Caroline County, Virginia
Standards
Volume I
Standard Specifications
and Details for
Construction of
Water and Sewer Lines
and Related Work

CAROLINE COUNTY
VOLUME I
ADOPTED  February 9, 2017
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FOREWORD

These Standards have been developed for use by consultants working on water and sewer utility projects within Caroline County and for Caroline County personnel who review those projects. The standards are not intended as a regulation but should be used as a guide which will establish a degree of uniformity for drawings and specifications for all water and sewer utility projects.

The Standards consist of two volumes as follows:

- Volume I - contains the design standard for water mains, pump stations and sewer lines, force mains and pump stations.
- Volume II - contains specifications for construction and materials for water and sewer lines.

Consultants working on water and sewer utility projects should recognize the fact that State and Federal regulations must be satisfied on all projects. In the event that the County Standards differ from State or Federal Requirements, the more restrictive standard shall be utilized.

It is very difficult to generalize when addressing matters of engineering design without endangering the final product; therefore, consultants should strive for designs which show consideration of details presented herein. However, these details are secondary to good engineering judgment. The design of water mains, pump stations, force mains and gravity sewers is a matter which requires special consideration for each specific project and can not be generalized for all projects. Therefore, the design engineer is responsible for checking the specific requirements of each project against these standards and making any additions, deletions or changes necessary for the project being designed.

The work described herein is under the jurisdiction of the Caroline County hereinafter referred to as the County.

The County will review all plans and specifications, however, all such documents for new construction must be submitted to the appropriate office of the State Health Department for review and a certificate of construction must be issued before construction can begin.
SECTION 1
1.1 General Requirements

1.1.01 General

A. The design of all utility systems and extensions or modifications thereto shall be performed under the direction of a registered professional engineer with a current registration in the Commonwealth of Virginia in accordance with Title 54, Chapter 3 of the Code of Virginia, 1950, as amended. Where applicable, design may be performed under the direction of a certified land surveyor in accordance with Sec. 54-1 7.1 (3) (b) of the above cited code.

B. All design shall conform to the Commonwealth of Virginia "Sewerage Regulations", the “Waterworks Regulations” and to the requirements of other State and Federal Agencies having jurisdiction.

C. Additionally, all design shall conform to the requirements of the Caroline County (hereinafter referred to as "County"). Where the requirements of the State and County, hereafter referred to as County, are in conflict, the more restrictive requirements shall govern.

1.1.02 Preliminary Engineering Report

A. Preliminary Engineering Report shall be submitted to and approved by the County before preparing drawings and specifications except for minor sewer extensions. The report shall contain an overall plan which shall incorporate all of the proposed construction together with a sufficient amount of the surrounding area in order to clearly outline the interrelationship of the two. Existing and proposed development shall be shown as well as existing and proposed utilities. Where phase development is contemplated, the extent of each phase shall be clearly delineated. Additional requirements shall be imposed as detailed in other divisions of these standards and as required by the County.

1.1.03 System Layout

A. Layout map shall be prepared which delineates sewer shed area boundaries or pressure zone boundaries for sewer projects and water projects respectively. The map shall clearly defining the areas pertinent to interim and ultimate development of the area proposed to be served. The Layout Map shall show present and future development, proposed interim and future utilities as well as those existing utilities that will be affected by or have an effect on the proposed utilities.
1.1.04 System Design

A. An analysis shall be prepared that will tabulate the numbers of people served or proposed to be served as determined from the County Land Use Map or existing Zoning. The tabulation shall be incremental areas for evaluation purposes.

B. Average and peak flows shall be developed for areas and sub-areas and tabulated in the report as deemed necessary or appropriate.

C. The design shall address overall present and future flows and system capacities of existing and proposed utilities as they may be affected by or may affect the facilities involved and shall develop proposed water main and sewer line sizes.

D. The design shall be based on ultimate development and shall present such factors as deemed necessary for a sound evaluation of the several factors used in development of the report.

E. Where an alternate design is proposed that would incorporate interim or staged construction, the report shall develop the alternate design and shall present a thorough investigation and justification for consideration of the alternate.

1.2 Drawing Organization and Format

1.2.01 Drawing Organization

A. Drawings shall consist of the following types of sheets arranged in the order listed:

   (1) Cover Sheet
   (2) Index Sheet (if necessary)
   (3) Plan Sheets
   (4) Plan and Profile Sheets
   (5) Standard Sheets and Special Details
   (6) Erosion and Sediment Control Details

B. Projects consisting of only structures may not require plan and profile sheets and projects for construction of gravity sewers, force mains or water lines may not require the use of plan sheets except for special details.

1.2.02 Sheet Format

A. All construction drawings shall be on sheets 24 inch x 36 inch.
B. The cover sheet shall contain the Owner’s name and project description in large, distinctive letters, a vicinity map with a minimum area of 144 square inch drawn where possible on a scale of 1 inch equals 2,000 feet to indicate the general vicinity of the contemplated construction, an index to the plan sheets and the signed and dated stamp of the registered professional engineer licensed to practice in the Commonwealth of Virginia.

C. An Index Map shall be prepared for sewer line, sewage force main and water line projects. The Index Map shall be to a scale of not less than 1 inch equals 600 feet and shall show all proposed utility construction with ties to existing utilities. The lines of proposed construction together with proposed utility structures shall be indexed to the drawings to indicate the extent of coverage on each drawing, or, in the case of structures, to the group of drawings involved.

D. All elevations will be based on NAVD88 datum. Horizontal datum shall be NAD 83 VA Grid North.

E. Plan sheets as well as Plan and Profile Sheets shall show horizontal, vertical and topographic data at 2’ contour intervals as outlined in Section 1.2. of these Standards.

F. Drafting Conventions

   (1) Designer shall provide a Standard Symbols Sheet. Line weight for existing facilities shall be no heavier than 0.021 inch.

   (2) Standard Symbols - Proposed Facilities

   Symbols shall be as shown above, except that solid lines shall be used for pipes. Line weight shall be no lighter than 0.005 inches and no heavier than 0.020 inches.

   (3) Drafting Standards For Good Reproduction

   Letters will be no smaller than 0.1 inch and care will be exercised to keep the lettering open so that it will be legible in the event drawings are reduced to half size. All drawings must be capable of producing legible second generation prints after being reduced to half size.

G. Additional Information

   (1) Drawings for minor utility extensions shall include estimated materials quantities and current County standard notes.
(2) Horizontal scale in Plan and Profile Sheets shall be no smaller than 1 inch equals 100 feet.

(3) Vertical profile scale shall be no smaller than 1 inch equals 10 feet.

(4) All existing and proposed underground utilities shall be shown in plan and profile.

(5) Bench Marks shall be set no more than 500 feet apart along the lines of construction outside the limits of construction. Datum for elevation shown shall be NAVD88.

1.3. Easement Requirements

1.3.01 All sewer and water lines to be under the jurisdiction of Caroline County shall be located either in public right of way or easements.

A. Private owners developing water and sewer facilities which will be under the control of Caroline County shall prepare plots and convey easements to Caroline County.

B. Water and sewer facilities prepared for Caroline County shall be prepared for all construction outside of public right of way.

1.3.02 Permanent easements shall be a minimum of 20 feet in width with consideration for wider easements where more than one facility may occupy an easement, or where, because of line size or access requirements, wider easements are desirable. Where lines have cover in excess of 10 feet, the minimum easement width shall be 20 feet between manholes.

1.3.03 Construction easements shall be acquired for all County contracts. Developers constructing facilities are not required to have construction easements where work is on the developer's property. Construction easements shall provide a minimum working width of 50 feet, including the 20 foot permanent easement. Generally it is desirable to provide more construction easement on one side than the other. This allows room for construction traffic and material storage.

1.3.04 Easement plats shall be on sheets 8-1/2 inch x 14 inch or 8-1/2 inch x 24 inch where longer easements are required, multiple sheets may be utilized. A sample plat sheet is shown on Form No. F-6.
A center line for the easement shall be shown together with the limits of both the proposed permanent and construction easement widths referenced to the center line of the easement. Bearings and distances shall be shown on the center line of the easement and on the right-of-way or property lines where they intersect the center line. Distances shall be shown from fixed points on both the center line and the property lines to the intersection of the two. Bearings, distances and closures shall be to the degree of accuracy of 1 in 8,000 except that approximations will be permitted where it is considered impractical to delineate existing property lines. The body of the plat shall show the name of the property owner and the Deed or Will Book reference for the source of title. The names of all adjacent property owners and a north arrow shall also be shown. Street names or highway route numbers shall also be shown where applicable.

1.4. Review Procedure

1.4.01 General

A. The engineer shall be responsible for obtaining the review and necessary approvals of all drawings and specifications by applicable County, State and Federal agencies having jurisdiction. Copies of such approvals shall be submitted to the County at the time of final review by the County.

1.4.02 County Review

A. Six sets of plans shall be submitted with the current Review Checklist for Water and Sewer Plans, Section 6, Form F-3(A) and F-3(B) and Review Sheet for Sewage Pump Station, Section 6, Form F-4(A), F-4(B) and F-4(C) as applicable to the County for review and if found acceptable shall be marked “Approved” by the County.

B. Additional sets of plans shall be required when backflow conditions are considered as a potential source of contamination of public water supply.

C. Final plats shall be provided in .dwg format. One (1) hard copy shall be submitted for final approval, which contains the professional engineer’s or land surveyor’s signed and dated seal.
SECTION 2
SECTION 2 - DESIGN STANDARDS FOR GRAVITY SANITARY SEWERS

2.1. General Requirements

2.1.01 Sanitary sewers are to be provided solely for the removal of sanitary waste. Under no circumstances shall any roof drains, foundation drains, surface of subsurface drains be either directly or indirectly connected to sanitary sewers. The following design parameters include an adequate allowance for normal infiltration but will not accommodate the above forbidden connections.

2.2 Technical Design

2.2.01 System Layout

A. The overall layout and general design shall conform to the parameters set forth in the approved Engineering Report.

B. All sanitary sewers shall be located in:

(1) Legally established road rights-of-way. Construction within right-of-way is subject to approval by appropriate jurisdiction.

(2) Legally established permanent easements for such purpose, either existing or as proposed by the designer in accord with 1.3. "Easement Requirements" of these Standards.

C. Construction shall be along the center line of rights-of-way or easements except when this location has been previously used by another utility, or when the width of a road right-of-way justified the use of two sewer lines. Exception to this specified location will be allowed only when it can be established that it is not practical to adhere to the standard location.

D. All sewers shall be on continuous grade between manholes.

E. Influent and effluent sewers shall not intersect in manholes at angles less than 90 degrees. In the event that this is impractical, the designer must satisfy the County that adequate losses have been provided in the hydraulic analysis.

F. Sewer mains and manholes shall be a minimum of 15 feet horizontally from any part of a building or structure.

G. No sewer shall be constructed within 50’ of a well.

2.2.02 System Design

A. The overall design shall be in accordance with the provisions of the approved
Engineering Report in accordance with 1.1.02 "Preliminary Engineering Report’’ of these Standards.

(1) Design carrying capacities of lateral, trunk and interceptor sewers shall be based upon the total drainage area served by the line or lines in question. The design flow shall be based on acreage density, using the Caroline County Land Use Map or approved zoning, whichever allows higher densities.

(2) Equivalent flows from motels, schools, hospitals, etc. shall be based upon that of the Commonwealth of Virginia “SCAT Regulations” (Sewage Collection and Treatment Regulations) formerly “Sewerage Regulations”.

(3) In the absence of information on densities or equivalent flow, the designer shall supply sufficient information, substantiated by sound engineering judgment to verify the design. This information shall be subject to approval by the County.

2.2.03 Capacity Design

A. Laterals shall be designed to carry ultimate tributary population with a 50 year projection as an upper limit. Proper allowance for peak flow shall be included.

B. Trunks and interceptors shall be designed on the same basis as laterals except in cases where capacities of system or parts thereof can be readily increased by future relief, allowing for shorter capacity design life of initial or subsequent lines.

C. Computations of all lines shall be provided, including anticipated future relief lines that may be required.

Computations shall be accompanied by a Drainage Area Map, conforming basically to requirements of Index Map, 1.2.02 C. Map(s) shall show entire drainage area involved, location(s) of line(s) in system and points of entry of flows, including any flows being received from other areas. Drainage Area Map shall be keyed to the referenced computation sheet. Computations and maps shall be submitted to the County for approval.

2.2.04 Hydraulic Design – Sewers

A. Minimum grades shall not be less than those required to produce a velocity of approximately two and one quarter (2.25) feet per second when the sewer size selected is flowing full or half full. Pipe sizes shall not be arbitrarily increased in order to take advantage of a flatter grade.
B. The minimum size pipe to be used in systems shall be eight (8) inches.

C. Allowable minimum grades shall be as follows:

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<th>SEWER SIZE (INCHES)</th>
<th>MINIMUM SLOPE IN FEET/100 FEET</th>
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<tbody>
<tr>
<td>8</td>
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<td>10</td>
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<tr>
<td>36</td>
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D. Computations for velocity of flows shall be based upon the following values of “N” as used in the Kutter or Manning formula for velocity of flow.

1. Sizes 8 inch through 21 inch: N equals 0.013
2. Sizes 24 inch and above: N equals 0.012

E. In cases where the calculated depth of flow is less than pipe flowing full, the velocity at actual depth of flow shall be computed.

F. For sewage flow depth less than 1/4 full, an allowance shall be made for increased value of “N” and in no case shall velocities of less than 2.0 feet per second be permitted for non-settled sewage. The improved velocities shall be accomplished by steeper grades and not by changing pipe diameter.

G. Generally the sizes of pipe shall be continually increasing with increase of tributary areas. However, when steep grades are available and length is such that a significant cost savings will result without jeopardizing the system, the size of pipe may be
reduced a maximum of two (2) normal diameters, but not below twelve (12) inches. Proper hydraulic allowances must be made for resulting head losses.

H. Miscellaneous head losses at manholes and curves shall be computed as follows. Junctions of more than two (2) pipes will require special consideration.

(1) Manholes where radius in turn is less than 2 pipe diameters:

\[
H_L = 0.50 \frac{V^2 \sqrt{\Delta}}{2g^{90^\circ}}
\]

(2) Manholes were radius of turn is greater than 2 pipe diameters.

\[
H_L = 0.25 \frac{V^2 \sqrt{\Delta}}{2g^{90^\circ}}
\]

Where:

\[g = \text{acceleration due to gravity}\]
\[\Delta = \text{is horizontal deflection angle.}\]
\[H_L = \text{head loss.}\]
\[V = \text{is velocity in influent pipe.}\]

(3) Loss for straight run manhole shall be 0.10 feet. In no case shall loss less than 0.10 feet be allowed.

I. Where pipe diameters increase at manholes, in direction of flow, effluent invert shall be lowered below influent invert, a distance of:

\[0.8 (D_1 - D_2):\]

\[D_1 \text{ equals downstream diameter}\]
\[D_2 \text{ equals upstream diameter}\]
This adjustment shall be in addition to computed miscellaneous head loss.

J. Special consideration shall be given to cases where pipe diameters decrease in direction of flow.

2.2.05 Structural Design

A. Structural requirements must be considered for the design of all sewers and appurtenances.

B. The proper strengths shall be determined and indicated for sewer pipe materials being specified. Strength shall be based upon pipe size, proposed depth, width of trench, bedding conditions, existing ground conditions, etc. This is a matter of detail design not subject to simple generalizations. Submittal of design calculations may be required on a case by case basis.

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

D. No change in pipe strength or material shall be made between manholes. Proper precautions shall be taken regarding correct location(s) of varying strength of pipe.

E. The thickness of pre-cast concrete manhole walls shall be increased when total depth of manhole exceeds thirty (30) feet. The minimum manhole diameter shall be increased to 60” when the total depth exceeds 24 feet.

F. Gravity systems receiving pumped flows shall be protected against sulfide attack for a distance of 1200 feet downstream and 600 feet upstream from point of pumped flow entry.

This shall be accomplished by the use of acid-resistant pipe and manholes. The County shall approve the materials and design for the conditions at each individual location.

G. Ductile iron pipe shall be used for all road, stream, or estuary crossings.

H. Anchor sewers on slopes of 20% or greater. Anchor spacing shall not exceed: 36' for slopes of 20% to 35%, 24' for slopes of 35% to 50% and 16’ for slopes greater than 50%.

I. Steel casing pipe shall be sized in accordance with Paragraph 3.2.01S.

J. Where velocities greater than 15 feet per second are anticipated, provisions shall be made to protect against internal erosion of the sewer.
2.2.06 Sewer Appurtenances

A. Standard and drop manholes, service connections and other appurtenances shall be constructed in accordance with Standard Drawings.

B. Manholes shall be installed at the end of each line, at all grade, size or alignment changes, and at all sewer line intersections.

C. Sewer connections serving more than one building shall be made by construction of a manhole on the County sewer and an 8" sewer line terminating in another manhole at the uppermost building connection. Such construction shall be in accordance with County Standards.

D. Manholes shall be spaced at distances no greater than 400 feet for sewer sizes up to 15 inches and 500 feet for sewer sizes 16 inch through 30 inch.

E. Sewer lines shall be protected from a 100 year flood by either raising manhole tops above flood plain or by the use of watertight frames and covers. Where watertight frames and covers are used; unventilated length of sewer cannot exceed 1000 feet. Manhole covers shall be no more than 30 inches above ground level.

F. Vandal proof manhole frames and covers shall be used on all manholes not in paved streets unless watertight covers are required.

G. All new food preparation facilities, such as restaurants and bakeries, shall be required to construct an outside grease trap for the retention of grease, fats, and oils generated by that business. The design of the grease trap shall be approved by the Director. The grease trap shall be operated and maintained properly by the discharger.

H. A monitoring manhole shall be required on all new construction or renovations or modifications to existing facilities, where the discharge originating in the new, renovated, or modified facility is, or will have the potential to be non-domestic in nature.

I. Where possible in unpaved areas, manhole castings shall be approximately 12 inches above final grade.

J. Sewer laterals for non-residential connections shall be a minimum of 6-inches. Sewer laterals for residential connections shall be a minimum of 4-inches. Connections shall be made at an angle of 90° to the main.
K. Where a sewer enters a manhole at an elevation greater than 24 inches above the exit invert, a drop manhole is required.

L. No manhole shall be constructed within 10 feet of an existing waterline.

2.2.07 Depth of Sewers

A. Generally, all sewers shall be of sufficient depth to provide service to lowest sewer elevation of structure in question, allowing proper service connection grade. However, a greater depth may be required due to future extension or possible future lowering of existing road grade or utilities, minimum depth of cover over sewers shall be 5.5 feet in rights-of-way and 3.5 feet in easements.

B. Sewer service connections shall be per Standard Details and shall have clean-outs at the discretion of the Director or in conformance with the State Plumbing Code.

C. Exceptions to the above requirements will be considered only if impractical to provide required depths, in which case, special approval must be secured, in writing, from the County. In the special case of less than minimal cover, ductile iron pipe of adequate thickness shall be provided.

D. Sewers over 15 feet deep shall be of ductile iron.

E. Sewers over 24 feet deep shall be polyethylene-lined ductile iron with a minimum film thickness of 40 mils.

F. Sewers crossing streams shall have one foot of cover and be concrete encased 1 foot if stream bed is in rock and three feet of cover if stream bed is other material.

G. No aerial gravity sanitary sewers will be permitted unless approved by the Public Utilities Director.

2.3. Drawings

2.3.01 In addition to requirements in Section 1.2. “Drawing Organization and Format” of these Standards, drawings shall also have:

A. Stationing, pipe size, material, coordinates, direction of flow, grade and distance between center lines of manholes.

B. All manholes numbered, with drop manholes identified and top, influent and effluent elevations clearly shown.

C. The plans shall indicate the following information to provide for service to elevation of the connection as follows:

(1) Lowest sewer structure elevation.
(2) Low ground corner of structure with first floor service only.

(3) Ground level at building line on unoccupied parcel.

(4) The elevation and location of any existing structure to be sewered shall be clearly shown.

D. Existing, and if applicable, proposed water mains shall be shown and profiles shall indicate points where crossings occur, clearly indicating vertical clearance between utilities.

E. Consultants shall show the location of erosion control devices on the plans. These devices shall be in conformance with the Virginia County Erosion and Sediment Control Handbook (Green Book). Consultants shall include approved erosion control details from the County.

F. Any other pertinent details.

(1) Consultants designing facilities for developers shall show the General Utility Construction Notes on the drawings (see Section 6, Forms F-1(A), F-1(B) and F-1(C)).
SECTION 3
3.1. General Requirements

3.1.01 The design of sewage pumping stations and force mains is an engineering matter and is not subject to detailed recommendations or requirements.

3.1.02 Sewage pumping stations and force mains are to be provided solely for the conveyance of sanitary wastes. Under no circumstances shall any roof, foundation, surface or sub-surface or any other form of storm drainage be allowed to pass through the proposed facilities.

3.1.03 A detailed Preliminary Engineering Report shall be submitted to and approved by the County prior to design. The report shall fully evaluate the proposed sanitary drainage area and the overall effect upon present and future County facilities.

3.1.04 The design must conform to the minimum standards set forth in the Commonwealth of Virginia “Sewage Collection and Treatment Regulations”. County requirements for specific equipment and submittals will be detailed during engineering review.

3.2 Technical Design

3.2.01 System Layout

A. The sizing and configuration of the pumping station and the sizing of the attendant force main shall be within the parameters set forth in the engineering report. The facilities to be provided shall be based on ultimate flows unless an interim flow design shall have been incorporated in the approved engineering report.

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

C. Pumping equipment shall be in general conform to the following types:

<table>
<thead>
<tr>
<th>Pump Type</th>
<th>Flow Range</th>
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<tbody>
<tr>
<td>Grinder Pumps</td>
<td>Up to 30 gpm</td>
</tr>
<tr>
<td>Wet pit or submersible</td>
<td>30 to 250 gpm</td>
</tr>
<tr>
<td>Dry pit or suction lift</td>
<td>250 gpm and over</td>
</tr>
</tbody>
</table>
D. An ample, all-weather road, including surface treatment, storm drainage and parking, shall be provided for easy access to the pumping station.

