk or ramp.
   (6) Fire hydrants shall be required as blow-offs on water mains 6-inch and larger to achieve a 2.5 foot per second scouring velocity.

J. **Yard Hydrants.**
   1. General.
      (1) All 4-inch dead-end water mains shall be designed to include a Post Hydrant.
      (2) Blow-off hydrants or other such appurtenances shall not be connected directly to any storm drain or sewer.

# 7.2 WATER DISTRIBUTION SYSTEM MATERIALS FOR CONSTRUCTION

A. **General.**
   1. This section includes pipe and fitting material specifications, joint materials, valves and encasement requirements.
   2. All materials used in the construction of water distribution systems shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used.
   3. All chemicals/ products added to public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.
   4. All brass components in contact with potable water must be made from either CDA/UNS Brass Alloys C89520 or C89833 with a maximum lead content of .25% by weight. Brass alloys not listed in ANSI/AWWA C800 Paragraph 4.1.2 are not approved. All fittings shall be

stamped or embossed with a mark or name indicating that the product is manufactured from the low-lead alloy.

5. All materials/products that contact potable water must be third party certified as meeting the specifications of ANSI/NSF Standard 61.
6. The pressure rating of pipe must be capable of handling 1.5 times the normal working pressure.
7. All pipe fittings, packing, jointing materials and valves must conform to Section C of the AWWA Standards.

B. **Bedding Material.**

1. Clean, well graded Class II and/or Class III soils.
2. Class II soils shall be used in the pipe zone.
3. Use Class II or Class III above the pipe zone.
4. Backfill material must be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe.
5. Stones must not come in contact with the pipe .

C. **Ductile Iron Pipe.**

1. All sizes of pipe shall be laying length of 18- feet to 20-feet.
2. All buried pipe shall be pressure class as follows:

| Table D.7.4 Buried Pipe Class | |
|---|---|
| **Pipe Size (inch)** | **Pressure Class (psi)** |
| **4 – 12** | **350** |
| **14 – 20** | **250** |

3. Pipe wall thickness shall be in accordance to bury depth as shown on drawing: ANSI/AWWA A21.50/C115.
4. Flange pipe or Victaulic grooved pipe shall be class 53.
5. Use cement mortar lining: ANSI/AWWA C104/A21.4, standard thickness.
6. Use rubber gaskets and lubricant: ANSI/AWWA C111/A21.11.
7. No metric sized pipe shall be permitted.

8. All pipe to be shipped with gaskets, glands, and bolts unless specified otherwise.
9. All pipe lengths must be tested to 500 psi working pressure prior to shipping.
10. Accepted products: American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, and McWane Cast Iron Pipe Company.

D. **PVC Pipe & Fittings.**

1. General.
   (1) Only the products of a manufacturer regularly engaged in the manufacturing of pipe used for the conveyance of potable water will be acceptable.
   (2) All PVC water line pipe must be approved by the National Sanitary Foundation (NSF) and must bear the NSF seal of approval.
   (3) Piping shall meet the following standards ASTM D1598, ASTM D1599, ASTM D1784, ASTM D2241, ASTM D 2321, ASTM D3139, and AWWA C104.
   (4) Manufacturers are required to inspect and test all pipe and fittings at the place of manufacturing.
   (5) Manufacturer's certificate must indicate joints of the type proposed have been hydrostatically tested to 600 psi.
   (6) For Engineering approval submit the following items:
      a. Shop drawings for all joint gaskets.
      b. One certified copy of the pipe manufacturer's allowable joint deflection limits.
2. PVC 4 Inches in Diameter and Larger.
   (1) Pipe shall meet AWWA C900 for 4 inch through 12-inch diameter and AWWA C905 for pipe in diameter greater than 12 inches.
   (2) Comply with the requirements of AWWA C900 or C905 as applicable for the size of the pipe, conforming with the outside diameter dimensions of cast iron pipe, with a maximum dimension ratio (DR) of 25. Mark pipe in compliance with the requirements of AWWA C900 or C905.
3. Pipe Lengths.
   (1) Provide pipe in nominal 20-foot lengths. Shorter lengths may be used where required by construction details or when approved by the Engineer.
4. PVC Pipe Joints.

(1) Provide gasket integral bell end pipe joints utilizing elastomeric gaskets. The joint must provide protection of the line from shock, vibration, and earth movement, and must compensate for the expansion and contraction of pipe lengths.

5. PVC Fittings.
   (1) Unless otherwise specified or indicated on the drawings, use Pressure Rated Class 250 fittings, either ductile iron or gray cast iron, conforming to applicable sections of AWWA C110. Unless otherwise shown on the Drawings, use push-on or mechanical joint fittings. Provide fittings in the size indicated on the Drawings, as specified herein, or as required to make connections or changes in horizontal and vertical alignment. Line the interior of the fittings with a cement mortar lining and bituminous seal coat conforming to AWWA C104.
6. Bedding Material.
   (1) Comply with the requirements of ASTM D2321 for Class III embedment material.
7. Thrust Restraint.
   (1) Provide mechanical joint thrust restraints for all tees, bends and plugs on pipe 2-1/2 inches in diameter and larger. Thrust restraints shall be by EBBA Iron Sales or equal.
8. Tracer Wire.
   (1) Tracer wire shall be continuous, single strand copper wire, insulated, 10 AWG diameter.

E. **Pipe Joints.**

1. General.
   (1) Ductile iron pipe, PVC pipe, and fittings shall be furnished with push-on joints, push- on restrained joints, mechanical joints, flanged joints, and grooved joints as required.
   (2) Pipe ends (spigot end, bell and socket) for all pipe shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to the standard dimensions of ANSI/AWWA C151/A21.5.
   (3) Provide rubber gaskets and lubricants complying with ANSI/AWWA C111/A21.11 for mechanical or push-on joints.
      a. Natural rubber gaskets are not acceptable.
      b. Lubricants, which will support microbiological growth, shall not be used for slip-on joints.
      c. Vegetable shortening shall not be used to lubricate joints.

2. Push-on Joints.
   (1) Provide push-on joints complying with ANSI/AWWA 21.11/C11 as modified by ANSI/AWWA C151/A21.51.
   (2) Accepted products: Fastite, Tyton, and Bell-tite.
3. Mechanical Joints.
   (1) Provide mechanical joints complying with ANSI/AWWA 21.11/C11 as modified by ANSI/AWWA C151/A21.51.
4. Flanged Joints.
   (1) Provide flanged joints complying with ANSI/AWWA C115/A21.15.
      a. Provide ASTM D1330, Grade I rubber, full face type gaskets.
      b. Thickness.
         (a) Up to 10-inch pipe diameter: 1/16-inch.
         (b) Larger than 10-inch pipe diameter: 1/8-inch.
      c. Certified as suitable for chlorinated and chloraminated potable water.
5. Restrained Joints.
   (1) Provide restrained joint pipe and fittings on all piping at each fitting, valve, fire hydrant connection and on pipe joints as shown on the plans.
   (2) Conform to ANSI/AWWA A21.11/C111 as modified by ANSI/AWWA C151/A21.51.
   (3) Accepted Products:
      a. American Cast Iron Pipe: Fast Grip, Flex-Ring, Field Flex- Ring or Lock-Ring
      b. US Pipe: TR Flex or Field Lok 350 Gaskets
      c. Griffin Pipe: Snap-Lok Restrained Joint, or Talon RJ Gasket
      d. EBAA: Series 1100 Megalug Restraint Gland
      e. Ford: Series 1400 Restraint Gland
      f. Sigma: One-Lok Series SLD Restraint Gland
      g. McWane: Sure Stop 350 Restraint Gasket
      h. For connections to PVC pipe:
         (a) EBAA: Megalug series 2000PV.
         (b) Ford: Series 1500 Restraint Gland.
6. Bolts, Nuts, and All-Threaded Rod.

(1) Tee bolts and nuts shall be made of high strength low alloy steel (ASTM A307), Cor-Ten (ASTM A242), 304 stainless steel, or 316 stainless steel.

(2) Nuts and bolts used for flanged connections shall be grade 316 stainless steel.

(3) All fasteners shall have minimum yield strength of 45,000 psi. Material type shall be marked on the fasteners.

(4) All-thread rod shall be grade 316 stainless steel.

(5) Stainless steel materials shall contain sufficient chromium to resist corrosion, oxidation, and rust.

(6) Materials shall be sound, clean, and coated with a rust resistant lubricant, approved for use with potable water.

(7) Threads shall be in accordance with ANSI B1.1, Unified Inch Screw Threads, and with B1.2, Screw Threads, Gages, and Gaging, conforming to the coarse thread series (UNC) Unified Coarse, with threads Class 2A internal and Class 2B external.

(8) Bolts 3/4" and smaller shall be furnished with heavy hex heads conforming to ANSI B18.2.1.

(9) Bolts larger than 3/4" may have either standard or heavy hex heads conforming to ANSI B18.2.1.

F. **Ductile Iron Pipe Fittings.**

1. General.

(1) Use cement mortar lining: ANSI/AWWA C104/A21.4, Standard thickness or epoxy lining.

(2) Compact fittings for piping 3-inch through 48-inch may be provided in accordance with ANSI/AWWA C153/A21.53.88.

(3) No metric sized fittings shall be permitted.

(4) All fittings are to be shipped with gaskets, glands, nuts, and bolts unless specified otherwise.

(5) Provide joint restraint at each fitting, valve and fire hydrant connection unless specified otherwise herein or indicated on the drawings.

2. Mechanical joint fittings shall conform to ANSI/AWWA A21.53/C153 or ANSI/AWWA A21.10/C110.

3. Flanged Fittings.

(1) Conform to ANSI/AWWA A21.10/C110.

(2) Fitting flanges shall have facing and drilling which match AWWA/ANSI C115/B16.1 except were class 250 flanges are specifically noted.

4. Sleeves, 4-inch and Larger.
   (1) Provide full-length mechanical joint ductile iron solid sleeve, 12-inch minimum length, where needed to make piping connections.
   (2) Provide cut-in sleeve, ductile iron, with mechanical restraint joint where installing fittings in an existing line.
5. Accepted products: Tyler Union, Star Pipe Products, and Sigma Corporation.

G. **Tapping Sleeves.**

1. Tapping sleeve sizes 4-inch through 36-inch shall conform to the following criteria:
   (1) Provide stainless steel tapping split-type sleeve with flanged outlet.
   (2) Provide bolts, follower rings and gaskets on each end of the sleeve.
   (3) Provide for minimum working pressure of 150 psi.
   (4) Provide square or hexagonal head bolts with hexagonal nuts. All square and hexagonal head bolts and hexagonal nuts shall be Cor-Ten steel, 304 stainless steel, or 316 stainless steel.
   (5) Provide ¾-inch NPT test plug on top of the outlet.
   (6) Accepted Products:
      a. 4-inch through 16-inch: Mueller H-615

H. **Valves.**

1. General.
   (1) All valves shall be in conformance with the latest revision of all reference standards of AWWA or ANSI.
   (2) 4-inch through 12-inch: Use resilient wedge gate valves.
   (3) All valves shall "Open Left".
   (4) Provide a 2-inch ductile iron wrench nut with direction of valve operation clearly visible when looking down on the nut. Hold-down nut or bolt will be Type 316 stainless steel.
   (5) Provide stem extensions on all valves where the top of the operator nut is located greater than 36-inches below the top of the valve box.
   (6) All valves shall be equipped with a non-rising stem.

2. Gate Valves.
   (1) All valves will meet or exceed all requirements of AWWA C509 or AWWA C515.
   (2) Outer valve body will have raised lettering cast in, providing manufacturers name, valve size, year of manufacture, pressure rating, location of casting and each part is to be clearly marked indicating ductile or cast iron.
   (3) All valves will be electrostatically, fusion-bonded epoxy coated, minimum 8-mil thickness inside and out, conforming to ANSI/AWWA C550 Standards.
   (4) Resilient wedge to be ductile or cast iron fully encapsulated with EPDM elastomer, including guide path and will be US Food and Drug Administration approved for potable water and have an EPDM visible marking.
   (5) All valves will have a minimum 250 psi working pressure and a 500-psi static pressure.
   (6) Valve stem material will be bronze, brass, or Type 304 stainless steel.
   (7) Valves will have two upper O-ring seals on the stem above the thrust collar and at least one O-ring seal below the collar so designed to allow for replacement of the upper O-rings with the valve under full operating pressure.
   (8) Valves will have thrust washers located above and below the thrust collar to insure smooth frictionless operation.
   (9) All exterior bonnet and thrust collar bolting, whether recessed or exposed, are to be Type 316 stainless steel and marked by type.
   (10) Waterway seat area will be smooth without ridges or cavities and valves will have full size bore throughout the flow-way.
   (11) All valves will be hydrostatically pressure tested prior to shipment in compliance with AWWA C509 or AWWA C515 Standards and be covered by the Manufacturer's Ten-Year Limited Warranty from the date of purchase by the end user.
   (12) Accepted products: Mueller and Clow.
3. Tapping Valves, 16-inch and Smaller.
   (1) Conform to the requirements for gate valves as specified in Item 2 above, Gate Valves.
   (2) Accepted products: Mueller and Clow.

I. **Fire Hydrants.**

1. Compression type, opening against pressure and closing with pressure, comply with ANSI/AWWA C502 dry-barrel fire hydrants, existing nation standards and ANSI B26.

2. Hydrants shall have a 6-inch mechanical joint connection with a 4 ½-inch main valve. EPDM rubber will be specified on all hydrants and hydrant replacement parts to protect against chloramine deterioration.
3. 6-inch bell connection, two (2) 2 ½-inch hose connections, one (1) 4 ½-inch pumper nozzle with mechanical removal feature, set screw, lock ring, etc., and shall conform to ANSI B26.
4. Hydrants shall have a 1 ½-inch pentagon shaped operating stem nut and shall "Open Right" (clockwise). Arrow shall be cast in top of hydrant indicating direction of opening.
5. National Standard screw threads on outlet nozzles.
6. Two- part breakable safety flange shall be integral parts of barrel casting at least 2-inch above bury line.
7. Barrel lengths shall generally be for 3 ½-foot bury.
8. Interior shall be two-part thermosetting or fusion bonded, coated holiday free to a minimum thickness of 4 mils conforming to AWWA C550: Standard for Protective Interior Coatings for Valves and Hydrants.
9. Exterior coating shall be as follows:
   (1) Hydrant barrel will be painted Sherwin Williams Chrome Yellow, product number B54T1104.
   (2) Weather cap (bonnet), operating nut, and nozzle caps will be painted Sherwin Williams Orange, product number B54E39 for 6" diameter waterlines. 8" waterlines will be painted Sherwin Williams Safety Green, product number B54T1104.
   (3) Exterior hydrant parts below ground will be asphaltic or epoxy coated.
10. All bronze or brass internal working parts in contact with service water are to be maximum 16% in zinc content and 79% minimum in copper.
11. Retaining bolts from shoe to lower barrel shall be 316 stainless steel.
12. Upper assembly shall be provided with a grease or oil reservoir that automatically lubricates all operating stem threads and bearing surfaces each time of operation. The system shall be completely sealed from waterway and external contaminants. The reservoir is to have an external filler point that does not require dismantling any portion of the hydrant during regular maintenance and all hydrants are to be completely lubricated with food grade product prior to leaving the factory.
13. Exterior casting shall indicate type, design, date, and location of manufacturer.

14. Upper and lower main stem rods shall be steel, stainless steel, or bronze in accordance with AWWA C502.
15. Accepted Products: Mueller Company: Super Centurion A-421.
16. Fire hydrants shall be equipped with Storz connector with cap.

J. **Services.**

1. Taps.
   (1) DIP water main.
      a. Services 1-inch: Tapping Saddle Double Strap
      b. Services 1 ½-inch to 2-inch: Tapping saddle
      c. Services greater than 2-inch: Tapping sleeve

   (2) Existing PVC water mains.
      a. Services 1-inch to 2-inch: Tapping saddle
      b. Services larger than 2-inch: Tapping sleeve with full body valve
2. Tapping Saddles.
   (1) Provide all of the following materials:
      a. Body - Ductile Iron ASTM-A536
      b. Bales and Strips – Type 304 or 316 stainless steel
      c. Studs - Type 304 or 316 stainless steel
      d. Hardware - Type 304 or 316 stainless steel
      e. Iron pipe thread
   (2) Provide double strap for all sizes.
   (3) Finish – Provide fusion bonded nylon to an average thickness of 12 mils.
   (4) Accepted products:
      a. Smith Blair: 317
      b. Ford: FCD 202
      c. Mueller: DR2S
      d. JCM: 406
      e. Romac: 202N
3. Service Line Piping.
   (1) Minimum size, 1-inch.

(2) Services 1-inch to 2-inch, provide CTS Poly, 0.065" minimum thickness, suitable for underground water services and supplied in conformance with ASTM B88.

(3) Services greater than 2-inch, provide PVC or Poly pipe.

4. Corporation Valves.

(1) Corporation Valves will have NPT thread inlets. The outlet connection will be CTS /OD, conductive compression (grip nut) type outlets.

(2) Accepted products:

a. Mueller: 300 Corp, Model # B-25028N.

b. Ford: Ball Corp, Model # FB1100-X-Q-NL.

c. A.Y. McDonald: Ball Corp, Model # 74704-BG.

5. Meter Setter.

(1) Meter setters for 2-inch flanged meters are constructed of brass and copper tubing, ball valve inlet with padlock wing, check valve outlet, brace pipe eyelet on FIP 90° Ells on inlet and outlet sides of set-up

(2) Accepted products:

a. Ford: # VBH 77-15-44-77-Q-NL for 2-inch

b. Mueller: 2" with 15" riser and 110 compression connection

c. A.Y. McDonald: 721- 715WDGG 770 for 2-inch

6. Curb Stops.

(1) Provide curb stops for 1 ½-inch and 2-inch services

(2) Accepted products:

a. Mueller: Model # B-25209N

b. A.Y. McDonald: Model # 76100-WG

c. Ford: Model # B44-XXX-Q-NL

7. Couplings.

(1) Provide couplings for service line connections.

(2) Accepted products:

a. Straight Couplings, 1-inch x ¾-inch

(a) Mueller: Model # H-15403N

(b) Ford: Model # C44-34-Q-NL

(c) A.Y. McDonald: Model # 74758G

b. Y Branch, 1-inch x ¾-inch x ¾-inch
   (a) Mueller: Model # H-15343N
   (b) Ford: Model # Y44-243-Q-NL
   (c) A.Y. McDonald, Model # 708YSG
c. 90 Degree Bends, 1 ½-inch and 2-inch
   (a) Mueller: Model # H-15526N
   (b) Ford: Model # L44-XX-Q-N
   (c) A.Y. McDonald: Model # 74761G

# 7.3 WATER DISTRIBUTION SYSTEM CONSTRUCTION PROCEDURES

A. **General.**
   1. Prior to construction activities taking place, the Engineer of Record shall coordinate in advance a Pre-Construction Meeting with the assigned City Engineering Inspector. The Engineer of Record, Contractor(s), and City's Engineering Inspector shall be in attendance at a minimum.
   2. The contractor is responsible for work site safety. Although the City will visit the construction site to observe construction, the City shall not be held liable for work site safety.
   3. If any requirements for carrying out project construction are not met, the City reserves the right to issue a stop work order.

B. **Operation of the City of Sumter Valves and Hydrants.**
   1. Only City of Sumter personnel shall operate City of Sumter valves or hydrants unless otherwise directed or approved by the City.
   2. All hydrant and blow-off operations shall be done in a manner to direct flow away from private property and to prevent flooding of streets or roadways and to not cause any traffic problems .

C. **Handling of Materials.**
   1. Store rubber gaskets and polyethylene film under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground. Keep all materials free of dirt and debris. Store per manufacturer's recommendations.

2. Keep valves off the ground and keep interior free of dirt and debris. Do not expose valve interior to direct sunlight. Store and maintain, if necessary, per manufacturer's recommendations.
3. Keep inside of pipe free of dirt and debris.
4. Handle pipe and fittings per manufacturer's recommendations so as to ensure delivery to the trench in sound, undamaged condition.
5. Use pinch bars, slings or tongs for aligning or turning pipe.
6. Use care not to damage pipe linings.

D. **Trench Excavation.** This section is provided to outline most types of laying conditions but is not intended to cover all special laying conditions or the Engineer's special requirements.

1. Trench excavation shall be made via open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of the trenches shall be cut in vertical, parallel planes equidistant from the pipe centerline. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed.
2. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe.
3. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade is encountered such material shall be removed and replaced with crushed stone (slag is not acceptable).
4. After excavation, the area between the final pipe grade and the trench soil bottom shall be filled with crushed stone materials as required, compacted to proper grade, and made ready for pipe laying (slag is not acceptable).
5. Debris encountered in trench excavation for water mains and other pipelines shall be removed for the overall width of trench which shall be as shown on the plans. It shall be removed to a depth of 6-inches below the bottom of the pipe for pipes smaller than 24-inch; 8-inches below the bottom of the pipe for pipes 24-inch to 36-inch; and 12-inches below the bottom of the pipe for pipes larger than 36-inch, if debris extends to such depth.
6. In all cases, materials deposited shall be placed so that in the event of rain, no damage will result to the work.

7. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions. Maintain the walls of the excavation properly in place and protect all persons and property from injury or damage. Sheeting, shoring or bracing materials shall not be left in place unless as shown by the plans or permitted by the City. All sheeting and bracing shall be left in place until the trench has been backfilled 1-foot above the top of the pipe.

E. **Trench Backfill.**

1. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected.

(1) The initial backfill material, placed to a height of 1-foot above the top of the pipe, shall consist of approved backfill material free from organic matter and deleterious substances, containing no rocks or lumps over 2-inch in any dimension. It shall be carefully placed and compacted throughout the entire area to be backfilled.

(2) Backfill shall be deposited in 6-inch layers (before compaction) and thoroughly compacted with power tools to 95% of theoretical maximum density, modified Proctor ASTM-D-1557.

(3) Where pipe trenches are cut across or along pavement, the trenches shall be backfilled in accordance with applicable permits.

(4) Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut from the bottom of the finished grade.

(5) Tracer Wire.

a. Provide continuous, single strand copper wire, insulated, 10AWG diameter wire for all direct buried water mains.

(6) All backfilling shall be done in such a manner as will not disturb or injure the pipe or structure over or against which it is being placed. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified.

(7) All backfilling shall be done in such a manner as will not disturb or injure the pipe or structure over or against which it is being placed. Any pipe or structure injured,

damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified.