E. The architecture of the pumping station shall be considered. Site grading, seeding or sodding, trees or shrubs shall be provided to present a finished appearance, as approved by the County, consistent with the zoning and general appearances of the surrounding area. Approved fencing with gates shall be provided as deemed necessary to properly protect the facility.

F. The Design Engineer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The engineer shall also determine the need for primary service extension and advise the County if an extension is necessary.

G. The Design Engineer shall determine the "Reliability Class" in accordance with the State "Sewage Collection and Treatment Regulations" and shall comply with the requirements thereof. Each pumping station serving multiple connections shall have a permanently installed emergency generator.

H. The Design Engineer shall consider the need for protection of the pumping station and force main against hydrogen sulfide attack and shall provide the proper equipment if such protection is found necessary.

I. All motors, motor control and other electrical equipment shall be housed in a weatherproof, above-ground structure. Adequate provisions shall be incorporated for the proper ventilation, drainage and flood protection in order to insure maximum reliability, electrical and personnel safety. All motors shall be non-overloading at all points on the pump operating curve.

J. All pumping station wet wells shall be considered explosion hazardous. All electrical equipment installed therein shall be approved for Nema 7, Class I, Group D. In accordance with Article 500 of the National Electric Code (NFPA No. 70). The use of intrinsically safe controls in accordance with NFPA No. 493 is satisfactory and their use is encouraged.

K. Where structurally separate wet well and dry wells are provided, adequate provision for differential settlement shall be incorporated by means of flexible pipe joints consisting of a minimum of at least two standardized mechanical joint bell connections or their approved equivalent.

L. All pumping stations shall be of sufficient size and contain adequate clearances to provide ample room for maintenance and equipment replacement.
M. Consideration shall be given to the need for a water supply well in locations where a public water supply is not available.

N. Force main locations shall generally conform to Section 2.2.01 - "System Layout" of these Standards. Force mains shall have a positive slope from the pumping station to the point of discharge unless unusual conditions make it impractical. Extra depth of bury shall be provided in lieu of air or air/vacuum relief valves wherever feasible. Every effort shall be expended to maintain the force main below the hydraulic gradient. Where a relief valve is required, an automatic valve shall be provided and installed inside a standard manhole with adequate means of drainage.

O. Every effort shall be made to maintain a full force main under operating conditions.

P. Sizing of main shall be such that velocity shall not be below 2 ft/sec flushing velocity.

Q. All force mains shall be ductile iron, polyvinylchloride (PVC) or high density Polyethylene (HDPE).

R. Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.

S. Steel casing pipe shall have a minimum yield strength of 35,000 p.s.i. and a minimum internal diameter of 4 inches greater the largest external diameter of the carrier pipe. The wall thickness of casing pipe shall be sufficient to resist loads to which it will be subjected, but in no case less than that shown in drawing No. 100 of Volume II.

T. Piping buried underground shall have a detectable tracer wire secured to the pipe and detectable warming tape buried in the trench approximately 18 inches above the conduit, but no less than 24 inches below grade.

3.2.02 Capacity Design

A. Capacity design for the pumping station and force main shall be based on Section 2.2.02 - "System Design” of these Standards, and shall take into consideration such parameters as minimum, average and peak station inflows as well as minimum, average and maximum pumping rates.

B. Pump selection and force main sizing shall be based on a hydraulic analysis of the required flows, pipeline velocities and receiving gravity sewer capacities.
C. Calculations shall be prepared and a system friction chart prepared that will show static head and total dynamic head for both single and multiple pump operation. The chart shall also show the pump performance curve for both single and multiple pump operation. Where variable speed pumping is contemplated, pump performance curves shall show performance at maximum speed, minimum speed just above static head and several intermediate speeds that will clearly indicate pump operation. The system friction curves shall illustrate the effect of wet well level on system friction. Particular attention shall be given to the available versus required net positive suction head (NPSH).

D. Consideration must be given to designs which produce minimum power requirements to accomplish the functions required. If requested supporting data shall be furnished to the County.

3.2.03 Structural Design

A. In addition to conventional design procedures there are several specific areas that must be considered.

   (1) The effect of hydraulic thrust must be countered by the use of thrust restraints, pipe anchorage or other suitable means to prevent movement of pumping equipment and pipelines.

   (2) Structural requirements for force mains include the proper selection of materials and strengths of pipe and pipe accessories. This will involve a study of anticipated trench conditions and bedding methods. The minimum depth of cover shall be governed by depths of other utilities and hydraulic gradient; however, not less than 3.5 feet of cover shall be provided.

3.2.04 Drawings

A. Drawings for pumping stations and plan and profiles for force mains shall be prepared in accordance with Section 1.2. – “Drawing Organization and Format”.

B. Drawings and specifications shall be of such quality and contain sufficient details so that no misunderstanding may reasonably arise as to the extent of the work to be performed, the materials to be used, the equipment to be installed or the quality of the workmanship. Manufacturers of major items of equipment shall be specifically approved. No deviation from the approved manufacturers will be permitted.

C. Drawings for pumping stations shall include a site plan drawn to a scale of not less than 1 inch equals 20 feet and shall contain existing and proposed contours on a no greater than 2 foot contour interval. The boundaries of the site shall be clearly shown on the site plan and shall be permanently marked in the field prior to completion of construction.
D. Drawings for pumping stations shall be drawn on a scale of not less than 1/4" equals 1'-0". Drawings required to clarify construction details shall be drawn on an appropriately larger scale.

E. Drawings for force mains shall show stationing, pipe size, bedding, direction of flow, coordinates and curve data.

F. Profiles for force mains shall show the ground line, force main profile, underground utility lines and structures that might affect force main depth. It shall also show areas where additional depth will be required, any required vertical curve data and locations of all relief valves and appurtenances. All crossings of existing and proposed water mains shall be shown to clearly indicate vertical clearance between utilities.

G. Details shall be shown for all pipe restraints and for relief valves.

H. Consultants shall show the location of erosion control devices on the plans. These devices shall be in conformance with the Virginia Erosion and Sediment Control Handbook.
SECTION 4
SECTION 4 - DESIGN STANDARDS FOR WATER DISTRIBUTION FACILITIES

4.1 General Requirements

4.1.01 Water and fire protection distribution facilities are to be provided solely for the purpose of supplying potable water and fire protection. Under no circumstances shall cross-connections be allowed to unapproved water facilities. The following design parameters should be used in the design of water distribution facilities. Water transmission facility design parameters are not included herein and such criteria will be established on a case by case basis.

4.1.02 Prior to submitting plans for new water distribution facilities or extensions to existing facilities the designer shall coordinate with the County and determine the available flow and pressure from the existing system. Water modeling shall be provided as requested by the County.

4.2 Technical Design

4.2.01 System Layout

A. The overall layout and general design shall conform to the parameters set forth in the approved Preliminary Engineering Report.

B. Generally, all water mains shall be located, where practical, in:

1. Legally established road rights-of-way.

2. Legally established permanent easements for such purpose and immediately adjacent to legally established road rights-of-way or paved areas, either existing or as proposed by the designer in accordance with Section 1.3. - "Easement Requirements" of these Standards.

3. Paved areas.

C. Construction shall generally be parallel to the center line of roads or easements. The same offset shall be used throughout except when existing utilities dictate a change in offset along the proposed line.

D. Water mains shall be installed a minimum of 15 feet from any part of any structure.

E. In general, main line valves are required at intervals of 1000 feet and at tees and crosses to allow adequate control of the system without major system shutdowns.

4.2.02 System Design

A. The proposed facilities together with the pertinent existing facilities shall be evaluated based on the hydraulic design, demand design and fire protection design requirements contained herein.
B. The Design Engineer shall submit to the County a neat and orderly set of design calculations to illustrate normal and fire flows, pipe size selection and fire protection requirements.

C. Non-ferrous mains shall have a detectable tracer buried in the trench 18 inches above the main but no less than 24 inches below grade.

D. Dead end lines shall be minimized by looping mains. Where looping is required the minimum size pipe shall be 8 inches. All dead end lines shall terminate at a fire hydrant.

E. No flushing device shall be directly connected to a sewer.

4.2.03 Hydraulic Design

A. Hydraulic design shall be accomplished by use of WaterCad or similar method acceptable to the County. A Hazen-Williams coefficient of friction equal to 120 shall be used for purposes of design unless the County has data to indicate a lesser coefficient should be used for existing lines.

4.2.04 Demand Design

A. Maximum rates of water consumption shall be calculated and used as a basis of hydraulic design. Average daily water consumption rate values for the number and type of consumers anticipated to be served shall be based on those contained in the State of Virginia "Waterworks Regulations". Any such rates not given or any deviations from tabulated rates shall be estimated and justified by the Design Engineer and approved by the County. The average annual daily water consumption rates shall be adjusted by a multiplier to arrive at the maximum daily water consumption rate by the application of a multiplier, expressed as follows:

\[ Q_m = Q_a \times C \]

- \( Q_m \) is peak daily water consumption rate.
- \( Q_a \) is average annual daily water consumption rate.
- \( C \) is constant varying from 1.5 to 1.75
- \( Q_m \) shall be used as the basis for hydraulic design.
4.2.05  Fire Protection

A. Rates of flow for fire protection shall be estimated as follows:

<table>
<thead>
<tr>
<th>USE</th>
<th>FLOW GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>750</td>
</tr>
<tr>
<td>Multifamily</td>
<td>1,000</td>
</tr>
<tr>
<td>Commercial / Industrial</td>
<td>2,500</td>
</tr>
</tbody>
</table>

or as approved by the Public Utilities Director.

B. The minimum fire flow from any individual fire hydrant shall be 500 gpm. The minimum flowing pressure at maximum flow shall be 20 p.s.i.

C. During maximum rated fire flow conditions, the residual pressure in the system shall not be less than 30 p.s.i., as based on the maximum day or peak hourly flow (whichever is greater) and fire flow (if provided).

D. The minimum size water line used for fire protection to properties zoned agricultural or single family residential shall be 8 inches in size. The minimum size water line used for fire protection to properties zoned multi-family residential, commercial or industrial shall be 12 inches in size.

E. The minimum sized fire service lines above shall be looped to provide feed from at least two directions. The sizing of minimum-sized fire services lines and larger than minimum fire service lines shall be determined by Sections 4.2.03 and 4.2.05 - "Hydraulic Design" and "Fire Protection". Not more than one fire hydrant shall be installed on a 8" dead end line.

F. Dead end lines shall not contain more than 600 feet of the minimum sized line. Additional lengths required shall be provided by increasing the line size.

G. Fire hydrants shall be located no further than 10 feet from edge of roadway shoulder.

H. Fire hydrants shall be placed on legal rights-of-way and shall generally be placed in line with street intersections. This shall be deemed to be the P.T. of the returns on the rights-of-way. Where long block lengths require the use of intermediate fire hydrants, they shall be placed in line with the property boundary between adjacent lots or parcels of land.

I. Fire hydrant spacing for properties zoned agricultural or single family residential shall not exceed 1000 feet or require a hose lay of over 650 feet from the hydrant to any part of any structure to be protected.
J. Fire hydrant spacing for properties zoned multi-family residential, commercial or industrial shall not exceed 500 feet or require a hose lay of over 350 feet from the hydrant to any part of any structure to be protected. Where multiple fire hydrants are needed to supply the required fire flow, all necessary hydrants must be located within the specified hose lay.

K. No fire hydrant shall be placed closer than 50 feet from the face or overhang of any building to be protected.

L. The above criteria for spacing fire hydrants may be modified by the County to improve fire hydrant accessibility for fire fighting purposes.

M. Structures protected by automatic sprinkler systems require installation of a detector check, dedicated fire hydrant, and a Siamese connection. The detector hydrant is not credited toward external protection requirements. Siamese connections must be located within 50 feet of the dedicated hydrant.

4.2.06 Structural Design

A. Structural requirements must be considered in the design of all water mains and appurtenances.

B. The proper strengths shall be specified for the pipe material being specified. Strength shall be based on operating pressures, depth of bury, trench width and foundation conditions. This is an engineering matter and not subject to generalization.

C. Proper joint restraints must be provided and shown on the drawings. Restrained joints shall be used. No concrete blocking will be permitted.

D. Proper support shall be provided for aerial or suspended lines.

E. In general, aerial crossings will not be permitted unless approved by the Public Utilities Director. If permitted, any potable waterline crossing above surface water must be:

   (1) Adequately supported.

   (2) Protected from freeze damage.

   (3) Accessible for repair or replacement.

   (4) Above the 100-year flood plain elevation.
F. Any potable waterline crossing under surface water must meet the following requirements:

(1) The pipe shall be of special construction having flexible watertight joints.

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

(3) Permanent sample taps shall be available at each end of the crossing and at a reasonable distance from each side of the crossing) for the purpose of testing and locating leaks in the section of line crossing the surface water. Temporary taps for pressure and disinfection testing shall be permanently plugged.

4.2.07 Miscellaneous Considerations

A. The minimum size water line pipe to be used for normal domestic water shall be 8 inches and be capable of supplying 3 gpm per residential connection at 30 p.s.i. except where fire protection lines are to be provided.

B. Air, air/vacuum or pressure reducing valves, blow-off tees and related fittings shall be provided. The type, size, etc., shall be specified by the Design Engineer, subject to approval by the County.

C. The minimum depth of cover for water mains shall be 3-1/2 feet. Additional depth shall be provided where required for thrust restraint or to clear underground obstructions.

D. The profile of water services at ditch lines shall be shown on plans and have a minimum of 24" cover at the ditch invert.

E. Service lines larger than 3/4 inch, with meters larger than 5/8 inch shall be sized in accordance with AWWA Manual M-22 "Sizing Water Service Lines and Meters" except as follows:

(1) Use constant pressure factor of 1.

(2) Include all outside hose bibs in combined fixture value total.

(3) Irrigation System shall be excluded from domestic meter sizing criteria except as follows:

a. Exclusion meters shall be at least one (1) size smaller than the domestic meter.
b. If metered separately, the irrigation meter shall be sized based on demand criteria furnished by the Engineer.

(4) The meter will be sized as follows:

<table>
<thead>
<tr>
<th>METER SIZE</th>
<th>COMBINED FIXTURE VALUE TOTAL</th>
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<tbody>
<tr>
<td>5/8</td>
<td>0 - 40</td>
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<tr>
<td>1</td>
<td>41 – 100</td>
</tr>
<tr>
<td>1 ½</td>
<td>101 – 650</td>
</tr>
<tr>
<td>2</td>
<td>651 – 3,500</td>
</tr>
</tbody>
</table>

(5) Meters 3 inches and greater shall be sized by a professional engineer. Meter size shall be in accordance with the requirements of AWWA Manual No. M-22 utility fixture counts in the Meter Sizing Form in Section 6, Form F-5. If utilizing AWWA Manual No. M-22 gives a meter size smaller than 3 inches, the meter size shall be 3 inches.

(6) Plumbing Fixtures Values shall be shown in AWWA Manual No. M-22 for 35 PSI.

(7) Meter installations requiring a flow of greater than 160 gpm or greater than the total fixture values indicated above shall be reviewed and/or approved on a case by case basis in accordance with AWWA Manual No. M-22.

(8) Steel casing pipe shall be sized in accordance with Paragraph 3.2.01S.

(9) A 5/8” meter may be used for non-residential facilities with tank type water closets and a combined fixture value total of 0-40. A 1” meter will be the minimum size used for any facility with flush valve fixtures.

(10) Fire flow is not to be routed through the meter.

(11) A separate meter shall be provided for irrigation.

F. Where water lines are subject to extreme variations in temperature (i.e., attached to bridges or box culverts) consideration shall be given to expansion and contraction of pipe materials and the freezing of the line contents.

G. Cathodic Protection - Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.

4.3. Drawings

4.3.01 In addition to the requirements of Section 1.2. – “Drawings Organization and Format" of these Standards, the drawings shall incorporate the following features:
A. Drawings for water lines shall show stationing, pipe size, bearings, deflection angles and curve data.

B. The drawings shall also show all fire hydrant and water service connections. Fire hydrants and water services over 3/4 inch in size shall be shown in plan and profile views which are labeled by stations.

C. Profiles shall be provided for all water lines excluding service connections. Profiles shall also show all air, air/vacuum relief valves and fire hydrant locations.

D. Water lines shall be referenced by distances from right-of-way lines, buildings and other utilities.

E. The drawings shall show restraint details and stationing.

F. All drawings for water mains crossing sewers, force mains or other utilities, shall show points where crossings occur. Crossings shall be shown in both Plan and Profile. The Profile shall clearly indicate vertical clearance between utilities.

G. Meter sizing form (Section 6, Form F-5) and backflow prevention details shall be shown on the plans.

H. All fittings to include valves, bends, tees, etc. shall be shown on the plan and profile.

I. Fire hydrants shall be used for blow-offs.
SECTION 5
SECTION 5 - DESIGN STANDARDS FOR WATER PUMPING STATIONS AND WELLS

5.1. General Requirements

5.1.01 The design of water pumping stations and wells is an engineering matter and is not subject to detailed recommendations or requirements.

5.1.02 A detailed engineering report shall be submitted to and approved by the County prior to design. The report shall fully evaluate the proposed service area and the overall effect upon present and future County facilities.

5.1.03 The design must conform to the minimum standards set forth in the Commonwealth of Virginia, VDH Waterworks Regulations and the requirements of the DEQ (for wells). Also, adhere to Caroline County requirements for specific equipment submittals to be produced for engineering review.

5.2. Technical Design

5.2.01 System Layout

A. The sizing and configuration of the pumping station and the sizing of the attendant water lines shall be within the parameters set forth in the engineering report. The facilities to be provided shall be based on ultimate flows unless an interim flow design shall have been incorporated in the approved engineering report.

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

C. An ample, all-weather road, including surface treatment, storm drainage and parking, shall be provided for easy access to the pumping station.

D. The architecture of the structure shall be considered. Site grading, seeding or sodding, trees or shrubs shall be provided to present a finished appearance, as approved by the County, consistent with the zoning and general appearances of the surrounding area. Approved fencing with gates with locking mechanisms and keys shall be provided as deemed necessary by the Department of Public Utilities to properly protect the facility.

E. The Design Engineer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The engineer shall also determine the need for primary service extension and advise the County if an extension is necessary.
F. An emergency generator will be required for all facilities except for those serving only one (1) single family dwelling unit.

G. Adequate provisions shall be incorporated for the proper ventilation, drainage and flood protection in order to insure maximum reliability, electrical and personnel safety.

H. All water pumping stations and well buildings shall be of sufficient size and contain adequate clearances to provide ample room for maintenance and equipment replacement.

5.2.02 Capacity Design

A. Hydraulic design for water pumping stations shall be based on Sections 4.2.04, 4.2.04, 4.2.05 – “System Design” of these Standards, and shall take into consideration such parameters average and maximum pumping rates, and fire flow.

B. Pump selection shall be based on a hydraulic analysis of the required flows.

C. The hydraulic analysis shall show static head and total dynamic head for both single and multiple pump operation. It shall also show the pump performance curve for both single and multiple pump operation. Where variable speed pumping is contemplated, pump performance curves shall show performance at maximum speed, minimum speed just above static head and several intermediate speeds that will clearly indicate pump operation.

D. Consideration must be given to designs which produce minimum power requirements to accomplish the functions required. If requested supporting data shall be furnished to the County.

E. All motors shall be non-overloading at all points on the pump operating curve.

5.2.03 Drawings

A. Drawings for pumping stations and plan and profiles for force mains shall be prepared in accordance with Section 1.2. - "Drawing Organization and Format".

B. Drawings and specifications shall be of such quality and contain sufficient details so that no misunderstanding may reasonably arise as to the extent of the work to be performed, the materials to be used, the equipment to be installed or the quality of the workmanship. Manufacturers of major items of equipment shall be specifically approved. No deviation from the approved manufacturers will be permitted.

C. Drawings for water pumping stations and wells shall include a site plan drawn to a scale of not less than 1 inch equals 20 feet and shall contain existing and proposed contours on no greater than a 2' contour interval. The boundaries of the site shall be clearly shown on the site plan and shall be permanently marked in the field prior to completion of construction.
D. Drawings for pumping stations shall be drawn on a scale of not less than 1/4" equals 1'-0". Drawings required to clarify construction details shall be drawn on an appropriately larger scale.

E. Consultants shall show the location of erosion control devices on the plans. These devices shall be in conformance with the Virginia Erosion and Sediment Control Handbook.
SECTION 6

STANDARD FORMS AND NOTES
**INDEX TO FORMS**

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<th>TITLE</th>
<th>FORM NO.</th>
</tr>
</thead>
<tbody>
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<td>Erosion Control Notes</td>
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<tr>
<td>Review Checklist Sheet for Water and Sewer Plans</td>
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<tr>
<td>Review Sheet for Sewage Pumping Station</td>
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<td>Meter Sizing Form</td>
<td>F-5</td>
</tr>
<tr>
<td>Easement Plat Example</td>
<td>F-6</td>
</tr>
</tbody>
</table>
CAROLINE COUNTY PUBLIC UTILITIES
GENERAL UTILITY CONSTRUCTION NOTES

1. All water and sewer construction and materials shall be in accordance with the latest edition of the Caroline County “Standard Specifications and Details for Construction of Water and Sewer Lines” and related work, the Commonwealth of Virginia Waterworks Regulations and the Sewage Collection and Treatment Regulations.

2. The Contractor shall contact the Caroline County Public Utilities Department to schedule a preconstruction conference at least 48 hours prior to beginning any construction activity on water and or sewer improvements. All work shall be subject to inspection by County inspectors.

3. The Contractor shall include in applicable bid price, the cost of locating and uncovering all sewer manholes and all valve boxes after completion of all paving and adjust them to the final road grades.

4. The Contractor is responsible for obtaining all required permits for the work.

5. The location of existing utilities across or along the line of the proposed work is not necessarily shown on the plans and where shown is only approximately correct. The Contractor shall, on his own initiative and at no extra cost, locate all underground lines and structures as necessary and shall pot hole existing underground lines as directed by the Department of Public Utilities. The Contractor shall be responsible for any damage to underground structures.