(8) All excavations suspected of not meeting compaction requirements shall be tested for conformance by a City approved testing lab. Tests shall be performed at the locations and depths directed by the City. Tests shall be at the expense of the installing contractor.

F. **Pipe and Appurtenances.**

1. General.

(1) Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Install a mechanical joint or push-on type ductile iron plug or cap whenever work stops for a period of one (1) day or greater.

(2) Replace pipe where any part of coating or lining is damaged.

(3) Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the pipe manufacturer.

(4) Do not dump or drop any of the materials into the trench.

(5) Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.

(6) Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.

(7) Bell pipe using manufacturer's approved leverage bar. Do not use machinery to bell pipe. Home line is to be clearly visible when pipe is joined.

(8) Do not lay pipe in water or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed.

(9) Re-lay pipe that has the grade or joint disturbed after laying.

2. Alignment and Grade.

(1) Install pipe to the alignment and profile shown on the approved drawings.

(2) Fittings, valves, and other appurtenances shall be located where shown on the approved plans, with the pipe being cut if necessary to ensure accurate placement.

(3) Cutting Pipe.

a. Cut pipe neatly and without damage to the pipe or lining.

b. Unless otherwise recommended by the pipe manufacturer, cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Use wheel cutters when practical.
c. Cuts must be even and perpendicular with length of pipe.
d. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made.
e. Cut ends and rough edges should be ground smooth and, for push-on type connection, the cut end must be beveled slightly.

(4) Pipe lines intended to be straight shall be so laid.

(5) Where vertical or horizontal alignment requires deflection from straight lines or grade, do not exceed 75% of maximum deflection recommended by the pipe manufacturer or AWWA Standard 600.

(6) If alignment requires deflection exceeding recommended limits, furnish bends to provide angular deflections within the allowable limits.

3. Jointing Pipe and Appurtenances.

(1) Mechanical, Push-On, and Restrained Joint.

a. Join pipe with mechanical or push-on type joints in a.ccordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricants for the pipe gaskets shall be used and shall be manufacturer's standard. All mechanical joints used on hydrants, hydrant leads, taps and valves shall have restraining glands.

(2) Flanged.

a. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque- limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re- tightened.

4. Installation of Restraining Glands.

(1) Adjoining surfaces shall be clean, lubricated and meet the requirements of ANSI/AWWA C111/A21.11.

(2) Install using assembly recommendations established in ANSI/AWWA C111/A21.11 as well as installation instructions provided by the manufacturer.

(3) If twist-off nuts are provided, tighten screws until nuts break loose.

G. **Tie-in to Existing Mains.**

1. General.

(1) Tie-ins to existing mains shall be done by use of wet taps using tapping sleeve and tapping valve or by installation of a tee and valve. Existing waterline shall not be tapped on the opposite side of the existing pipe from where the new waterline intersects the existing waterline, also known as "back tapping" a waterline.

(2) Engineer of Record or Contractor shall coordinate with the assigned City Construction Inspector to schedule wet tap or tee installation. A minimum of 3 working days shall be allowed for scheduling.

2. Wet Taps.

(1) Tapping sleeve shall be installed on the water main with the tapping flange and valve at the 3 o'clock or 9 o'clock position.

(2) Provide thrust blocking behind tapping sleeve.

(3) Pressure test the tapping sleeve and valve at 150 psi. Pressure shall hold steady for 15 minutes.

(4) Tap main thru the tapping valve.

(5) When tap is complete, remove pipe coupon from shell cutter and provide to the City Construction Inspector.

(6) Encase tapping sleeve, pipe and valve .

(7) Backfill and set valve box.

3. Tee and Valve.

(1) Cut out section of main to allow the installation of the tee with a solid sleeve.

(2) Install tee and solid sleeve.

(3) Add valve to the branch side of tee.

(4) Shut new valve on branch side of tee, restore water to main and check for leaks.

(5) Encase new tee, sleeve, pipe and valve in polywrap.

(6) Backfill and set valve box.

H. **Setting Valves and Valve Boxes.**

1. Valves shall be carefully handled, cleaned and checked for operation prior to backfilling. Care shall be taken to ensure that no dirt, rock, or other obstacles that would interfere with the operation are left in the valve.
2. Center valve box on the valve, setting plumb. Valve box shall not rest on any part of the valve.
3. Tamp earth fill around each valve box to a distance of 4-feet on all sides, or to the undisturbed trench face if less than 4-feet.
4. Install shaft extensions plumb without any binding.
5. Valves shall be installed in a position such that the plane of operation or rotation for the operating nut is parallel to the ground surface.
6. Fully open and close each valve to manufacturer's specifications to assure that all parts are in working condition. All valves shall be left in the fully open position unless directed otherwise by the City.
7. Place valve box protection ring around top of valve box. Top of the ring is to be level with top of valve box and or no more than 1-inch above finish grade.

I. **Fire Hydrants.**

1. Installation.
   (1) Inspect hydrant carefully, ensuring that all foreign material is removed from the barrel. Inspect materials upon receipt for damaged or missing items. Store rubber gaskets under cover, out of direct sunlight. Do not store nuts, bolts, glands, and other appurtenances directly on the ground. Keep interiors free of dirt and debris.
   (2) Hydrants shall be carefully handled, cleaned and checked for operation prior to backfilling. Care shall be taken to ensure that no dirt, rock and other obstacles that would interfere with the operation are left in the hydrant.
   (3) Provide proper anchorage to fire hydrant installations by means of retainer glands.
   (4) Rotate fire hydrant offset fitting so hydrant is plumb and at the elevation detailed or install extension kit as necessary to position the bury line at finished grade.
   (5) Install stone drainage bed. Fire hydrants must be provided with a gravel pocket or dry well.

(6) Fully open and close each hydrant to manufacturer's specification to assure that all parts are in working condition.

2. Acceptance.

(1) Prior to acceptance by the City, hydrants shall be repainted in accordance with these Standards.

(2) Under the direction of the City Inspector, the Engineer of Record shall perform a flow test on all newly installed fire hydrants. Flow test results shall be furnished to the City as part of the project acceptance paperwork.

(3) All hydrants shall be bagged until South Carolina Department of Environmental Services (SC DES) permit to operate has been received and City Council has accepted the infrastructure.

(4) The Developer or Developer's Contractor shall not move fire hydrants after the infrastructure has been inspected and accepted due subdivision phasing. Any movement of accepted infrastructure must be approved in writing by City Engineering and updated record drawings will have to be submitted and approved.

J. **Services.**

1. General.

(1) All residential water services shall be located as shown on the approved plans. Provide straight alignment perpendicular to the road centerline from the meter to the main.

(2) Saddle taps are required on all PVC mains and when making 2-inch taps on ductile iron mains. Taps will be made with through-the-saddle style tapping machines, using coupon-type tapping bits under system pressure. The tapered iron drill bit shall be used where saddles are required on ductile iron. All saddle taps are to be located at the 2 o'clock or 10 o'clock position on the main.

2. Service Line Installation.

(1) All service lines will be installed with a minimum of 24-inches to a maximum of 36-inches of cover on all street crossings, and a minimum of 24-inches under all open ditches.

(2) PVC sleeves are optional on service lines crossing streets, driveways or parking areas. The Contractor may install a capped 4- inch Schedule 40 PVC water service carrier pipe to provide the flexibility of installing the water service line at a later date during the construction period. The carrier pipe shall be installed a minimum of 36-inches and

a maximum of 60-inches below the surface of the road and made easily accessible. The carrier pipe shall be flagged with direct burial electronically detectable tape.

(3) Meter Box and Meter Vault Installation.

a. Install meter box or meter vault within road right-of-way, outside of the paved roadway or in a City easement.

b. Provide straight alignment perpendicular to the road centerline from the meter box to the main.

c. Locate meter box or meter vault either completely inside or completely outside of paved sidewalks. No portion of a meter box shall be inside an ADA sidewalk ramp

d. Do not locate meter box or meter vault in driveways, under or behind parking spaces, or in any other areas that could inhibit access for operation and maintenance.

e. Meter boxes for 1-inch services shall be placed on a 6- inch bed of gravel.

f. Meter boxes for 1½-inch and 2-inch services shall be supported with 4- inch x 8-inch x 16-inch concrete blocks.

g. Meter setters for 1½-inch and 2-inch services shall utilize a spacer between the flanges to stabilize the setup during installation and backfill procedures.

h. Set top of meter boxes or meter vault at final finished grade.

(4) City Meter Installation.

a. The following requirements shall be met prior to the City installing a meter:

(a) Meters are required on all water services and fire lines.

(b) Meter box or meter vault shall be flush and level to final finished grade.

(c) Water shall be on at the meter box or meter vault.

(d) Meter box or meter vault shall be tied to house, unit, condo, apartment, etc.

b. Contractor shall provide assistance when meters are being installed where it is not readily evident as to which customer the meter is serving.

K. **Hydrostatic Testing.**

1. General.

(1) Conduct a hydrostatic pressure test on all newly installed water mains, including connected service lines, in accordance with AWWA C600.

(2) Conduct test on each main or on sections of main between valves.

(3) Clean and flush mains of dirt and foreign material prior to conducting test.

(4) If concrete thrust blocking is installed, do not perform hydrostatic test until at least 5 days after placement of blocking.

(5) Test pressure shall be a minimum of 150 psi based on the elevation of the lowest point of the section of main being tested and corrected to the elevation of the test gauge.

(6) Slowly fill main in order to expel all air through air release valves or other installed appurtenances and to avoid excessive surge pressures at air vent opening(s).

(7) Test shall be conducted in the presence of the Engineer of Record or his representative and witnessed by a City representative. To schedule the test, the City Engineering Inspector requires a minimum of 3 business days notice. This does not include holidays or weekends.

(8) Main installation will not be accepted if the quantity of makeup water required for the test is greater than the calculated testing allowance.

2. Hydrostatic Pressure Test.

(1) After filling water main and before applying test pressure, the main shall be maintained at the working pressure for a sufficient period of time for it to stabilize with respect to line movement, water absorption by the lining, etc. This may require several cycles of pressurizing and bleeding of trapped air.

(2) A suitable test pump, furnished by the Contractor, shall be connected to the main by means of a tap, or other suitable method, and the proper test pressure slowly applied to the main. Test pressure shall not vary by more than +/- 5 psi for the duration of the test and shall at no time during the test drop below 150 psi. The test shall be conducted for a minimum of 2 hours.

(3) Test pressure shall be maintained within the tolerance by adding makeup water through the pressure test pump into the main. The amount of makeup water added to the main (i.e. leakage) shall be accurately measured (in gallons per hour) by suitable methods and shall not exceed the applicable testing allowance.

(4) Testing allowance is defined as the maximum quantity of makeup water that is added into the main undergoing hydrostatic pressure testing, or any valved section thereof, in order to maintain pressure within +/- 5 psi of the specified test pressure. No water main installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

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

Where:

L = testing allowance (makeup water), in gallons per hour S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

(5) Acceptance of any main shall be determined on the basis of the testing allowance only. If any test discloses that the quantity of makeup water (i.e. leakage) is greater than the testing allowance as determined above, repairs or replacements shall be made to the main and the main retested. Any visible leaks shall be immediately repaired regardless of the allowance used for testing

(6) During the pressure test, any exposed pipe, fittings, valves, hydrants, and joints shall be carefully examined. Any damage or defects discovered during or following the pressure test shall be repaired or replaced with new material and the test repeated until satisfactory results are obtained.

(7) Certified test results shall be provided by the Engineer of Record to the assigned City Engineering Department with the project acceptance paperwork.

L. **Disinfection**

1. Conduct disinfection in accordance with AWWA C651 before being placed in service.

(1) Upon completion of testing, disinfect all water mains in accordance with SCDES requirements.

(2) Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent.

(3) If bacteriological test results fail, to meet results specified, repeat procedures until satisfactory results are obtained.

2. Procedure.

(1) Flush line to extent possible with available pressure and outlets, prior to disinfection.

(2) Apply chlorine as liquid chlorine and chlorine compound such as calcium hypochlorite with known chlorine content. Water from the existing distribution system or other source of supply should be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine.

(3) Apply through corporation cock in top of main, at beginning of section being sterilized.

(4) Use proper feeder and flow regulator to introduce chlorinating agent.

(5) Application rate shall not be less than 50 ppm.

(6) Retain chlorinated water in main not less than 24 hours.

(7) At end of retention period, at least 10 ppm of chlorine shall remain in the water at the extreme end of section.

(8) Flush the system with potable water and the sampling program begins.

(9) Dechlorinate chlorinated water used for disinfecting in accordance with the requirements of SCDES.

3. Acceptance.

(1) Provide 2 separate samples for each sample location, taken at 24 hour intervals, free of coliform bacteria. The Engineer of Record or contractor shall pull samples in accordance with SCDES specifications. Provide a copy of sample results to City Engineering.

(2) Sample locations shall be as required by SCDES and, at a minimum, at the following locations:

a. The tie-in location of new and existing water mains.

b. The end of all dead-end mains.

c. At intervals of no more than 1,200-feet.

(3) All sample locations are to be given an identifying label.

# 8. WASTEWATER

## 8.1 WASTEWATER COLLECTION SYSTEM GRAVITY SEWER DESIGN STANDARDS

A. **General.**

1. The following wastewater collection system gravity sewer design standards are based on Federal, State, and the requirements of the City.
2. These design standards are applicable to all developments requiring wastewater service from the City.
3. Where it is necessary for gravity sewer mains to cross surface water or wetlands, the preferred method is directional boring. The engineer shall submit a proposed method of construction to the City for review and approval prior to submitting plans for review.
4. All regulations, procedures, fees, and penalties listed in City Ordinance 2716 Sewage and Sewage Disposal are applicable when designing sewer systems. See appendix 4 for Ordinance 2716.

B. **Design Criteria.**

1. Design gravity sewer mains in accordance with the requirements of the *South Carolina Department of Environmental Services (SCDES) Standards for Wastewater Facility Construction: R.61-67* and the requirements of these standards.
2. Plan and Profile.
   (1) Provide plan and profile for all gravity sewer mains drawn to a horizontal scale no smaller than 1 inch equals 50 feet and a vertical scale no smaller than 1 inch equals 5 feet.
3. Gravity sewer mains shall be polyvinyl chloride (PVC) SDR 35, SDR 26 or DIP Class 150.
   (1) SDR 35 or DIP shall be used at depths of 3' to 12'.
   (2) SDR 26 or DIP shall be used at depths greater than 12'.
4. Minimum depth of cover 3 feet at finished grade and maximum depth of 15 feet inside subdivisions.

5. Minimum gravity sewer main diameter shall be 8 inches. Maximum diameter shall not exceed the diameter of the downstream main from the point of connection.
6. Gravity sewer line shall be designed to have a velocity at 2 feet per second.
7. Sewer manholes shall be placed a maximum of 400 feet apart, at change of direction of the sewer line and at the end of the sewer line.
8. Where a smaller gravity sewer main joins a larger one, match the crowns of each.
9. Manholes should have a minimum of 0.1 feet between invert in and invert out of the manhole.
10. Provide straight alignment with uniform slope between manholes and depth adequate to receive wastewater from the lowest service.
11. Minimum downstream angle between gravity sewer mains intersecting at manhole: 90 degrees.
12. Locate gravity sewer mains and manholes outside of paved roadway, if possible.
13. Manholes shall be either fully inside or fully outside of paved roadways and sidewalks. No portion of a manhole shall be inside of an ADA sidewalk ramp.
14. Do not locate manholes under or behind parking spaces or in any other areas that could inhibit access for operations and maintenance.
15. All manholes shall have paved access for cleaning. Such paved access shall be suitable to accommodate a gross vehicle weight capacity of 66,000 pounds.
16. Services with cleanouts shall be installed to all lots so as to properly serve each existing house and each vacant lot facing or abutting on the street or alley in which the gravity sewer main is being laid, and at such other locations as may be designated by the City.
17. Locate cleanout at the property line or edge of easement to provide access for maintenance.
18. Gravity sewer pipe shall be PVC SDR 35 or DIP to 12 feet. Pipe deeper than 12 feet shall be DIP or PVC SDR 26.

C. **Capacity Design.**

1. Size gravity sewer mains based on peak hourly flow projections 2.5 times the average daily flow projection.
2. Average daily flow projections for all domestic wastewater facilities shall be based on the type of facility to be served and shall comply with the unit contributory loading criteria,

*Appendix A* of the *South Carolina Department of Environmental Services (SCDES) Standards for Wastewater Facility Construction: R.61-67.*

3. Design for minimum velocity of 2 feet per second with pipe flowing full. Use Manning coefficient of roughness n = 0.013
4. Minimum Slope.

**Table D.8.1 Sewer Size and Minimum Slope**

| Nominal Sewer Size | Minimum Slope in Feet Per 100 Feet |
|---|---|
| 8 inch | 0.40 |
| 10 inch | 0.28 |
| 12 inch | 0.22 |
| 15 inch | 0.15 |
| 18 inch | 0.12 |
| 21 inch | 0.10 |
| 24 inch | 0.08 |
| 27 inch | 0.067 |

D. **Relation to Water Mains.**

1. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a gravity sewer manhole.
2. Horizontal and Vertical Separation**.**
   (1) Gravity sewer mains shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. For gravity sewers where it is not practical to maintain 10 foot separation, deviation may be allowed provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the gravity sewer main and at an elevation so the bottom of the water main is at least 18 inches above the top of the gravity sewer main. Justification and any deviation must be acceptable to the City.
3. Crossings.

(1) Gravity sewer mains crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the gravity sewer main. This shall be the case whether the water main is either above or below the gravity sewer main. Whenever possible, the water main shall be located above the gravity sewer main. The crossing shall be arranged so that the gravity sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a gravity sewer main, adequate structural support shall be provided for the gravity sewer main to maintain line and grade.

(2) Where it is not practical to obtain proper horizontal and vertical separation as stipulated above, either the water main or the gravity sewer main shall be installed in a watertight steel casing that extends 10-feet on both sides of the crossing, measured perpendicular to the outside of the water main.

E. **Relation to Storm Drains.**

1. General.
   (1) No gravity sewer main shall pass through or come into contact with any part of a storm drainage pipe or structure.
2. Horizontal Separation.
   (1) Gravity sewer mains shall be laid at least 5-feet horizontally from any existing or proposed storm drainpipe or structure. The distance shall be measured edge to edge.
3. Crossings Above.
   (1) Gravity sewer mains crossing above storm drains shall be laid to provide a minimum vertical distance of 12 inches between the outside of the storm drain and the outside of the gravity sewer main.
4. Crossings Below.
   (1) Single Barrel, 24 inch Diameter or Less.
      a. Gravity sewer mains crossing below a single barrel storm drain pipe 24 inch diameter or less shall be laid to provide a minimum vertical distance of 18 inches between the outside of the storm drain and the outside of the gravity sewer main.
      b. Where vertical separation is between 18 inches and 42 inches, one full length of Ductile Iron Pipe shall be centered under the storm drain crossing. The crossing

shall be arranged so that the gravity sewer joints will be equidistant and as far as possible from the storm drain crossing.

(2) 30 inch Diameter or Greater, Multiple Drain Lines or Box Culvert.

a. Gravity sewer mains crossing below a single barrel storm drain pipe 30 inch diameter or greater shall laid to provide a minimum vertical separation of 18 inches between the outside of the storm drain and the outside of the gravity sewer main and shall be installed in a steel casing, regardless the depth of vertical separation, that extends 5- feet on both sides of the crossing, measured perpendicular to the outside of the storm drain. A longer length may be required, as determined by the City, based on the depth and location of the crossing. The crossing shall be arranged so that the gravity sewer joints will be equidistant and as far as possible from the storm drain crossing.

F. **Services.**

1. Locate at property line in grass in landscape area. Service should not be located under concrete. Provide straight alignment perpendicular to the road centerline from the cleanout to the point of connection at the main.
2. Size:
   (1) Minimum service size is 4 inch diameter for residential construction and shall conform to ASTM D 1785 Schedule 40.
   (2) Commercial services will be specified by the design professional.
3. Service Connections
   (1) Service connections shall be watertight and shall not protrude into the gravity sewer main. All materials used to make service connections shall be compatible with each other and with the pipe materials to be joined and shall be corrosion proof.
   (2) Commercial 6 inch services or greater must connect at a manhole.
   (3) When connection is to the gravity sewer main, use wye branches. Wyes shall be installed at an angle of 30 to 45 degrees to the horizontal to avoid deposition and buildup of solids at the connection.
   (4) When connection is at the manhole, install so the crown of the gravity sewer main and the service is the same. The service shall protrude at least 1 inch and no more than 2 inches from the inside manhole wall and be properly grouted.

G. **Manholes.**

1. Location.
   (1) Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 400 feet.
   (2) Locate manholes either fully inside or fully outside of paved roadways and sidewalks. No portion of a manhole shall be inside of an ADA sidewalk ramp.
   (3) Do not locate manholes under or behind parking spaces or in any other areas that could inhibit access for operations and maintenance.
2. Diameter.
   (1) Drop manholes and manholes over 8 feet deep shall be a minimum of 5 feet in diameter.

**Table D.8.2 Nominal and Manual Measurement**

| Nominal Sewer Main Size | Manhole Diameter |
|---|---|
| 8 inch to 12 inch | 4 foot |
| 15 inch to 18 inch | 5 foot |
| 21 inch to 30 inch | 6 foot |

3. Flow Channel.
   (1) The flow channel straight through a manhole shall be made to conform as closely as possible in shape and slope to that of the connecting gravity sewer mains. The channel walls should be formed or shaped to the full height of the crown of the outlet gravity sewer in such a manner as to not obstruct maintenance, inspection, or flow in the gravity sewer. The connecting gravity sewer mains, inflow and outflow, shall protrude at least 1 inch and no more than 2 inches from the inside manhole wall and be properly grouted.
4. Bench.
   (1) A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than ½ inch per foot. No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench
5. Access.

(1) All manholes shall have paved access for cleaning. Such access shall be smooth concrete or asphalt pavement designed to meet the following minimum requirements:

a. Gross vehicle weight capacity: 66,000 pounds
b. Pavement width: 12 feet
c. Left turn radius: 40.8 feet
d. Right turn radius: 36.1 feet
e. Turnaround diameter: 87.1 feet

# 8.2. WASTEWATER COLLECTION SYSTEM GRAVITY SEWER MATERIALS FOR CONSTRUCTION

A. **General.**

1. This section includes pipe and fitting material specifications, and joint material and encasement requirements.
2. All materials used in the construction of gravity sewers shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used.

B. **Pipe and Fittings.**

1. Polyvinyl Chloride (PVC) Pipe and Fittings.

(1) 4" – 15" SDR 35 and 18" - 36" SDR 26:

a. Pipe and fittings shall meet the requirements of ASTM D3034 for 4" through 15" SDR 35 and F679 for 18" through 36" SDR 26 sewer pipe.
b. The pipe shall be colored green for in-ground identification as sewer pipe.
c. Pipe shall be made from quality PVC resin equal to or exceeding cell class 12454 or 12365 as defined in ASTM D1784.
d. Provisions must be made for expansion and contraction at each joint with an elastomeric gasket.
e. The bell shall consist of an integral wall section with a solid cross section elastomeric gasket which meets the requirements of ASTM F477.
f. Gaskets shall be factory assembled and securely locked in place to prevent displacement during assembly.
g. Standard laying lengths shall be 14' or 20'.

h. Fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe.

i. For transitions between PVC and Ductile Iron Pipe use ductile iron adapter with Protecto 401 lining by Romac Industries, Inc., Model 501 Transition Coupling or approved equal.

(2) C900/C905:

a. Pipe and fittings 4" through 12" shall meet the requirements of AWWA C900. Pipe and fittings 14" through 24" shall meet the requirements of AWWA C905.

b. The bell shall consist of an integral thickened wall section with an elastomeric seal. The wall thickness in the bell section shall conform to the requirements of Section 6.2 of ASTM D3139.

c. The pipe shall be manufactured to cast iron outside diameter in accordance with AWWA C900/C905.

d. The seal shall meet the requirements of ASTM F477.

e. Standard laying lengths shall be 20'.

f. The pipe shall be colored green for in-ground identification as sewer pipe.

(3) Ductile Iron Pipe (DIP) and Fittings.

a. Pipe and fittings shall be lined with Protecto 401, 40 mils nominal thickness.

b. For transitions between PVC and Ductile Iron Pipe use ductile iron adapter with Protecto 401 lining by Romac Industries, Inc., Model 501 Transition Coupling or approved equal.

c. Pipe shall be in accordance with ANSI A21.50/AWWA C150 and conform to the requirements of A21.51/AWWA C151. Push-on and restrained joint pipe shall have a minimum rated working pressure of 150 psi.

d. Pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, and flanged joints as required. Pipe ends (spigot end, bell, and socket) for all pipes shall comply with the standard dimensions of ANSI/AWWA C151/A1.5.

e. Push-on joints shall conform to ANSI A21.11/AWWA C111.

f. Mechanical joints and bolts shall conform to AWWA C111. Bolts shall be high strength low alloy steel.

g. Polyethylene encasement shall NOT be used on gravity sewers.

h. Acceptable products: American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, and McWane Cast Iron Pipe Company.

C. **Tracer Wire.**

1. Provide continuous, single strand copper wire, insulated, 12 AWG diameter tracer wire.

D. **Manholes.**

1. Precast manholes shall be in accordance with ASTM C478.
2. Use precast manholes without steps. Factory installed steps shall be removed and penetrations grouted.
3. Manhole diameter:

| Table D.8.3 Standard Manholes Schedule of Governing Dimensions | |
|---|---|
| Pipe Size | Manhole Diameter |
| 8" to 12" | *4' – 0" |
| 14" to 18" | 5' – 0" |
| 21" to 30" | 6' – 0" |
| 36" or Larger | 7' – 0" |

*Drop manholes and manholes over 8' deep shall be a minimum of 5' in diameter

4. Manhole riser sections, minimum wall thickness shall be:

| Table D.8.4 Minimum Wall Thickness | |
|---|---|
| 4' Diameter Manhole | 5" |
| 5' Diameter Manhole | 5" |
| 6' Diameter Manhole | 6" |

Cone sections shall have a minimum wall thickness of 8" at their top

5. Provide monolithic base slab with walls. Bottoms cast with invert and bench are acceptable. Minimum base slab thickness shall be:

| Table D.8.5 Minimum Base Slab Thickness | |
|---|---|
| 4' Diameter Manhole | 6" |
| 5' Diameter Manhole | 8" |
| 6' Diameter Manhole | 8" |

6. Suitable openings for inlet and outlet sewer pipe shall be cast or cored into the base sections and into riser sections for drop connections. These openings shall be circular, accurately made, and located as required for each manhole. Base riser sections shall be set on compacted pipe embedment material, 12" in thickness.
7. Flexible manhole sleeves or flexible manhole entrance joints shall be installed on all pipe entering and leaving manholes. The flange shall be secured to the wall of the manhole base to form a tight water-stop. Sleeve material shall comply with the requirements of ASTM C-923. Sleeves shall be secured to the sewer pipe to make a watertight union with stainless steel strap clamps, draw bolts, and nuts.
8. The manhole sections shall be jointed with "Ram-Nek" joint sealer or equal. "Ram-Nek" shall be placed as recommended by the manufacturer. Outside of joint shall be wrapped with WrapidSeal Manhole Encapsulation System or approved equal. Material shall be 12" in width, centered on the joint. Install in accordance with manufacturer's recommendations.
9. Manhole inverts shall be constructed of cement grout and shall have the same cross section as the invert of the sewers, which they connect. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. All channels shall be troweled smooth. Changes in direction to flow through the manhole shall be made to a true curve with as large a radius as the size of the manhole will permit. Concrete brick will be used to form only the invert channel walls. All other annular space shall be filled with non-shrink concrete grout. No fillers such as broken block, gravel, sand, or excavated material, are allowed in the construction of fillets (benches). Inverts shall be "U" design with top of "U" even with the crown of the

pipe. Invert piping shall not extend inside manhole any farther than 2". The slope of the invert benches shall be a minimum of 2" higher than the crown of the pipe. When dissimilar pipe size occurs, the elevation of the crown of the pipes must be the same

10. Manhole sections shall be free from large honeycombs, cracks, spalds, large chips, exposed reinforcing, and broken bells or spigots. Allowable deviation in form joints shall be 1". Edges of bells and spigots shall be even and straight.
11. Size lift holes and inserts for a precision fit with the lift devices. Do not penetrate through the manhole wall. Comply with OSHA Standard.
12. Provide flat slab tops where manhole depth is less than 4'-0". Use flat slab top section: HS-20 traffic loading.
13. Frames and covers:
    (1) General:
        a. This Works, Inc. or U.S. Foundry shall manufacture all castings. Frames and covers shall be East Jordan Iron Works model 2029 or U.S. Foundry model 480 frame and RA-SSG cover.
    (2) Materials:
        a. Grey iron castings for heavy-duty applications shall be manufactured from iron conforming to ASTM A48 Class 35B, as noted in AASHTO M306-04.
    (3) Manufacture:
        a. The covers will be water tight with no holes or perforations. Two stainless steel pick bars will be included on cover. Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects. Surfaces of the castings shall be free from burned-on sand and shall be reasonably smooth. Runners, risers, fins and other cast-on pieces shall be removed from the castings and such areas shall be ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. As-cast dimensions may vary within accepted industry tolerances.
    (4) Proof Load Testing:
        a. Traffic service castings shall have a first article proof load test conducted and the results of that proof load test shall be made available to the City upon request. The proof load test shall be conducted in accordance with the

methods and procedures outlined in AASHTO M306-04, Section 5, Proof Load Testing.

(5) Marking:

a. Each casting shall be identifiable and show, at a minimum, the following: name of the producing foundry, country of manufacture (such as "Made in USA"), ASTM material designation, recycle symbol, individual part number. Cast into the cover will be the words SANITARY SEWER, 1 ½" – 2" in height. Producing foundry name will be cast with a height of 1".

14. Manhole Frame to Cone Connection (Exterior)

(1) Wrap outside of frame to cone connection using WrapidSeal Manhole Encapsulation System. Install per manufacturer's instructions.

15. Coatings:

(1) Coat force main receiving manholes and the next manhole downstream.

(2) Coat pump station receiving manhole.

(3) Coating shall be Raven 405 Epoxy System and shall be applied by a Raven Certified Applicator.

a. Deviations from the Raven 405 Epoxy System will need to be submitted to City Engineering for review and approval.

(4) Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing.

E. **Pipe and Manhole Foundation and Backfill Materials.**

1. Pipe and manhole bedding material shall be No. 57 stone.
2. Backfill Materials.

(1) Reuse of existing excavated materials will be allowed provided the materials are compactable, dried or dampened to their optimum moisture content, are free from roots and large clods of clay, and are granular and non-cohesive in nature.

(2) Select fill shall be sand-clay, fine sand or sand gravel mixes.

# 8.3.WASTEWATER COLLECTION SYSTEM GRAVITY SEWER CONSTRUCTION PROCEDURES

A. **General.**

1. Construction of the wastewater system to be conveyed to the City shall be performed in accordance with the approved engineering drawings, specifications and applicable permits. Any unapproved deviations from the engineering plans, specifications and permits shall prevent the City from accepting the wastewater system for ownership.
2. Prior to construction activities taking place, the Engineer of Record shall coordinate in advance a Pre-Construction Meeting with representatives from the City and the contractor.
3. The contractor shall bring up any issues that may require deviating from the approved engineering plans, specifications, and permits. The plans or specifications will need to be altered by the Engineer of Record and approved by the Engineering and Public Works department in writing prior to beginning construction.
4. The contractor is responsible for work site safety. Although the city will visit the construction site to observe construction, the City shall not be held liable for work site safety.
5. If any requirements for carrying out project construction are not met, the City reserves the right to issue a stop work order.

B. **Handling of Materials.**

1. All construction material shall be shipped and handled to prevent any damage to the material and stored in units received from the manufacturer prior to use.
2. All material that can be damaged from direct sunlight shall be covered with opaque material prior to use.
3. Any material that becomes damaged from delivery, handling or storage of construction material shall be removed from the construction site.
4. All construction material to be used in the wastewater system shall be new from material supplier. The city will not accept material that has been used previously or has been scrapped or discarded.

5. All construction materials shall be placed on site in a location that can be inspected by the city's representative to ensure the material is in conformance with the approved plans and specifications.

C. **Pipe Cutting.**

1. Unless otherwise recommended by the pipe manufacturer, cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Use wheel cutters when practical. Cuts must be even and perpendicular with length of pipe. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made. Cut ends and rough edges should be ground smooth and, for push-on type connection, the cut end must be beveled slightly.

D. **Trench Excavation.**

This section of the Minimum Standards is provided to outline most types of laying conditions, but is not intended to cover all special laying conditions or the Engineer's special requirements.

1. Trench excavation shall be made in open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of the trenches shall be cut in vertical, parallel planes, equidistant from the pipe centerline. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed. The overall width of trench shall be as recommended by the manufacturer.
2. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe.
3. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade is encountered, such material shall be removed and replaced with No. 57 stone.
4. After excavation, the area between the final pipe grade and the trench soil bottom shall be filled with No. 57 stone as required, compacted to proper grade, and made ready for pipe laying.
5. Debris encountered in trench excavation for sewer mains and other pipelines shall be removed for the overall width of trench to be 12 inches below the bottom of the pipe.

6. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions. Maintain the walls of the excavation properly in place and protect all persons and property from injury or damage. All sheeting and bracing shall be left in place until the trench has been backfilled.

E. **Trench Backfill.**

1. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected. The initial backfill material, placed to a height of 1' above the top of the pipe, shall consist of approved backfill material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in any dimension. It shall be carefully placed and compacted throughout entire area backfilled.
2. Backfill the trench above the pipe zone with approved backfill material in lifts not exceeding 6" loose depth and compact each lift to a minimum of 95 percent of maximum dry density, as determined by ASTM D 1557, with mechanical vibrating or impact tampers.
3. Where pipe trenches are cut across or along pavement, the trenches shall be backfilled in accordance with the approved plans and permits.
4. Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut to the top of the finished grade.
5. All backfilling shall be done in such a manner as will not disturb or damage the pipe or structure over or against which it is being placed. Any pipe or structure damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified.
6. All excavations suspected of not meeting compaction requirements shall be tested for conformance by the contractors or developer testing lab. Tests shall be performed at the locations and depths directed by the City.

F. **Pipe Installation.**

1. General.
   (1) Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Install a mechanical joint or push-on type ductile iron plug whenever work stops for a period of a day or greater.

(2) Replace pipe where any part of coating or lining is damaged.

(3) Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the manufacturer.

(4) Pipe or other construction supplies should not be dumped or dopped in the trench.

(5) Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.

(6) Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.

(7) Bell pipe using manufacture's approved leverage bar. Do not use machinery to bell pipe. Home line is to be clearly visible when pipe is joined.

(8) Do not lay pipe in water or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed.

(9) Re-lay pipe that has the grade or joint disturbed after laying.

2. Alignment and Grade:

(1) Gravity sewer pipe installation must comply with ANSI/ASTM D2321 as the minimum acceptable standard as well as any additional requirements as stated herein.

(2) Before sewer pipe is placed in position in the trench the bottom and sides to the trench shall be carefully prepared as per manufacturer's specifications. Each pipe shall be accurately placed to the exact line and grade called for on the approved drawings. Laser equipment shall be used in setting pipe.

(3) PVC and Ductile Iron Pipe shall be laid in a full bed of No. 57 stone. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. Pipe shall be straight when placed in the trench. Trench bottoms found to be at incorrect grade after pipe laying operations having begun shall be corrected and brought to exact line and grade.

(4) After each line of pipe has been laid, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the interior.

(5) Each joint shall be laid so that it will form a close concentric joint with adjoining pipe and so as to avoid sudden deflections.

(6) All jointing of pipe and fittings shall be in accordance with the pipe manufacturer's recommendations.

(7) Any leaks or defects discovered after completion of the work shall be repaired immediately. All pipes in place shall be carefully protected from damage until the backfilling operations have been completed.

(8) Water shall not be allowed to run through the pipe or stand in the trench.

G. **Connections to Existing Mains.**

1. Connection of gravity sewer main to an existing system shall be made at an existing manhole or by constructing a cut-in Manhole.

(1) Existing manhole:

a. Connection to an existing manhole shall be made in the presence of the City inspector.

b. New holes in manholes shall be core drilled.

c. When connecting to an existing manhole, temporarily block and/or divert sewage flows. Use high early strength cement to form proper channels with minimum interruption of service.

d. Seal around new pipe as specified.

(2) Cut-in manhole:

a. Temporarily block and/or divert sewage flows. Cut out length of existing pipe to accept new pipe in manhole.

b. If benches are pre-formed, insert short section of PVC pipe in the existing holes and seal. Lower bottom section of manhole into hole and sleeve to existing piping.

c. If benches are not pre-formed, cut the PVC pipe to form the channel and insert the required length of pipe through the holes in the bottom section of the manhole, set to match existing slope, and seal. Lower the assembly into the hole, sleeve to existing piping, and unblock sewage flows. Using high early strength cement, form benches as in typical manholes.

H. **Manholes.**

1. Use proper bedding as specified.
2. Set base level so that the walls will be plumb.
3. Clean inverts, spigots, and pipe ends.
4. Apply joint sealer and set firmly in place to assure watertight joints.
5. Connect pipe boot to piping with dual stainless steel straps.

6. Grout lift holes from the outside using non-shrink grout.
7. Install exterior joint collar.
8. Form the invert channels directly in the concrete of the manhole base with mortar and concrete brick. Smooth the floor of the manhole outside the channels and slope toward the channels at not less than 1" per foot, nor more than 2" per foot.
   (1) Shape the invert channels to be smooth and semi-circular, conforming to the inside of the adjacent sewer section. Channel top shall be to crown of pipe.
   (2) Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will permit.
   (3) Make changes in size and grade of channels smoothly and evenly.
   (4) Slope invert uniformly from invert of inlet to invert of outlet.
9. Match manhole top to finish grade utilizing concrete adjustment rings.
   (1) Manhole tops shall be watertight and at finished grade elevation. If located in pavement, elevation shall be set to match finished grade.
   (2) Leveling and final grading of manhole frames and covers shall be accomplished by using concrete brick or concrete grade rings. When using grade rings, a maximum of two (2) 4" grade rings or one (1) 6" grade ring shall be used. The total number of grade rings shall not exceed 8" in thickness. Grade rings shall be laid in a full bed of non- shrink grout and covered after laying with a smooth coating of non- shrink grout or hydraulic cement a minimum of 2" thick.
   (3) After the manhole has been set in its final position, the cast iron frame for the cover shall be carefully set at finished grade and properly bonded using a full bed of non-shrink grout. Where manholes are constructed in paved areas, sidewalks, etc., the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown, and grade of the existing pavement.
10. Coatings.
   (1) Coat force main receiving manhole and the next manhole downstream.
   (2) Coat Pump Station receiving manhole.
   (3) Coating shall be Raven 405 Epoxy System and shall be applied and tested by a Raven Certified Applicator.
      a. Deviations from the Raven 405 Epoxy System will need to be submitted to City Engineering for review and approval.

11. Manhole Markers.
    (1) Where a manhole is located in a non-landscaped or hard surface area, a fiberglass carsontie marker is required.
        a. Marker shall be driven into the ground a minimum of 12" and extend above grade a minimum of 60".
        b. Lettering on the marker shall indicate "sewer main line/manhole".

I. **Services.**

1. Services with cleanouts shall be installed to all lots so as to properly serve each existing house and each vacant lot facing or abutting on the street in which the gravity sewer main is being laid, and at such other locations as may be designated by the engineering or public works departments.
2. Locate services as shown on approved plans. The letter "X", minimum 3" in height, shall be stamped into concrete curb to identify location of service.
3. In landscaped areas, cleanout caps shall be SMARTPlug as manufactured by GPK Products, Inc. Cleanouts shall terminate 3" to 6" below finish grade.
4. In paved areas, a PVC cleanout plug shall be installed 3" below finish grade and covered by a Neenah R-1976 frame and lid.
5. Do not stack service lines vertically over the gravity sewer main.

J. **Testing.**

The Engineer of Record is responsible for coordinating the testing of the wastewater system with the engineering department. The City will observe all testing of the wastewater system. The Engineer of Record and contractor will be responsible for implementing all testing and the Engineer of Record is responsible for determining the test results. The Engineer of Record will submit successful test results to the engineering department

1. Air Testing.
    (1) The Contractor shall conduct low-pressure air tests on all completed sections of gravity sewer. The air test results will be used to evaluate materials and construction methods on the sewer line sections. The Contractor shall furnish an air compressor which will provide at least 300 cubic feet of air per minute at 100 psi, pressure gauges, air hoses, air hose connections and other equipment necessary to conduct the air test. Plugs in sewers 18" in size and larger shall be connected by

cable for thrust reaction. The following provisions will be adhered to when conducting low- pressure air tests:

a. Equipment:

(a) Plug Design. Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

(b) Singular Control. To facilitate test verification, all air used shall pass through a single, above ground control panel.

(c) Air Control.

(a) The above ground air control equipment shall include a shut- off valve, pressure regulating valve, input pressure gauge, and a continuous monitoring, calibrated pressure gauge having a pressure range from 0 to at least 10 psi. Gauge shall display a NIST traceable calibration sticker with calibration date. The continuous monitoring gauge shall be no less than 4" in diameter with minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi.

(b) Acceptable Air Test Control Units:

i. SEALCO Model 5012-100 Portable Low Pressure Air Test Control Unit.
ii. Cherne Air-Loc Low Pressure Air-Testing System.
iii. Approved equal

(c) Separate Hoses.

i. Two separate hoses shall be used to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line.

(d) Pneumatic Plugs.

i. If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

b. Test Procedure:

(a) Plug Installation and Testing.

(a) After a manhole-to-manhole reach of pipe has been backfilled to final grade, prepared for testing, and the specified waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

(b) Line Pressurization. Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psi greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psi. Immediately before testing, if groundwater is present, the groundwater elevation must be determined by appropriate means.

(c) Pressure Stabilization. After achieving the required internal pressure, the air supply shall be throttled to maintain the pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe walls.

(d) Timing Pressure Loss.

**Table D.8.6 Pressure Test**

| Groundwater Above Pipe Invert (ft) | Pressure (psi) |
|---|---|
| 1 | 4.5 |
| 2 | 5.0 |
| 3 | 5.5 |
| 4 | 6.0 |
| 5 | 6.5 |
| 6 | 7.0 |
| 7 | 7.0 |
| 8 | 7.5 |
| 9 | 8.0 |
| 10 | 8.5 |
| 11 | 9.0 |

(e) Specified Time Tables.