6. The Contractor shall call “Miss-Utility” at 811 or 1-800-552-7001 prior to the start of work.

7. Water and sewer connections shall not be backfilled prior to approval by Caroline County Department of Public Utilities.

8. All water lines shall have a minimum cover of 3.5 feet.

9. Datum for all elevations shown in NAVD 88.

10. Restrained joint pipe shall be utilized at all water stub-outs and dead ends for a minimum of 60 feet or back to the far side of the nearest valve, tee, or cross, whichever is shorter, unless another distance is specifically called out on the plans.

11. It is the intent of these drawings to show all necessary work. Any item of work not specifically shown, but necessary to eligibility for acceptance, is hereby implied.

12. No more that 100 feet of trench may be open at one time. Backfilling of trenches shall be compacted when backfilling.
13. No trenches shall be left open overnight.

14. Contractor shall install a construction entrance wherever construction vehicles enter or exit undeveloped areas.

15. Contractor shall conform to the guidelines as presented in the Virginia Erosion and Sediment Control Handbook, as pertinent to his work.

16. The Contractor shall verify the location of all underground utilities and their actual material type. Caroline County Public Utility Department uses the available records and does not guarantee the location and or utility material type.

17. Install metallic marking and tracer wire at all trenches containing buried, gravity and pressure pipelines.

18. The Contractor shall notify Caroline County Public Utilities Department in writing 72 hours before connecting to existing utility lines. All water line connections shall follow the Caroline County Public Utilities guidelines for flushing and testing of water lines prior to making any connections.

19. Engineer shall certify that unpaved streets are to sub-grade prior to Contractor installing water & sewer lines. Curb and gutter, if required, shall be installed prior to acceptance of water & sewer lines.

20. The Contractor shall maintain current utility services when working on existing water lines, in circumstances were this is not possible the connection shall be made at night or during the lowest demand period established by the Caroline County Public Utilities Department.

21. The Contractor is responsible for all site safety and the ways, means and methods of construction.

22. No structures or planting of trees shall be permitted in utility easements.

23. Service saddles must be used on all water connections.

24. Fire hydrants shall be installed in accordance with standard drawing 107.

25. Vandal proof covers shall be used on all manholes in easements. Watertight covers shall be used in flood plains. The manhole covers shall be in accordance with the standard drawings.

26. Four sets of prints and one set of electronic Auto Cadd .dwg file of the as-built drawings must be submitted to the Department of Public Utilities prior to tentative acceptance of the work by the County.
27. Final acceptance of work by Caroline County Department of Public Utilities shall not be made until all work shown on the approved plans and in accordance with the Caroline County standards are completed.

28. A permit from the Virginia Department of Transportation (VDOT) is required for all work within a public road right-of-way.

29. A wetlands permit may be required from the U.S. Army Corps of Engineers for this development. For information concerning such a requirement, contact the Corps at (804) 462-5382

30. Contractor shall be informed and comply with the Virginia Overhead High Voltage Line Safety Act. All costs to cover lines, flaglines, or disconnect service shall be at the contractors expense.

31. Contractor shall comply with no lead regulations for water infrastructure.

32. Based on graphical determination, the property described herein lies within flood zone “______”, areas outside of the 0.2% annual chance flood plain, as determined by the United States Federal Emergency Management Agency and as shown in the Flood Insurance Rate Map (FIRM) Community ________, Panel Number ________ with an effective date of ________.
EROSION CONTROL NOTES

GENERAL EROSION AND SEDIMENT CONTROL NOTES

1. Unless otherwise indicated, all vegetative and structural erosion and sediment control practices will be constructed and maintained according to minimum standards and specifications of the Virginia Erosion and Sediment Control Handbook and Virginia Regulations Erosion and Sediment Control Regulations.

2. The plan approving authority must be notified one week prior to the preconstruction conference, one week prior to the commencement of land disturbing activity, and one week prior to the final inspection.

3. All erosion and sediment control measures are to be placed prior to or as the first step in clearing.

4. A copy of the approved erosion and sediment control plan shall be maintained on the site at all times.

5. Prior to commencing land disturbing activities in areas other than indicated on these plans (including, but not limited to, off-site borrow or waste areas), the contractor shall submit a supplementary erosion control plan to the owner for review and approval by the plan approving authority.

6. The Contractor is responsible for installation of any additional erosion control measures necessary to prevent erosion and sedimentation as determined by the plan approving authority.

7. All disturbed areas are to drain to approved sediment control measures at all times during land disturbing activities and during site development until final stabilization is achieved.

8. During dewatering operations, water will be pumped into an approved filtering device.

9. The contractor shall inspect all erosion control measures periodically and after each runoff-producing rainfall event. Any necessary repairs or cleanup to maintain the effectiveness of the erosion control devices shall be made immediately.

10. No disturbed area will be denuded for more than 30 calendar days.

11. All storm and sanitary sewer lines not in streets are to be mulched and seeded within fifteen days after backfill. No more than one hundred feet are to be open at one time.
12. Electric power, telephone, and gas supply trenches are to be compacted, seeded and mulched within fifteen days after backfill.

13. All temporary earth berms, diversions, and silt dams are to be mulched and seeded for vegetative cover within ten days after grading. Straw or hay mulch is required. The same applies to all soil stockpiles.

14. During construction, all storm sewer inlets will be protected by silt traps, maintained and modified as required by construction progress.

15. Any disturbed area not paved, sodded, or built upon by November 1st, is to be seeded on that date with oats, abruzzi, rye, or equivalent and mulched with hay or straw mulch. Modify as applicable depending on proposed time of construction.

16. Silt fence is to be provided between any disturbed area and adjacent waterbody.
Caroline County
REVIEW CHECKLIST FOR WATER AND SEWER PLANS

Project Title

Existing utilities to be extended to service this project are shown on Sheet No. __ or Approved Utility Plan No. __.

__1. Virginia registered engineer’s stamp & signature.

__2. Plan and profile sheets are on 24" x 36" paper.

__3. Project vicinity map.

__4. Owner/Developer name and address shown on plans.

__5. Fire Flow computations shown on plans (where applicable).

__6. Domestic water meter calculations shown on plans in accord with AWWA Manual M-22 (where applicable).

__7. Water System designed to provide adequate domestic service and fire protection to owner's property. ___” diameter line required to adequately serve this project in accord with County standards.

__8. Sanitary Sewer Service area map submitted with plans. (Calculations shown thereon) ___” diameter line required to adequately serve this project in accord with the County standards.

__9. Overall water, and sanitary sewer plan submitted for phased projects. Fire hydrants and valve locations shown on water overall plan.

__10. Coordinates and inside diameter shown on all manholes.

__11. Standard water and sewer notes shown on plans.

__12. Benchmarks shown on every 500 feet.

__13. Direction of flow arrows shown on sanitary sewer.

__14. All underground utility conflicts profiled and resolved.

F-3(A)
15. This project has been designed in accord with the latest County Standard and State Regulations (whichever is more restrictive).

16. All proposed water and sewer lines connect to existing facilities which have been previously accepted by the County for operations and maintenance.

17. All off-site easements necessary for the completion of this project have been acquired, recorded and their Deed Book and Page references are shown on the plans.

18. A list of the pipe sizes, materials and appurtenances to be used & the following material notes shown on plans:

<table>
<thead>
<tr>
<th>Sanitary Sewer</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC plastic shall be ASTM D-3034 PSM SDR 35 min.</td>
<td>PVC plastic pipe shall be AWWA C-900 Table 2 Class 150 (min.)</td>
</tr>
<tr>
<td>Ductile Iron pipe shall be ANSI/AWWA C151 Class 52 for 12&quot; and smaller and Class 51 for 16&quot; and larger</td>
<td></td>
</tr>
</tbody>
</table>


I hereby certify that I have complied with the above and do herewith submit these plans for approval.

______________________________________  ______________________________________
P.E.                                      Certificate Number
Signature                                  Date

______________________________________  _____________________________
Name Typed or Printed                          Date
CAROLINE COUNTY
REVIEW SHEET FOR SEWAGE
PUMPING STATION

SUBJECT: __________________
SEWERAGE: __________________
PROJECT NO.: _________________

DESCRIPTION.: _________________________________________
REVIEWED BY: _______________________________
DATE: _______________________________________
CONSULTING ENGINEERS: ______________________________
REFERENCES AND CORRESPONDENCE ___________________

LOCATION OF PROJECT _______________________________

TYPE OF PUMPS PROVIDED ______________________________
NUMBER OF UNITS ______________________________________
PUMP CAPACITY _______________________________________

<table>
<thead>
<tr>
<th>PUMP NO.</th>
<th>SIZE (INCHES)</th>
<th>FRICTION HEAD (FT)</th>
<th>STATIC HEAD (FT)</th>
<th>RATED CAPACITY (GPM)</th>
<th>RATED TDH (FT)</th>
<th>COMPUTED TDH (FT)</th>
<th>OPERATING CAPACITY (GPM)</th>
<th>VARIABLE OR CONSTANT SPEED</th>
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IS CAPACITY OF PUMP STATION ADEQUATE?
CAN PEAK FLOW BE PUMPED WITH LARGEST UNIT OUT OF SERVICE?

CAPACITY OF RECEIVING SEWER LINE ___ MGD ADEQUATE CAPACITY AVAILABLE ______________

CAPACITY OF ULTIMATE TREATMENT MGD _________ AVERAGE FLOW (1 YR) ______________

BAR SCREENS & COMMINUTOR
ARE BAR SCREENS OR COMMINUTOR PROVIDED?
SPACE BETWEEN BARS ___________ INCHES EFFECTIVE AREA _________________________ SQ. IN.
VELOCITY THROUGH BAR SCREEN ________________________________ FT. /SEC.
MECHANICALLY CLEANED? _____________________________________________

COMMINUTOR PROVIDED? __________ SIZE __________ CAPACITY _________________________ GDM.
IS AUTOMATIC BYPASS TO BAR SCREEN PROVIDED?
GENERATOR CAPACITY ____________ KW

REVISIONS
REVIEW SHEET FOR SEWAGE PUMPING STATION
FORM F-4(A)
1 OF 3

F-4(A)
CAROLINE COUNTY

VENTILATION FAN CAPACITY ______________ CFM  TURNOVER TIME ______________________ MIN.

IS POTABLE WATER SUPPLY ADEQUATELY PROTECTED? ________________________ PUMPS

POSITIVE SUCTION HEAD? ___________________  ALTERNATING CONTROL? ___________

TYPE OF CONTROL MECHANISM? ____________________________

SUCTION LINE SIZE ___________ INCHES DISCHARGE LINE SIZE ___________ INCHES

IS PLUG VALVE PROVIDED ON SUCTION LINE? ____________________________

PLUG VALVE AND CHECK VALVE ON DISCHARGE LINE? ________________

SIZE OF SPHERES THAT PASS THROUGH PUMP ____________________________ INCHES

VELOCITY OF DISCHARGE LINE ___________ FPS

VELOCITY OF SUCTION LINE ___________ FPS

WET WELL FILLET SLOPE ___________ VOLUME BETWEEN HWL AND LWL _________ GAL

IS VOLUME SUFFICIENT TO CAUSE ONE PUMP TO RUN CONTINUOUSLY FOR FIVE MINUTES OF EVERY 30 MINUTE PERIOD AT MINIMUM FLOW? ____________________________

VOLUME ABOVE LWL _________ CU. FT.  VENTILATION FAN CAPACITY ___________ CFM

CONTINUOUS OR INTERMITTENT VENTILATION? ____________________________

AIR CHANGES PER HOUR ____________ ADEQUATE ACCESS PROVIDED? ________________

ADEQUATE VENTILATION? ____________________________

DRY WELL PROVISIONS FOR REMOVING EQUIPMENT? ________________

ADEQUATE ACCESS PROVIDED? ________________ SUMP PUMP PROVIDED? ________________

ADEQUATE DISCHARGE POINT FOR SUMP PUMP? ____________________________

VOLUME OF DRY WELL _________ CU. FT.  VENTILATION FAN CAPACITY ___________ CFM

CONTINUOUS OR INTERMITTENT VENTILATION? ____________________________

AIR CHANGES PER HOUR ____________ ADEQUATE PROTECTION OF WATER SUPPLY? ________________

REVISIONS

REVIEW SHEET FOR
SEWAGE PUMPING STATION

FORM
F-4(B)
2 OF 3

F-4(B)
DOES PUMPING STATION HAVE A CAPACITY OF 10% OF ULTIMATE TREATMENT CAPACITY?

IS ADEQUATE FLOW MEASURING DEVICE PROVIDED? ______________________________________ RELIABILITY

ADEQUATE ALTERNATIVE MOTIVE FORCE PROVIDED? _______________________________________

PROVISION FOR CONTINUOUS OPERABILITY PROVIDED? _____________________________ TYPE OF PROVISION

IS ADEQUATE POWER DISTRIBUTION PROVIDED? ______________________________________

BREAKER SETTINGS OR FUSE RATINGADEQUATE? ______________________________________

ELECTRICAL CONTROL CENTERS LOCATIONS ADEQUATE? ________________________________

ARE MOTORS ADEQUATELY PROTECTED? _____________________________________________

EMERGENCY POWER EQUIPMENT ADEQUATELY LOCATED? ______________________________________

DOES ELECTRICAL EQUIPMENT COMPLY WITH NATIONAL BOARD OF FIRE UNDERWRITERS SPECIFICATIONS? ________________________________

ARE THREE PHASE MOTORS ADEQUATELY PROTECTED FROM SHORT CIRCUITS AND OVERLOADS? ________________________________

LOW VOLTAGE PROTECTION FOR LARGE MOTORS? _______________________________________

DO UNDERGROUND CONDUITS HAVE MOISTURE RESISTANT INSULATION? ________________________________

CONCRETE, METAL AND SAFETY DEVICES ADEQUATELY PROTECTED AGAINST CORROSION? ______

ADEQUATE ELECTRICAL EQUIPMENT TESTING PROVISIONS? ________________________________

ADEQUATE EMERGENCY POWER GENERATOR STARTING SYSTEM? ________________________________

ADEQUATE ALARM SYSTEM PROVIDED? _________________________________________________

FORCE MAIN PIPE DIAMETER _______ INCHES DISCHARGE VELOCITY ______________________ FPS

ADEQUATE AIR RELIEF VALVES PROVIDED? _______ ADEQUATE TERMINATION? ______________

PIPE MATERIAL SPECIFIED ______________ JOINT SPECIFICATIONS ________________________________

ADEQUATE LEAKAGE TESTING? _______ ALLOWABLE LEAKAGE _________________________________

GALLONS/HR ADEQUATE? _______ ADEQUATE BEDDING? _____ THRUST BLOCKS PROVIDED? ______
### COUNTY OF CAROLINE
### DEPARTMENT OF PUBLIC UTILITIES
### P.O. BOX 424
### BOWLING GREEN, VIRGINIA 22427
### METER SIZING FORM

Customer________________________Address________________________

Building Address________________________Type of Occupancy________________________

Development Name________________________GPRIN Number________________________

Applicant________________________

Title/Company________________________Daytime Phone #________________________

I certify that the information on this form is true and correct to the best of my knowledge.

<table>
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<th>Domestic Demand</th>
<th>Fixture Value</th>
<th>No. of Ex. Fixtures</th>
<th>No. of Prop. Fixtures</th>
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<td>Dishwasher</td>
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<td>Drinking Fountain</td>
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<tr>
<td>Other___________</td>
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<td><strong>Combined Fixture Value Total</strong></td>
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NOTE: PLAT TO MEET CAROLINE COUNTY CLERK OF THE COURT STANDARDS
Caroline County, Virginia Standards Volume II Standard Specifications and Details for Construction of Water and Sewer Lines and Related Work
CAROLINE COUNTY
STANDARDS
VOLUME II
STANDARD SPECIFICATIONS
AND DETAILS FOR
CONSTRUCTION OF WATER AND SEWER
LINES AND RELATED WORK

ADOPTED  February 9, 2017
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FOREWORD

These Standards have been developed for use by consultants working on water and sewer utility projects within Caroline County and for Caroline County personnel who review those projects. The standards are not intended as a regulation but should be used as a guide which will establish a degree of uniformity for drawings and specifications for all water and sewer utility projects.

The Standards consist of two volumes as follows:

- Volume I - contains the design standard for water mains, pump stations and sewer lines, force mains and pump stations.
- Volume II - contains specifications for construction and materials for water and sewer lines.

These Standards are online on the County Website under the Department of Public Utilities subsite.

Consultants working on water and sewer utility projects should recognize the fact that State and Federal regulations must be satisfied on all projects. In the event that the County Standards differ from State or Federal Requirements, the more restrictive standard shall be utilized.

It is very difficult to generalize when addressing matters of engineering design without endangering the final product; therefore, consultants should strive for designs which show consideration of details presented herein. However, these details are secondary to good engineering judgment. The design of water mains, pump stations, force mains and gravity sewers is a matter which requires special consideration for each specific project and cannot be generalized for all jobs. Therefore, the design engineer is responsible for checking the specific requirements of each project against these standards and making any additions, deletions or changes necessary for the project being designed.

The work described herein is under the jurisdiction of Caroline County hereinafter referred to as the County.

The County will review all plans and specifications, however, all such documents for new construction must be submitted to the appropriate agencies for review and a certificate of construction must be issued before construction can begin.
PROCEDURAL SECTION

1.0 GENERAL

A. These specifications will be provided by Caroline County upon request for the cost of reproduction and handling, or are available online.

B. The purpose of these specifications is to standardize the construction of water lines and sewer lines in Caroline County.

C. The design professional who is responsible for the project must prepare project plans and has the responsibility of determining that all standard details and standard specifications are appropriate for the intended use. He also has the responsibility of stating upon completion of project construction that all specified tests were performed with results within specified limits and that the project was built in accordance with the plans and specifications.

D. The specifications have been developed using Construction Specification Institute (CSI) format. Additional sections or modifications to the enclosed should be incorporated as needed for specific projects.

2.0 WATER

A. Design notes and calculations must be submitted by the design professional to the Virginia Department of Health, Office of Drinking Water along with the plans for the project.

B. Any deviations to these specifications and standards must have prior approval from the Virginia Department of Health, Office of Drinking Water before installation.

C. These specifications may be used for projects to be built within Caroline County. Project plans will be required for each project and will be prepared and submitted in accordance with the Commonwealth of Virginia Department of Health, Office of Drinking Water.

D. All requests for deviation from these standard specifications will be set forth in writing and directed to Caroline County. Permission for same will be issued by Caroline County in the form of a letter. A copy of the letter of permission will also be sent to the Commonwealth of Virginia, State Department of Health, Office of Drinking Water.

E. Caroline County Department of Public Utilities has been granted authority by the Office of Drinking Water to review plans for extensions of water lines 12-inches in diameter and less. All other public water lines, e.g. extensions, are to be submitted to the Office of Drinking Water Culpeper Field Office for review and approval.
3.0 SANITARY SEWER

A. All gravity sanitary sewers, pumping stations and force mains are to comply with the requirements of the Department of Environmental Quality Sewage Collection and Treatment Regulations, to include obtaining a Certificate to Construct and a Certificate to Operate. A copy of the referenced certificates are to be provided to the Department of Public Utilities when obtained. The Certificate to Construct is to be provided prior to the start of construction. The Certificate to Operate is to be provided prior to bond release.

B. The Department of Public Utilities will review and approve plans for all gravity sanitary sewer pumping stations and force mains to be constructed in Caroline County.
SECTION 02110 - SITE CLEARING

1.0 GENERAL

1.1 Description

A. Work under this Section of the Specifications includes general site clearing operations, including trees and vegetation removal, protection of existing trees to be left standing, and clearing and grubbing.

1.2 Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements not indicated to be removed, and improvements on adjoining properties.

A. Restore all improvements damaged by this Work to their original condition, and acceptable to the Owner or other parties or authorities having jurisdiction.

1.3 Protect existing trees and other vegetation indicated to remain in place against cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

1.4 Burning where allowed by local ordinances will be permitted.

2.0 PRODUCTS

2.1 Not Applicable.

3.0 EXECUTION

3.1 Clearing

A. Remove from the site trees, brush, shrubs, down timber, rotten wood, rubbish, other vegetation as well as fences, and incidental structures necessary to allow for new construction.

   (1) Remove all trees, stumps and roots within 10' of any structure or pipeline.

   (2) Stumps of trees, other than the above, to be left in place shall be cut off and shall be left not more than 6" above original grade.
Remove all stumps when such stumps will be less than 5' below finished grade.

B. Clearing work shall be restricted to area within rights-of-way, or easements or within "Construction Limits" indicated on Contract Drawings.

3.2 Existing Trees and Shrubs

A. Trees and shrubs that are to remain within "Construction Limits" will be indicated on Contract Drawings or conspicuously marked on site.

B. Ownership to Trees: Unless otherwise noted, trees within the "Construction Limits" shall become the property of the Contractor and shall be removed from the site.

3.3 Grubbing

A. Grub areas within and to a point 10' outside of all structures and pipe lines, areas to receive fill where finished grade will be less than 3' above existing grade, cut areas where finished grade will be less than 2' below existing grade, transitional areas between cut and fill, and any area to receive control fill.

B. Remove from the ground to a depth of 24”, all stumps, roots ½” and larger, organic material and debris.

C. Use only hand methods for grubbing inside the drip lines of trees which are to remain.

3.4 Clean up debris resulting from site clearing operations continuously with the progress of the work.

3.5 Remove all waste material from site.

3.6 Remove debris from site in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt and debris at all times.

END OF SECTION
1.0 GENERAL

1.1 Work included in this Section includes trenching and backfilling for underground pipelines and related structures only.

1.2 Reference Specifications are referred to by abbreviation as follows:

A. American Society for Testing and Materials .................................... ASTM

B. American Association of State Highway and Transportation Officials ........................................... AASHTO

C. Virginia Department of Transportation ............................................. VDOT

D. U. S. Army Corps of Engineers ....................................................... COE

1.3 The Contractor shall perform all construction operations in accordance with the U.S. "Occupational Safety and Health Act of 1970", the Standards of the U.S. Department of Labor, Occupational Safety and Health Administration and the latest amendments thereto.