(a) To facilitate the proper use of this recommended practice for air testing, the following tables are provided. Table I contains the specified minimum times required for a 1.0 psi pressure drop from a starting pressure of at least 4.0 psi greater than the average back pressure of any groundwater above the pipe's invert. Table II contains specified minimum times required for a 0.5 psi pressure drop from a starting pressure of at least 4.0 psi greater than the average back pressure of any groundwater above the pipe's invert. Both Tables also include easy to use formulas for calculating required test times for various pipe sizes and odd lengths.

| Table D.8.7 Specification time required for a 1.0 psig pressure drop for size and length of pipe indicated for Q=0.0015 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>Pipe Diameter (in) | 2<br>Min Time (min:sec) | 3<br>Length for Min Time (ft) | 4<br>Time for Longer Length (sec) | Specification Time for Length (L) shown (min:sec) | | | | | | | |
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |
| 4 | 4:00 | 597 | 0.380L | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 |
| 6 | 5:40 | 398 | 0.854L | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:42 | 6:24 |
| 8 | 7:34 | 298 | 1.520L | 7:34 | 7:34 | 7:34 | 7:34 | 7:36 | 8:52 | 10:08 | 11:24 |
| 10 | 9:26 | 239 | 2.374L | 9:26 | 9:26 | 9:26 | 9:53 | 11:52 | 13:51 | 15:49 | 17:48 |
| 12 | 11:20 | 199 | 3.418L | 11:20 | 11:20 | 11:24 | 14:15 | 17:05 | 19:56 | 22:47 | 25:38 |
| 15 | 14:10 | 159 | 5.342L | 14:10 | 14:10 | 17:48 | 22:15 | 26:42 | 31:09 | 35:36 | 40:04 |
| 18 | 17:00 | 133 | 7.692L | 17:00 | 19:13 | 25:38 | 32:03 | 38:27 | 44:52 | 51:16 | 57:41 |
| 21 | 19:50 | 114 | 10.470L | 19:50 | 26:10 | 34:54 | 43:37 | 52:21 | 61:00 | 59:48 | 78:31 |
| 24 | 22:40 | 99 | 13.674L | 22:47 | 34:11 | 45:34 | 56:58 | 68:32 | 79:46 | 91:10 | 102:33 |
| 27 | 25:30 | 88 | 17.306L | 28.51 | 43:16 | 57:41 | 72:07 | 86:32 | 100:57 | 115:22 | 129:48 |
| 30 | 28:20 | 80 | 21.366L | 35:37 | 53:25 | 71:13 | 89:02 | 106:50 | 124:38 | 142:26 | 160:15 |
| 33 | 31:10 | 72 | 25.852L | 43:05 | 64:38 | 86:10 | 107:43 | 129:16 | 150:43 | 172:21 | 193:53 |
| 36 | 34:00 | 66 | 30.768L | 51:17 | 76:55 | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 | 230:46 |

| Table D.8.8 Specification time required for a 0.5 psig pressure drop for size and length of pipe indicated for Q=0.0015 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>Pipe Diameter (in) | 2<br>Min Time (min:sec) | 3<br>Length for Min Time (ft) | 4<br>Time for Longer Length (sec) | Specification Time for Length (L) shown (min:sec) | | | | | | | |
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |
| 4 | 4:00 | 597 | 0.190L | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 |
| 6 | 4:00 | 398 | 0.427L | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 |
| 8 | 4:00 | 298 | 0.760L | 4:00 | 4:00 | 4:00 | 4:00 | 4:00 | | 5:04 | 5:42 |
| 10 | 4:43 | 239 | 1.187L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 | 8:54 |
| 12 | 5:40 | 199 | 1.709L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:58 | 11:24 | 12:50 |
| 15 | 7:05 | 159 | 2.671L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 | 20:02 |
| 18 | 8:30 | 133 | 3.846L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 | 28:51 |
| 21 | 9:55 | 114 | 5.235L | 9:55 | 13:05 | 17:27 | 21:49 | 26:11 | | 34:54 | 39:16 |
| 24 | 11:20 | 99 | 6.837L | 11:24 | 17:57 | 22:48 | 28:30 | 34:11 | 39:53 | 45:35 | 51:17 |
| 27 | 12:45 | 88 | 8.653L | 14:25 | 21:38 | 28:51 | 36:04 | 43:16 | | 57:43 | 46:54 |
| 30 | 14:10 | 80 | 10.683L | 17:48 | 26:43 | 35:37 | 44:31 | 53:25 | | 71:13 | 80:07 |
| 33 | 15:35 | 72 | 12.926L | 21:33 | 32:19 | 43:56 | 53:52 | 64:38 | 75:24 | 86:10 | 96:57 |
| 36 | 17:00 | 66 | 15.384L | 25:39 | 38:28 | 51:17 | 64:06 | 76:55 | 89:44 | 102:34 | 115:23 |

(f) Manhole Vacuum Test

i. When directed by the City, manholes shall be tested via vacuum testing per ASTM C1244 except that the minimum test times shall be as defined in the Manhole Vacuum Test Table (test times modified from those in ASTM C-1244). Vacuum testing shall not be performed until the manhole is completely finished, including applying any protective coating where specified. Manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind prior to the vacuum testing and then again prior to final inspection as required.

ii. Vacuum tests shall be performed by placing the testing unit at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test unit closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the test times indicated in Table 1 below. The test times in Table 1 are modified from those in ASTM C-1244. Table 1 shall be included on the Contractor's test reports. Refer to ASTM C-1244 for further requirements.

iii. Any leaks found during the vacuum testing shall be repaired by the Contractor in a manner approved by the City. The manhole shall be vacuum tested again after such repairs are made until the manhole passes the vacuum test.

**Table D.8.9 Minimum Vacuum Test Times for Various Manhole Diameters**

| Manhole Depth (feet) | Manhole Diameter (inches) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 36 | 42 | 48 | 54 | 60 | 66 | 72 | 84 | 96 |
| | Test Time (seconds) | | | | | | | | |
| 8 | 60 | 60 | 60 | 60 | 60 | 60 | 66 | 72 | 78 |
| 10 | 60 | 60 | 60 | 60 | 66 | 72 | 82 | 98 | 114 |
| 12 | 60 | 60 | 60 | 70 | 78 | 86 | 98 | 118 | 138 |
| 14 | 60 | 60 | 70 | 82 | 92 | 102 | 114 | 136 | 158 |
| 16 | 60 | 68 | 80 | 92 | 104 | 116 | 134 | 160 | 188 |
| 18 | 64 | 76 | 90 | 104 | 118 | 130 | 146 | 178 | 208 |
| 20 | 70 | 84 | 100 | 116 | 130 | 144 | 162 | 194 | 226 |
| 22 | 78 | 92 | 110 | 128 | 144 | 158 | 178 | 212 | 246 |
| 24 | 84 | 102 | 118 | 140 | 156 | 174 | 194 | 232 | 270 |
| 26 | 92 | 110 | 128 | 150 | 170 | 188 | 210 | 250 | 290 |
| 28 | 98 | 118 | 138 | 162 | 182 | 202 | 226 | 270 | 314 |
| 30 | 106 | 126 | 148 | 174 | 196 | 216 | 242 | 288 | 334 |

(g) There shall be no groundwater infiltration or other leakage (active or evidence of being previously active) through the manhole walls, benches, inverts or pipe connections at the manholes. If leakage is found, it shall be eliminated with an appropriate grout or non-shrink cement mortar approved by the City. Injection grouting (Avanti AV- 202 Multigrout or approved equal) may be required to stop leaks around the pipe connections or in the invert channel or benches.The City's decision on how defective manholes are repaired shall be final. If any defective manholes are discovered after they have been installed or during the warranty period, they shall be repaired or replaced in a satisfactory manner at no additional cost to the City. Repaired manholes, including those repaired during the warranty period, shall be vacuum tested again at no additional cost to the City

(h) Manhole Coating Test.

(a) Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

K. **Closed Circuit Television (CCTV) Inspection**

1. Intent

(1) It is the intent of this specification to provide inspection criteria for all sanitary sewer pipelines installed as part of any new development project. This specification requires that the pipelines be inspected utilizing the Pipeline Assessment Certification Program (PACP) inspection standards and closed-circuit television techniques. This process has been developed to identify and locate any sewer line defects, determine corrective action and perform/document post-correction inspection. It is the responsibility of the Engineer of Record to ensure that these CCTV inspection procedures are performed. All costs associated with CCTV inspection are the responsibility of the Developer/Contractor

2. Scope of Work:

(1) The CCTV Contractor shall video inspect all mainline sections from manhole to manhole, and all service laterals from the right-of-way boundary to the mainline connection or manhole connection. Video inspection shall be performed immediately following construction and prior to the low-air pressure and deflection testing. It is in the best interest of the Developer/Utility Contractor to complete this task in a timely manner

(2) Prior to performing CCTV inspection activities, all sewer lines and service laterals designated to be televised shall be thoroughly cleaned. After cleaning, all equipment will be removed from the sewer line(s). Just prior to performing the video inspection procedure, water must be introduced into the nearest upstream

manhole, and all cleanouts for laterals, until observed at the nearest downstream manhole

3. CCTV and associated equipment:

   (1) Television inspection equipment shall have an accurate footage counter that will display on the monitor and record the camera distance from the centerline of the starting manhole. Distance measurements within the sewer line are to be accurate within 0.5% of the above ground measurement. Line segment inspections shall be made manhole to manhole. Prior to the beginning of each CCTV inspection, manhole identification numbers, as indicated on project drawing or as supplied by the Engineer of Record, will be displayed in the title and shall become a part of the video record. These manhole identification numbers shall correspond to the numbers shown on the project plans

   (2) The camera shall be of the remotely operated pan and tilt type. The rotating camera and light head configuration shall have the capability of 360 degree rotating view angle and a minimum 270 degree pan angle with the capability to pan and tilt simultaneously while the transporter moves to view defects and voids around the entire diameter of the pipe wall, ensuring complete inspection of the mainline pipe, service laterals and any deficiencies

   (3) The camera, television monitor, and other components shall be color. Geometrical distortion of the image shall not exceed one percent. To ensure peak picture quality throughout all conditions encountered, the color camera shall be equipped with the necessary circuitry to allow for the remote adjustment of the optical focus iris from the power control unit at the viewing station. A variable intensity control of the camera lights shall also be located at the viewing station

   (4) All fog shall be evacuated from the pipeline and the pipeline kept clear of any fog during the CCTV inspection process

   (5) Lighting and camera quality shall be suitable to allow a clear, in-focus picture for the entire inside periphery of pipelines extending at least 10 feet in front of the camera. In High Density Polyethylene (HDPE) or ductile iron poly-lined pipe, lighting should be sufficient enough to provide a clear view at least 2 feet in front of the camera. The replay of the recorded video information shall be free of electrical interference and shall provide a clear stable image

4. Execution:

   (1) It is the responsibility of the Engineer of Record to provide the CCTV Contractor with a set of City stamped "APPROVED FOR INSTALLATION" Construction Plans prior to CCTV inspection activities. Line segment inspections shall be made manhole to manhole

(2) Internal inspection of pipelines shall be performed by PACP certified personnel, trained in the identification of pipe deficiencies and condition assessment utilizing closed-circuit television inspection equipment. A full 360 degree view of the pipe is required during inspection. The pipe must be clear and free of any dirt and/or debris. The CCTV Inspection Technician shall have full control of the movement of the television camera unit at all times. The travel speed of the camera shall be variable but uniform and shall not exceed 20 feet per minute (fpm). Any means of propelling the camera through the sewer line which would produce non- uniform or jerky movement of the camera, will not be acceptable. The television system shall be capable of performing line segment inspection in increments of 400 feet with one setup

(3) Service laterals shall be inspected utilizing a CCTV inspection push system, capable of inspecting up to 100 feet of pipe. All sanitary service lateral segments must be CCTV inspected from the top of the riser located at the property line, to the sewer mainline, noting type of cleanout installed, on the same disk for a continuous run. Continuous footage readings for identifying the location of defects must be accurate to within 3% tolerance. Deficiency identifications are to be called out and recorded to the nearest full foot. Any inaccuracy in the continuous footage meter, identified deficiencies, or lateral location descriptions which cause doubt as to the accuracy of the locations or total length shall render the line segment recording as unacceptable

(4) As directed by the City, the Engineer of Record or his representative, the camera shall be stopped to view and analyze conditions that appear unusual or uncommon. The CCTV Inspection Technician shall, at all times, be able to move the camera through the lines in either direction without the loss of quality in the video presentation

(5) The interior of the pipe shall be carefully inspected to determine the location and extent of all deficiencies. Pipe conditions that result in a question of proper installation procedures shall be noted so that these conditions can be reviewed and, if necessary, corrected before actual acceptance of the sewer system

(6) CCTV inspections will take place immediately after construction and prior to, or concurrent with the low pressure air testing. This will allow the correction of deficiencies found during the CCTV inspection process

(7) Access for CCTV inspection purposes shall be made via existing line segment manholes and lateral cleanouts. Should access to a particular sewer segment be difficult, and where adjacent segments require television inspection, the CCTV Contractor may be allowed to complete the inspection of multiple sewer line segments with one setup. When multiple sewer line segments are inspected utilizing

one setup, the CCTV Contractor shall zero the footage counter at each subsequent sewer manhole to establish a uniform starting point, Station 0+00, for each line segment televised

(8) At all defects and service connections, the camera shall be stopped and the pan and tilt features shall be used to obtain a clear picture. At each service lateral, the camera shall be panned to view up each lateral or point of connection. Make note of any deficiencies through the use of Data Collection Software

(9) CCTV Contractor shall record inspections in a PACP format and the video shall be recorded in a high quality CD/DVD format. The title block shall include the following information:

a. Date and time of day

b. PACP certified television operator's identification (Name, ID number, etc.)

c. Sewer segment number. Segment numbers shall be designated by the ENGINEER

d. Upstream manhole number

e. Downstream manhole number

f. Size of sewer pipe

g. Pipe material

h. Closest cross street or address where the line segment is located

i. Direction of movement of camera and direction of normal flow

j. Location of service connections indicated by clock position and with counter distance in feet from beginning manhole's centerline

k. Location (start and end counter distances in feet from the beginning manhole's centerline) and description of obstructions, structural defects, longitudinal and/or circumferential cracking, joints including open and/or offset joints, ovality, leakage or evidence thereof, break in connections, protruding connections, mineral deposits, roots, previous repairs, deposits on pipe walls, sags, and other abnormalities with respect to the sewer's condition with counter distance in feet from the beginning manhole's centerline

l. CCTV Contractor's log shall contain the same information

(10) CD/DVD shall visually display, at a minimum, the CCTV Contractor's name, Project name, City Job Number and Extension, date of inspection, pipe segment number, manhole numbers or lateral lot numbers. The distance between manholes shall be

verified by measuring tape. If the counter distance and the taping distance differ by more than 3 feet per 100 feet, the run shall be re-televised by CCTV Contractor.

(11) USB drives shall be maintained and delivered in a hard case, which shall display the project name, City Job Number, date of inspection, manhole segment number(s) inspected, and camera operator's identification. No segment shall be split between two disks. A disk may have multiple segments, so long as an entire section is on one disk. Original disks of all sections will be provided to the City Construction Inspector along with the respective television inspection field logs to be reviewed for completeness and soundness of construction prior to the Commissioning. Upon review and approval, copies will be provided to the Utility Contractor and Engineer of Record. Originals will remain the property of the City.

(12) If during video operations the television camera will not pass safely through the entire sewer line segment being inspected, CCTV Contractor shall set up equipment in the reverse, so that the inspection can be performed from the opposite manhole; from downstream to upstream. Where an obstruction is encountered and a reverse set up is required, the distance shall be entered into the log and noted on the video format from which manhole the measurements are being made. If under the reverse setup the camera again fails to pass through the entire sewer line segment, the inspection shall be stopped. All obstructions in the sewer segment that prohibit passage of the television camera shall be immediately reported to the Engineer by the CCTV Contractor, referencing location and nature of the obstruction. No correction work shall proceed until Utility Contractor receives direction from the Engineer of Record or the City Construction Inspector regarding removal or repair of deficiency.

(13) Should CCTV Contractor's televising equipment become lodged in any sewer line, it shall be removed by CCTV Contractor at his expense. This shall include, if necessary, excavation and repair of the sewer main and/or lateral, underground utility repairs, backfilling and surface restoration. Upon removal of CCTV equipment and repair, CCTV Contractor shall re- televise the line segment to Engineer of Record or his representative that the line segment has been placed back into operational condition with no further deficiencies.

5. Acceptance:

(1) CCTV Contractor shall present inspection video and inspection logs on USB drives. A continuous image in complete conformance with these specifications and with a full view of the internal pipe surface is required. CCTV Contractor shall re-clean and televise any segment for which the video does not present a clear image of 100% of the internal pipe surface at all times, and/or is accompanied by an incomplete inspection log

(2) Any of the following observations shall be considered defects:

a. Any bellies in a joint of pipe will be cause for rejection of the pipe segment

b. Joint separations

c. Offset joints

d. Chips in pipe ends

e. Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rocks, roots, etc.)

f. Infiltration

g. Roots

h. Debris or other foreign objects inside of pipe

i. Other obvious deficiencies when compared to Approved Plans, Permits, and/or Minimum Standards

(3) The Engineer of Record and Developer shall be notified in writing of any deficiencies revealed by the CCTV inspection that will require repair. After repairs have been made, the line segment(s) shall be re-inspected at the Developer's/Contractor's expense. The CCTV inspection video shall be submitted to the City for review upon completion of discrepancies. Correction of any and all deficiencies must be corrected prior to acceptance of the project by the City.

# 8.4. WASTEWATER COLLECTION SYSTEM FORCE MAIN DESIGN STANDARDS

A. **General.**

1. The following force main design standards are based on Federal, State and local health requirements and the requirements of the City.
2. These design standards are applicable to all developments requiring wastewater service from the City.
3. Where it is necessary for wastewater force mains to cross surface water or wetlands, the engineer shall submit a proposed method of construction to the City's Engineering Department for review and approval prior to submitting plans for permitting.

4. The preferred method of installation for force mains crossing surface water or wetlands is by Horizontal Directional Drill.
5. All regulations, procedures, fees, and penalties listed in City Ordinance 2716 Sewage and Sewage Disposal are applicable when designing sewer systems. See appendix 4 for Ordinance 2716.

B. **Design Criteria.**

1. Design force mains in accordance with the requirements of the *South Carolina Department of Environmental Services (SCDES) for Wastewater Facility Construction: R.61-67*, and the requirements of these Standards.
2. Size force mains to provide minimum velocity of 2 feet per second at design flow and maximum velocity of 8 feet per second for PVC force mains. Maximum velocity determination should be based with two pumps operating.
3. Use Hazen and Williams design coefficient: PVC: C=150, DIP: C=140, HDPE: C=155.
4. Minimum force mains diameter shall be 4".
5. PVC force main shall be AWWA C900 for force mains between 4 through 12 inches in diameter and AWWA C905 for force mains 14 and 48 inches in diameter.
6. Ductile Iron Pipe force mains shall be pressure class 250 for all pipe diameters.

C. **Separation of Water Mains and Force Mains.**

1. Where possible, locate force mains at least 10' feet horizontally away from water mains.
2. Should 10' feet separation not be practical, then the force main may be located closer provided:
   (1) It is laid in a separate trench.
   (2) It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.
   (3) In either of the above cases, crown elevation of the force main shall be at least 18" below bottom of water main.
   (4) Where force mains and water mains cross, the force main shall go under the water main and be at least 18" below the bottom of water main.

D. **Cover.**

1. Provide suitable cover over all mains. Minimum cover depth as follows:
   (1) 12" diameter and smaller: 36"
   (2) 14" dimeter and larger: 48"

(3) All piping located within a public right-of-way shall be constructed in accordance with applicable permits and these Standards

E. **Connection to an Existing Gravity System.**

1. Connection to an existing gravity system shall be made at an existing manhole or by constructing a cut-in manhole
2. Coat force main receiving manhole and the next manhole downstream

F. **Valves.**

1. Air Release Valves:
   (1) Design force main to minimize the number of air release valves
   (2) Provide at high points in the force main
   (3) Provide at maximum 3000' intervals
   (4) Maintain minimum 36" cover at location of air release valve
   (5) Provide valve vault
2. Gate Valves:
   (1) Force Mains greater than 5,000' in length, provide a gate valve at the halfway point
   (2) Where no other force main isolation valve exists, provide gate valve within 250' of an air release valve
   (3) Provide valve box and valve box protection ring

# 8.5. WASTEWATER COLLECTION SYSTEM FORCE MAIN MATERIALS FOR CONSTRUCTION

A. **General.**

1. This section includes pipe and fitting material specifications, and joint material and encasement requirements.
2. All materials used in the construction of force mains shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used.

B. **Pipe and Fittings.**

1. Polyvinyl Chloride (PVC) Pipe and Fittings:

(1) 4" diameter and above: ANSI/AWWA C900/AWWA C905, Table 2, Pressure Class 150, and ASTM D-2241
(2) Use integral bell or coupling type with elastomeric gaskets
(3) Factory-installed gaskets integral with the pipe
(4) Use ductile iron fittings with pressure rating of 150 psi: ANSI/AWWA C110/A21.10, lined with Protecto 401, 40 mils nominal thickness
(5) Provide adaptor glands, gaskets, etc. as required to accommodate any differences in pipe and fitting dimensions

2. Fusible Polyvinyl Chloride (FPVC) Pressure Pipe:
(1) Fusible Polyvinyl Chloride pipe shall conform to AWWA C900 or AWWA C905, and/or ASTM D2241 or ASTM D1785 for IPS standard dimensionality, if applicable. Testing shall be in accordance with AWWA standards for all pipe types
(2) Fusible Polyvinyl Chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe
(3) Fusible Polyvinyl Chloride pipe shall be manufactured in a standard 20', 30' or 40' nominal length
(4) Fusible Polyvinyl Chloride Pipe shall be green in color for wastewater use
(5) Pipe generally shall be marked per AWWA C900 or AWWA C905, and shall include as a minimum:
a. Nominal pipe size
b. PVC
c. Dimension Ratio, Standard Dimension Ratio, or Schedule
d. AWWA pressure class or standard pressure rating for non- AWWA pipe
e. AWWA Standard designation number or pipe type for non- AWWA pipe
f. Extrusion production-record code
g. Trademark or trade name
h. Cell Classification 12454 and/or PVC material code 1120 may also be included
(6) Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults
(7) Use ductile iron fittings with pressure rating of 150 psi: ANSI/AWWA C110/A21.10, lined with Protecto 401, 40 mils nominal thickness

3. High Density Polyethylene (HDPE) Pipe and Fittings:
   (1) Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350-02 with a minimum cell classification of PE345464C. Pipe O.D. sizes shall be ductile iron pipe sizes (DIPS). Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects
   (2) Fittings:
      a. Butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification. All fittings shall be pressure rated to provide a working pressure rating no less than that of the pipe. Fabricated fittings shall be manufactured using a McElroy Datalogger to record fusion pressure and temperature. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained as part of the quality control. The fitting shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
      b. Electrofusion fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02 and be the same base resin as the pipe. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055
      c. Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02 and be the same base resin as the pipe. Flanged and mechanical joint adapters shall have a manufacturing standard of ASTM D3216. All adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe.
      d. Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to

the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure. Serrated restrainer shall be ductile iron ASTM A536-80 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel. The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 PSI whichever is lesser. Restrainers shall be JCM Industries, Sur-Grip or approved equal.

| Nominal Size (Inch) | Restraint Width (Inch) | Serrations Per Inch |
|---|---|---|
| 4 – 6 | 1 ½ | 8 |
| 8, 10, & 12 | 1 ¾ | 8 |

e. Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or approved equal.

4. Ductile Iron Pipe (DIP) and Fittings:
   (1) All Ductile Iron Pipe and fittings shall be lined with Protecto 401, 40 mils nominal thickness
   (2) Ductile Iron Pipe shall be in accordance with ANSI A21.50/AWWA C150 and conform to the requirements of A21.51/AWWA C151. Push-on and restrained joint pipe shall have a minimum rated working pressure of 150 psi. All buried pipe shall be pressure class as follows:

| Pipe Sizes (Inch) | Pressure Class (psi) |
|---|---|
| 4 – 12 | 350 |
| 14 – 20 | 250 |
| 24 | 200 |
| 30 – 64 | 150 |

(3) Ductile Iron Pipe and fittings shall be furnished with push-on joints, push- on restrained joints, mechanical joints, and flanged joints as required. Pipe ends (spigot end, bell, and socket) for all pipes shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to the standard dimensions of ANSI/AWWA C151/A1.5

(4) Push-on joints shall conform to ANSI A21.11/AWWA C111

(5) Mechanical joints shall conform to AWWA C111. Bolts shall be high strength low alloy steel per AWWA C111

(6) All buried ductile iron force main pipes shall be polyethylene wrapped. Thickness: 8 mils; Color: green (AWWA C105)

(7) Acceptable products: American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, and McWane Cast Iron Pipe Company

5. Restrained Joint Fittings:

(1) Provide at each fitting and valve. Restrained joints shall be in accordance with DIPRA, "Thrust Restraint Designed for Ductile Iron Pipe"

(2) Restrained joint pipe will be indicated clearly on plans. The location and length of restrained joint pipe will be clearly marked on the drawings at all points where the direction or cross-sectional area of the pipe changes as well as at all bends, reducers, offsets, tees, wyes, dead ends, valves and transitions from PVC, FPVC or HDPE to Ductile Iron Pipe

(3) Acceptable products:

a. American Cast Iron Pipe – Fast Grip, Flex-Ring, Field Flex- Ring or Lock-Ring

b. US Pipe – TR Flex or Field Lok 350 Gaskets

c. Griffin Pipe – Snap-Lok Restrained Joint
d. EBBA – Megalug Restraint Gland
e. Ford – Series 1500 Restraint Gland
f. Sigma – One-Lok Series SLD Restraint Gland
g. McWane – Sure Stop 350 Restraint Gasket
h. Cape Fear Industries – EZ Restraint Gland for Ductile Iron

C. **Tracer Wire.**

1. All force main installations shall include the installation of a locator wire. The locator wire shall be taped to the top of the pipe with polyethylene tape during the pipe laying operation. For force mains, which are installed by the open- trench method, the locator wire shall be stranded 12-gauge copper with insulation rated UF or USE by Underwriter's Laboratories. For force mains, which are installed by a trenchless method, horizontal directional drilling or other, the locator wire shall be stranded 10-gauge stainless steel with insulation rated UF or USE by Underwriter's Laboratories. Underground splice connections shall be minimized and shall be rated for direct burial service. The tracer wire shall be looped into "dummy" cast-iron water valve boxes with caps labeled "SEWER", painted green, and at grade level, one being installed adjacent to the valve vault at the source pump station. Additional valve boxes shall be installed at intervals of no greater than every1000' along the length of the force main, unless the main was installed by a trenchless method. A final valve box shall be installed at the discharge point of the force main, whether that is at a manhole or at a "tee" into another force main. The looped termination shall allow for the connection of an electronic locator transmitter

D. **Air Release Valves.**

1. Provide combination air valve
2. Maintain minimum 36" cover over force main at location of air valve
3. The combination air valve shall be suitable for use at pressures up to 150 PSI
4. The valve shall have Type 316 stainless steel body, cover and cover bolts with a NPT inlet and outlet connection. Valves shall have a Type 316 stainless steel float and a replaceable seat of Buna-N or other suitable material. Venting orifice and internal linkage mechanism shall be Type 316 stainless steel

5. Valve size shall be 1" or 2" size as shown on the plans, both sizes to be supplied with 2" NPT pipeline connection. The distance from 2" pipeline connection to the top of the combination air valve shall not exceed 10"
6. Valve shall be supplied with flushing attachments consisting of 2" stainless steel inlet isolating ball valve, 1" stainless steel blow off ball valve and ½" stainless steel flushing ball valve and stainless steel pipe nipples and a 5' rubber hose with quick connect couplings
7. Valves shall be GA Industries Figure 959SS-ESF
8. Provide valve vault:
   (1) Air release valves shall be enclosed in a 4' diameter precast manhole with a flat slab top as a minimum standard
   (2) Provide manhole frame and vented cover. Frame and cover shall be East Jordan Iron Works model 2029 or U.S. Foundry model 480 frame and RA- SSG cover. Cast into the center of the cover will be the letters CPW, 2" - 3" in height. Also cast into the cover will be the words SANITARY SEWER, 1.5" - 2" in height
   (3) Base shall be formed using solid concrete blocks set on a 12" deep bed of compacted No. 57 stone
   (4) Coatings:
      a. Coat interior surfaces of air release valve vault
      b. Coating shall be Raven 405 Epoxy System, 120 mil nominal thickness, and shall be applied by a Raven Certified Applicator
         (a) Deviations from the Raven 405 Epoxy System will need to be submitted to City Engineering for review and approval
      c. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

E. **Cushioned Swing Check Valves.**

1. Provide cast iron body with bronze seating ring and stainless steel shaft for attachment of weight and lever with non-corrosive adjustable air cushioned shock chamber
2. Mount the cushioned chamber to the side of the valve body with piston operating in the chamber, which will prevent valve closing without any hammering action
3. Shock absorption by air: Adjustable closing speed
4. Approved manufacturer: G. A. Industries, Inc. Figure 250-D

F. **Gate Valves.**

1. All valves shall be in conformance with the latest revision of all reference standards of AWWA or ANSI
2. 4-inch through 12-inch: Use resilient wedge gate valves
3. All valves shall "Open Left"
4. Provide 2-inch ductile iron wrench nut with direction of valve operation clearly visible when looking down on the nut. Hold-down nut or bolt will Type 316 stainless steel
5. Provide stem extensions on all valves where the top of the operator nut is located greater than 36-inches below the top of the valve box
6. All valves shall be equipped with a non-rising stem
7. All valves will meet or exceed all requirements of AWWA C509 or AWWA C515
8. Outer valve body will have raised lettering cast in, providing manufacturer's name, valve size, year of manufacture, pressure rating, location of casting and each part is to be clearly marked indicating ductile or cast iron
9. All valves will be electrostatically, fusion-bonded epoxy coated, minimum 8-mil thickness inside and out, conforming to ANSI/AWWA C550 Standards
10. Resilient wedge to be ductile or cast iron fully encapsulated with EPDM elastomer, including guide path and will be US Food and Drug Administration approved for potable water and have an EPDM visible marking
11. All valves will have a minimum 250 psi working pressure and a 500-psi static pressure
12. Valve stem material will be bronze, brass, or Type 304 stainless steel
13. Valves will have two upper O-ring seals on the stem above the thrust collar and at least one O-ring seal below the collar so designed to allow for replacement of the upper O-rings with the valve under full operating pressure
14. Valves will have thrust washers located above and below the thrust collar to insure smooth frictionless operation
15. All exterior bonnet and thrust collar bolting, whether recessed or exposed, are to be Type 316 stainless steel and marked by type
16. Waterway seat area will be smooth without ridges or cavities and valves will have full size bore throughout the flow-way

17. All valves will be hydrostatically pressure tested prior to shipment in compliance with AWWA C509 or AWWA C515 Standards and be covered by the Manufacturer's Ten-Year Limited Warranty from thee date of purchase by the end user
18. Approved manufacturer: Mueller
19. Provide valve box:
    (1) Valve box shall be full cast or ductile iron with iron covers suitable for heavy traffic use and conform to ASTM A-48, Class 20 Specifications
    (2) Valve boxes shall be screw type and have a 5.25" inside shaft diameter
    (3) Have the word "SEWER" cast into the cover
    (4) Coat box and cover with 2 shop coats of bitumastic paint
    (5) No part of the valve box is to rest on the buried valve
    (6) Acceptable product: Products of Tyler Union #6850 Series, Bingham & Taylor #4905 Series of U.S. manufacture only, AFC Box with external stem and locking lid, and East Jordan Ironworks #8550 Series
    (7) Provide at each valve box in unpaved areas a precast concrete protection ring

G. **Valve Markers.**

1. Where air valves and gate valves are located in areas that are not landscaped or hard surface, a Carsontie marker shall be installed within 1' of the valve. The marker shall be driven into the soil a minimum of 12" and extend above grade 60".Marker shall indicate sewer valve

# 8.6 WASTEWATER COLLECTION SYSTEM FORCE MAIN CONSTRUCTION PROCEDURES

A. **General.**

1. Prior to construction activities taking place, the Engineer of Record shall coordinate in advance a Pre-Construction Meeting with the assigned City Engineering Inspector. The Engineer of Record, Contractor(s), and the City's Engineering Inspector shall be in attendance at a minimum.
2. If any requirements for carrying out project construction are not met, the City reserves the right to issue a stop work order.

B. **Operation of City System Valves.**

1. Only City personnel shall operate City valves or hydrants unless otherwise directed or approved by the City

C. **Handling of Materials.**

1. General.
   (1) Store rubber gaskets and polyethylene film under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground. Keep inside of pipe and fittings free of dirt and debris.
   (2) Keep valves off the ground and keep interior free of dirt and debris. Do not expose valve interior to direct sunlight.
   (3) Handle pipe so as to ensure delivery to the trench in sound, undamaged condition.
   (4) Carry pipe into position.
   (5) Use pinch bars, slings or tongs for aligning or turning the pipe.
   (6) Use care not to damage Ductile Iron Pipe linings.
2. Polyvinyl Chloride (PVC) pipe:
   (1) Store in unit packages as received from manufacturer until just prior to use.
   (2) Stack units to prevent deformation to pipe barrels and bells.
   (3) Protect from direct sunlight by covering with opaque material.
3. Fusible Polyvinyl Chloride (FPVC) pipe:
   (1) Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
   (2) Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
   (3) If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe, which allows for temperature build-up, is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
   (4) Pipe shall be stored and stacked per the pipe manufacturer's guidelines.

(5) High Density Polyethylene (HDPE) pipe:

a. Pipe shall be delivered without, nicks, gouges, or other physical damage.

b. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

c. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method.

d. Fused segments of the pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

D. **Trench Excavation.**

This section of the Standards is provided to outline most types of laying conditions, but is not intended to cover all special laying conditions or the Engineer's special requirements.

1. Trench excavation shall be made in open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of the trenches shall be cut in vertical, parallel planes, equidistant from the pipe centerline. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed. The overall width of trench shall be as recommended by the manufacturer.
2. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe.
3. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade is encountered, such material shall be removed and replaced with No. 57 stone.
4. After excavation, the area between the final pipe grade and the trench soil bottom shall be filled with No. 57 stone as required, compacted to proper grade, and made ready for pipe laying.

5. Debris encountered in trench excavation shall be removed for the overall width of trench which shall be as shown on the plans. It shall be removed to a depth of 6" below the bottom of the pipe for pipes smaller than 24" in size; 8" below the bottom of the pipe for pipes 24" to 36" in size; and 12" below the bottom of the pipe for pipes larger than 36" in size, if debris extends to such depth.
6. In all cases, materials deposited shall be placed so that in the event of rain, no damage will result to the work.
7. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions. Maintain the walls of the excavation properly in place and protect all persons and property from injury or damage. Sheeting, shoring or bracing materials shall not be left in place unless as shown by the plans or permitted by the City. All sheeting and bracing shall be left in place until the trench has been backfilled 1' above the top of the pipe.

E. **Trench Backfill.**

1. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected. The initial backfill material, placed to a height of 1' above the top of the pipe, shall consist of approved backfill material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in any dimension. It shall be carefully placed and compacted throughout entire area backfilled. Backfill the trench above the pipe zone with approved backfill material in lifts not exceeding 6" loose depth and compact each lift to a minimum of 95% of maximum density, as determined by ASTM D 1557, with mechanical vibrating or impact tampers.
2. Where pipe trenches are cut across or along pavement, the trenches shall be backfilled in accordance with applicable permits.
3. Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut to the top of the finished grade.
4. All backfilling shall be done in such a manner as will not disturb or damage the pipe or structure over or against which it is being placed. Any pipe or structure damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified.

5. All excavations suspected of not meeting compaction requirements shall be tested for conformance by a City approved testing lab. Tests shall be performed at the locations and depths directed by the City.

F. **Pipe, Valve, and Appurtenance Installation.**

1. General:
   (1) Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Securely close open ends of pipe, fittings, and valves when work is not in progress.
   (2) Replace pipe where any part of coating or lining is damaged.
   (3) Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the manufacturer.
   (4) Do not dump or drop any of the materials into the trench.
   (5) Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
   (6) Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
   (7) Bell pipe using manufacturer's approved leverage bar. Do not use machinery to bell pipe. Home line is to be clearly visible when pipe is joined.
   (8) Do not lay pipe in water or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed.
   (9) Re-lay pipe that has the joint disturbed after laying
   (10) Valves shall be carefully handled, cleaned and checked for operation prior to backfilling. Care shall be taken to ensure that no dirt, rock, or other obstacles that would interfere with the operation are left in the valve. Valves shall be installed in a position such that the plane of operation or rotation for the operating nut is parallel to the ground surface.

2. Alignment and Grade.
   (1) Fittings, valves, and other appurtenances shall be located where shown on the approved plans, with the pipe being cut if necessary to assure accurate placement. Install the pipe, valves, and appurtenances to the alignment and profile shown on the approved drawings.
   (2) Pipe lines intended to be straight shall be so laid.

(3) Where vertical or horizontal alignment requires deflection from straight lines or grade, do not exceed 75% of maximum deflection recommended by the pipe manufacturer or AWWA Standard 600.

(4) If alignment requires deflection exceeding recommended limits, furnish bends to provide angular deflections within the allowable limits.

3. Jointing Pipe, Valves, and Appurtenances:

(1) Mechanical, Push-On, and Restrained Joint

a. Join pipe with mechanical or push-on type joints in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricants for the pipe gaskets shall be used and shall be manufacturer's standard. All mechanical joints used on taps and valves shall have restraining glands.

b. Flanged.

(a) Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re- tightened.

4. Installation of Restraining Glands:

(1) Adjoining surfaces shall be clean, lubricated and meet the requirements of ANSI/AWWA C111/A21.11.

(2) Install using assembly recommendations established in ANSI/AWWA C111/A21.11 as well as installation instructions provided by the manufacturer.

(3) If twist-off nuts are provided, tighten screws until nuts breaks loose.

5. Cutting pipe:

(1) Cut pipe neatly without damage to the pipe

(2) Unless otherwise recommended by the pipe manufacturer, cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Use wheel

cutters when practical. Cuts must be even and perpendicular with length of pipe. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made. Cut ends and rough edges should be ground smooth.

(3) DIP and PVC pipe with push-on type connection, the cut end must be slightly beveled.

6. Polyethylene Encasement.

(1) All valves, ductile iron force mains, fittings, and appurtenances are to be wrapped in a linear low-density polyethylene film, 8 mil, color green, in accordance with ANSI Standard A21.5 (AWWA C105). Close all open ends and damaged areas securely with poly-tape. If damaged polyethylene film cannot be repaired, replace with new film.

G. **Connection to an Existing Gravity System.**

1. Connection of new force main to an existing gravity system shall be made at an existing manhole or by constructing a cut-in manhole.

(1) Existing manhole:

a. Connection to an existing manhole shall be made in the presence of the City inspector
b. Connection shall be made at existing flow line
c. New holes in manholes shall be core drilled
d. When connecting to an existing manhole, temporarily block and/or divert sewage flows. Use high early strength cement to form proper channels with minimum interruption of service
e. Seal around new pipe

(2) Cut-in manhole:

a. Temporarily block and/or divert sewage flows. Cut out length of existing pipe to accept new pipe in manhole
b. If benches are pre-formed, insert short section of PVC pipe in the existing holes and seal. Lower bottom section of manhole into hole and sleeve to existing piping
c. If benches are not pre-formed, cut the PVC pipe to form the channel and insert the required length of pipe through the holes in the bottom section of the manhole, set to match existing slope, and seal. Lower the assembly into the

hole, sleeve to existing piping, and unblock sewage flows. Using high early strength cement, form benches as in typical manholes

(3) Coatings:

a. Coat force main receiving manhole and the next manhole downstream

b. Coating shall be Raven 405 Epoxy System, 120 mil nominal thickness, and shall be applied by a Raven Certified Applicator

(a) Deviations from the Raven 405 Epoxy System will need to be submitted to City Engineering for review and approval

c. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing.

H. **Installation of Air Release Valves.**

1. Maintain minimum 36" cover over force main at location of air release valve
2. Force mains less than 6" in diameter; install air release valve using 316 stainless steel tapping saddle
3. Force mains 6" in diameter and larger; install air release valve using 316 stainless steel tapping sleeve
4. Provide 316 stainless steel isolation ball valve
5. Set plumb valve
6. Provide valve vault:
   (1) Air release valves shall be enclosed in a 4' diameter precast manhole with a flat top slab as a minimum. Base shall be formed using solid concrete blocks set on a 12" deep bed of compacted No. 57 stone
   (2) Provide manhole frame and vented cover
7. Provide Carsontie valve marker

I. **Installation of Cushioned Swing Check Valves.**

1. Maintain minimum 36" cover over force main at location of check valve
2. Set valve level
3. Mount the cushioned chamber to the side of the valve body with piston operating in the chamber, which will prevent valve closing without any hammering action

J. **Installation of Gate Valves.**

1. Maintain minimum 36" cover over force main at location of gate valve

2. Provide valve box. No part of the valve box is to rest on the buried valve. Sewer shall be printed on the valve cover
3. Provide at each valve box in unpaved areas a precast concrete protection ring
4. Provide Carsontie valve marker

K. **Tracer Wire Installation.**

1. All force main installations shall include the installation of a locator wire. The locator wire shall be taped to the top of the pipe with polyethylene tape during the pipe laying operation. For force mains, which are installed by the open- trench method, the locator wire shall be stranded 12-gauge copper with insulation rated UF or USE by Underwriter's Laboratories. For force mains, which are installed by a trenchless method, horizontal directional drilling or other, the locator wire shall be stranded 10-gauge stainless steel with insulation rated UF or USE by Underwriter's Laboratories. Underground splice connections shall be minimized and shall be rated for direct burial service. The tracer wire shall be looped into "dummy" cast-iron water valve boxes with caps labeled "SEWER", painted green, and installed at grade level, one being installed adjacent to the valve vault at the source pump station. Additional valve boxes shall be installed at intervals of no greater than every1000' along the length of the force main, unless the main was installed by a trenchless method. A final valve box shall be installed at the discharge point of the force main, whether that is at a manhole or at a "tee" into another force main. The looped termination shall allow for the connection of an electronic locator transmitter.
2. Prior to acceptance of the wastewater force main by the City, the Contractor shall demonstrate that the locator wire functions properly. The Contractor shall use one of several commercially available utility locating instruments to energize and trace the locator wire. When the wastewater force main is installed in the road shoulder, green-marking flags (pin flags) shall be installed along the length of the wastewater main at intervals of no greater than 20' feet. Where the force main is installed under concrete or asphalt, green marking paint shall be used. Testing of the locator wire and installation of the marking flags shall be done prior to scheduling a final inspection of the wastewater system.

L. **Jack and Bore.**

1. General.

(1) Description.

a. This section covers the work necessary to furnish and install steel casings and carrier pipes under surface structures, where indicated, as specified herein, and as needed for a complete and proper installation.

(2) Safety.

a. Perform all excavation and backfilling activities in accordance with the *Occupational Safety and Health Act.*

2. Materials.

(1) Carrier pipe shall be restrained joint ductile iron.

(2) Steel Pipe Casing shall be manufactured from steel conforming to ASTM A 139 for Grade B, with minimum yield strength of 35,000 psi before cold forming.

a. Pipe shall be straight seam welded. A protective coating will not be required.

b. Minimum diameter and wall thickness of the steel piping shall be as listed in the following table.

| Restrained Joint DIP Carrier Pipe Size (inches) | Minimum Casing Size (inches) | Minimum Casing Thickness (inches) |
|---|---|---|
| 4 | 14 | 0.250 |
| 6 | 16 | 0.281 |
| 8 | 18 | 0.312 |
| 10 | 20 | 0.375 |
| 12 | 24 | 0.375 |
| 14 | 26 | 0.438 |
| 16 | 30 | 0.469 |
| 18 | 32 | 0.500 |
| 20 | 36 | 0.532 |
| 24 | 42 | 0.625 |
| 30 | 48 | 0.688 |
| 36 | 54 | 0.781 |
| 42 | 56 | 0.812 |
| 48 | 62 | 0.875 |
| 54 | 72 | 1.000 |

c. The thicknesses of the casing shown in 2.*b*.2 are minimum thicknesses. Actual thicknesses shall be determined by the casing installer based on an evaluation of the required jacking forces.

(3) Casing Spacers.

a. Casing spacers shall be flanged, bolt-on style with a two-section stainless steel shell lined with a PVC liner, minimum 0.09" thick, also having a hardness of 85-90 durometer. Runners shall be attached to stainless steel risers which shall be properly welded to the shell. The height of the runners and risers shall be manufactured such that the pipe does not float in the casing. Casing spacers shall be as manufactured by Cascade Waterworks Manufacturing Company, Contractors Manufacturing, Inc., or approved equal.

3. Execution.

(1) Installation of Steel Pipe Casing

a. Installation of steel pipe casing shall be by the dry bore method at locations as shown on the Contract Drawings and approved by the applicable permits. Installation of steel pipe casing shall be in accordance with applicable regulations, the Contract Drawings, these specifications, and any permits required with respect to the particular boring

(a) Boring Pit and Receiving Pit.

(a) The boring pit shall be solid sheeted, braced, and shored as necessary to provide a safe operation. The Contractor shall take all precautions, and comply with all local, state and federal requirements as may be necessary to protect private property, public property and/or existing utilities. Maintain in dry condition by use of pumps, drains or other approved method.

(b) The receiving pit shall be constructed in accordance with the Contract drawings and applicable permits

(b) Line and Grade.

(a) The Contractor shall set the boring rig so that after the casing is complete, and the carrier pipe is installed, the invert of the pipe shall conform to grade and alignment as shown on the Contract Drawings. As the casing is installed, Contractor shall check the horizontal and vertical alignment

frequently. Contractor shall install the boring at a 90-degree angle to the crossing unless permitting authority approves a different specific angle of crossing. The depth shall be a minimum depth as prescribed by the governing authority unless a deeper depth is dictated by design

(c) Boring.

(a) In all cases, jacking and boring of the casing pipe shall be accomplished by the dry jack and bore method without jetting, sluicing, or wet boring. For casing pipes 48" in diameter and larger, a closed face shield bore head shall be utilized in front of the casing. For casing pipes less than 48" in diameter, the casing may be installed via open face method whereby the hole shall be bored and cased through the soil by a cutting head on a continuous auger mounted inside the casing pipe. The distance between the leading end of the first auger section and the leading end of the casing shall be as necessary to maintain a solid plug of spoil material inside the forward portion of the casing. At no time during the operation shall the auger head be allowed to extend out in front of the casing being installed. The boring of the hole and jacking of the casing pipe shall be done simultaneously, with continuous installation, until the casing pipe is in final position

(d) Dewatering.