1.4 The Contractor shall perform all construction operations in accordance with the "Rules and Regulations Governing the Safety and Health of Employees Engaged in Construction" as adopted by the Safety and Health Codes Commission of the Commonwealth of Virginia and all latest revisions thereto and issued by the Department of Labor and Industry.

1.5 Store and use explosives in accordance with Federal, State and Local regulations. The Contractor shall be responsible for and shall satisfactorily correct all damage resulting from use of explosives.

1.6 Provide compaction testing.

1.7 Locate existing utilities, culverts and structures, above and/or below ground, before any excavation starts. Coordinate work with utility companies through MISS UTILITY. Protect, maintain in service, and prevent damage to utilities not designated to be removed. When utilities are encountered and are not shown on Drawings or when locations differ from those shown on Drawings, notify the County for instructions before proceeding.

1.8 All excavation is unclassified and no additional payment will be allowed regardless of materials encountered.
2.0 PRODUCTS

2.1 Pipe Bedding Fill

A. Granular fill shall meet requirements for coarse aggregates, VDOT Specifications, Size No. 57.

2.2 Select Backfill

A. Aggregate fill shall meet requirements for coarse aggregates, VDOT Specification, size No. 57.

B. Clean earth fill shall be an approved material free of debris, roots, frozen materials, organic matter, rock or gravel larger than 1" in any dimension or other harmful matter and shall be ASTM D 2487, Classification GW, GP, GM, GC, SW, SP, SM, SC, ML with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.3 Borrow

A. Obtain borrow materials required in excess of those furnished from excavations from off-site sources approved by the Department of Public Utilities. Provide and submit soil classification testing to ensure borrow materials meet the requirements of this specification.

2.4 Rip-rap, where shown on the Drawings shall conform to VDOT Specification "Dry Rip - Class I."

2.5 Geotextile Fabric

A. Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot,. insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface testing to ensure borrow materials meet the requirements of this specification. installation shall not be exposed to direct sunlight for more than 24 hours during installation.

B. Geotextile fabric for riprap bedding material shall be woven polypropylene and meet the requirements of VDOT Road and Bridge Specification 245 / AASHTO M288. Geotextile shall be listed on the VDOT Materials Division Approved Products list for Riprap Bedding Fabric.
3.0 EXECUTION

3.1 Strip existing topsoil, leaf mold and organic materials, meeting topsoil requirements of Section 02935 - Seeding. Deposit in storage piles separate from other excavated material.

3.2 Where the trench width exceeds the allowable width, the Contractor at his own expense shall provide for increased loads on pipe as directed by the County.

3.3 Unauthorized excavation consists of the removal of material beyond indicated subgrade elevations or side dimensions without specific approval of the County. Where unauthorized excavations occur, restore these areas to the elevations and dimensions shown on the Drawings with granular fill.

3.4 Where removal of unsatisfactory material is due to fault or negligence of the Contractor, by inadequate shoring or bracing, dewatering, material storage or other failure to meet specified requirements, any work deemed necessary by the County to correct the faulty condition shall be performed at no additional cost to the Owner.

3.5 Excavation.

A. Open trenches only so far in advance of pipe laying as permitted by County. In no case will more than 100 ft. of trench may be open at one time. Trenches shall be backfilled at the end of each working day except where otherwise permitted.

B. The width of the trench at and below the top of the pipe shall not exceed the outside diameter of the pipe plus 18 inches except that for pipe 12 inches or less in diameter, the trench width shall not exceed 33 inches. Where this width is exceeded, Contractor shall provide for increased pipe loading as directed by the County.

C. The trench walls above the top of the pipe may be sloped or the trench, above the top of the pipe, may be widened as necessary for bracing, sheeting and shoring. Construction methods shall be subject to review and approval by the County.

D. Excavate trenches for gravity lines to elevations shown on Contract Drawings. Excavate trenches for pressure lines to elevations shown on Contract Drawings or to depths specified.

E. The bottom of the trench for gravity lines shall be as specified herein under "Pipe Bedding".

F. The bottom of the trench for pressure lines shall be shaped to fit the bottom of the pipe as specified herein under "Pipe Bedding".

1. Excavate for bell holes at each joint.
2. Where rock is encountered, excavate a minimum of 6 inches below the bottom of the pipe for bedding.

G. Provide for the collection and disposal of surface and subsurface water encountered during construction

(1) Surface Drainage: Completely drain the construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified in this section at no additional cost to the Owner.

(2) Subsurface Drainage: Consider site surface and subsurface conditions, available soil, and hydrological data. Remove water by benching, sump pumping, deep well pumping, or other methods to prevent softening of surfaces exposed by excavation. Use filters on dewatering devices to prevent removal of fines from soil. Provide erosion control at the outlet of piping to prevent erosion. Operate dewatering system continuously until construction work below existing water levels is complete.


H. Where unsuitable soil is encountered, excavate to depth determined by the County and replace with select backfill thoroughly and uniformly compacted at no additional cost.

I. Where underground streams or springs are found, provide temporary drainage and notify the County.

J. Remove from project site and dispose of material unsatisfactory for backfill, trash, and all excess material continuously with the progress of the work. Dispose of the unsuitable material off the project area in accordance with all federal, state and local regulations at no additional cost.

K. Remove shoring and all form materials, unless ordered to remain.

L. Where rock is encountered so that a manhole, vault, or other structure will bear entirely on rock, it shall be used to support the foundation.
only a part of the foundation would bear on rock, excavate to an even depth of 8 inches below the entire structure and backfill with aggregate fill and thoroughly compact.

M. Provide a minimum of 8 inches between rock excavation and sides of structures.

N. Blasting

(1) The Contractor shall provide a blast warning signal system. The blast warning signal system shall consist of one or more air horns located at the blast site. The air horn(s) shall be audible a minimum of 1 mile from the blast site. The signals shall be one long horn 5 minutes prior to the blast, one short horn 1 minute prior to the blast, and one long horn after the blast to signal all clear. The Contractor shall erect two clear and legible blast warning signal signs at locations determined by the Engineer. The signs shall list the blast warning signal system, the Contractor Superintendent’s name and telephone number, and the Project Inspector’s name and telephone number.

(2) The Contractor shall establish test pits at up to two representative locations to determine if the rock is “rippable” with a track backhoe Caterpillar 225 or equivalent and the feasibility of rock excavation by “hoe ramming.” If these procedures do not offer reasonable production for rock excavation, then blasting will be allowed unless otherwise indicated. Reasonable production for rock excavation will be as defined by the Department of Public Utilities.

(3) The blasting shall be performed by a qualified contractor. Qualifications, proposed procedures and schedule shall be submitted for approval at least 2 weeks prior to commencing any blasting operations.

(4) The Contractor shall notify in writing all property owners within 250 feet of the proposed blast, and the Department of Public Utilities representative, at least 1 week prior to the proposed blast and verbally on the day of the scheduled blast.

(5) Blasting shall be limited to mid-morning hours on days of clear to partly cloudy skies with increasing surface temperature and light wind. Blasting will not be allowed after 3:30 P.M. or on overcast, low ceiling days. The Contractor shall provide seismograph monitoring equipment to monitor all blasting. A copy of the monitor record shall be given to the Department of Public Utilities.

(6) The use of unconfined explosives shall be prohibited.
The maximum allowable peak particle velocity shall be 1¼ inches per second for all structures located 0 to 300 feet from the blasting site. The maximum allowable peak particle velocity shall be 1-inch per second for all structures located 301 to 5,000 feet from the blasting site. The maximum allowable peak particle velocity shall be ¾-inch per second for all structures located 5,001 feet and beyond from the blasting site.

To minimize vibration, a minimum scaled distance (SD) of 50 shall be used to determine maximum explosive weight per delay. A test blast shall be conducted to verify the scaled distance. The maximum explosive weight per delay shall not exceed the distance from the blast to the nearest structure divided by 50 squared. The maximum explosive weight per delay may be revised pending the outcome of the test blast. Test blast monitoring shall be at the expense of the Contractor. The recommendations indicated for blasting criteria in no way relieves the Contractor of his liability.

The peak overpressure or air blast shall not exceed the maximum limits specified in the following table:

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<tr>
<th>Lower Frequency of Measuring System [Hz (+3 DCB)]</th>
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<td>0.1 Hz or lower - flat response</td>
<td>134 peak</td>
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<tr>
<td>2 Hz or lower - flat response</td>
<td>133 peak</td>
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<tr>
<td>6 Hz or lower - flat response</td>
<td>129 peak</td>
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<tr>
<td>C-weighted – slow response</td>
<td>105 peak</td>
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Pre-blast meetings may be scheduled by the Engineer to document hole depths and spacing, charge weight per delay, shot scheduling, and weather conditions. The Contractor shall obtain accurate measured distances from structures to center of blast area prior to determining the safe maximum charge-weight per delay and loading blast holes.

Pre-blast and post blast surveys will be performed by the Contractor. Written permission shall be submitted to the Department of Public Utilities prior to entering upon private property to conduct a survey. The pre-blast and post blast surveys will include all occupied buildings within 250 feet of blasting areas. The Department of Public Utilities may have a representative present during these surveys. The pre-blast and post blast surveys performed by the Contractor in no way relieve the Contractor of his liability.

The Department of Public Utilities reserves the right to monitor production blasting. In this event, the Contractor shall provide the
Department of Public Utilities ample notice of scheduled blasts to allow set-up of monitoring equipment.

3.6  Sheet, Shoring and Bracing

A. Maintain trench walls in a safe condition at all times. Provide sheeting, shoring, and bracing as necessary to prevent cave-in of excavation or damage to existing structures on or adjoining the site.

B. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

C. Maintain sheeting, shoring and bracing in excavations regardless of time period excavations will be open. Carry down sheeting, shoring and bracing as excavation progresses in accordance with the proper authority.

D. Sheet, shoring and bracing left in place shall be cut off to a depth of not less than 18 inches below grade.

E. Provide sheeting, shoring and bracing as required in accordance with the U. S. Army Corps of Engineers “Safety and Health Requirements Manual” EM-385-1-1, Section 25.

3.7  Protections

A. Underground Utilities: Location, elevation, and size of existing utilities indicated on the drawings are approximate. Provide pot holing as required. Physically verify the location, elevation, and size of the existing utilities, whether indicated or not, prior to starting construction.

B. Machinery and Equipment: Movement of construction machinery and equipment over pipes during construction shall be at the Contractor’s risk. Repair or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged at no additional cost.

C. Flotation: The Contractor shall take all necessary precautions to prevent the flotation of the piping during installation and the period before the new piping and structures are backfilled and placed in service.

3.8  Pipe Bedding

A. Bed all water, gravity sewer pipe and sewer force main in accordance with bedding details as shown in Section 00870 - Standard Details.

B. Compact pipe bedding by tamping or rodding to prevent settlement.
3.9 Backfill

A. Backfill trench to a compacted depth of 1 foot over the pipe with select backfill in accordance with the details shown in Section 00870 - Standard Details. Backfill shall be placed by hand, uniformly on each side of the pipe and compacted in layers not exceeding 5". Do not backfill on muddy or frozen soil, or with muddy or frozen soil.

B. Backfill trench from 1 foot above the pipe to grade with clean earth fill free of stones not larger than 5" or 1/2 the layer thickness, whichever is smaller. Layers shall not exceed 12", except that under road shoulders and under existing or future paved areas, layers shall not exceed 8 inches. Backfill shall be compacted to the density specified for the areas in which it is located except that minimum compaction in any area shall be to the density of the adjacent soil.

C. Excavation depressions caused by removal of stumps or other clearing operations to firm subgrade, fill with clean earth fill and compact as specified.

D. Place backfill materials evenly adjacent to structures. Take care to prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.

E. Compact soil materials using equipment suitable for materials to be compacted and work area locations. Use power-driven hand tampers for compacting materials adjacent to structures.

F. Compact aggregate fill placed around manholes or other structures to required density.

3.10 Compaction

A. Percentage of maximum density requirements.

(1) Compact each layer of fill or backfill to not less than the following percentages of the maximum density at + 3% optimum moisture content as determined by ASTM D 698.

98% beneath and within 25 ft. of buildings and structures, including those shown for future construction.

98% beneath pavements, walks, and road shoulders, including those shown for future construction.

85% in other unpaved areas.
3.11 Grading

A. Uniformly grade all areas within the limits designated on the Contract Drawings, including adjacent transition areas. Finish surfaces within specified tolerances with uniform levels or slopes between points where elevations are shown and existing grades.

B. Finish all surfaces free from irregular changes.

C. Finish subgrade areas to receive topsoil to within 0.10 foot of required subgrade elevations.

D. Shape subgrade under walks to line, grade, and cross-section to within 0.10 ft. of required subgrade elevations.

E. Shape subgrade under pavement to line, grade, and cross-section to within ½" of required subgrade elevations.

F. Protect newly graded areas from traffic and erosion. Repair and reestablish grade in settled, eroded, or rutted areas to the specified tolerances.

G. Where compacted areas are disturbed by subsequent construction or adverse weather scarify the surface, reshape and compact to the required density. Use hand tamper for re-compaction over underground utilities.

3.12 Utilities to be Abandoned or Removed

A. When underground utilities are to be abandoned in place, plug, cap, or seal with concrete at the "construction limits" or at points shown.

B. Remove underground utilities indicated on the Drawings to be removed and backfill resulting excavation with suitable material, compacted as specified. Plug, cap or seal utilities with concrete, at the construction limits or at points shown.

3.13 Erosion Control

A. Comply with local erosion control ordinance and with the "Virginia Erosion and Sediment Control Handbook" by the Virginia Soil and Water Conservation Commission to control erosion and sedimentation.

B. Submit erosion control plan to the County for review and approval prior to commencing any grading operations.

C. Install all applicable erosion and siltation control measures in accordance with approved plan prior to grading.
D. No more than 100 feet of trench shall be open at any one time.

E. All utility lines, not in streets, shall be mulched with hay or straw and seeded within 15 days after backfill

F. Any disturbed area, not paved, sodded or built upon by November 15 is to be seeded on that date with oats, abrucci rye, or equivalent and mulched with hay or straw.

G. Protect graded areas from the action of the elements. Settlement or other damage that occurs prior to acceptance of the work shall be repaired and grades satisfactorily reestablished.

H. Repair after cleanup: Upon completion of construction work and after spoils and debris have been removed, regrade any areas disturbed by operations.

3.14 Clean Up

A. Keep area of Work cleaned up at all times and promptly remove all materials and debris not intended for incorporation in the Work. Broom clean the surfaces of all paved areas immediately after backfilling operations.

B. Maintain backfilled trenches from the nuisance of dust, mud or settling during the entire length of the Contract and for a period of one year following Final Acceptance of the Work.

C. In the event the Contractor fails to satisfy these requirements to the satisfaction of the County, or otherwise prosecute the Work in a reasonable or proper manner, and after a reasonable period of time has elapsed after notification by the County of unsatisfactory conditions, the Owner reserves the right to employ outside services to take such corrective action as deemed necessary by the County. The cost incurred in taking corrective actions will be deducted from any monies due the Contractor by the Owner or such other means of collection as may be available to the Owner.

3.15 Preparation for Final Inspection

A. Locate and adjust all manholes, valve boxes, etc. to final grade and flush out all gravity pipe lines as necessary prior to final inspection by the County. The costs of this work shall be included in the applicable bid prices.
3.16 Existing Driveways, Fences, Culverts, etc.

The Contractor shall return all driveways, fences, culverts, lawn areas, paved areas, etc. to the same condition existing prior to construction. Any culverts damaged during construction shall be replaced with new culverts at no cost to the Owner.

3.17 Field Quality Control: The Contractor shall employ an independent testing firm to provide all soil testing.

A. Sampling: Take the number and size of samples required to perform the following tests.

B. Testing: Perform one of each of the required tests for each material used. Provide additional tests for each source change and as requested by Caroline County.

(1) Clean Earth Fill: Test clean earth fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 423 for liquid limit and ASTM D 424 for plastic limits; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

(2) Density Tests: Test soil density in accordance with ASTM D 698, or ASTM D 6938. When ASTM D 6938 density tests are used, verify density test results by performing an ASTM D 698 density test at a location already ASTM D 6938 tested as specified herein. Perform an ASTM D 698 density test at the start of the project, and for every 10 ASTM D 6938 density tests thereafter. Test every 250 linear feet in pavement and every 500 feet in non-paved areas for pipe line installation (minimum one test per pipe line), and additional tests as requested by Caroline County.

END OF SECTION
1.0 GENERAL

1.1 Work in this Section includes all exterior potable water distribution system piping and appurtenances.

1.2 Reference Specifications are referred to by abbreviation as follows:

A. American National Standards Institute .......................................................... ANSI

B. American Society for Testing and Materials .............................................. ASTM

C. American Water Works Association ......................................................... AWWA

D. Commercial Standard(National Bureau of Standards) .............................. CS

E. Federal Standards ......................................................................................... FS

F. Virginia Department of Transportation ...................................................... VDOT

1.3 Separation of water lines and sanitary sewers.

A. Follow State Health Department "Waterworks Regulations" for separation of water mains and sewer lines.

B. Parallel Installation

   (1) Normal Conditions - Water lines shall be constructed at least 10' horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.

   (2) Unusual Conditions - When local conditions prevent a horizontal separation of at least 10', the water line may be laid closer to a sewer or sewer manhole provided that:

       (a) The bottom of the water line is at least 18" above the top of the sewer.

       (b) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.
C. Crossing
   (1) Normal Conditions - Water lines crossing over sewers shall be laid to provide a separation of at least 18" between the bottom of the water line and the top of the sewer whenever possible.

   (2) Unusual Conditions - When local conditions prevent a vertical separation described in Crossing, Normal Conditions, Paragraph C above, the following construction shall be used.

   (a) Sewers passing over or under water lines shall be constructed of the materials described in Parallel Installation, Unusual Conditions - Paragraph B above.

   (b) Water lines passing under sewers shall, in addition, be protected by providing:

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

      2. Adequate structural support for the sewers to prevent excessive deflection and settling.

      3. That the length of the water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. Sanitary sewers or sewer manholes - No water pipes shall pass through or come in contact with any part of sewer or sewer manhole.

E. Submit shop drawings on all products as required by Caroline County.

F. Provide certified test results of pipe testing.

1.4 All products in contact with drinking water shall meet NSF/ANSI Standard 61, and either NSF/ANSI, Annex G or NSF 372 for compliance with new “lead free” content requirements.

2.0 PRODUCTS

2.1 Piping Applications

   A. The following piping systems shall be constructed of push-on joint Special Thickness Class 52 ductile iron pipe or AWWA C900 polyvinylchloride (PVC).

   (1) Below grade water main piping 3–inches in diameter or greater.
B. The following piping system shall be constructed of flanged joint Special Thickness Class 53 ductile pipe.

(1) Above grade piping and piping in vaults 3-inches in diameter or greater.

C. The following piping system shall be constructed of mechanical joint Special Thickness Class 52 ductile iron pipe.

(1) Below grade water main piping 3-inches in diameter or greater where restrained joints are required.

D. The following piping systems shall be constructed of ASTM B88 Type K flexible copper pipe.

(1) Below grade water service laterals 2-inches in diameter or less.

E. The following piping system shall be constructed of threaded Schedule 40 galvanized steel pipe.

(1) Above grade piping not otherwise specified

2.2 Pipe

A. Ductile Iron Pipe

(1) Ductile iron pipe shall be manufactured in accordance with specifications (ANSI/AWWA, A21.51 minimum) wall thickness shall be Special Thickness Class 52 according to Table 51.6, Dimensions and Weights For Special Classes 3 inches and above.

(2) Flanged ductile iron shall be Special Thickness Class 53 unless otherwise indicated and shall meet the requirements of ANSI/AWWA C115.

(3) Fittings shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of the pipe.

(4) Provide mechanical joints or push-on joints for underground piping. Jointing materials shall meet requirements of ANSI/AWWA C111.

(5) Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism that, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 526-80. Restraining devices
shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., Megalug, Ford Uni-Flange, US Pipe Field Lok Restraining Gasket or approved equal.


(7) Push-on joint and rubber gasket shall meet requirements of ANSI/AWWA C111. Restrained push-on joints may be used where restrained joints are required. FIELD-LOCK push-on gaskets or similar products will not be allowed as the sole method of joint restraint.

(8) Provide flanged joints for all aboveground piping and as indicated on the drawings. Flanges shall meet requirements of Class 125 ANSI B16.1.

(9) Flanged joint gaskets shall be full face, made of rubber, and shall meet requirements of ANSI/AWWA C111/A21.11.

(10) Cement mortar lining with bituminous seal coat for ductile iron pipe and cast iron fittings shall meet requirements of ANSI/AWWA C104. Cement mortar lining shall be standard thickness.

(11) Exterior bituminous coating shall meet requirements of ANSI/AWWA C110, C115, C151, and C153, as applicable.

(12) Above grade ductile iron pipe shall have exterior coating of manufacturers blue shop primer.

B. Galvanized Steel Piping

(1) Hot-dipped, zinc-coated galvanized steel piping shall be ASTM A 53, Schedule 40, with threaded end connections.
(2) Provide ANSI B16.3 Class 300 hot-dipped, zinc-coated threaded fittings, ANSI B16.5 Class 300 hot-dipped, zinc-coated flanges, ANSI B16.39 hot-dipped, zinc-coated threaded unions, and pipe thread tape suitable for drinking water applications.

C. Water Service Lateral Piping

(1) Copper tubing and associated fittings shall be ASTM B 88, Type K Flexible.

(2) Fittings shall be wrought copper or cast bronze of flared joint type in sites above 1-inch diameter. Fittings should be manufactured by Ford Meter Box Company, Inc. or approved equal.

D. Polyvinyl Chloride (PVC) Pressure Piping

(1) Polyvinyl Chloride (PVC) pressure piping shall meet requirements of AWWA C900. Pipe shall be DR 18, Pressure Class 235. Pipe connection shall be plain end pipe with a rubber gasketed coupling or plain end and rubber gasketed bell end. Pipe shall conform to the outside dimension of ductile iron pipe. Special Thickness Class 52 ductile iron fittings shall be used in conjunction with PVC pressure piping.