(a) Contractor shall fully investigate the location of all jack and bores for the project and determine required dewatering methodologies for each location in order to provide for and conduct a dry jack and bore. Contractor shall submit plans and specifications for dewatering to the Engineer for approval prior to beginning the process (for railways, railway authority must also approve). Pumps of sufficient capacity to handle the flow shall be maintained at the site, provided the Contractor has received approval from the engineer to operate them. Pumps in operation shall be constantly attended on a 24-hour basis until, in the sole judgment of the DOT or railway authority ; the operation can be safely halted. When dewatering, a process for monitoring any settlement of tracks, roads, or structures must be in place. Prior to commencing boring,

the Contractor shall verify, with acceptance by the Engineer, the absence of groundwater to below the lowest elevation of the casing at each entry/exit pit and as necessary along the casing route.

(e) Diameter of hole.

(a) Bored installations shall have a bored hole no more than 1" greater than outside diameter of the casing pipe to be installed. In the event that voids are detected, the voids shall be grouted

(f) Casing Pipe Length.

(a) Lengths of casing pipe shall be as long as practical for site conditions. Joints between lengths shall be completely welded in accordance with American Welding Society recommended procedures. Prior to welding joints, the Contractor shall ensure that both ends of the casing sections being welded are square. The length of the casing shall be such that each end of the casing shall extend a minimum of 6' beyond the edge of pavement/back of curb of a paved roadway, or if railway installation, in accordance with requirements of the railway authority

(g) Lubricant.

(a) The Contractor shall plan to use a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation

(h) Jacking.

(a) Once the jacking procedure has begun, it shall be continued without stopping until the boring and jacking operation is complete

(i) Installation of the Carrier Pipe.

(a) Inspect carefully, ensuring that all foreign material is removed from the casing and the casing meets alignment criteria for the type of carrier pipe being used

(b) The casing shall be installed as closely to grade as possible with no more deviation than can be adjusted with spacers to achieve the carrier pipe design grade

(c) Install casing spacers on the carrier pipe per the manufacturer's instructions

(d) Provide a minimum of one spacer per ten linear feet of pipe

(e) Install the carrier pipe in the casing ensuring each joint is pushed "home" before the joint is installed into the casing

(f) Provide centered and restrained configuration

(j) End Seals.

(a) Grout each end of the casing with concrete brick and Type II concrete in such a manner to prevent the infiltration of foreign materials into the casing pipe, but allowing leakage to pass in the event of a carrier pipe break

b. Rights-of-Way, Easements, and Permits.

(a) Prior to the beginning of the Work, consult with the Engineer to determine that all rights-of-way, easements, permits, or other legalities are in order and become familiar with the requirements thereof. Confine the Work as required to comply with such requirements. Any encroachment beyond such limits shall be the Contractor's responsibility

c. Conflict of Specifications.

(a) Where laws or orders of public authority prescribes a higher degree of protection than specified herein, then the higher degree so prescribed shall be deemed a part of this specification and govern the specific installation.

M. **Hydrostatic Testing.**

1. Conduct hydrostatic testing in accordance with AWWA C600.
   (1) Conduct tests on each line or valved section of line.
   (2) Clean and flush line of dirt and foreign material.
   (3) Slowly fill main in order to expel air from the main through the air release valves or other appurtenance.
   (4) Tests are to be conducted in the presence of the Engineer of Record or his representative and witnessed by a City representative.
2. Pressure Tests.
   (1) Pressure leakage test shall be conducted in accordance with AWWA C600. Each section of the pipeline shall be subjected to and successfully meet a pressure test

of 150% of its working pressure, but not less than 100 psi. The line shall be slowly filled with water and all air expelled through the air valves or other means.

(2) A suitable test pump, furnished by the Contractor, shall be connected to the line by means of a tap in the line, or other suitable method, and the proper test pressure slowly applied to the line. The test pressure, +/- 5 psi, shall be maintained for at least 2 hours. Leaks, if found, shall be immediately repaired. The Engineer of Record or his representative shall be present on site and confirm the test results.

(3) Replace defective pipe, joints, fittings and valves with new material and repeat the test until results are satisfactory.

3. Leakage Test.

(1) Conduct leakage test in conjunction with pressure test.

(2) Testing allowance shall be defined as the maximum quantity of makeup water that is added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, in order to maintain pressure within +/- 5 psi of the specified test pressure (after the pipeline has been filled with water and the air has been expelled). No pipe installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

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

Where:

L = Allowable Leakage, in gallons per hour S = Length of Pipe tested, in feet

D = Nominal Diameter, in inches P = Average test pressure, in psig

(3) Should test disclose leakage greater than that specified above, repair, or if necessary, remove and replace the defective joint or valve until the leakage is within the specified allowance

# 8.7 WASTEWATER COLLECTION SYSTEM PUMP STATION DESIGN STANDARDS

A. **General.**

1. The following wastewater pump station design standards are based on Federal, State, and the requirements of the City.
2. These design standards are applicable to all developments requiring wastewater service from the City.
3. Design pump station in accordance with the requirements of the South Carolina Department of Environmental Service (SCDES) Standards for Wastewater Facility Construction: R.61-67, and the requirements of these Standards.
4. Pump Stations that serve a single customer will not be accepted for ownership by the City. These stations will be privately owned, operated, and maintained.
5. All regulations, procedures, fees, and penalties listed in City Ordinance 2716 Sewage and Sewage Disposal are applicable when designing sewer systems. See appendix 4 for Ordinance 2716.

B. **Capacity Design.**

1. Average daily flow projections for all domestic wastewater facilities shall be based on the type of facility to be served.
2. All flows shall comply with the unit contributory loading criteria, Appendix A of the South Carolina Department of Environmental Service Standards for Wastewater Facility Construction: R.61-67.
3. Size pump stations based on peak hourly flow projection two and one half (2.5) times the average daily flow projection.
4. When designing pumps, consideration is to be given to the ultimate capacity of the pump station, and the ability for growth surrounding the station.

C. **Equipment Requirements.**

1. Equipment for pump stations shall conform to the following requirements:
   (1) Totally submersible centrifugal pumps capable of handling raw, unscreened sewage, including up to 3" diameter spherical solids.
   (2) The design shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, permanently installed in the wetwell.

(3) The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or fastenings to be disconnected. For this purpose, there shall be no need for personnel to enter the wetwell**.**

D. **Pump Station Design.**

1. Pumps:

(1) Provide at least two (2) pumps of equal capacity, each capable of handling the design peak flow

(2) Pumps shall be designed to operate in a lead-lag sequence and be on an alternating cycle

(3) Pumps shall have an operating point at or near peak efficiency

(4) Pumps shall be non-overloading for all duty points

(5) Pump suction and discharge piping shall be at least 4" in diameter

(6) Provide a swing check valve, gate valve, and pressure gauge connection on each pump discharge line

(7) A spare pump shall be provided to the City upon completion of the installation

2. Wetwell:

(1) Normal operating volume shall prevent any one pump from starting more than four (4) times per hour

(2) Minimum allowable wetwell diameter shall be 8'-0"

(3) Maximum allowable depth shall be 26' below finished grade

(4) Size the wetwell based on allowing each pump to run no more than 4 times per hour

(5) Wetwell level settings:

a. Distance between pump "OFF" and lead pump "ON": minimum as specified by the pump manufacturer, or as calculated for cycle time; whichever is greater. "OFF" level shall be 3" from the top of the pumps

b. Distance between lead pump "ON" and lag pump "ON": 6" minimum

c. Distance between lag pump "ON" and alarm "ON": 6" minimum

d. Distance between alarm elevation and inlet pipe: 12" minimum

(6) Top of wetwell slab shall be set to provide positive drainage away from the station and minimize flooding. At a minimum, top of slab shall be 6" above centerline elevation of public access road

3. Pump Station Site:

(1) Minimum property size: 50' x 50'

(2) Site shall be asphalt paved. Provide 8" stone aggregate base course and 2" asphalt surface course type C

(3) Design pump station site layout to allow access of service trucks to the pump station wetwell

(4) Provide receiving manhole on influent line within pump station fence

(5) Provide by-pass connection

(6) Provide camlocks on pump station control panel for a portable generator

(7) No overhead power line will be allowed to cross the site

(8) The station shall have a 1" water service terminated in a City water meter box

(9) Provide a freeze proof yard hydrant

(10) Fencing:

a. Site shall be secured by a 6' high chain link fence. NOTE: Brick fences will be reviewed on a case-by-case basis and are subject to the approval of the City. Wooden fences shall not be allowed

b. Provide vehicle access gate. Design vehicle access gate to allow entrance of service trucks without blocking the main roadway

(11) Access road:

a. Site shall be serviced by an asphalt road with top of road above the 25- year flood elevation. Road and site drainage shall be included in the design and approved by appropriate permitting agency

b. Minimum road width: 16'

c. Type C surface course in accordance with SCDOT specifications

4. Electrical:

(1) General:

a. Electrical design of pump station shall conform to the latest editions of NFPA 70 (National Electrical Code) and NFPA 820 (Standard for Fire Protection in Wastewater Treatment and Collection Facilities)

b. All electrical work shall be performed by licensed personnel

c. Design electrical service to handle the ultimate capacity of the pump station. Coordinate electrical service with local utility, 3phase 480 volt is preferred

d. Single phase power, phase converters, and "add-a-phase" systems are not allowed

e. Provide a site flood light that will be owned by the City

(2) Electrical Equipment Rack:

a. Electrical equipment rack shall be large enough to house all control equipment to include SCADA.

b. Electrical equipment rack shall be made entirely of structural aluminum and be adequately grounded.

c. Power shall be located underground and shall be located on the rack in such a manner so the electric meter can be easily read from outside the fenced area.

d. Concrete pad shall be provided for the electrical equipment rack and extend a minimum of 4' outside of wetwell to face of the control panel.

e. The control panel shall be located a minimum radius of 5'-0" outside the hatch opening and shall be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code, to prevent the atmosphere of the wetwell from gaining access to the control panel. The seal shall be located so that the motor and level sensors may be removed and electrically disconnected without disturbing the seal.

f. All electrical cables from the motor and wetwell level sensors shall be terminated in a weather tight box located directly below the control panel. If size of pump cables allows use of boxes, install minimum 8"x10" with 316 stainless steel terminal strip and backing plate.

g. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wetwell. Terminals and connectors shall be protected from corrosion by location outside the wetwell or through use of watertight seals. If located outside, weatherproof equipment shall be used.

h. Soft starts are not allowed on any motors unless approved by the City. If soft starts are required by the electric utility provider, the system must be designed to clear their own faults due to power outages and prior approval from the City is still required. The City prefers VFDs in these situations over soft starts.

i. Provide transient voltage surge suppresser on load side of transfer switch.

j. Provide GFI Duplex receptacles.

5. Generators.

(1) All pump station sites require an onsite generator.

a. Provide Caterpillar Inc. diesel generator with 1 year subscription to CATRAM monitoring

(a) Include a manual starting switch

b. The generator shall be complete in all respects and shall include all equipment and controls necessary for a fully operational standby power supply system

c. The unit shall be provided in an outdoor, weatherproof, sound attenuated enclosure. The unit shall be provided with a double-walled, sub-base fuel tank

6. Aeration Supplementation.

(1) Provide a fine bubble and course bubble mixing system at pump stations. All parts to be stainless steel.

(2) Approved Manufacturer – Risen Water Fog Log

7. Cellular SCADA System.

(1) Submit cellular based SCADA system to the City for approval

(2) Manufacturer – Streametrics Model M or approved equal

# 8.8 WASTEWATER COLLECTION SYSTEM PUMP STATION MATERIALS FOR CONSTRUCTION

A. **General.**

1. This section includes material specifications for pump stations and associated appurtenances.

2. All materials used in the construction of pump stations shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used.

B. **Wetwells.**

1. Use manhole sections complying with Section 8.2of these Standards
2. Wetwell vent cap:
   (1) Size: 6"
   (2) Approved product: Josam Vandal-Proof Vent Cap, Model 26706
3. Wetwell access door:
   (1) Fabricate from welded aluminum sections.
   (2) Provide dual hinged door of ¼" aluminum tread plate for each pump.
   (3) Upper surface shall be flush, with no protrusions.
   (4) Fit door with recessed latch requiring a special square tool for access.
   (5) Provide all hardware of Type 316 stainless steel.
   (6) Provide Type 316 stainless steel support bracing with a self-locking hinge mechanism to lock into open position.
   (7) Provide a recessed padlock hasp.
   (8) Access doors must be sized properly to allow for easy pump removal. Include coordination with pump manufacturer and precast manufacturer for final design.
   (9) Access doors shall include Protective Grating Panel option by Halliday Products, Inc., or Safe Grate System by ITT Flygt.

C. **Float Control System.**

1. Use 4 float switches:
   (1) Single action design, integrally weighted floats
   (2) Capable of withstanding water penetration under 25' of water
   (3) Micro-switch type
   (4) Seal in a polypropylene housing
   (5) No less than 40' of cable with polypropylene cord grips and mounting hardware
   (6) 3 to 1 safety factor, minimum
2. Float cable holder:
   (1) Use six (6) hook, Type 316 stainless steel
   (2) Mount with Type 316 stainless steel anchors

(3) Approved products: Halliday Product Series J4A Cable Holder, Type 316 Stainless Steel

D. **Pipe and Fittings.**

1. All piping shall be Pressure Class 250 Ductile Iron Pipe and all fittings shall be Pressure Class 150 Ductile Iron Pipe. Except piping within the wetwell shall be stainless steel type 316.
2. Provide flanged pipe ends complying with pertinent provision of ANSI/AWWA C110/A21.10
3. Fittings: Use flanged ductile iron fittings complying with ANSI/AWWA C110/A21.10
4. Couplings:
   (1) Provide cast iron flanged coupling adapters to connect discharge and suction piping to field piping
   (2) Provide restraining glands
5. All pipe and fittings shall be lined for sewers with Protecto 401 and conform to ANSI/ASTM D1248
6. Exterior of all piping and fittings shall be coated with TNEMEC paint in accordance with the following specifications:
   (1) Exterior exposed steel:
      a. Surface Preparation - SSPC-SP6/NACE 3 Commercial Blast Cleaning. The surface shall be free of all foreign matter and dry prior to painting
         (a) 1st Coat – Series 1 Omnithane applied at 2.5-3.5 dry mils
         (b) 2nd Coat – Series N-69 (Color: 110GN Clover) Hi-Build Epoxoline II applied at 4.0-6.0 dry mils
         (c) 3rd Coat – Series 73-U (Color: 112GN Foliage) Endura Shield applied at 3.0-5.0 dry mils
      b. Steel (Immersion):
         (a) Surface Preparation – SSPC-SP10/NACE 2 Near White Blast Cleaning. The surface shall be free of all foreign matter and dry prior to painting
         (b) 1st Coat – Series 1 Omnithane applied at 2.5-3.5 dry mils
         (c) 2nd Coat – Series N-69 (Color: 110GN Clover) Hi-Build Epoxoline II applied at 4.0-6.0 dry mils

(d) 3rd Coat – Series 104 (Color: 112GN Foliage) H.S. Epoxy applied at 3.0-5.0 dry mils

c. All field applications shall be inspected and approved by a Tnemec authorized factory representative and City of Sumter approved representative

d. Approval shall be in the form of a written acceptance letter to be supplied by the Tnemec representative stating that all areas of application have been cleaned, primed and coated in accordance with the factory's approval for warranty acceptance.

E. **Valves.**

1. Gate Valves:

(1) All valves shall be in conformance with the latest revision of all reference standards AWWA or ANSI

(2) Valve Actuator:

a. Gate valves inside of the valve vault to be gear actuated

b. The permanent bypass connection gate valve shall be underground and nut operated

c. Valves shall open left

d. Approved manufacturer: Mueller Co

2. Cushioned Swing Check Valves:

(1) Provide cast iron body with bronze seating ring and stainless steel shaft for attachment of weight and lever with non-corrosive adjustable air cushioned shock chamber

(2) Mount the cushioned chamber to the side of the valve body with piston operating in the chamber, which will prevent valve closing without any hammering action

(3) Shock absorption by air: Adjustable closing speed

(4) Approved manufacturer: G. A. Industries, Inc., Figure 250-D

(5) Valve size shall be 1" or 2" size as shown on the plans, both sizes to be supplied with 2" NPT pipeline connection. The distance from 2" pipeline connection to the top of the combination air valve shall not exceed 10"

(6) Valve shall be supplied with flushing attachments consisting of 2" stainless steel inlet isolating ball valve, 1" stainless steel blow off ball valve and ½" stainless steel

flushing ball valve and stainless steel pipe nipples and a 5' rubber hose with quick connect couplings

(7) Valves shall be GA Industries Figure 942SS-F

3. Coatings:
   (1) Coat exterior of gate valves, and cushioned swing check valves with TNEMEC paint.
   (2) The following coatings shall be applied in accordance with manufacturer's recommendations:
      a. Surface Preparation - SSPC-SP6/NACE 3 Commercial Blast Cleaning. The surface shall be free of all foreign matter and dry prior to painting
      b. 1st Coat – Series 1 Omnithane applied at 2.5-3.5 dry mils
      c. 2nd Coat – Series N-69 (Color: 110GN Clover) Hi-Build Epoxoline II applied at 4.0-6.0 dry mils
      d. 3rd Coat – Series 73-U (Color: 112GN Foliage) Endura Shield applied at 3.0-5.0 dry mils
   (3) All field applications shall be inspected and approved by a Tnemec authorized factory representative and City of Sumter approved representative
   (4) Approval shall be in the form of a written acceptance letter to be supplied by the Tnemec representative stating that all areas of application have been cleaned, primed and coated in accordance with the factory's approval for warranty acceptance.

F. **Portable Hoist.**

1. Provide a portable hoist with a minimum 1,000 pound capacity. Coordinate hoist size with pump size on a per station basis.
2. Hoist to have stainless steel winch, hook, and cable.
3. Furnished and install a lined, stainless steel socket for embedment into the precast wetwell top. Coordinate location with wetwell supplier and the City.
4. Furnish a stainless steel cap to keep the socket free from debris.
5. Hoist shall be Halliday Model D2B36D or approved equal.
6. Hoist should be manually operated but winch should have the option of being drill driveable.

G. **Fencing.**

1. Provide chain link fence
2. All materials shall be galvanized including fabric, posts, rails and associated appurtenances
   (1) Chain link shall be 6' high, ends twisted and barbed, and commercial grade 9-gauge 2" mesh
   (2) End, corner and pull posts shall be 2.875" O.D
   (3) Line posts shall be 2.375" O.D
   (4) Top rail shall be 1.66" O.D
   (5) Bottom tension wire shall be 7-gauge spring coil wire
   (6) Gate posts shall be 3" O.D. for gates up to 6' wide
   (7) Gate posts shall be 4" O.D. for gates 7' to 13' wide
3. Vehicle Access Gate:
   (1) Vehicle access gate shall be a pair of 7' long by 6' high sections constructed of 2" O.D. pipe. Frame members shall not exceed 6" in length.
   (2) Gate shall be equipped with a prop post center latch and hasp assembly. A ground anchor cast in concrete shall be provided.
   (3) Gates shall be factory fabricated and equipped with gate hold backs. Panel shall have a horizontal brace at center of fabric height.