(2) Restraining devices for pipe fittings shall be Uni-Flange Series 1300 by Ford Meter Box Company, Inc., or approved equal by EBAA Iron, Inc., or Romac Industries, Inc. Restraining devices for pipe joints shall be Uni-Flange Series 1390 by Ford Meter Box Company, Inc., or approved equal by EBAA Iron, Inc., or Romac Industries, Inc.

2.3 Flexible couplings for ductile iron piping shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section gaskets, and sufficient galvanized track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be Style 38 manufactured by Dresser Manufacturing Division of Dresser Industries or approved equal by Smith-Blair Products of Rockwell International. All couplings shall be provided with tie rod restraint.

2.4 Flange adapters for joining plain-end pipe to flanged items shall be Style 127 or 128 as manufactured by Dresser Manufacturing Division of Dresser Industries or approved equal by Smith-Blair Products of Rockwell International.

2.5 Gate Valves

A. Non-rising stem valves, 3" thru 16", shall be resilient seated and shall meet requirements of AWWA C509. Valves shall have 250 psi working
pressure. Valve ends shall be compatible with piping systems in which they are installed. Valve shall have ductile iron (ASTM A536) body, bronze mounted, bronze stem, ductile iron wedge coated with nitrile rubber. The interior and exterior of the body and bonnet shall have fusion bonded epoxy coating in accordance with ASNI/AWWA C550. Valve shall have o-ring seals and open counter-clockwise.

B. Operators

(1) Buried valves shall be equipped with 2" square operating nuts unless otherwise shown on the Drawings. Where nuts will be more than 48" below finished grade, extension stems shall be pin connected to valve stem. Extension stem shall raise operating nut to within 24" of finished grade.

C. Valves shall be American-Darling, Clow, Dresser (M&H), Kennedy, Mueller, A.P. Smith (MET.), or approved equal meeting this Specification.

D. Gate valves smaller than 3" shall be bronze, solid wedge, rising stem, at least 200 psig working pressure, Jenkins 49-U threaded ends or Jenkins 1242 solder ends.

E. Tapping Sleeves and Valves

(1) Tapping sleeves shall meet requirements of ANSI/AWWA C110 for pressure rating of piping. All wet taps over 2-inch in size shall be made with Mueller Co. H-304-SS stainless steel sleeve and T-2369 Tapping Valve or an approved equal.

(2) Tapping valves shall meet requirements of gate valves specified in this section, except that seat opening shall be larger than nominal size and valve outlet end shall be mechanical joint.

F. Insertable Gate Valves

(1) Insertable gate valves shall be ductile iron resilient wedge gate valve in accordance with American Water Works Association Standard C509 or C515 for 250 psi working pressure. The design shall allow the valve to be installed on a pressurized line while maintaining pressure and service as usual. After closing the wedge and adequately restraining the valve body the downstream pipe can be completely removed and replaced. The host pipe shall not be a permanent component of the insertable valve.

(2) Valves listed above shall be InsertValve as manufactured by TEAM Industrial Services or approved equal.
2.6 Check Valves

A. Check valves 3" and larger shall be iron body, bronze mounted, swing check valves, meeting requirements of AWWA C508. Check valves 3 through 12" shall be for 175 psi non-shock cold water working pressure. Valves shall be spring loaded.

B. Manufacturer shall be American Darling Valve and Manufacturing Company, Eddy-Iowa Division of Clow Corporation, Kennedy Valve Manufacturing Company, M&H Division of Dresser Industries, or G-A Industries, Inc.

2.7 Pressure Reducing Valve

A. Valves shall be hydraulically operated and of the self-contained, differential piston type. The valves shall function to reduce high upstream pressure to a predetermined lower downstream pressure without shock or hammer.

B. The valve shall be air and water cushioned and when required, provide tight valve closure. When required, the valve shall open wide to permit full pipe line opening. An indicator shall be furnished as an integral part of the valve to show piston position within the body.

C. The valves shall be cast iron body. The piston shall be of cast bronze provided with renewable leather or composition cup and seat. The valve liner shall be of cast bronze provided with a leather or composition cup. The valve shall be provided with "V" shaped ports for flow passage downstream of the seat opening. The valve assembly shall be so constructed as to permit removal of the piston or liner from the valve body without removing the valve body from the line.

D. The pilot valve shall be of the single seated, globe body pattern, diaphragm operated and spring loaded with convenient discharge pressure setting over a range no less than 30 psi.

E. Valves in sizes 3-12" shall have a working pressure of 175 psi. Valves in sizes 14" and up shall have a working pressure of 150 psi. Valves shall be provided with 125 lb. ANSI flanges and shall be similar to G-A Industries, Inc., Fig. No. 4500-D.

2.8 Valve boxes shall be adjustable cast iron valve boxes of the three-piece type, consisting of lid, two-piece screw type extension and base, and shall be traffic rated. Base shall be proper type and size for the valve with which it is used. The word "water" shall be cast or embossed on the valve box lid in letters not less than 1" high. Valve box shall be manufactured by Mueller Company, Richard Foundry, or Tyler.
2.9 Fire hydrants shall conform to the requirements of AWWA Standard C502, latest revision for "Dry Barrel Fire Hydrants" and shall comply in full with the following requirements.

A. Hydrants shall be of the three post type of dry top design rated 150 psi with compression main valve opening counterclockwise against pressure. Each hydrant shall have a 6" standardized, mechanical joint inlet connection with accessories. The internal valve shall provide a minimum of 4½" unobstructed flow area. Each hydrant shall be designed to allow the removal of all operating parts through the standpipe without excavation. Each hydrant shall be constructed with an oil lubricated dry type bonnet with "O" ring seals above and below operating threads.

B. The standpipe sections shall be connected at the ground line by a two-part safety flange that prevents damage to the barrel sections when the hydrant is struck by a vehicle. The standpipe and safety flange design shall permit rotation of the hydrant nozzles to any desired position without excavation or disassembly of the operating components. Threaded joints, above or below ground, or breakable bolts will not be allowed for the barrel assembly.

C. The main valve operating rod shall be designed with a travel stop so that the rod cannot be placed in compression. Travel stops located at the bottom of the hydrant will not be acceptable. The operating rod threads top and bottom shall be isolated from contact with water in the bonnet or in the inlet shoe. A safety stem coupling on the operating rod shall be placed at the ground line.

D. The drain mechanism shall be co-related with the operation of the main valve to provide a momentary flushing of the drain ports each time the hydrant is opened. The drain ports shall be fully closed when the hydrant valve is more than 2½ turns open. The drain ports shall be fully open when the hydrant is in the closed position.

E. The nozzle outlets shall consist of two (2) 2½" hose nozzles 180° apart and one (1) 4½" pumper connection. The nozzle threads shall conform to National Standard Hose Coupling Thread Specifications (NST). The nozzle caps shall be individually attached to the standpipe with heavy duty non-kinking chains that permit free turning of the cap. The operating nut and cap nuts shall be National Standard pentagon with 1½" from point to flat.

F. The exterior of the hydrants above the ground line shall be shop painted red or as approved by the County.

G. Fire hydrants shall be Kennedy K-81-A "Guardian", or an approved equal.
2.10 Pressure gages shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4½" white coated dial graduated from 0 to 100 psi. Gages shall be similar to Ashcroft No. 1279.

2.11 Compound gages shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4½" white coated dial graduated from 0 to 100 psi and 0 to 30" vacuum.

2.12 Air Release Valves
   A. Air release valves shall be APCO Model 145C combination air valves as manufactured by Cla-Val Company (Series 36) or ARI USA, Inc. (Model D-040). Valves shall have the following dimensions:
      
      (1) Inlet Diameter: 2-inch NPT
      (2) Outlet Diameter: 2-inch NPT
      (3) Large Orifice Diameter: 2-inch
      (4) Small Orifice Diameter: 3/32-inch
   
   B. Valves shall have ASTM A126 Grade B cast iron body, cover, and lever frame, ASTM B124 bronze plug, Buna-N needle and seat, and ASTM A240 stainless steel float. Valve shall be suitable for 350 psig working pressure.

2.13 Water service connection accessories shall consist of a corporation stop, meter box and meter yoke as shown on Standard Drawing No. 109.

2.14 Corporation stops shall be one-piece bronze body with integral wrench flats, CC inlet taper threads, o-ring sealed, balanced pressure, ball type valve, having a round, full open unobstructed flow way and meeting requirements of AWWA C800, “Underground Service Line Valves and Fittings.” Corporation stops shall be manufactured by Mueller Company, Ford Meter Box Company, or A.Y. McDonald.

2.15 Meter Box shall be as shown on Standard Drawing No. 111 and shall be traffic rated with plastic box and cast lid.

2.16 Manholes
   A. Manholes shall be constructed of pre-cast reinforced concrete manhole sections in accordance with the requirements of ASTM C478 and detailed in Section 00870 - Standard Details.
   
   B. A maximum of two lift holes per manhole section may be provided.
C. Provide tongue and groove joints in manhole sections with a preformed groove in the tongue for placement of an O-ring type round, rubber gasket.

1. Gasket shall comply with requirements of ASTM C361.

2. Gasket shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure.

D. Joint sealant shall be a one-component polyurethane sealant similar to Pioneer 301 Mastic.

E. Manhole steps shall be corrosion-resistant and shall be 1" square cast iron, rubber-covered steel or aluminum. The steps shall conform to the dimensions shown in Section 00870 - Standard Details.

F. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 30. Castings shall be coated with a coal tar pitch varnish, to which sufficient oil has been added to make a smooth coating, tough and tenacious when cold, but not tacky or brittle. Seating surfaces between frame and cover shall be machined. The dimensions and weights shall conform to the requirements shown in Section 00870 - Standard Details.

1. Standard Manhole Frame and Cover shall be similar to Richards Foundry Corporation No. D-1125.

2. Vandal-proof Manhole Frame and Cover shall be similar to Neenah Foundry Co., Cat. No. R-1926-C with 4 - 1" diameter vent holes.

2.17 Precast Reinforced Concrete Valve Vaults

A. Valve vaults shall be manufactured by Rotondo Precast, Americast, Tindall Corporation, Engineered Fluid, Inc., or approved equal. Vaults shall meet requirements of ASTM C 890 and ASTM C 913. Top sections for all valve vaults shall be designed to withstand HS-20 traffic loading. Vaults shall be manufactured as indicated on the drawings and shall be watertight. Provide wall sleeves, aluminum access hatches, aluminum access ladder, manhole steps, vents, and other appurtenances as specified herein and indicated on the drawings to ensure complete assembly. Valve vaults shall be anti-buoyant.

B. Provide adequate concrete riser sections to bring HS-20 traffic loading rated aluminum access hatches to grade.

C. Concrete/Reinforcing Steel Requirements: Provide an air content of 6%, ±2% and a minimum wall thickness of 6 inches. ASTM A 615 reinforcing bars, ASTM A 497 welded wire fabric, ASTM C 443 gaskets for joint
connections. Vaults shall be manufactured with calcareous aggregate so that the finished product shall have an AZ factor equal to 90. Sleeves through concrete or masonry walls or slabs shall be cast iron or Schedule 40 steel. Provide sleeves through walls, floors, and ceilings for all pipe penetrations except where wall pipes are indicated.

D. Precast concrete vault top shall be equipped with an access hatch.

(1) The access hatch shall have a 1/4 inch (7mm) thick, mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1-1/2 inch (38mm) drainage coupling shall be located in the front left corner of the channel frame. Hatch drain shall be equipped to outfall outside of the vault. A bituminous coating shall be applied to the frame exterior where it will come into contact with concrete. The door panel shall be 1/4” (7mm) aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf (1464 kg. psm) uniform live load with a maximum allowable deflection of 1/150 of the span and shall not protrude into the channel frame when in the open position. Doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open arm with an aluminum release handle. For ease of operation, the hold open arm shall incorporate an enclosed stainless steel compression spring assist. Doors shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all hardware shall be T-316 stainless steel. Hatch shall be equipped with locking hasp and associated hardware. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle. Coordinate keying of lock with the Owner. Unit shall carry a lifetime guarantee against defects in material and/or workmanship. The access hatch shall be a W2C series hatch as manufactured by Halliday Products, Inc. of Orlando, Florida or approved equal.

E. Vault shall be equipped with an access ladder with a telescoping ladder safety extension.

(1) The vault access ladder shall be constructed entirely of aluminum. The rails shall be 1/2” x 2 3/4” (13mm x 70mm) aluminum extrusion and shall be spaced 16” (406mm) apart. The wall mounted standoffs shall be 3/8” x 2 ½” (10mm x 64mm) flat bar and welded to the rails at a maximum of 60” (1.5m) on center. The standoffs shall be a minimum of 7” (178mm) and manufactured to fit flush with the wall. 1 3/8” (35mm) diameter type “D” rungs with flat slip resistant surface shall be spaced at 12” (305mm) on center and welded to the outside of each rail. The access ladder shall be a series L1D ladder as manufactured by Halliday Products Inc. of Orlando, Florida, or approved equal.
F. Ladder Safety Extension

(1) The vault ladder safety extension shall be constructed entirely of aluminum and stainless steel. The aluminum housing shall mount to the ladder by means of stainless steel channel clamps secured to the ladder rungs with stainless steel “U” bolts. The aluminum telescoping post shall extend 37” (940mm) (for Model A) above the top of the housing and lock into position with a stainless steel pin. The ladder safety extension shall be a Model A series L1E safety extension as manufactured by Halliday Products Inc. of Orlando, Florida, or approved equal.

2.18 Globe valves smaller than 3” shall be of bronze construction with bronze plug type discs and solder joint ends.

2.19 Ball Valve: Ball valves shall be Class 350 meeting requirements of ANSI B16-34. Valves shall have ANSI carbon steel bodies and balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals. Valves shall be lever operated. Valves shall be manufactured by Velan Valve Corporation, ITT-Grinnell, Worcester, Inc., or approved equal.

2.20 Mechanical Type Pipe to Wall Sleeve Seals: Mechanical type pipe to wall sleeve seals shall be “Link-Seal” pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening.

2.21 Detectable Marking Tape

A. Plastic marking tape consisting of one layer of aluminum foil laminated between two layers of inert plastic film. Tape shall be resistant to alkanis, acids and other destructive agents commonly found in the soil. The laminate shall be strong enough that the layers cannot be separated by hand.

B. Tape shall be a minimum of 4½ mils thick with a minimum tensile strength of 60 lbs. in the machine direction and 58 lbs. in the transverse direction per 3” wide strip. Tape color shall be APWA Color Coded for marking the particular utility line and shall be imprinted with a continuous warning message to indicate the type of utility being marked, the message normally being repeated every 16" to 36". Tape shall be inductively locatable and conductively traceable using a standard pipe and cable locating device. Tape shall be 3" wide Terra Tape "Sentry Line Detectable 620".
2.22 Trace Wire

A. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked (blue for water).

(1) Open Trench: Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.

(2) Directional Drilling/Boring: Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

(3) Trace Wire - Pipe Bursting/Slip Lining: Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 mil HDPE insulation thickness.

B. Connectors

(1) All mainline trace wires shall be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.

(2) Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.

(3) Non locking friction fit, twist on or taped connectors are prohibited.

C. Termination/Access

(1) All trace wire termination points shall utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

(2) All grade level/in-ground access boxes shall be appropriately identified with “water” cast into the cap and shall be color coded.
(3) A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.

(4) All trace wire access boxes shall include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for grounding anode wire connection.

(5) Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

(6) Service Laterals on Public Property: Trace wire must terminate at an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.

(7) Service Laterals on Private Property: Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.

(8) Hydrants: Trace wire must terminate at an approved above-ground race wire access box, properly affixed to the hydrant grade flange. (Affixing with tape or plastic ties shall not be acceptable.)

(9) Long-runs, in Excess of 500 Linear Feet without Service Laterals or Hydrants: Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a marker post, color coded per APWA standard for the specific utility being marked. (See Standard Details Drawing No. 127.)

D.  Grounding

(1) Trace wire must be properly grounded at all dead ends/stubs.

(2) Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 ft. of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.

(3) When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
When grounding the trace wire in areas where the trace wire is continuous, and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. The grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.

Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

3.0 EXECUTION

3.1 Pipe Laying, General

A. Take all precautions necessary to insure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

B. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

C. Bedding of pipe shall be as specified in Section 02225 - Trenching & Backfilling.

D. Do not lay pipe when trench bottom is muddy or frozen, or has standing water.

E. Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.

F. Lay pipe with bell ends facing the direction of laying. Where grade is 10% or greater, lay pipe uphill with bell ends upgrade.

3.2 Install pressure line with a minimum depth of cover of 42" over the top of the pipe, where no grades are shown on the Contract Drawings.

A. Where grades on the pressure line conflict with existing pipes or structures, lay pressure line to additional depth with a uniform vertical curve to provide proper clearance without the use of fittings. No additional payment will be allowed for additional excavation.
B. Lay pressure line pipe with bell ends facing the direction of laying. Where grade is 10% or greater, pipe shall be laid uphill with bell ends upgrade.

### 3.3 Joining Mechanical Joint Pipe

A. Thoroughly clean inside of the bell and 8" of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

B. Push the spigot end forward to seat in the bell. Then, press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts and screw nuts up finger tight. Then tighten all nuts to torque listed below:

<table>
<thead>
<tr>
<th>Bolt Size - Inches</th>
<th>Torque Ft. - Lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>40 - 60</td>
</tr>
<tr>
<td>3/4</td>
<td>60 - 90</td>
</tr>
<tr>
<td>1</td>
<td>70 - 100</td>
</tr>
<tr>
<td>1¼</td>
<td>90 - 120</td>
</tr>
</tbody>
</table>

Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed.

C. Join lock-type mechanical joint pipe according to manufacturer's recommendations.

D. Permissible deflection in mechanical joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

E. Permissible deflection in lock-type mechanical joint pipe shall be as recommended by manufacturer.

### 3.4 Joining Push-On Joint Pipe

A. Thoroughly clean inside of the bell and 8" of the outside of spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to either the gasket or the spigot end of the joining pipe. Start the spigot end of the pipe into the socket with care. Then complete the joint by forcing the plain end of the bottom of the socket with a forked tool or jack-type device. File the end of field cut pipe to match the manufactured spigot end.
B. Join restrained push-on joints according to manufacturer's recommendations.

C. Permissible deflection in push-on joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

D. Permissible deflection in restrained push-on joint pipe shall be as recommended by manufacturer.

3.5 Join PVC pipe and fittings in accordance with manufacturers' instructions and install in accordance with ASTM D2321.

3.6 Welded, soldered or brazed joints between sections of copper pipe and between pipe and fittings shall be in compliance with ANSI B31.1. Make joints in piping system tight and leak-proof against the design pressure. Peening of welded joints to correct leaks will not be permitted. Brazed or soldered joints that leak shall be disassembled, cleaned, and made again.

3.7 Setting Valves and Valve Boxes

A. Install valves with operator stems in the vertical plane through the pipe axis and perpendicular to the pipe axis. Locate valves where shown on Drawings. Thoroughly clean before installation. Check valves for satisfactory operation.

B. Equip all underground valves with valve boxes where shown on the Drawings. Set valve boxes in accordance with Standard Details. Set box in alignment with valve stem centered on valve nut. Set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement. PVC extensions shall not be permitted.

C. Construct manholes for all underground valves where shown on the Contract Drawings. Construct manholes so as to prevent transmitting any load or shock to the valve or pipe. Locate manholes and valve relative to each other in order that packing, operator and other parts of the valve are readily accessible for minor repairs.

3.8 Manhole shall be constructed to the elevations shown on the Contract Drawings in accordance with the provisions of Standard Details.

A. Set manhole base section on bed of VDOT #57 stone to a minimum depth of 6”. Stone shall be thoroughly compacted and carefully leveled.

B. Join all manhole riser and cone or flat slab top sections by the use of rubber gaskets.
C. Plug lift holes and repair any defects in manhole.

D. Set adjusting rings in portland cement mortar bed.
   (1) Rings will not be required outside of paved roadways or walkways unless called for on the Drawings.
   (2) Rings in paved roadways or walkways shall permit upward or downward adjustment of manhole frame by 6".

E. Set manhole frame in bed of sealant. Bed shall consist of one, 3/8" bead laid flush with the inside edge of the frame base and another 3/8" bead laid flush with the outside edge of the frame base.

F. Bolt watertight manhole frames to manhole cone or flat slab top section as shown on the Standard Details.

3.9 Install precast concrete vaults in accordance with the manufacturer’s written recommendations. Provide a 6-inch layer of clean VDOT No. 57 coarse aggregate fill beneath each vault.

3.10 Construct concrete cap or cradle in accordance with the latest edition of the VDOT Road and Bridge Standards at locations where the vertical separation between the new water main piping and adjacent utilities is less than 6 inches.

3.11 Locate fire hydrants as shown on Drawings and in accordance with Standard Details.

3.12 Provide air and vacuum valve at locations shown on Drawings. Install gate valve between water main and relief valves. Construct manholes for air and vacuum relief valve as shown on Drawings.

3.13 Provide restrained joint type pipe at all changes in direction of pressure pipelines and as shown on Drawings.
   A. Where mechanized joint retainer glands are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.
   B. All pipe joints shall be restrained a minimum of 80 feet on each side of a fitting or valve.

3.14 Installation of Tapping Sleeves and Tapping Valves
   A. All tapping sleeves shall be set to avoid interference with existing pipe joints.
   B. After all tapping sleeves and valves have been set in place, a pressure test of 150 psi shall be made to insure that there are no leaks around the sleeve
or through the valve. All leakage shall be corrected.

C. The actual tap shall be made in presence of a representative of the County. The County shall be notified 48 hours in advance of making the tap.