H. **Station Security Light.**

1. Provide a site flood light that will be owned by the City.

I. **Submersible Pump Station.**

1. Pumps:
   (1) General:
      a. ANSI 125 lb standard cast iron flange fitting or cast with volute
      b. Pump components: cast iron, ASTM A48, Class 30
      c. All exposed fasteners and washers: Type 316L stainless steel
      d. Pump lift handle: Type 316 stainless steel
      e. Chopper pumps may be required by City Engineering. Each pump station will be evaluated on a case-by-case basis to determine if a chopper pump is required.
      f. Grinder pumps are not allowed on residential or commercial services

g. Coating:

(a) All components coming into contact with sewage

(b) Pump exterior: PVC epoxy primer and a chlorine rubber paint finish

(2) Impeller:

a. Double shrouded non-clog type

b. Gray cast iron, Class 30, balanced dynamically to 0.5"

c. Paint with one coat of alkyd resin primer

d. Provide wear ring consisting of a replaceable stationary ring made of brass, drive fitted to the volute inlet

e. Sliding fit between the impeller and the shaft with one key

(3) Volute.

a. Single piece, non-concentric design

(4) Shaft:

a. ANSI Type 420 stainless steel

(5) Bearings:

a. 2 permanently lubricated bearings

b. B-10 bearing life of 50,000 hours

c. Upper bearing: single deep groove ball bearing

d. Lower bearing: two row angular contact ball bearings

(6) Watertight seals:

a. Nitrile rubber O-rings

b. Fittings: Accomplish sealing by metal-to-metal contact between machined surfaces

c. Gaskets, elliptical O-rings, grease or other devices are not acceptable

(7) Mechanical seals:

a. Tandem mechanical shaft seal system

b. Operate the upper of the tandem set of seals in an oil chamber

c. Upper seal set: one stationary tungsten carbide ring soldered to a holder of stainless steel and one positively driven rotating carbon ring to function as an independent secondary barrier between the pumped liquid and the stator bearings

d. Lower seal set: a stationary ring soldered to a holder of stainless steel and a positively driven rotating ring, both of tungsten carbide. Hold each interface in contact by its own spring system
e. Require neither maintenance nor adjustment, easily inspected and replaced
f. Provide all seal hardware of stainless steel

(8) Warranty:

a. The pump manufacturer shall warrant the units being supplied against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater Permanent Installation Warranty Policy under normal use, operating and service. The warranty shall be in printed form and apply to all similar units

(9) Approved Pump Manufacturer:

a. Barnes Pumps
b. Ebara Pump
c. Flygt

2. Pump Motor:

(1) General:

a. Submersible type, designed for continuous duty, suitable for Class I, Div. I area and capable of sustaining a minimum of twelve (12) starts per hour
b. Integral motor and pump
c. Air filled, squirrel cage induction, shell type design, Class F insulation system. Class F materials rated for continuous duty in 40 degree C (104 degree F) liquids
d. Cast iron motor frame and end shields
e. Stainless steel hardware and shaft
f. Service factor: 1.15
g. Minimum efficiency rating of 90% viii.Minimum power factor rating of 85%
h. Stator:

(a) Heat-shrink fitted to shaft
(b) Dip and bake in Class F varnish
(c) Do not use bolts, pins or other fastening devices requiring penetration of the stator housing

(d) Aluminum rotor bars and short-circuit rings

(2) Cable entry water seal system:

a. Single cylindrical elastomer grommet, flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable

b. Bear assembly against a shoulder in the pump top

c. Separate the cable entry junction chamber and motor by a stator lead sealing gland or terminal board to isolate the motor interior from foreign material gaining access through the pump top. Do not use epoxies, silicones, or other secondary sealing systems

(3) Provide pre-lubricated bearings: Minimum B-10 life of 50,000 hours

(4) Thermal protection:

a. Motor rated thermally to NEMA MG1-12.42

b. 3 thermostatic switches (one in each phase) in the stator windings

(5) Junction chamber:

a. Seal from the motor by elastomer compression seal (o-ring)

b. Connect between the cable conductors and stator leads with threaded compressed type binding, post permanently affixed to a terminal board

(6) Seal protection:

a. Provide moisture detection device

3. Discharge connection:

(1) Permanently installed discharge connection system

(2) Pump(s) automatically connected to the discharge connection elbow when lowered into place. Easily removed for inspection or service

(3) Accomplish sealing of the pump unit to the discharge connection elbow by a simple linear downward motion of the pump

(4) Stainless steel sliding guide bracket to be an integral part of the pump unit

(5) Guide the entire weight of the pumping unit by no less than two guide bars and press tightly against the discharge connection elbow with metal-to- metal contact

(6) A diaphragm, O-ring or other devices to interface sealing of the discharge are not acceptable

(7) No portion of the pump to bear directly on the floor of the sump

4. Discharge elbow:
   (1) Grey cast iron: ASTM A48, Class 30
   (2) Vertical leg: ANSI Class 125 lb. flange
   (3) Provide integral cast iron base
   (4) If necessary, size elbow with a reducer to reduce the maximum velocities and to match discharge piping
5. Pressure gauges:
   (1) Provide on the discharge side of each pump
   (2) Range - nearest available upper range above pump shut off head
   (3) Provide rounded type, stainless steel case, 4 ½" nominal diameter with phosphor-bronze bourdon tubes, glycerin filled, 3" NPT bottom male threaded connections, stainless steel rack and pinion movement, black micro-adjusted corners and black figures with white plastic dials, and a threaded ring
   (4) Gauge accuracy: Within 1% of the total scale range
   (5) Provide diaphragm isolators on all gauges. Provide diaphragm material resistant to chemicals in the process line being measured
   (6) Gauge connections to consist of the following:
      a. ¼" Type 316 stainless steel shutoff valve with Viton seals as manufactured by Whitey ball valve
      b. ¼" stainless steel piping connections
6. Guide rails (per pump):
   (1) Provide two lengths of Schedule 40, Type 316 stainless steel pipe, with diameter as specified by manufacturer
   (2) Type 316 stainless steel bottom and top pilots
   (3) Acceptable manufacturer: Halliday Metals
7. Pump guides:
   (1) Attach to pump volute with stainless steel hex head cap screws
8. Lift chain:
   (1) Provide each pump and motor with Type 316 stainless steel lifting chain sized per manufacturer's recommendations. Minimum ¼" welded stainless steel link chain
   (2) Length to reach top of station plus an additional 3'

(3) Attach upper end of chain to wetwell access frame with Type 316 stainless steel clip and stainless steel eye nut

(4) Connect chain to pump using Type 316 stainless steel screw pin and shackle

9. Pump control panel:

(1) Standards Compliance – the panel and all components meet the relevant safety and performance standards. To include Underwriters Laboratories (UL) 508A for industrial control panels, the National Electrical Code (NEC)/NFPA 70, and NFPA 79 for industrial machinery.

(2) The enclosure and its components shall be constructed from 14-gauge mild steel and provided with a door over door construction to provide protection of all control components, pushbuttons, indicting lights, switches, etc. Enclosure to be NEMA 12 rated at a minimum.

(3) See Figure 3 Pump Station Control Panel for standard pump station control panel drawings

(4) Exterior of enclosure to be painted ANSI 61 gray powder coating. Interior to be white

(5) Internal components

a. Controller – Intrinsically safe duplex microprocessor-based controller as manufactured by Diversified Electronics.

(a) Basis of design is Diversified Electronics ARM-120-AFEP.

(a) No approved equals

(b) This controller is to be furnished with lead/lag motor alternator with pump 1-2 run indicators, pump 1-2 hand-off-auto, pump 1-2 lead select, automatic transfer to non-operating pump in event of overload in operating pump.

b. Operator interfaces – All pushbuttons, switches, etc. to be type 22mm NEMA 12/4X rated and mounted to the interior door face. All interfaces to be protected behind outside enclosure door. At a minimum an overload reset button, overload indicator light and over temperature indicator for each motor shall be provided. A unit alarm beacon (mounted on top exterior of enclosure) shall be provided to allow indication that the pump station has reached the alarm level. No audible alarm shall be provided.

c. Main disconnect and circuit protection – Unit is required to be provided with two UL rated power circuit breaker with sliding bar interlock and external handle (behind exterior door). One main is for Normal power input and one is for Generator power input. These two main circuit breakers to be sized in accordance with the requirements of the systems and as indicated on the plans. Breakers shall be provided with appropriate voltage and current ratings. Unit to be provided with phase protection monitor. All control circuits to be protected by a transient voltage surge suppressor.
d. Individual Motor Disconnects – Each motor shall be provided with its own disconnect which shall be lockable for maintenance purposes. Each motor to be provided with overload unit and magnetic contactors.
e. Motor components – Each motor to be provided with overload, short circuit protection and magnetic contractors for automatic operation. Each motor to be provided with a pump run time meter.
f. Power supply – Panel service to be three phase (480V, 240V, or 208V) as specified by Electrical engineer of record. Current rating to be as specified by Electrical engineer of record. A separately derived control power supply shall also be furnished as called for on the control panel drawings. Control power supply primary and secondary voltage ratings and VA rating(s) shall be as called for on the control panel drawings.
g. Generator input connections – The generator connection input shall consist of a set of three phase plus ground coded cam-lock male inlet connectors rated at 200amp each. These connections shall be located at the bottom of the control panel as indicated on the control panel drawings (See Figure 3 Pump Station Control Panel). Color codes (Brown, Orange, Yellow, and Green for 480V) and (Black, Red, Blue, and Green for 208/240V).
h. GFCI receptable – The control panel shall be provided with a ground fault circuit interruptible outlet for customer use.
i. Provide an LED strip light with 6 feet cord for remote use when needed.
   (a) Stego model 025423-10 or equal
j. Terminals and busbars – Require tin-plate alloy terminal blocks rated for copper wiring. A separate neutral (when required) and ground bar shall be provided. A

separate three phase power terminal block shall be provided between the generator input terminals and the generator main breaker for operation connection by the owner.

k. Mounting – Requires a removable inner panel for component mounting.

l. Wiring and labeling.

(a) Wiring – Wiring shall be MTW or SIS type stranded of gauge as called for on the control panel drawings. Color coded wiring where called for on the control panel drawings. Labeling shall be provided on all wiring.

(b) Labeling – The City requires permanent labels for all internal and external components, including wire labels, component tags, and main panel identification. Components tags shall be provided with ¼-inch letters on permanent plastic nametags. All wiring shall be labeled on both ends.

m. Electrical ratings.

(a) Supply Ratings – Voltage, phase, frequency, and ampere ratings shall be as called for on the control panel drawings.

(b) Short-circuit current rating (SCCR) – Control panel shall be required to have a minimum of 5000 amps SCCR for the entire panel.

(c) Overcurrent protection – Control panel shall be properly protected from overcurrent conditions.

n. Factory testing.

(a) Testing procedures – The control panel must be fully tested at the manufacturer's facility before shipping.

(b) Testing criteria – Testing shall be performed to confirm that all circuits are complete and correct, interlocks are functional, and all devices operate as specified.

o. Manufacturer.

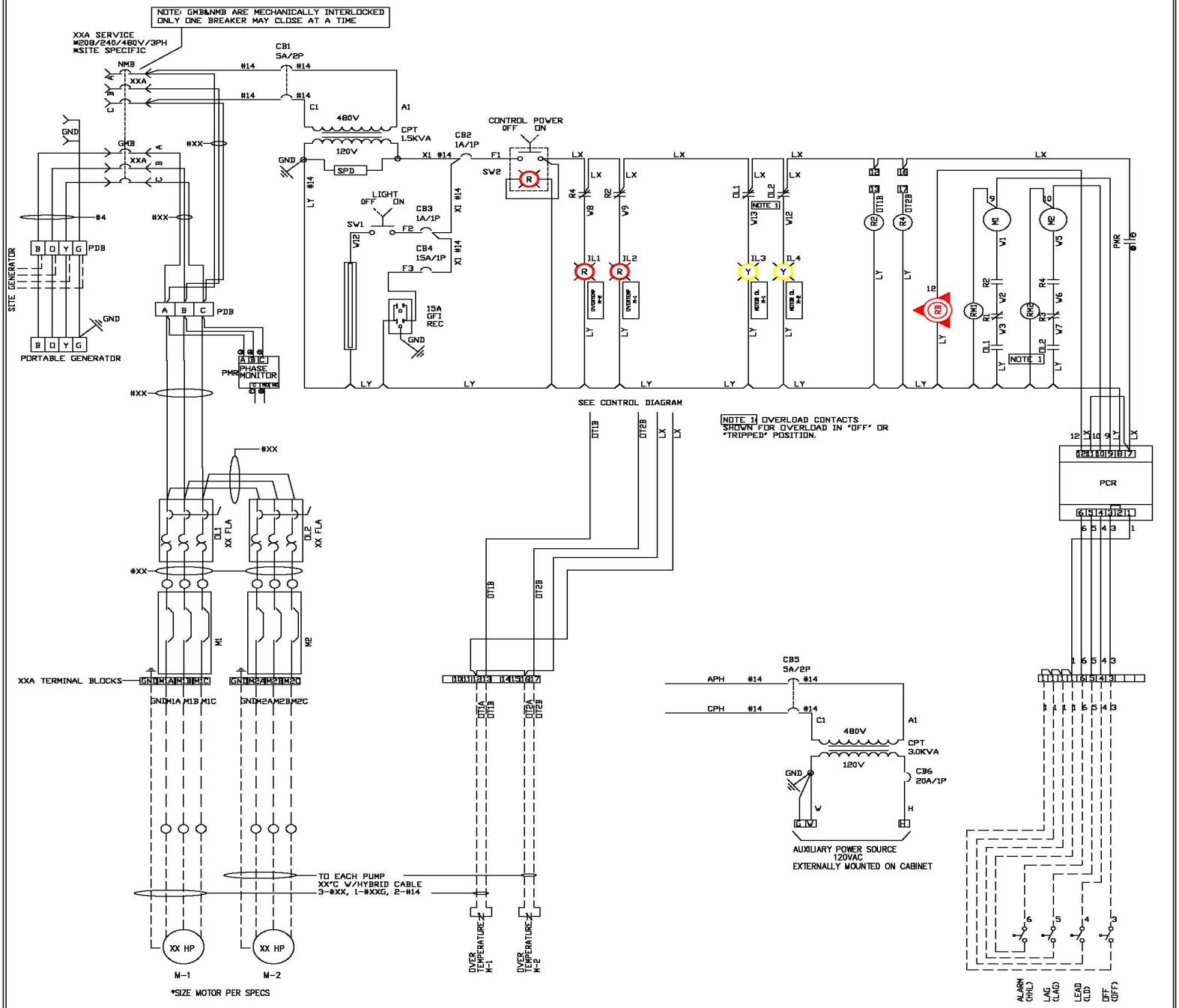
(a) Approved manufacturer – WEB Electric, Inc (450 South Guignard Drive Sumter, SC 29150).

(b) Approved equal will need to be submitted to the City for review and approval.

p. Installation and inspection.

(a) Installation – The control panel shall be properly mounted to the surface and to include a minimum of (4) 3/8 inch bolts. Panel to be affixed at all four corners of the panel. Panel shall be mounted such that there is a minimum of 36" of working clearance in front of the panel with overhead cover. There shall be ease of access to the mounted control panel. Control panel shall be properly grounded as per NED.

Figure 3 Pump Station Control Panel (See below

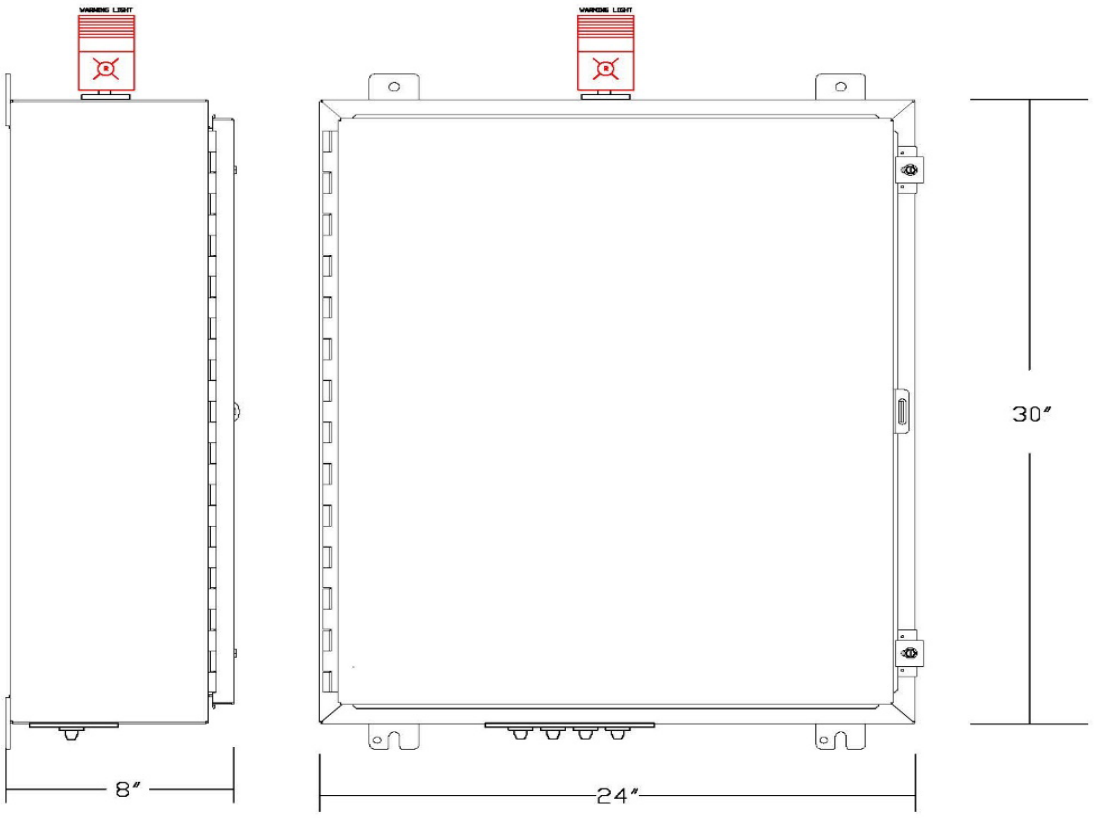



| | | | |
|---|---|---|---|
| PROJECT NAME: | FILE NAME: | XX | |
| CITY OF SUMTER<br>XX LIFT STATION | ENGINEER: | WEB | |
| | DRAFTER: | WEB | |
| SHEET NAME: | CHECKED: | WEB | |
| WASTE WATER LIFT STATION CONTROL<br>XXA XXVAC/3PH SERVICE | APPROVED: | | |
| | DATE: | XX | |

W. ERVIN BRUNSON
ENGINEER

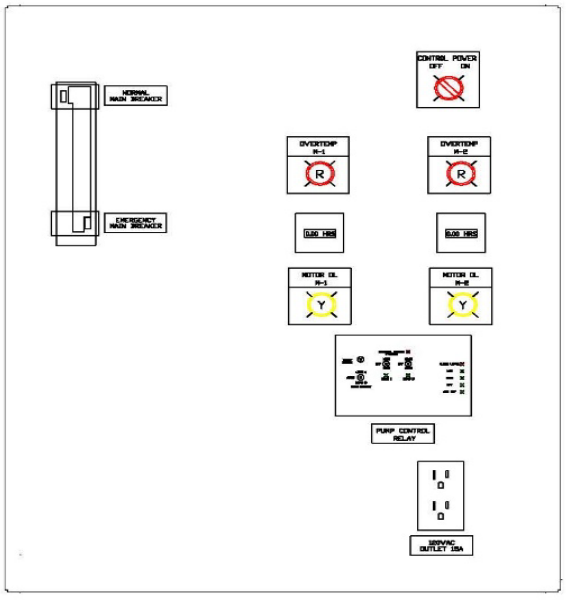
WEB ELECTRIC, INC.
450 SOUTH GUIGNARD DRIVE
SUMTER, S.C. 29150
803/773-4102
803/775-3636

1 REV 1 REVISIONS

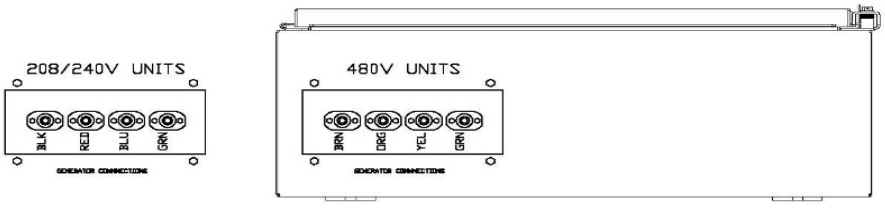



LEFTSIDE VIEW

FRONT VIEW




INNER PANEL VIEW




BOTTOM VIEW

| | | | |
|---|---|---|---|
| PROJECT NAME: | | FILE NAME: | XX |
| CITY OF SUMTER<br>XX LIFT STATION | | ENGINEER: | WEB |
| | | DRAFTER: | WEB |
| SHEET NAME: | | CHECKED: | WEB |
| WASTE WATER LIFT STATION CONTROL<br>XXA XXVAC/3PH SERVICE | | APPROVED: | |
| | | DATE: | XX |

2 / 3

W. ERVIN BRUNSON
ENGINEER

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803/773-4102
803/775-3636

REVISIONS
1 REV 1

# 8.9 WASTEWATER COLLECTION SYSTEM PUMP STATION CONSTRUCTION PROCEDURES

A. **General.**

1. Prior to construction activities taking place, the Engineer of Record shall coordinate in advance a Pre-Construction Meeting with the assigned City Engineering Inspector. The Engineer of Record, Contractor(s), and City's Engineering Inspector shall be in attendance at a minimum.
2. If any requirements for carrying out project construction are not met, the City reserves the right to issue a stop work order.
3. The contractor is responsible for work site safety. Although City personnel will visit the site to observe construction, the City shall not be held liable for work site safety.

B. **Operation of City Valves.**

1. No City valve shall be operated without prior approval of the City.

C. **Handling of Materials.**

1. General:
   (1) Store rubber gaskets under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground.
   (2) Keep inside of pipe and fittings free of dirt and debris.
   (3) Keep valves off the ground and keep interior free of dirt and debris. Do not expose valve interior to direct sunlight.
   (4) Handle pipe so as to ensure delivery in sound, undamaged condition.
   (5) Carry pipe into position. Use pinch bars, slings or tongs for aligning or turning the pipe.
   (6) Use care not to damage Ductile Iron Pipe linings.
2. Submersible Pumps:
   (1) Store pump in shipping container until ready for use. The pump should be covered to protect it from dust, dirt and water. The ends of the cable must be protected against moisture.
   (2) Do not allow the pump to freeze. If the pump must be stored in a sub- freezing environment, consult the factory for specific recommendations.

(3) Prior to installation, the pump motor should be rotated by hand to ensure the .mechanical seals are free-spinning.

D. **Wetwell.**

1. Install wetwell in accordance with pertinent provisions for manhole installation in Section 8.2 of these Standards
2. The bottom slab of the wetwell shall be set on a minimum of 18" of No. 57 stone
3. Set base level so that walls will be plumb
4. Form constant height slope on walls of wetwell bottom using Portland cement grout
5. Steps shall not be used in wetwell
6. All interior hardware shall be Type 316 stainless steel including, but not limited to, the following:
   (1) Lifting chains
   (2) Anchor bolts
   (3) Bolts, nuts, and washers
   (4) Guide rails and supports
   (5) Rail guides
   (6) Power cable holder
   (7) Cable strain support
   (8) Float cable holder
7. Coatings:
   (1) Coat all interior concrete surfaces of wetwell to include walls and bottom surface of the top slab
      a. Coating shall be Raven 405 Epoxy System and shall be applied by a Raven Certified Applicator
         (a) Deviations from the Raven 405 Epoxy System will need to be submitted to City Engineering for review and approval
      b. Care shall be taken to protect all pumps, valves, piping and internal hardware form overspray during application
      c. Coating shall be installed at 120 mils nominal thickness. Applicator shall verify thickness during installation by the use of a wet film thickness gauge
      d. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

8. Locate floats where flow from the inlet pipe will not interfere with the floats.

E. **Piping and Fittings.**

1. Join pipe in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricants for the pipe gaskets shall be used and shall be the manufacturer's standards.
2. Flanged pipe:
   (1) Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material.
   (2) Rubber gaskets shall be checked for proper fit and thoroughly cleaned.
   (3) Care shall be taken to ensure proper seating of the flange gasket.
   (4) Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible.
   (5) If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re-tightened.
3. Restraining Glands:
   (1) Adjoining surfaces shall be clean, lubricated and meet the requirements of ANSI/AWWA C111/A21.11.
   (2) Install using assembly recommendations established in ANSI/AWWA C111/A21.11 as well as installation instructions provided by the manufacturer.

F. **Valves.**

1. General:
   (1) Install all valves in accordance with manufacturer's recommendations.
   (2) Valves shall be installed plumb and level.
   (3) After installation, valves shall be fully operated in the presence of the City inspector.
2. Cushioned swing check valves:
   (1) Provide one cushioned swing check valves on each discharge pipe.
   (2) Mount the cushioned chamber to the side of the valve body with piston operating in chamber, which will prevent valve closing without any hammering action.
   (3) Shock absorption by air: Adjustable closing speed.
   (4) Approved manufacturer: G.A. Industries, Inc., Figure 250-D.