3.15 Detectable Tape

A. Install marking tape in all trenches containing buried, non-metallic, pressure pipe lines. Tape shall be installed in all trenches with a cover of 18" to 54" and a minimum clearance over the pipe lines of 18". Place tape on edge of trench toward the center of the pavement in roadways. In other locations, place tape to the north or east of the utility line. Wrap tape around all valves, corporation stops and meter setters. Wrap tape three turns around base of fire hydrants and extend tape up above ground against fire hydrants. Tape shall be made electrically conductive throughout the entire system through the use of splices of a type recommended by the manufacturer.

3.16 Trace Wire System

A. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

B. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

C. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

D. Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5’ intervals.

E. Trace wire shall be properly grounded as specified.

F. At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire (See Grounding).

G. Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end. Ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.
H. All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.

I. In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

J. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.

K. Lay mainline trace wire continuously, by-passing around the outside of valves and fittings on the North or East side.

L. Trace wire on all water service laterals must terminate at an approved trace wire access box color coded blue and located directly above the service lateral at the edge of road right-of-way.

M. Above-ground tracer wire access boxes will be installed on all fire hydrants.

N. All conductive and non-conductive service lines shall include tracer wire.

O. Testing

(1) All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor and Caroline County as applicable, prior to acceptance of ownership.

(2) This verification shall be performed upon completion of rough grading, and again prior to final acceptance of the project.

(3) Continuity testing in lieu of actual line tracing shall not be accepted.

3.17 Disinfection of Water Lines

A. Disinfect and test water mains and accessories in accordance with AWWA Standard C651 and the following:

B. All water lines shall be disinfected prior to being placed in operation and in accord with the Caroline County Public Utilities “Guidelines for Flushing and Testing of Water Lines” and these specifications. Where these specifications are more stringent than the “Guidelines”, use these specifications.
C. Prior to disinfection, all water lines shall be flushed. All valves and hydrants shall be operated during this operation. Flushing velocities should not be less than 3.0 ft./sec. Adequate provisions shall be made for drainage of flushing water.

D. Methods of Chlorine Application

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

(2) Slug Method - Potable water shall be introduced into the pipe line at a constant flow rate. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/L in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the pipe are exposed to the 100 mg/L chlorine solution for at least 3 hours. The chlorine residual shall be checked at regular intervals not to exceed 1200’ to insure that adequate disinfection is occurring. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances.

(3) Tablet Method - This method shall not be used if non-potable water or foreign materials have entered the lines or if the water temperature is below 50°C (41°F).

The tablets shall be placed in each pipe section and in all appurtenances. Enough tablets shall be used to insure that a chlorine concentration of 25 mg/L is provided in the water. They shall be attached by an adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The adhesive shall be acceptable to the State Health Department. The filling velocity of the potable water in the pipe line shall be less than 1 ft./sec. The water chlorine solution shall remain in contact with the pipe for 24 hours. All valves and appurtenances shall be operated while the chlorinated water is in the pipe line.

E. Final Flushing - After the required retention period, the heavily chlorinated water shall be flushed from the pipe line using potable water.

F. Testing - After the lines have been flushed, the water lines shall be tested. Samples shall be collected at regular intervals, not exceeding 1200’
throughout the length of pipe line.

(1) All chlorine residual determinations shall be made using only those methods approved by the State Health Department.

(2) Two water samples for bacteriological analysis must be collected at least 16 hours apart and analyzed by a certified laboratory. The results of these samples must indicate no coliform contamination before the pipe, tanks, or equipment can be utilized as part of the waterworks. If contamination is indicated, then the disinfection procedures must be repeated.

G. Maintain a copy of AWWA Standard C651 on Project site during all disinfecting operations.

3.18 Acceptance Tests

A. Supply the pumps, calibrated gages and meters, and all the necessary apparatus. Notify Caroline County at least 48 hours in advance of the test date and perform tests in presence of Caroline County's representative.

B. Caroline County will supply water at no cost for one test of potable water lines only; all other water will be supplied by the Contractor at his own cost.

C. After the line has been backfilled, subject the line or any valved section of the line to a hydrostatic pressure test in accordance with AWWA C600, except as modified herein. Fill the system with water at a velocity of approximately 1' per sec. while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 1.5 x the working pressure. Test pressures shall: (1) Not be less than 1.25 x the working pressure at the highest point along the test section, (2) not exceed thrust restraint pressure, (3) not vary by more than + or -5 psi, (4) not exceed twice the rated pressure of the valves or hydrants when test includes closed gate valves, (5) not exceed rated pressure of valves if resilient-seated butterfly valves are used, (6) shall be at least 100 psig. Measure pressure at the low point on the system compensating for gage elevation. Maintain this pressure for two hours. If pressure cannot be maintained, determine cause, repair and repeat the test until successful.

D. A leakage test shall be conducted concurrently with the pressure test in accordance with AWWA C600, except as modified herein. Leakage shall be determined with a calibrated test meter, furnished by the Contractor. Leakage is defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and
the pipe filled with water. Leakage loss shall not exceed the following leakage formula:

\[ L = SD \left( \sqrt{P} \right) / 148,000 \]

where:  
- \( L \) = Allowable leakage in gallons/hour  
- \( S \) = Length of pipe line testing in feet  
- \( D \) = Nominal diameter of pipe in inches  
- \( P \) = Average test pressure during leakage test in psig

If leakage exceeds that specified, find and repair the leaks and repeat the test until successful. Line shall be re-disinfected and tested (bacteriological and pressure)

E. All visible leaks shall be repaired regardless of the amount of leakage.

F. No leakage will be allowed for welded steel pipe. If leaks are revealed by test, repair by re-welding. Peening of leaks will not be allowed.

END OF SECTION
1.0 GENERAL

Work in this Section includes all exterior sanitary sewer system and force main work on the construction plans.

1.1 Related requirements in other sections of the Specifications.

1.2 Reference Specifications are referred to by abbreviation as follows:
   A. American National Standards Institute ....................................................... ANSI
   B. American Society for Testing and Materials ............................................. ASTM
   C. American Water Works Association ....................................................... AWWA
   D. Virginia Department of Transportation ................................................. VDOT

1.3 Definitions
   A. Outside or exterior shall mean 5' beyond the perimeter of buildings, except that footing drains are included.
   B. Inside or interior shall mean inside buildings and within 5' of the perimeter of buildings, except that footing drains are excluded.

1.4 Separation of water lines and sanitary sewers.
   A. Follow State Health Department "Waterworks Regulations" for separation of water mains and sewer lines.

   B. Parallel Installation
      (1) Normal Conditions - Water lines shall be constructed at least 10' horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.
      (2) Unusual Conditions - When local conditions prevent a horizontal separation of at least 10', the water line may be laid closer to a sewer or sewer manhole provided that:
          (a) The bottom of the water line is at least 18" above the top of the sewer.
(b) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. Crossing

(1) Normal Conditions - Water lines crossing over sewers shall be laid to provide a separation of at least 18" between the bottom of the water line and the top of the sewer whenever possible.

(2) Unusual Conditions - When local conditions prevent a vertical separation described in Crossing, Normal Conditions, Paragraph C above, the following construction shall be used.

(a) Sewers passing over or under water lines shall be constructed of the materials described in Parallel Installation, Unusual Conditions - Paragraph (B) above.

(b) Water lines passing under sewers shall, in addition, be protected by providing:

   (1) A vertical separation of at least 18" between the bottom of the sewer and the top of the water lines.

   (2) Water lines passing under sewers shall, in addition, be protected by providing:

   (3) That the length of the water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. Sanitary sewers or sewer manholes - No water pipes shall pass through or come in contact with any part of sewer or sewer manhole.

2.0 PRODUCTS

2.1 Piping Application

A. All below grade force main piping shall be constructed of heat fusion PE 3408/3608 high Density Polyethylene (HDPE) pressure rated pipe, 160 psi (DR-11); heat fusion joint PE 6710 High Density Polyethylene (HDPE) pressure rated pipe, 160 psi (DR-13.5); push on joint DR 25 Pressure Class 165 psi AWWA C900 polyvinyl chloride (PVC), or restrained joint ductile iron pipe Special Thickness Class 52 ANSI/AWWA C159 and C151. Force main shall be constructed of a single material.
B. All below grade gravity sewer 4” through 15” shall meet the requirements of ASTM Standard D 3034 SDR 35, type PSM.

C. All below grade gravity sewer 15” through 27” shall meet the requirements of ASTM F679 wall thickness T-1, PS 46.

D. All below grade gravity sewer 4” through 27” shall meet the requirements of AWWA/ANSI C151/A21.51 for pressure 150 and AWWA C151 for thickness Class 51.

E. All pressure sewers 3-inch and greater in diameter in vaults shall be flanged ductile iron pipe Special Thickness Class 53 and shall meet the requirements of AWWA/ANSI C115/A21.5

2.2 Pipe

A. High Density Polyethylene (HDPE) Pressure Sewer Pipe:

(1) Pipe: PE 3408/3608 high density polyethylene meeting: ASTM 2239; ASTM D3350 cell classification 345464C for black and 345464E for color identification stripes; manufactured in accordance with ASTM D3035 for 6-inch diameter DIPS, DR-11, 160 psi pressure-rated.

(2) Pipe: PE 4710 high density polyethylene meeting: ASTM 2239; ASTM D3350 cell classification 345464C for black and 345464E for color identification stripes; manufactured in accordance with ASTM D3035 for 6-inch diameter DIPS, DR-13.5, 160 psi pressure-rated.

(3) Pipe shall be marked in accordance with ASTM F714 and AWWA C906. Marking will indicate the pipe’s Pressure Rating (PR) and Pressure Class (PC).

(4) Fittings: Fittings shall be of the same materials and classifications as the pipe unless otherwise indicated. If a fitting is to be a ductile iron fitting it shall be a Special Thickness Class 52 ductile iron fitting and shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of pipe. The ductile iron fitting shall be equipped to adapt to the HDPE pipe and provide a leak proof seal.

(5) Polyethylene fittings and custom fabrications shall be molded or fabricated by an Approved Manufacturer. All fittings and custom fabrications shall be pressure rated for the same internal pressure rating as the mating pipe.
(6) Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked. Molded fittings shall be tested in accordance with AWWA C906.

(7) Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full service pressure rating of the mating pipe. Fabricated fittings shall be tested in accordance with AWWA C906.

(8) Joints: Butt fusion between plain ends of polyethylene pipe; restrained mechanical for transition between pipe, valves, etc., of differing materials as approved by Engineer.

B. Polyvinyl Chloride (PVC) Pressure Piping:

   (1) Pipe: Polyvinyl chloride (PVC) pressure piping, 6 inches in diameter, shall meet requirements of AWWA C900. Pipe shall be DR 25, Pressure Class 165. Pipe connection shall be plain end pipe with a rubber gasketed coupling or plain end and rubber gasketed bell end. Pipe shall conform to the outside dimension of ductile iron pipe.

   (2) Fittings: Special Thickness Class 52 ductile iron fittings shall be used in conjunction with PVC pressure piping. Fittings shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of pipe.

   (3) Restraining devices for pipe fittings shall be Uni-Flange Series 1300 by Ford Meter Box Company, Inc., or approved equal by EBAA Iron, Inc., or Romac Industries, Inc. Restraining devices for pipe joints shall be Uni-Flange Series 1390 by Ford Meter Box Company, Inc., or approved equal by EBAA Iron, Inc., or Romac Industries, Inc.

C. Ductile Iron Pipe:

   (1) Ductile iron pipe for pressure sewers shall be Special Thickness Class 52 and Class 51 for gravity sewers unless otherwise indicated and shall meet requirements of ANSI/AWWA C150 and C151.

   (2) Fittings shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of the pipe.

   (3) Provide mechanical joints or push-on joints for underground piping. Jointing materials shall meet requirements of ANSI/AWWA C111.
Mechanical joint retainer glands shall be ductile iron and shall be manufactured by EBAA Iron, Inc, or approved equal by American Cast Iron Pipe Company, Ford Meter Box Company, or Romac Industries, Inc.

Restrained joints shall be “FLEX-RING” as manufactured by American Cast Iron Pipe Company, “TR FLEX” as manufactured by U.S. Pipe and Foundry Company, “SNAP-LOK” as manufactured by Griffin Pipe Products Company, or approved equal. Jointing materials shall meet requirements of ANSI/AWWA C111.

Push-on joint and rubber gasket shall meet requirements of ANSI/AWWA C111. Restrained push-on joints may be used where restrained joints are required.

Provide flanged joints for all above ground piping and as indicated on the drawings. Flanges shall meet requirements of Class 125 ANSI B16.1.

Flanged joint gaskets shall be full face, made of rubber, and shall meet requirements of ANSI/AWWA C111/A21.11.

Cement mortar lining with bituminous seal coat for ductile iron pipe and cast iron fittings shall meet requirements of ANSI/AWWA C104. Cement mortar lining shall be standard thickness.

Exterior, bituminous coating shall meet requirements of ANSI/AWWA C110, C115, C151, and C153 as applicable.

Valve boxes shall be adjustable cast iron valve boxes of the three piece type, consisting of lid, two piece screw type extension and base. Base shall be proper type and size for the valve with which it is used. The word "Sewer" shall be cast or embossed on the valve box lid in letters not less than 1" high. Valve box shall be manufactured by Mueller Company, Richard Foundry, or Tyler.

Plug Valves

A. General

Valves shall be of the non-lubricated type. Valves in sizes 36" and smaller shall be designed for a working pressure of 150 psi. Valves in sizes 42" and larger shall be designed for a working pressure of 125 psi. Valves shall provide tight shutoff with rated pressure from either direction.
(2) Ports in valves shall be round or rectangular style. Where rectangular port valves are furnished, valves shall have a minimum flow area of 100% of corresponding port area.

(3) Valve bodies shall be of ASTM A-126, Class B cast iron. Valves shall have a molded elastomer covering all seating surfaces. The elastomer shall be suitable for the service intended. Valves 3" and larger shall have welded-in overlay seat of nickel-copper alloy conforming to ASTM B127. Nickel content shall be not less than 90% nickel. Overlay shall be applied to all surfaces in contact with plug face.

(4) Plugs shall be of cast iron complying with ASTM A126, Class B or ductile iron complying with ASTM A126, Grade 65-45-12. Plugs shall be of one piece construction.

(5) Valves shall be equipped with PTFE thrust bearings on the upper and lower bearing journals. Bearings shall be permanently lubricated and replaceable, sleeve type bearings conforming to AWWA C504-10, Sec. 3.6 and AWWA C507-85, Sec. 3.2. Bearings shall be of sintered oil impregnated type 316 stainless steel, ASTM A743, Grade CF-8M.

(6) Valve shaft seals shall be of the "U" type in accordance with AWWA C504-87, Sec. 3.7. Seals shall be self-adjusting and repackable without removing the bonnet from the valve.

(7) Each valve shall be given a hydrostatic and seat test in accordance with AWWA C504-87, Sec. 5.2. Certified copies of test results and Proof-of-Design shall be furnished in accordance with the cited standard, when requested.

B. Operators

(1) Valves shall be equipped with 2" sq. operating nuts unless otherwise shown on the Drawings. Operating torque shall be 450 ft./lbs. Where nuts will be more than 48" below finished grade, extension stems shall be pin connected to valve stem. Extension stem shall raise operating nut to within 24" of finished grade.

C. Manufacturer

(1) The valves shall be as manufactured by Flomac, DeZurik, Clow or approved equal.

2.5 Flexible couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section
gaskets and sufficient galvanized track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be manufactured by Dresser Manufacturing Company or Smith-Blair.

2.6 Flanged adapters for joining plain-end pipe to flanged items shall be 128 or 127 as manufactured by Dresser Manufacturing Division of Dresser Industries or Smith-Blair type 912 or 913.

2.7 Pressure gages shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4½" white coated dial graduated from 0 to 100 psi. Gages shall be Ashcroft No. 1279.

2.8 Compound gages shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4½" white coated dial graduated from 0 to 100 psi and 0 to 30" vacuum.

2.9 Sewage Combination Air Valves

A. Sewage combination air valves shall be APCO Model 443 sewage combination air valves as manufactured by Valve and Primer Corporation, 1420 South Wright Blvd., Schaumburg, Illinois 60193, Val-Matic Corporation, or approved equal. Valves shall have the following dimensions:

(1) Inlet Diameter: 2-inch NPT
(2) Outlet Diameter: 2-inch NPT
(3) Large Orifice: 2-inch
(4) Small Orifice Diameter: 7/32-inch

B. Valves shall have cast iron body and cover, bronze mechanism and seat, Buna-N needle, and stainless steel float and lever pins. Valves shall be equipped with valved quick disconnect coupling for backflushing, inlet and blowoff valves, and minimum of 10 feet of hose for backflushing.

C. Provide double strap stainless steel banded service saddle and corporation stop approved for wastewater use for connection to force main.

2.10 Steel casing pipe for trenchless installation under highways, railroads or streams shall meet requirements of ASTM A 139, Grade B. Nominal pipe diameter and wall thickness shall be as indicated on the drawings. No protective coating or lining, nor hydrostatic testing will be required.
A.  Casing Spacers/End Seals

(1) Casing spacers shall be bolt-on style with a two-piece shell made from T-304 stainless steel of a minimum 14-gauge thickness. Each shell section shall have bolt flanges formed with ribs for added strength. Each connecting flange shall have a minimum of three 5/16-inch T-304 bolts. The shell shall be lined with a ribbed PVC extrusion with a retaining section that overlaps the edge of the shell and prevents slippage. Bearing surfaces (runners) made from UHMW polymer with a static coefficient of friction of 0.11-0.13 shall be attached to support structures (risers) at appropriate positions to properly support the carrier within the casing and to ease installation. The runners shall be attached mechanically by T-304 threaded fasteners that are inserted through the punched riser section and tig-welded for strength. Risers shall be made of T-304 stainless steel of a minimum 14-gauge. All risers over 2 inches in height shall be reinforced. Risers shall be migwelded to the shell. All metal surfaces shall be fully chemically passivated. Casing spacers shall be Model CCS as manufactured by Cascade Waterworks Manufacturing Company, 1213 Badger Street, Yorkville, Illinois 60560, Telephone Number: (800) 426-4301, or Model S12G-2 by Pipeline Seal and Insulator, Inc, 6525 Goforth Street, Houston, Texas 77021, Telephone Number: (800) 423-2410.

(2) End seals shall be Link-Seal as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

2.11 Manholes

A.  Manholes shall be constructed of pre-cast reinforced concrete manhole sections in accordance with the requirements of ASTM C478 and detailed in Standard Details.

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

C.  Provide tongue and groove joints in manhole sections with a preformed groove in the tongue for placement of an O-ring type round, rubber gasket.

(1) Gasket shall comply with requirements of ASTM C361.

(2) Gasket shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure.

D.  Provide flexible pipe connections to manholes, other than acid-resistant manholes, for pipes 15” and smaller in size.

(1) Materials shall be resistant to water, sewage, acids, ozone, weathering and aging. Use neoprene conforming to ASTM C443
and stainless steel, Series 300.

(2) Cast or core drill openings in manholes to receive connectors. Connectors shall be suitable for field repair or replacement. Connectors not suitable for field replacement are unacceptable.

(3) The assembled connectors shall allow at least an 11° angular deflection of the pipe and at least 1” of lateral misalignment in any direction and be suitable for a normal variation in diameter or roundness for the pipe material used.

(4) Connectors shall be similar to Kor-n-Seal as manufactured by National Pollution Control Systems, Inc.

E. Liners for acid-resistant manholes shall be of fiberglass reinforced polyester or polyvinylchloride construction and shall be installed to protect the pre-cast manhole sections from the inside base of the manhole to the base of the manhole frame.

(1) FRP liners shall consist of a 3/16” thick fiberglass reinforced polyester with a 15 mil gel coat interior surface. The polyester resin shall be similar to Dion No. 6694. Joints between sections of the liner shall be sealed in accordance with the manufacturer's instructions.

(2) PVC liners shall consist of polyvinylchloride plates, not less than 0.060” thick, with integral bonding ribs and shall be similar to Amercoat "T-Lock Amer-Plate". Joints between sections of liner shall be welded in accordance with the manufacturer's instructions.

F. Sealant for manhole frames shall be a mastic sealant similar to Pioneer 301 Mastic.

G. Sealant for flexible pipe connections shall be a two-component polyurethane sealant similar to Sika "Sikaflex" Type 2c with primer Type 429.

H. Manhole steps shall be corrosion-resistant and shall be 1” square cast iron, rubber-covered steel or aluminum. The steps shall conform to the dimensions shown in Standard Details.

I. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 30. Castings shall be coated with a coal tar pitch varnish, to which sufficient oil has been added to make a smooth coating, tough and tenacious when cold, but not tacky or brittle. Seating surfaces between frame and cover shall be machined. The dimensions and weights shall conform to the requirements shown in Section 00870 - Standard Details.
(1) Standard Manhole Frame and Cover shall be similar to Richards Foundry Corporation No. D-1125.

(2) Vandal-proof Manhole Frame and Cover shall be similar to Neenah Foundry Co., Cat. No. R-1926-C with 4 - 1" diameter vent holes.

(3) Watertight Manhole Frame and Cover shall be similar to Richards Foundry Corporation No. B-9960.

2.12 Detectable Marking Tape

A. Plastic marking tape shall consist of one layer of aluminum foil laminated between two layers of inert plastic film. Tape shall be resistant to alkalis, acids and other destructive agents commonly found in the soil. The laminate shall be strong enough that the layers cannot be separated by hand.

B. Tape shall be a minimum of 4½ mils thick with a minimum tensile strength of 60 lbs. in the machine direction and 58 lbs. in the transverse direction per 3" wide strip. Tape color shall be APWA Color Coded for marking the particular utility line and shall be imprinted with a continuous warning message to indicate the type of utility being marked, the message normally being repeated every 16" to 36". Tape shall be inductively locatable and conductivity traceable using a standard pipe and cable locating device. Tape shall be 3" wide Terra Tape "Sentry Line Detectable 620".

2.13 Trace Wire System

A. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked. (Green for sewer).

   (1) Open Trench: Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.

   (2) Directional Drilling/Boring: Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

   (3) Trace Wire – Pipe Bursting/Slip Lining: Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.
B. Connectors

(1) All mainline trace wires shall be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.

(2) Direct Bury Wire Connectors: Shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.