3. Gate valves:
   (1) Provide two gear operated hand wheel actuated gate valves, one on each discharge piping to permit either or both pumps to be isolated from the header. Provide one gear operated nut actuated gate valve on the bypass pumping connection.
   (2) Furnish valve with a drip tight shutoff plug mounted in stainless steel bearings.
   (3) Furnish gate valves, with "open-left" operation.
   (4) Approved manufacturer: Mueller Co.

G. **Cellular SCADA System.**

1. General:
   (1) Include tying in the new pump station SCADA system into the City's existing SCADA system.

H. **Fencing.**

1. Fencing installation shall not begin before the proposed fence line has been inspected for low areas and incidental grading and compacting have been completed.
2. Excavation for post footings shall be drilled holes in virgin or compacted soil.
3. Depth of each post shall be set as specified by the manufacturer, but not less than 24" below finished grade when in firm, undisturbed soil. Posts shall be set deeper, as required, in soft and problem soils and for heavy lateral loads.
4. Setting posts:
   (1) Loose and foreign material shall be removed from holes and the soil moistened prior to placing concrete.
   (2) Top of footings shall be trowel-finished and sloped or domed to carry water away from posts.
5. All posts to be plumb.
6. All posts should be able to pass a pull test when a force of 48 pounds is applied perpendicular to the fence at the top of the post. The post should not deflect more than 1" at the locations where the force is applied.
7. Concrete:
8. Concrete shall conform to ASTM C 94/C94M. Mix shall be designed to obtain concrete with a minimum 28-day compressive strength of 2,500 psi.

9. Concrete shall have attained at 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails or fabric are installed. Fabric and wires shall not be stretched or gates hung until the concrete has attained its full strength.

I. **Asphalt.**

1. Provide asphaltic concrete pavement across entire pump station site, extending a minimum of 6" past fence line.
2. Provide asphaltic concrete paved entrance road, minimum 16' wide.
3. Asphaltic concrete pavement shall comply with the following requirements:
   (1) Underlayment - Provide geofrabric underlayment
   (2) Stabilized Aggregate Base Course (SABC) – Provide SABC In accordance with SCDOT Standard Specifications, Section 306, Type 1, placed at a depth of 8", compacted to 95% of maximum dry density in accordance with ASTM D 1557, Method D
   (3) Prime Coat – Applied uniformly at a rate of 0.5 gallons per square yard over compacted and cleaned sub-base surface in accordance with SCDOT Standard Specifications
   (4) Surface Course - Provide hot laid asphaltic concrete surface course in accordance with SCDOT Standard Specifications, Section 403, Type C Asphaltic Concrete, placed at a minimum depth of 2"

J. **Submersible Pump Station.**

1. Use base plate as a template for drilling individual hole patterns. Mount base plates using Type 316 stainless steel expansion anchors.
2. Form constant height slope on walls of wetwell bottom using Portland cement grout.
3. Assemble guide rails to access frame and plumb the assembly.
4. Install cable holder to precast top: Use Type 316 stainless steel anchors.
5. Install pumps and piping, plumbing the assembly for proper alignment and fit.
6. Seal around inlet and discharge piping with non-shrink grout.
7. Install power cables using cable strain relief and cord grips (stainless steel).
8. Field wiring:
   (1) Extend grounding wire from control panel main ground screw to external ground as shown in details. Comply with NEC and local electrical codes.

(2) Make motor lead, level control, temperature sensor, moisture sensor, and power supply connections.

(3) Seal all conduits between junction box and control panel as shown in details. Comply with all pertinent National Electric Code requirements.

(4) Seal conduit terminations in control panel with duct seal.

9. Electrical schematic:

(1) Provide three (3) laminated electrical schematic diagrams of the pump controls including terminal board connections.

a. Permanently mount one (1) schematic diagram on the inside of the enclosure door

b. Include one (1) schematic diagram in inside panel door document pouch

c. Provide one (1) schematic diagram

10. Startup and Testing:

(1) Factory representative shall remain on site until startup and performance testing has been accepted by the City. Factory representative to provide instruction to City staff on the proper operation and maintenance.

(2) The Engineer of Record shall conduct testing of pump station pumps and controls to verify operating parameters are met per design criteria. The Engineer of Record shall be responsible for coordinating the pump manufacturers, the City representative, and the contractor for draw down testing.

(3) In the presence of the Engineer of Record and the City:

a. Remove pump from structure

b. Replace, demonstrating proper alignment and operation of mating parts

c. Operate pumps utilizing manual and automatic modes

d. Demonstrate proper operational sequences, including alarm conditions

e. Measure amperage, voltage, pumping rate and discharge pressure for:

(a) Each pump operating separately

(b) Both pumps operating simultaneously

f. The Engineer of Record shall email a copy of final test report to the City

(4) Provide one hard copy and one electronic copy of the Operations and Maintenance Manuals. The manual shall contain a complete parts list showing

factory part numbers. It shall also contain complete operating and service instructions and shall be tabbed and indexed for each use

(5) Spare parts:

a. Provide the following minimum spare parts:

(a) One spare pump

(b) One of each seal assemblies

(c) One complete set of bearings

(d) One set of wear rings

(e) One of each type relay

(f) One pump alternator

(g) One float switch with cable

(h) One of each type pilot light

(i) One box of each type lamp

(j) One set of fuses complete

b. Package in one container all spare parts and clearly identify on the outside what the unit is for. Seal tightly and properly protect for long term storage

# 9. INSPECTIONS AND CLOSEOUT

## 9.1 INSPECTIONS AND CLOSEOUT

A. **Roadway Testing and Inspections.**

1. Roadway Construction shall follow City of Sumter requirements as outlined in Section D.5.2.

| Table D.7.1: Roadway Course Testing Requirements | | | |
|---|---|---|---|
| **Roadway Courses** | **Mix Design Required?** | **Thickness and Density Frequency** | **Prime Coat Required?** |
| **Subgrade Course** | | | |
| Cement Modified | Yes | 500 ft per 2 lane roadway | No |
| Soil Aggregate | No | 250 ft per 2 lane roadway | Yes |
| **Base Course** | | | |
| Cement Stabilized Earth (Soil Cement) | Yes | 250 ft per 2 lane roadway | Yes (curing coat) |
| Macadam | No | 250 ft per 2 lane roadway | Yes |
| **Intermediate Course** | | | |
| Asphalt Binder or Immediate Course | No | 500 ft per 2 lane roadway | Yes (tack coat) |
| **Surface Course** | | | |
| Asphalt Surface Course Type C or Type D | Yes | 500 ft per 2 lane roadway | Yes (tack coat) |

B. **Stormwater Inspections**

1. See Stormwater Ordinance 2469 in Appendix 1 for inspection requirements.

C. **Water and Sewer.**

1. Final Inspections.

(1) The purpose of the Final Inspection is to inspect all aspects of the constructed water and sewer utility, drainage, and road systems to determine conformance with the plans stamped "Approved for Installation" or "Approved for Construction" by the City of Sumter.

(2) All inspections require a minimum 3 business day notice. This does not include holidays or weekends.

(3) Subdivisions: Upon completion of construction and prior to scheduling the Final Inspection, the Engineer of Record shall submit a Final Inspection package to the City Engineering Department. The Final Inspection package shall include the following items:

a. One (1) draft digital PDF, DWG file, and hard copy of Record Drawings for review. Record Drawings shall be prepared in accordance with City requirements. The Engineer of Record or Surveyor shall deliver digital files in AutoCad format (.dwg). The State Plane Coordinates shall be tied to the drawing in AutoCad in order for the drawings to be placed in the correct position inside GIS.

(a) Record Drawings.

(b) Record Drawing PDF should be of the final approved Record Drawings as submitted in accordance with the requirements of this Section; sealed, signed, dated by the Professional Land Surveyor and the Engineer of Record reflecting all as- constructed conditions.

(c) PDF shall be black and white with white background. Minimal color text or graphics pertinent to the submittal will be accepted.

(d) Final PDF should be saved to open in proper orientation.

(e) If drawing is multiple pages, a single multi-page PDF shall be submitted.

b. Record Drawings in AutoCad form:

(a) Provide in NAD 83 (2011) South Carolina State Plane Coordinates, oriented Grid North and tied to the current realization of the South Carolina Geodetic Survey Virtual Reference Station (VRS) network. Vertical coordinates shall be related to the National Geodetic Vertical Datum NAVD88 (Z coordinate). The Benchmark and vertical datum shall be noted on each sheet of the Developer's plans. Example: THIS DRAWING REFERENCES NAD 83 (2011) HORIZONTAL STATE PLANE COORDINATE SYSTEM, ELEVATIONS ARE BASED ON NAVD889 VERTICAL DATUM.

(b) Show each drawing entity with coordinates tied to SC Grid, and show the grid tie at the point of connection to the existing system with bearing and distance to the Grid monument used and identified.

(c) Have water and wastewater lines in separate drawing layers.

(d) Have all water appurtenances (i.e., hydrants, valves, services, tees, etc.) and all wastewater appurtenances (i.e., manholes, valves, cleanouts, etc.) in separate drawing layers.

(e) Roads and drainage features shall be in separate drawings layers.

(4) Letter from the geotechnical engineer indicating the roads are constructed in general accordance with the project report. Any deviations from the report shall be noted in the letter.

(5) One (1) draft digital, DWG, and hard copy of all water main and wastewater force main Valve Cards for review. Valve Cards shall be prepared in accordance with the requirements City requirements.

(6) All easements must be listed on the as-builts and subdivision plat.

(7) For roads with between 0.5% and 1.0% slope provide asbuilt plans with the plan, profile, and road cross sections. The road cross sections should indicate elevations at the gutter lines, center of travel lane, and road center every 50 feet.

(8) Pressure test results for all water mains and wastewater force mains. Test results

shall be certified by the Engineer of Record.

(9) Flow test results for all installed fire hydrants. Flow tests shall be performed under the supervision of a City Inspector and the results certified by the Engineer of Record.

(10) Low-pressure test results for wastewater gravity sewers. Test results shall be certified by the Engineer of Record.

(11) Two (2) USB drives containing Closed Circuit Television (CCTV) inspection video and CCTV Contractor's Log for gravity sewer services and gravity sewer mains. Engineer of Record shall review the CCTV video and inspection report for any deficiencies prior to submitting to the City.

(12) Two (2) USB drives containing Closed Circuit Television (CCTV) inspection video and CCTV Contractor's Log for storm drains. Engineer of Record shall review the CCTV video and inspection report for any deficiencies prior to submitting to the City.

(13) Manhole vacuum test results for wastewater gravity sewers. Test results shall be certified by the Engineer of Record.

(14) Spark test results for epoxy coated manholes and wet wells.

(15) Pump Stations - For projects involving wastewater pump stations, the following additional items shall be provided:

a. One (1) draft digital and hard copy of Pump Station Record Drawings and Valve Cards for review.
b. All electrical schematics, drawdown test results, and float level settings laminated and mounted inside the control panel door.
c. Complete list of supplied spare parts as specified in these standards.
d. Operation and Maintenance Manuals:
   (a) Manuals shall be specific to the equipment supplied.
   (b) Provide factory pump curves for installed pumps.
   (c) Manuals applicable to many different configurations and which require the operator to selectively read portions of the instructions will not be accepted.
   (d) The equipment model that the manual applies to shall be

indicated by an arrow.

(e) Table of contents specific to each manual.

(f) At the beginning of each manual, provide a description of the equipment to include model numbers, purchase order numbers, serial numbers, motor information, and performance and design criteria.

(g) Correlate manuals with approved shop drawings and include the following minimum information:

1. Parts list, including recommended spare parts.
2. Guarantees/Warranties.
3. Provide a maintenance and lubrication schedule to be a summary of all preventative maintenance and lubrication.
4. Address and telephone numbers of the source for repairs, spare parts, and service.
5. Detailed descriptions of operating procedures for the item of equipment specifically written for this installation, including start-up and shut- down procedures.
6. Equipment performance specifications, including pump curves and drawdown test data.
7. Results of start-up and any further recommendations resulting from start-up.

(h) Upon Council approval, the Developer will transfer the pump station electrical service account to the City.

(16) If any items are determined to be missing or if corrections are required, the City will provide notification to the Engineer of Record.

(17) Please allow a minimum of seven (7) working days for review and approval of the Final Inspection package.

(18) Upon notification of approval, the Engineer of Record shall schedule a Final Inspection with the City Inspector. A minimum of seven (7) working days shall be allowed for scheduling. The Engineer of Record, Developer's Contractor, City Inspector, and representatives from the City's Water Distribution and/or Wastewater Collection Department(s) shall be in

attendance, at a minimum.

(19) Upon completion of the Final Inspection, the City's Inspector will prepare a punch list of items to be corrected by the Developer. The punch list will be issued to the Engineer of Record.

(20) To ensure all punch list items have been satisfactorily addressed by the Developer, there will be a final walk through to confirm any deficiencies have been corrected.

(21) After the Final Inspection, the Engineer of Record shall submit one digital and hard copy of revised Record Drawings and Valve Cards for final approval to the City Engineering Department. Requirements for digital submittals for approved Record Drawings and Valve Cards are described in this Section.

2. For Main Extension Projects: Upon completion of construction and prior to scheduling the Final Inspection, the Engineer of Record shall submit a Final Inspection package to the City Engineering Department. The Final Inspection package shall include the following items:

(1) One (1) draft digital PDF, DWG file, and hard copy of Record Drawings for review. Record Drawings shall be prepared in accordance with City requirements.

(2) One (1) draft digital and hard copy of all water main and wastewater force main Valve Cards for review. Valve Cards shall be prepared in accordance with the requirements City requirements.

(3) All easements must be listed on the as-builts and subdivision plat.

(4) Pressure test results for all water mains and wastewater force mains. Test results shall be certified by the Engineer of Record.

(5) Low-pressure test results for wastewater gravity sewers. Test results shall be certified by the Engineer of Record.

(6) Two (2) USB drives containing Closed Circuit Television (CCTV) inspection video and CCTV Contractor's Log for gravity sewer services and gravity sewer mains. CCTV submittal shall be in accordance with the requirements of Section 11 of these standards. The Engineer of Record shall review the CCTV

video and inspection report for any deficiencies prior to submitting to the City.

(7) Two (2) USB drives containing Closed Circuit Television (CCTV) inspection video and CCTV Contractor's Log for storm drains. CCTV submittal shall be in accordance with the requirements of Section 11 of these standards. The Engineer of Record shall review the CCTV video and inspection report for any deficiencies prior to submitting to the City.

(8) Manhole vacuum test results for wastewater gravity sewers. Test results shall be certified by the Engineer of Record.

(9) Spark test results for epoxy coated manholes and wet wells.

(10) If any items are determined to be missing or if corrections are required, the City will provide notification to the Engineer of Record.

(11) Please allow a minimum of seven (7) working days for review and approval of the Final Inspection package.

(12) Upon notification of approval, the Engineer of Record shall schedule a Final Inspection with the City Inspector. A minimum of seven (7) working days shall be allowed for scheduling. The Engineer of Record, Developer's Contractor, City Inspector, and representatives from the City's Water Distribution and/or Wastewater Collection Department(s) shall be in attendance, at a minimum.

(13) Upon completion of the Final Inspection, the City's Inspector will prepare a punch list of items to be corrected by the Developer. The punch list will be issued to the Engineer of Record.

(14) To ensure all punch list items have been satisfactorily addressed by the Developer, there will be a final walk through to confirm any deficiencies have been corrected.

(15) After the Final Inspection, the Engineer of Record shall submit a digital and one hard copy of revised Record Drawings and Valve Cards for final approval to the City Engineering Department. Requirements for digital submittals for approved Record Drawings and Valve Cards are described in this Section.

3. For Service Only Projects: Due to the smaller scope of service only projects, fewer inspection days are typically necessary. It is possible that the Preconstruction Meeting and Final Inspection could occur on the same day.
   (1) While it may not be practical to submit all required closeout items prior to Final Inspection, all required items must be submitted and approved by the City prior to final approval and acceptance of the new service.
   (2) Service only project closeout requirements outlined below will be communicated in writing to the Developer, Engineer of Record, and Contractor by the City Inspector during the Preconstruction Meeting.
   (3) For service only projects, Record Drawings should be updated copies of the City stamped "Approved for Construction" construction plans submitted by the Engineer of Record and shall be updated to reflect actual installed infrastructure.
   (4) For wastewater service only projects, an open trench inspection of infrastructure installed in the public right-of-way or City of Sumter easement is required.

D. **Council Submission Package.**

1. A council submission package is required for all subdivisions and main extension projects. The following items are required to be submitted to the City Engineering Department for Council submission:
   (1) Letter of Credit
   (2) Maintenance Guarantee
   (3) Deed of Dedication
   (4) Easement Forms
   (5) Title Certificate
   (6) Owner's affidavit
   (7) Right of Way Plat
   (8) Contract details for water lines, sewer lines, and roads including dollar amounts and lengths of infrastructure.
2. Legal (A fillable PDF of each legal document is available on our website).
   (1) Affidavit of Title Water – Establishes the Developer (Grantor) as the possessor

of the title of the water utility infrastructure assets to be transferred to the City of Sumter (Grantee).

(2) Affidavit of Title Wastewater – Establishes the Developer (Grantor) as the possessor of the title of the wastewater utility infrastructure assets to be transferred to the City of Sumter (Grantee).

(3) Bill of Sale Water – Conveys ownership of the water utility infrastructure to the City of Sumter.

(4) Bill of Sale Wastewater - Conveys ownership of the wastewater utility infrastructure to the City of Sumter.

(5) Maintenance Guarantee - Water – Establishes a two-year maintenance period for repair of any deficiencies in the water utility infrastructure at the expense of the Developer.

(6) Maintenance Guarantee - Wastewater – Establishes a two- year maintenance period for repair of any deficiencies in the wastewater utility infrastructure at the expense of the Developer.

(7) Maintenance Guarantee - Roads – Establishes a two-year maintenance period for repair of any deficiencies in the road infrastructure at the expense of the Developer.

(8) Pump Stations – For projects involving wastewater pump stations, the following additional legal documents shall be provided:

a. Affidavit for Transfer of Real Property - Establishes the Grantor as the possessor of the title of the real property to be transferred to the City of Sumter (Grantee).

b. Title to Real Estate – Conveys ownership of the real property from the Grantor to the City of Sumter (Grantee).

c. Affidavit for Exempt Transfer – Establishes the deed as being exempt from the deed recording fee because it is a transfer to a political subdivision of the State.

3. **Performance Guarantee.**

(1) A Performance Guarantee is only allowed to be used for subdivision roads.

(2) The Performance Guarantee will be a binding agreement between Council

and developer/subdivider. The agreement will be accompanied by a Letter of Credit in an amount equal to 150% of the cost of the required improvements as certified by the City Engineer or City Manager to enter into a Performance Guarantee with the developer/subdivider.

(3) The Performance Guarantee must be accepted by Council and must include a specific and satisfactory date for the completion of the roads. In no case shall a Performance Guarantee be accepted for more than 2 years. The date of completion will be at least 3 months prior to the expiration of the financial instrument accepted by Council.

(4) When the improvements have been completed and approved for conformity, and accepted by Council with the appropriate Maintenance Guarantee, the financial instrument and Performance Guarantee shall be released and returned.

(5) In the event the developer/subdivider fails to construct the required improvements and have them accepted in time indicated on the Performance Guarantee, the financial instrument shall be forfeited to the City to be used for the completion of the improvements. A Performance Guarantee will initially be accepted for a maximum time of 2 years. The time frame and it associated financial instrument may only be extended by Council after the developer/subdivider has demonstrated hardship due acts of God.

(6) The successful conclusion of the Performance Guarantee shall include the automatic initiation of the Maintenance Guarantee and Council action to accept the improvements.

(7) Building permits may be issued during the Performance Guarantee process provided the Final Plat has been approved, recorded, and proper applications with required fees have been submitted. However, no Certificate of Occupancy (CO) shall be issued until all the improvements are in place, inspected, accepted by Council, and Maintenance Guarantee is in place.

4. Easements.

(1) The Developer will record all easements. Copies of recorded easements will be email to the City Engineering Department.

(2) Easement Agreement – As an instrument of conveyance, prepare and submit a City Easement Agreement.

5. Right of Way Plat should be submitted with Council Submission package but cannot be recorded until after the package has received Council approval.
6. All documentation must be received and approved by City Engineering and Planning prior to being eligible to go before Council. City staff requires 5 business days to review and approve the Council Submission Package. Once all changes have been made and approved, City Administration will review for being placed on the next Council agenda.

E. **Permit to Operate.**

1. Upon Council approval , the Developer and the Engineer of Record shall coordinate the submittal of a Permit to Operate package. The Engineer of Record shall review and certify that all items submitted as part of the Permit to Operate package are complete and meet the requirements of these standards.
2. For subdivisions and main extension projects, the Permit to Operate package shall include all the items listed below and shall be submitted to the City Engineering Department.
3. For service only projects, the Permit to Operate package may not include all of the items listed below. The required items will be communicated to the Developer and the Engineer of Record by the City Inspector during the Preconstruction Meeting.

(1) Permit to Operate Package Items:

a. A letter from the engineer of record indicating all work for encroachment permits have been inspected and approved and the permit has been closed out.
b. Engineer of Record's Letter of Certification stating the project is complete and has been constructed in accordance with the stamped approved plans by the City .
c. Bacteriological sample test results from an SC DES certified laboratory.

Test Results must be less than 30 days old.

d. Upon approval of the Permit to operate package the City Engineering Department will issue an O&M letter to the Engineer of Record. The Engineer of Record is required to make final package submission to SC DES for issuance of Permit to Operate.

F. **Project Cancellation.**

1. Any project without "Activity" from the Owner, Developer, the Engineer of Record or the Developer's Utility Contractor for a period of twelve (12) months, concerning intent to proceed with the project, shall be cancelled by the City of Sumter and any Ability to Serve or Willingness to Serve Letters issued by the City for utility service shall be considered withdrawn. Examples of "Activity" include such actions as plan submittals, payment of fees, meetings with City Engineering or Public Works Staff, written correspondence concerning design, submittal of permit applications, and water and/or wastewater construction activities. Examples not considered "Activity" are submittals to other municipal planning departments or review boards, telephone calls, and correspondence with other permitting agencies.

# APPENDICES

# APPENDIX 1 – *2013 STORMWATER ORDINANCE*

# APPENDIX 2 – *CITY OF SUMTER BACK FLOW & CROSS CONNECTION POLICY MANUAL*

# APPENDIX 3 – *DISCHARGE PERMIT APPLICATION*

# APPENDIX 4 – *CURRENT SEWER USE ORDINANCE*