(3) Non locking friction fit, twist on or taped connectors are prohibited.

C. Termination/Access

(1) All trace wire termination points shall utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

(2) All grade level/in-ground access boxes shall be appropriately identified with “sewer” cast into the cap and shall be color coded.

(3) A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.

(4) All trace wire access boxes shall include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for grounding anode wire connection.

(5) Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

(6) Service Laterals on Public Property: Trace wire must terminate at an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.

(7) Service Laterals on Private Property: Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above
finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.

(8) Long-runs, in Excess of 500 Linear Feet without Service Laterals: Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a marker post, color coded per APWA standard for the specific utility being marked. (See Standard Details Drawing No. 127.)

D. Grounding

(1) Trace wire must be properly grounded at all dead ends/stubs.

(2) Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 ft. of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.

(3) When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.

(4) When grounding the trace wire in areas where the trace wire is continuous, and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. The grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.

(5) Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

2.14 Precast Reinforced Concrete Vaults for Air Release Valves

A. Valve vaults shall be manufactured by Rotondo Precast, Americast, Tindall Corporation, Engineered Fluid, Inc., or approved equal. Vaults shall meet requirements of ASTM C 890 and ASTM C 913. Top sections for all valve vaults shall be designed to withstand HS-20 traffic loading. Vaults shall be manufactured as indicated on the drawings and shall be watertight. Provide wall sleeves, aluminum access hatches, aluminum access ladder, manhole steps, vents, and other appurtenances as specified.
herein and indicated on the drawings to ensure complete assembly. Valve vaults shall be anti-buoyant.

B. Provide adequate concrete riser sections to bring HS-20 traffic loading rated aluminum access hatches to grade.

C. Concrete/Reinforcing Steel Requirements: Provide an air content of 6%, ±2% and a minimum wall thickness of 6 inches. ASTM A 615 reinforcing bars, ASTM A 497 welded wire fabric, ASTM C 443 gaskets for joint connections. Vaults shall be manufactured with calcareous aggregate so that the finished product shall have an AZ factor equal to 90. Sleeves through concrete or masonry walls or slabs shall be cast iron or Schedule 40 steel. Provide sleeves through walls, floors, and ceilings for all pipe penetrations except where wall pipes are indicated.

D. Precast concrete vault top shall be equipped with an access hatch.

(1) The access hatch shall have a 1/4 inch (7mm) thick, mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1-1/2 inch (38mm) drainage coupling shall be located in the front left corner of the channel frame. Hatch drain shall be equipped to outfall outside of the vault. A bituminous coating shall be applied to the frame exterior where it will come into contact with concrete. The door panel shall be 1/4” (7mm) aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf (1464 kg. psm) uniform live load with a maximum allowable deflection of 1/150 of the span and shall not protrude into the channel frame when in the open position. Doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open arm with an aluminum release handle. For ease of operation, the hold open arm shall incorporate an enclosed stainless steel compression spring assist. Doors shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all hardware shall be T-316 stainless steel. Hatch shall be equipped with locking hasp and associated hardware. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle. Coordinate keying of lock with the Owner. Unit shall carry a lifetime guarantee against defects in material and/or workmanship. The access hatch shall be a W2C series hatch as manufactured by Halliday Products, Inc. of Orlando, Florida or approved equal.

E. Vault shall be equipped with an access ladder with a telescoping ladder safety extension.

(1) The telescoping access ladder shall be constructed entirely of aluminum. The rails shall be 1/2” x 2 3/4” (13mm x 70mm) aluminum extrusion and shall be spaced 16” (406mm) apart. The
wall mounted standoffs shall be 3/8” x 2 1/2” (10mm x 64mm) flat bar and welded to the rails at a maximum of 60” (1.5m) on center. The standoffs shall be a minimum of 7” (178mm) and manufactured to fit flush with the wall. 1 3/8” (35mm) diameter type “D” rungs with flat slip resistant surface shall be spaced at 12” (305mm) on center and welded to the outside of each rail. The access ladder shall be a series L1D ladder as manufactured by Halliday Products Inc. of Orlando, Florida, or approved equal.

F. Ladder Safety Extension

(1) The ladder safety extension shall be constructed entirely of aluminum and stainless steel. The aluminum housing shall mount to the ladder by means of stainless steel channel clamps secured to the ladder rungs with stainless steel “U” bolts. The aluminum telescoping post shall extend 37” (940mm) (for Model A) above the top of the housing and lock into position with a stainless steel pin. The ladder safety extension shall be a Model A series L1E safety extension as manufactured by Halliday Products Inc. of Orlando, Florida, or approved equal.

3.0 EXECUTION

3.1 Take all precautions necessary to insure that pipe, valves, fittings, and related items are not damaged in unloading, handling and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

A. Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling and placing in trench. Close ends of in-place pipe at the end of any work period to prevent entry of animals and foreign material.

B. Bed pipe as specified in Trenching & Backfilling.

C. Do not lay pipe when weather or trench conditions are unsuitable.

3.2 Lay gravity sewers so as to maintain a true alignment and grade as indicated on Contract Drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

A. Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.

B. Pipe Joint. Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives and similar materials as recommended by the manufacturer. Place, fit, join and adjust the jointing materials or factory
fabricated joints as recommended by the manufacturer to obtain the degree of water tightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified under Trenching & Backfilling, along each side of the pipe to resist forces that might tend to move the pipe off line and grade.

C. Complete backfilling as specified under Trenching & Backfilling. Place backfill over the pipe immediately after the pipe has been laid. Provide ductile iron pipe where cover over main line sewer pipe is less than 5.5' in public roads and 3.5 in easements.

3.3 Install force main with a minimum depth of cover of 42" over the top of the pipe, where no grades are shown on the Drawings.

A. Where grades on the force main conflict with existing pipes or structures, lay force main to additional depth with a uniform vertical curve to provide proper clearance without the use of fittings and without creating a high point in the line. No additional payment will be allowed for additional excavation. Provide allowance for expansion as directed by the County.

B. Lay force main pipe with bell ends facing the direction of laying. Where grade is 10% or greater, pipe shall be laid uphill with bell ends upgrade.

3.4 Joining Pipe

A. Join mechanical joint pipe as follows:

(1) Thoroughly clean inside of the bell and 8" of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter from the joint. Paint the bell and spigot with soap solution (half cup granulated soap dissolved in 1 gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

(2) Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that is located evenly around the joint. The gland is moved into position, bolts inserted and nuts screwed up finger tight, then tighten all nuts to torque listed below. Contractor shall provide a calibrated torque wrench for verification of torque.
<table>
<thead>
<tr>
<th>Bolts Size – Inches</th>
<th>Torque Ft. - Lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>40 - 60</td>
</tr>
<tr>
<td>3/4</td>
<td>60 - 90</td>
</tr>
<tr>
<td>1</td>
<td>70 - 100</td>
</tr>
<tr>
<td>1¼</td>
<td>90 - 120</td>
</tr>
</tbody>
</table>

(3) Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.

(4) Permissible deflection in mechanical joint pipe shall not be greater than listed in AWWA C600.

B. Join push-on joint Ductile Iron pipe as follows.

(1) Thoroughly clean inside of the bell and 8” of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to either the gasket or the spigot end of the joining pipe.

(2) Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.

(3) Permissible deflection in push-on joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

C. Join reinforced concrete pipe with rubber gaskets installed as recommended by the manufacturer.

D. Install PVC pipe in accordance with ASTM D-2321.

E. Set valves and valve boxes as follows.

(1) Set vertically installed valves with stems in the vertical plane through the pipe axis and perpendicular to the pipe in the plane 90° to the pipe axis. Locate valves where indicated on Drawings. Thoroughly clean valves before installation. Check valves for satisfactory operation.

(2) Equip all underground valves without gearing or operators with valve boxes. The box shall be in alignment with valve stem centered on valve nut. The valve box shall be so as not to transmit
shock or stress to the valve. Set box cover flush with the finished ground surface or pavement.

3.5 Provide force main combination air valves at locations indicated on Drawings and at all high points of the mains. Install gate valve between main and air valves. Construct precast reinforced concrete vault for combination air valves.

3.6 Use sleeves where pipes, valves stem extensions or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be either cast iron or schedule 40 steel of sufficient size to allow sealing around pipes and clearance for valve stems or equipment. Extend vertical sleeves through slabs 1" above top surface.

A. Use cast iron sleeves with intermediate collars to anchor and provide a water stop on outside of sleeves that pass through exterior walls below grade. Seal pipes using oakum and leadite.

3.7 Provide retainer gland at all changes in direction of pressure pipelines and as shown on Drawings.

A. Use retainer gland restraints as indicated on Drawings.

B. All pipe joints shall be restrained a minimum of 80 feet each side of valve or fitting.

3.8 Construct service connections for sewer main to property line as follows:

A. Place a tee fitting with 4 or 6" outlet in the sewer where service connection is to be constructed. Lay pipe from the tee to the property line on a grade of not less than ½" per foot or lay ductile iron pipe or PVC pipe on a grade of not less than 1/8" per foot. Close service connection at the property line with a water-tight plug. See Standard Details.

B. Install service connections on existing sewer mains with a compression type cast iron saddle as manufactured by Pioneer, Geneco or approved equal. Secure saddle to the pipe with a 24 gage stainless steel strap and two nickel-bronze T bolts. Make connections of this type by machine tapping or cutting the pipe. Use mastic sealer type gasket to insure a water-tight connection.

C. Determine the depth of service connections by the deepest of the following:
(1) Provide 5' cover at the edge of the road paving or 15' from the center line of the street.

(2) Provide 18" cover at the bottom of highway ditches unless protected by concrete ditch apron.

(3) Provide 30" cover at the property line when property is above street.

(4) Provide depth necessary for a 1% grade if required to provide service to a property.

D. Place a 2" x 4" solid piece of lumber at the end of each service connection. The 2" x 4" marker shall be set vertically and extend from invert to 6" above grade.

E. Construct concrete pedestals where shown on the Drawings and/or as directed by the County, in accordance with Standard Detail.

F. Provide ductile iron pipe or concrete encasement where cover over sewer connections is less than 3.5' in public roads or right-of-way and 3.5' in easements.

3.9 Manholes shall be constructed to the elevations shown on the Contract Drawings in accordance with the provisions of Standard Details.

A. Set manhole base section on bed of VDOT #57 stone to a minimum depth of 6". Stone shall be thoroughly compacted and carefully leveled.

B. Join all manhole riser and cone or flat slab top sections by the use of rubber gaskets.

C. Pack and brush joints in FRP lining in acid-resistant manholes with sealant to provide a watertight and acid-resistant seal. Field weld joints in PVC lining of acid-resistant manholes in accordance with manufacturer's instructions.

D. Install pipe stubs in manholes where called for on the Contract Drawings. All stubs shall extend 12" -18" beyond the manhole and shall be sealed watertight with a plug or cap.

E. Install flexible manhole connections for all pipes sizes 8” to 15”, inclusive and apply sealant to completely fill joint between manhole barrel and flexible connection for the full thickness of the manhole barrel.

F. Plug lift holes and repair any defects in manhole.

G. Set adjusting rings in portland cement mortar bed.
(1) Rings will not be required outside of paved roadways or walkways unless called for on the Contract Drawings.

(2) Rings in paved roadways or walkways shall permit upward or downward adjustment of manhole frame by 6”.

H. Set manhole frame in bed of sealant. Bed shall consist of one, 3/8” bead laid flush with the inside edge of the frame base and another 3/8” bead laid flush with the outside edge of the frame base.

I. Bolt watertight manhole frames to manhole cone or flat slab top section as shown on the Standard Details.

J. Construct drop connections where called for on the Contract Drawings.

(1) Drop connection shall be constructed of ductile iron pipe and fittings.

(2) Drop connections shall not be encased in concrete.

K. Construct bench of concrete or brick and mortar.

(1) Lowest elevation of bench shall be at the spring line of the outgoing pipe.

(2) Slope bench 3” toward channel for drainage.

(3) Where stubs or knockouts are provided for future pipe connections, bench shall be so formed.

(4) Use sulfate resistant cement for concrete or mortar on all acid-resistant manholes.

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

3.10 Install detectable marking tape in all trenches containing buried pipe lines. Tape shall be installed in all trenches with a cover of 18” to 54” and a minimum clearance over the pipe lines of 18”. Place tape on edge of trench toward the center of the pavement in roadways. In other locations, place tape to the north or east of the utility line. Wrap tape around all valves, corporation stops and meter setters. Wrap tape three turns around base of fire hydrants and extend tape up above ground against fire hydrants. Tape shall be made electrically conductive throughout the entire system through the use of splices of a type recommended by the manufacturer.
3.11 Trace Wire Installation

A. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

B. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

C. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

D. Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5’ intervals.

E. Trace wire shall be properly grounded as specified.

F. Trace wire on all service laterals/stubs shall terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace Wire Termination/Access.)

G. At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire (See Grounding).

H. Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end. Ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.

I. All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.

J. In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.

K. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
L. Lay mainline trace wire continuously, by-passing around the outside of valves and fittings on the North or East side.

M. Trace wire on all sanitary service laterals shall terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right-of-way.

N. Testing

(1) All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor and Caroline County as applicable, prior to acceptance of ownership.

(2) This verification shall be performed upon completion of rough grading, and again prior to final acceptance of the project.

(3) Continuity testing in lieu of actual line tracing shall not be accepted.

3.12 Testing Gravity Sewer Lines and Manholes

A. Testing of gravity sewer lines shall be conducted on short sections of sewer line, i.e., between manholes, or at the end of each day's work. Provide all labor, materials, tools, and equipment necessary to make the tests.

B. Sanitary sewer lines 24" diameter and smaller shall be tested after backfill using a low-pressure air test in accordance with the appropriate ASTM Standard Test Method. (F1417 PVC Pipe)

C. Low-pressure air test

(1) Summary of Method: Plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line. Use the quantity and rate of air loss to determine the acceptability of the section being tested.

(2) Preparation of the Sewer Line: Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested to resist the test pressure. Give special attention to laterals.

(3) Ground Water Determination: Install a ½" capped galvanized pipe nipple, approximately 12" long, through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line
acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.

(4) Procedures: Determine the test duration for the section under test by computation from the applicable formulas shown in the appropriate (test method) ASTM. The pressure-holding time is based on an average holding pressure of 3 psi gage or a drop from 3.5 psi to 2.5 psi gage.

Add air until the internal air pressure of the sewer line is raised to approximately 4.0 psi gage. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gage, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psig. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gage during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.

The test procedure may be used as a presumptive test which enables the installer to determine the acceptability of the line prior to backfill and subsequent construction activities.

If the pipe to be tested is submerged in ground water, the test pressure shall be increased to 1.0 psi for every 2.31' the ground water level is above the invert of the sewer.

(5) Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as much as a force of 250 lb. is exerted on an 8" plug by a internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
As a safety precaution, pressurized equipment shall include a regulator or relief valve set at perhaps 10 psi to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

D. Vacuum testing of manholes: Vacuum tests shall be conducted on newly constructed manholes following construction & after all connections have been made but before any backfilling around the manhole. Successful testing shall be accomplished before any backfilling operations.

(1) Provide necessary vacuum pump, pneumatic plugs and accessories required for proper performance of the test. Plugs shall have a sealing strength equal to or greater than the diameter of the connecting pipe to be sealed.

(2) Follow all local, state and federal safety precautions. Brace invert if lines entering the manhole have not been backfilled or otherwise restrained to prevent pipe from being dislodged and pulled into the manhole.

(3) Install vacuum tester head assembly at the top access of the manhole. Adjust the cross brace to insure that the inflatable sealing element inflates and seals against the straight top section of the manhole if possible.

(6) Attach the vacuum pump assembly to the proper connection on the test head assembly. Make sure the vacuum inlet/outlet valve is in the closed position.

(7) Following safety precautions and testing equipment manufacturer's instructions, inflate sealing element to the recommended maximum inflation pressure. Do not overinflate.

(8) Start the vacuum pump assembly engine and allow preset pump to stabilize. Open the inlet/outlet ball valve and evacuate the manhole to 10" Hg (approximately -5psig). Pressurizing the manhole may result in damage to manhole or to test equipment.

(9) Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see table). If vacuum does not drop in excess of 1" Hg, manhole is considered acceptable and the manhole passes the test. If the manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.
<table>
<thead>
<tr>
<th>Depth of Manhole (Feet)</th>
<th>Manhole Diameter (inches)</th>
<th>Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48&quot;</td>
<td>60&quot;</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>18</td>
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<td>18</td>
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<td>41</td>
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<td>20</td>
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<td>60</td>
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<td>28</td>
<td>49</td>
<td>64</td>
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<tr>
<td>30</td>
<td>53</td>
<td>69</td>
</tr>
</tbody>
</table>

(10) Repeat the above test procedure after backfilling manhole for final acceptance test.

3.13 Deflection testing of flexible pipe gravity sewer

A. Conduct deflection tests on all flexible pipe gravity sewer lines in order to verify the roundness and proper installation of the pipelines. When tests are conducted within 30 days after backfilling has been completed and compacted, 95% of the pipe must have a deflection on less than 5%. When tests are conducted more than 30 days after backfilling has been completed and compacted, 92½% of the pipe must have a deflection of less than 7½%. Mandrel diameter shall be in accordance with ANSI/ASTM D-3034 & F-679.

B. Mandrels shall be approved by the County with proving rings prior to use and shall meet the following requirements:

(1) Mandrel Sizing shall be the base pipeline diameter times the percent of deflection limit.
(2) The mandrel shall be of open design to prevent debris build-up from occurring between the channels of adjacent fins which in-turn causes erratic test results. The fin sets shall number at least nine (9) and shall be removable from the mandrel core by unscrewing the wing-nut and loosening the end caps which secure the fins in position. The contact area of the fins shall be equal to the nominal inside diameter of the pipe. Gauges of various diameters shall be assembled by substituting fin sets of appropriate dimension.

C. After the pipeline has been installed and backfill materials have been compacted to their required standard densities, as set out in ASTM D 2321 or other applicable standard, the mandrel shall be pulled by hand through the pipeline with a suitable rope or cable that is connected to an eye-bolt at one end of the gauge. A similar rope or cable shall be attached to the eye-bolt at the opposite end of the mandrel and tension shall be applied to it to insure that the mandrel maintains its correct position during testing and also to remove the mandrel if it should become lodged in an excessively deflected pipeline. Winching or other means of forcing the mandrel through the pipeline are unacceptable.

D. A permanent record of all testing with locations where excessive pipeline deflections occur shall be kept by the Contractor and forwarded to the County after completion of testing and acceptance of each line.

E. The Contractor shall immediately replace all sections of pipe which deflect more than the acceptable limits set out above.

F. All materials and labor required for testing and replacement of pipelines shall be furnished by the Contractor and the cost thereof included in the price bid for furnishing and installing pipelines.

3.14 Force Main tests shall be as follows:

A. Supply the pumps, water, calibrated gages and meters, and all the necessary apparatus. Notify the Owner and the County at least 48 hours in advance of the test date and perform tests in presence of the County.

B. Hydrostatic pressure test. After the line has been backfilled and at least seven days after the last concrete anchor block was poured, a hydrostatic pressure test shall be performed. Carefully fill the system with water at a velocity of approximately 1' per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 50 psi above the working pressure indicated on Drawings, as measured at end of force main closest to sewage pump discharge. Measure pressure at lowest point in system with gage compensated for elevation. Maintain this pressure for at least two hours. No leakage will be allowed and if pressure cannot be maintained determine the cause, repair and repeat the test until successful.
C. All visible leaks shall be repaired regardless of the amount of leakage.

D. A leakage test shall be conducted concurrently with the pressure test. Leakage shall be determined with a calibration test meter, furnished by the Contractor. Leakage is defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed 10 gallons per day per mile per inch of diameter. If leakage exceeds that specified, find and repair the leaks and repeat the test until successful.

END OF SECTION
SECTION 02935 - SEEDING

1.0 GENERAL

1.1 Description

A. Furnish and install all items of seeding as specified herein and shown on the Contract Drawings.

1.2 Reference Specifications are referred to by abbreviation as follows:

A. American Society for Testing and Materials .............................................. ASTM

B. Federal Specifications .................................................................................. FS

1.3 Submit three copies of following:

A. Seed Test Report

B. Fertilizer Analysis

1.4 Materials shall be delivered in unbroken containers, clearly marked by the manufacturer as to contents. Seed, limestone, and fertilizer shall be labeled as to proportions, analysis and quality. Store all materials in a manner affording protection from damage by weather or vandalism.

2.0 PRODUCTS

2.1 Topsoil shall be the top 6” of original soil from the site, unless otherwise noted on the Drawings. Topsoil obtained off-site shall be fertile, friable loam, containing not less than 2 pct., by weight, of finely divided, decomposed vegetable matter. Topsoil shall be free of subsoil, clay lumps, brush, weeds, roots larger than ½” diameter, stones larger than ½” diameter and other material toxic or harmful to growth.

2.2 Fertilizer shall meet requirements of Federal Specification 0-F-241. Provide fertilizer that is complete, inorganic, uniform in composition and suitable for application with approved equipment.

A. Proportions of fertilizer nutrients shall be as follows:

Mixed grasses and legumes: 1000 lbs./acre 10-20-10 or equivalent nutrients (23 lbs./1000 ft²).
Legume stands only: 1000 lbs./acre 5-20-10 (23 lbs./1000 ft²) is preferred; however, 1000 lbs./acre of 10-20-10 or equivalent may be used.

Grass stands only: 1000 lbs./acre 10-20-10 or equivalent nutrients, (23 lbs./1000 ft²).

Other fertilizer formulations, including slow-release sources of nitrogen (preferred from a water quality standpoint), may be used provided they can supply the same amounts and proportions of plant nutrients.

2.3 Certified seed will be used for all permanent seeding. The seed must meet published state standards and bear an official "Certified Seed" label. Grass seed, shall be tested within 6 months of sowing and shall have the following characteristics.

A. Permanent Seeding

1. General Slope (3:1 or less)

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Total Lbs. Per Acres</th>
<th>% Purity</th>
<th>% Germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky 31 fescue</td>
<td>220 lbs.</td>
<td>98</td>
<td>90</td>
</tr>
<tr>
<td>Red Top Grass</td>
<td>5 lbs.</td>
<td>94</td>
<td>80</td>
</tr>
<tr>
<td>Seasonal Nurse Crop*</td>
<td>35 lbs.</td>
<td>96</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>260 lbs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Low-Maintenance Slope (Steeper than 3:1)

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Total Lbs. Per Acres</th>
<th>% Purity</th>
<th>% Germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky 31 Fescue</td>
<td>200 lbs.</td>
<td>98</td>
<td>90</td>
</tr>
<tr>
<td>Red Top Grass</td>
<td>5 lbs.</td>
<td>94</td>
<td>80</td>
</tr>
<tr>
<td>Seasonal Nurse Crop*</td>
<td>35 lbs.</td>
<td>96</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>240 lbs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Use seasonal nurse crop in accordance with seeding dates as stated below:

Feb.16-April...............................................................Annual Rye
May 1-Aug.15.............................................................Foxtail Millet
Aug.16-Oct.................................................................Annual Rye
Nov.-Feb.15 ..............................................................Winter Rye
B. Temporary Seeding

<table>
<thead>
<tr>
<th>Planting Dates</th>
<th>Species</th>
<th>Rate (lbs./acre)</th>
<th>% Purity</th>
<th>% Germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept.1-Feb.15</td>
<td>50/50 Mix of Annual Ryegrass (Lolium multi-florum) &amp; Cereal (Winter) Rye (Secale cereale)</td>
<td>50</td>
<td>97</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>98</td>
<td>84</td>
</tr>
<tr>
<td>Feb.16-Apr.30</td>
<td>Annual Ryegrass (Lolium multi-florum)</td>
<td>100</td>
<td>97</td>
<td>90</td>
</tr>
<tr>
<td>May 1-Aug.31</td>
<td>German Millet (Setaria Italica)</td>
<td>50</td>
<td>98</td>
<td>85</td>
</tr>
</tbody>
</table>

2.4 Lime shall be ground agricultural grade limestone containing not less than 85% calcium and magnesium carbonates. Fineness shall be such that 100% will pass a No. 20 sieve, not less than 50% will pass a No. 100 sieve. Burnt lime or hydrated lime may be substituted in equivalent carbonates, if requested.

2.5 Type I mulch shall be "Hold/Gro" erosion control fabric manufactured by Gulf States Paper Corporation, P. O. Box 3199, Tuscaloosa, Alabama 35401 or equivalent. The fabric shall be manufactured of materials which degrade in 6 to 8 months under outdoor exposure. Type I mulch shall be used on slopes greater than or equal to 3:1.

2.6 Type II mulch composed of straw or hay, fiber mulch or corn stalks shall be free of objectionable weed seeds or other harmful materials. Type II much may be used on slopes less than 3 to 1.

2.7 Type II mulch shall be anchored by means of a mulch anchoring tool, fiber mulch application or a synthetic mulch binder which is organically formulated.

2.8 Fiber mulch shall not be used during the dry summer months or used for a late fall mulch cover. Straw, hay or corn stalk mulch shall be used.

2.9 Asphalt, petroleum based or chemical binders shall not be used.
2.10 Sod shall be composed of at least 70% of Kentucky 31 tall fescue and be cut to provide a minimum thickness of 2". Vegetation more than 5" in height shall be cut to 3" or less before sod is lifted.

3.0 EXECUTION

3.1 Seed all areas within "Limits of Construction" and all areas disturbed during construction.

3.2 Apply seeding products only when wind velocity is less than 15 miles per hours.

3.3 Temporary Seeding

A. Use to reduce erosion and sedimentation in disturbed areas that will not be brought to final grade for a period of more than 30 days. Use to reduce damage from sediment and runoff to downstream or off-site areas, and to provide protection to bare soils exposed during construction until permanent vegetation or other erosion control measures are established.

B. Apply fertilizer at a rate of 600 lbs./acre of 10-20-10 (14 lbs./1,000 sq.ft.) or equivalent nutrients.

C. For loose soil, work lime and fertilizer into soil and then seed. For packed or hard soil, loosen top layer while working lime and fertilizer into soil and then seed at the rate required for the temporary seeding species.

D. Seed shall be evenly applied with a broadcast seeder, drill, culti-packer seeder or hydroteeder. Small grains shall be planted no more than 1" deep. Grasses and legumes shall be planted with no less than 1/4" soil cover.

E. Seeding made in the fall for winter cover and during hot and dry summer months shall be mulched with straw. Fiber mulch will not be considered adequate during these periods.

F. Areas which fail to establish vegetation cover, adequate to prevent rill erosion, shall be reseeded as soon as such areas are identified.

3.4 Permanent Seeding

A. Prepare soil for permanent seeding by tillage of topsoil in place to loosen thoroughly and break up all clods to a depth of 6". Remove all stumps and roots, coarse vegetation, stones larger than 1½" and all construction debris. Soil shall be worked by suitable agricultural equipment to a depth of not less than 4". Rake to a uniform, smooth and drainable surface.
B. Apply lime and fertilizer uniformly and mix well into top 4" of seed bed. Apply lime at the rate of 90 lbs. per 1,000 sq. ft. Apply fertilizer at the rate of 100 lbs. of 10-20-10 per acre or 23 lbs. of 10-20-10 per 1,000 sq. ft. Rates should be adjusted for other grades of fertilizer.

C. Seeding in Lawn and Easement Areas: After final grading, a finely pulverized seed bed shall be prepared using a minimum of 3" of topsoil over the entire area to be seeded. Topsoil, previously placed, may be used to the extent available. Cost of any additional topsoil shall be included in the cost of seeding. Mulch shall be Type II. Type I may be required depending on the slope of area to be seeded.

D. Sow permanent grass seed between dates of March 1 and April 15 or September 1 and November 15.

3.5 Use seasonal nurse crop in accordance with dates as specified in this Section part 2.3.

3.6 Sow permanent seed by mechanical seeder as follows:

A. Apply seed uniformly with a broadcast seeder, drill, culti-packer seeder, or hydroseeder on a firm, friable seedbed. Seeding depth should be ¼ to ½”. Apply in cross directions to ensure uniform distribution.

B. Mulch shall be applied as follows:

(1) Straw or hay mulch shall be applied at the rate of 1.5-2 tons per acre or 70-90 lbs. per 1,000 sq. ft. with a mulch blower or by hand. It shall be anchored after application.

(2) Fiber mulch shall be applied at the rate of a minimum of 1,500 lbs. per acre or 35 lbs. per 1,000 sq. ft. It shall be applied as a slurry.

(3) When fiber mulch is the only available mulch during periods when straw should be used, apply at a minimum rate of 2,000 lbs. per acre or 45 lbs. per 1,000 sq. ft.

(4) Corn stalk mulch shall be applied at the rate of 4-6 tone per acre or 185-275 lbs. per 1,000 sq. ft. It shall be applied with a mulch blower or by hand. Stalks shall be cut or shredded in 4-6” lengths and air dried. It shall not be used in fine turf areas.
C. Anchor mulch to the following standards:

(1) Straw mulch shall be anchored immediately after spreading to prevent displacement.

(2) Use of a mulch anchoring tool (i.e. Krimper Tool) shall be limited to grades less than 3 to 1. Machinery shall be operated on the contour.

(3) Use a fiber mulch, shall be applied by means of a hydroteeder at a rate of 500-750 lbs. per acre over top of straw mulch or hay.

(4) If a synthetic mulch binder is used, apply at the rate recommended by manufacturer.

(5) On slopes steeper than 3 to 1 fasten Type I mulch as recommended by the manufacture.

3.7 Remove all soiling or staining of finished walks, drives and parking areas resulting from seeding work. Maintain paved areas in clean condition.

3.8 Turfgrass Maintenance

A. Water as required to keep soil moist during germination period.

B. Mowing

(1) When grass reaches height of 3½" to 4", mow to height of 2½".

(2) Maintain grass height between 2½" and 4".

(3) Do not remove more than 33% of total height of grass in one mowing.

C. Reseed and mulch spots larger than 1 sq. ft. without uniform stand of grass.

D. Mow and maintain all seeded areas until uniform stand of grass is acceptable to the County.

E. In the event that growth is not established by final project inspection, continue the specified attention until stand is accepted by the County.

F. Correct or repair all undue settling as evidenced by complaints received within one year after final inspection.

END OF SECTION
SECTION 15151 - DISPLACEMENT TYPE
COLD WATER METERS 5/8" THRU 2"

1.0 GENERAL

1.1 Furnish and install cold water meters as specified herein where shown on drawings.

1.2 Reference Specifications are referred to by abbreviation as follows:

A. American Water Works Association ............................................. AWWA

1.3 Submit three (3) copies of shop drawings for meters.

2.1 PRODUCTS

A. All meters shall be constructed in accordance with AWWA C700 latest revision "Standard Specification for Cold Water Meters - Displacement Type." Meters may be oscillating-piston or nutating-disc.

B. All meters shall be Sensus Technologies, Inc. as shown below:

<table>
<thead>
<tr>
<th>Meter Size</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>SR-11, Radio Read</td>
</tr>
<tr>
<td>3/4</td>
<td>SR-11, Radio Read</td>
</tr>
<tr>
<td>1&quot;</td>
<td>SR-11, Radio Read</td>
</tr>
<tr>
<td>1½-2&quot;</td>
<td>Omni R2, Radio Read</td>
</tr>
<tr>
<td>3-4&quot;</td>
<td>Omni C2, Radio Read</td>
</tr>
</tbody>
</table>

C. REGISTERS:

(1) Registers shall be straight reading in gallons and have a center sweep test hand and a separate flow detector device. Numeral wheels for units and tens shall be different color from other numeral wheels.

D. GUARANTEE AND MAINTENANCE PROGRAM:

(1) Manufacturer must provide a meter maintenance plan in writing which includes the price of repairing meters to meet AWWA new meter accuracy standards after the expiration of the performance guarantee.
3.0 EXECUTION

3.1 Install meters in accordance with manufacturer’s instructions.

END OF SECTION
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<td>104</td>
<td>Air Release and Combination Air Valve Assembly</td>
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<td>Valve Box</td>
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<tr>
<td>112-1</td>
<td>Manhole Sizing and Minimum Angle Table</td>
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<td>Sewage Air Release Combination Air Valve Assembly</td>
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<tr>
<td>127</td>
<td>Utilities Marker</td>
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</tbody>
</table>

END OF SECTION
Standard Details have been adopted in order to produce uniformity of facilities to be operated by the County. These details are a guide to the normal procedure. However, where it is necessary due to specific job requirements to deviate from the standards, the designer shall prepare the appropriate detail and show it on the drawings.
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<td>Air Release and Combination Air Valve Assembly</td>
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<td>Standard Valve Vault (16” and Larger)</td>
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<td>Valve to Main Connection</td>
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<td>Typical Fire Hydrant Detail</td>
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<td>5/8” or 3/4” Disc Meter Settings</td>
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<td>121</td>
<td>Vandal Proof Manhole Frame and Cover</td>
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<td>128</td>
<td>3” or Larger Double Detector Check Valve and Vault</td>
</tr>
</tbody>
</table>

END OF SECTION
GASKET BRIDGE: TYPE 304 STAINLESS STEEL

DUCTILE IRON CAST IRON STEEL COPPER PE PVC

NUTS & BOLTS: TYPE 304 STAINLESS STEEL ROLLED THREAD & ANTI GALLING COATINGS.

VALVE

SPHERICAL SPACER TYPE 304 L STAINLESS STEEL.

"GRIP" TYPE COUPLING OR APPROVED EQUAL

M.J. PLUG

TEE OR CROSS

END RING: 1.5"- 3" CAST STEEL 4"- 12" DUCTILE IRON CASTING

PLAN NOT TO SCALE

NOTE:
RESTRAIN ALL JOINTS A MINIMUM OF 60' EACH DIRECTION.

VALVE TO MAIN CONNECTION
NOTES:

1. ALL JOINTS TO BE RESTRAINED.
2. WHERE HYDRANT DRAINS ARE NOT PLUGGED, THEY SHALL DRAIN TO THE GROUND SURFACE OR TO DRY-WELLS PROVIDED EXCLUSIVELY FOR THIS PURPOSE IN A MANNER THAT WILL AVOID CONTAMINATION OF THE HYDRANT OR WATER MAIN FROM HIGH GROUNDWATER, SURFACE FLOODING OR PONDING, AND CONTAMINANT OR POLLUTANT SPILLS.
NOTES:
1. METER SETTERS TO BE FORD, A.Y. MCDONALD OR APPROVED EQUAL.
2. PROVIDE DUAL ANGLE CHECK VALVE ON OUTLET SIDE (CUSTOMERS SERVICE).
3. METER BOXES INSTALLED OUTSIDE THE RIGHT OF WAY SHALL BE INSTALLED INSIDE A PERMANENT UTILITY EASEMENT GRANTED TO CAROLINE COUNTY.
4. METER BOXES SHALL NOT BE INSTALLED IN ROAD DITCHES OR SHOULDERS.
5. METER BOXES SHALL NOT BE INSTALLED IN SIDEWALKS, DRIVEWAYS, ROADS OR ENTRANCES UNLESS TRAFFIC RATED METER BOX, TOP AND LID ARE USED. THE METER BOX, TOP, AND LID SHALL BE APPROVED BY CAROLINE COUNTY DPU PRIOR TO INSTALLATION.
6. THE SERVICE LINE BETWEEN THE MAIN AND METER SHALL BE ONE CONTINUOUS PIECE OF PIPE. NO JOINTS OR SPLICES WILL BE PERMITTED.
CAP/PLUG TO BE LOCATED 12" MIN. PAST THE EDGE/BACK OF THE IMPROVED HARD SURFACE; I.E. PAVEMENT, CURBING, SIDEWALK, ETC.

TYPICAL WATER SERVICE CONNECTION FOR 1-1/2" AND 2" METERS
5/8" OR 3/4"

DISC METER SETTINGS

FINISH GRADE TO DIRECT SURFACE DRAINAGE AWAY FROM STRUCTURE

3/4" M - 9"

5/8" M - 7 1/2"

TOUCH READ PAD

PLASTIC BOX WITH REMOVABLE LID

5/8" OR 3/4" METER

PLAIN STOP

ANGLE DUAL CHECK VALVE

SERVICE LINE

POC ⊙

METER SETTER

3/4"

BRICK

CUSTOMER LINE

24" MIN.

4" #57 STONE UNDER BRICK OR PRE-CAST BOX BOTTOM.
NOTE:
BYPASS SHALL BE LOCATED ABOVE OR AT FLOOR LEVEL OF METER VAULT.

FINISH GRADE TO DIRECT SURFACE DRAINAGE AWAY FROM STRUCTURE

PRECAST BOX WITH REMOVABLE LID

ANGLE DUAL CHECK VALVE

VARIABLE LENGTH PIPE

VALVE

MIN. 12" COPPER PIPE

BYPASS

MIN. 12" COPPER PIPE

4" #57 STONE UNDER BRICK OR PRE-CAST BOX BOTTOM.

1-1/2" OR 2"
DISC METER SETTINGS

1 OF 2
NOTES:
1. ALL METERSETERS PROVIDED FOR 1–1/2” & 2” METERS SHALL HAVE REMOVABLE PACK JOINTS SUITABLE FOR COPPER PIPE.
2. ALL METERSETERS SHALL HAVE SADDLE NUTS, PADLOCK WINGS, AND SHALL BE SIMILAR TO FORD, MUeller, OR ANY MCDONALD.
3. BYPASS SHALL BE PROVIDED.
4. METER BOX TO BE AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.

MATERIAL FOR 1 1/2” DISC METER WITH 1–1/2” INLET AND 1–1/2” OUTLET

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1–1/2” DISC METER W/GASKETS, BOLTS AND NUTS</td>
</tr>
<tr>
<td>1</td>
<td>1 1/2” FLANGED ANGLE VALVE</td>
</tr>
<tr>
<td>1</td>
<td>1–1/2” ANGLE DUAL CHECK VALVE</td>
</tr>
<tr>
<td>5</td>
<td>1–1/2” BRASS PIPE (2 PCS. 12” LONG; 1 PC. VARIABLE LENGTH; PIPE TO BE CUT AND THREADED BY CONTRACTOR)</td>
</tr>
<tr>
<td>2</td>
<td>1–1/2” BRASS ELBOWS</td>
</tr>
<tr>
<td>1</td>
<td>1–1/2” BRASS BLIND CAP</td>
</tr>
<tr>
<td>1</td>
<td>1–1/2” BY-PASS PIPE AND SHUT-OFF VALVE</td>
</tr>
</tbody>
</table>

MATERIAL FOR 2” DISC METER WITH 2” INLET AND 2” OUTLET

<table>
<thead>
<tr>
<th>QTY.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2” DISC METER W/GASKETS, BOLTS AND NUTS</td>
</tr>
<tr>
<td>1</td>
<td>2” FLANGED ANGLE VALVE</td>
</tr>
<tr>
<td>5</td>
<td>2” BRASS PIPE (2 PCS. 12” LONG; 1 PC. VARIABLE LENGTH; PIPE TO BE CUT AND THREADED BY CONTRACTOR)</td>
</tr>
<tr>
<td>2</td>
<td>2” BRASS ELBOWS</td>
</tr>
<tr>
<td>1</td>
<td>2” BRASS BLIND CAP</td>
</tr>
<tr>
<td>1</td>
<td>2” BY-PASS PIPE AND SHUT-OFF VALVE</td>
</tr>
</tbody>
</table>

2 OF 2

NOTES AND MATERIALS LIST FOR 1–1/2” OR 2” DISC METER SETTING

<table>
<thead>
<tr>
<th>REVISIONS</th>
<th>DRAWING NO.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>110–3</td>
</tr>
</tbody>
</table>
NOTES:

1. THE CONTRACTOR SHALL NOT INSTALL PIPING UNTIL THE METER AND ASSOCIATED APPURTENANCES HAVE BEEN PURCHASED FROM THE UTILITIES DEPARTMENT AND ARE ON THE PROJECT SITE, SO THAT THE CORRECT LENGTH OF PIPE IS INSTALLED ACCORDING TO THIS DETAILED CONFIGURATION. STRAINER, METER AND TEST TEE WILL BE PROVIDED BY THE COUNTY.

2. THE CONTRACTOR IS REQUIRED TO COORDINATE WITH THE CAROLINE COUNTY DEPARTMENT OF PUBLIC UTILITIES. THE PICK UP OF A COUNTY APPROVED METER, ALL CONNECTION FEES AND/OR OTHER APPLICABLE CHARGES OR FEES MUST BE PAID PRIOR TO PICKING UP THE WATER METER, TEST TEE AND STRAINER FROM THE UTILITIES DEPARTMENT.

3. 3" OR 4" APPROVED JOINT RESTRAINT DEVICES ARE REQUIRED ON ALL MECHANICAL JOINT (M.J.) CONNECTIONS. ALL FITTINGS SHALL BE MECHANICAL JOINT.

4. ALL FITTINGS INSIDE THE VAULT SHALL BE FLANGED.

5. NO CHECK VALVE OR PRV IS ALLOWED ON THE INLET SIDE OF THE METER.

6. FOR VAULT DETAILS SEE DWG. NO. 111-4.
NOTES:

1. METER BOX TO BE OLDCASTLE CARSON
   PLASTIC MODEL 1015 MSBC HEAVYWALL
   13" X 17" OR APPROVED EQUAL.
2. COVER SHALL BE FLUSH SOLID WITH AMR
   RECESS AND READER DOOR.
3. COVER SHALL BE DUCTILE IRON. READER
   DOOR SHALL BE CAST IRON.

FINISH GRADE TO DIRECT SURFACE
DRAINAGE AWAY FROM STRUCTURE

PROVIDE 3" WIDE BY 4"
TALL MOUSEHOLES EACH SIDE OF 18-1/4"
DIMNSION

TOP OUTSIDE DIMENSIONS
17-3/4" X 13"

BOTTOM OUTSIDE DIMENSIONS
23" X 18-1/4"

1-1/4" FOOTING

10-1/8"
15-3/8"
1-3/4" DIA.
AMR RECESS

PLASTIC METER BOX FOR
(5/8" X 3/4" METER)
FINISH GRADE TO DIRECT SURFACE DRAINAGE AWAY FROM STRUCTURE

PROVIDE 2-1/4" WIDE BY 3-3/4" TALL MOUSEHOLES EACH SIDE OF 19-1/4" DIMENSION

NOTES:
1. METER BOX TO BE OLDCASTLE CARSON PLASTIC MODEL 1118 MSBC HEAVYWALL 13" X 17" OR APPROVED EQUAL.
2. COVER SHALL BE FLUSH SOLID WITH AMR RECESS AND READER DOOR.
3. COVER SHALL BE DUCTILE IRON. READER DOOR SHALL BE CAST IRON.

PLASTIC METER BOX FOR (3/4" X 1" METER)
NOTES:

1. MONOLITHIC CONSTRUCTION POLYMER CONCRETE OR COMPOSITE BOX WITH SEPARATE LID. BOX MAY HAVE BOTTOM AS PART OF CAST STRUCTURE. BOX WITHOUT BOTTOM AND BRICK BASE SHOWN ABOVE.
NOTES:

1. CLEAR FLOW VAULT SHIPPED ASSEMBLED WEIGHING APPROX. 12,000 LBS.

2. METER VAULT TO BE PLACED AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING VAULT IN AREAS SUBJECT TO VEHICULAR TRAFFIC.

3" & 4" WATER METER VAULT DETAIL
NOTE:

SEE DRAWING NO.113 FOR ADDITIONAL MANHOLE DETAILS.

NOTE:

CONCRETE = 3,000 PSI @ 28 DAYS.

STANDARD DROP MANHOLE
NOTE:

SEE DETAIL NO. 113 FOR ADDITIONAL MANHOLE DETAILS.
DOUBLE CHECK DEVICE SHALL BE INSTALLED IN A BOX AS NEAR TO THE WATER MAIN AS POSSIBLE WITHOUT PLACING BOX IN AREAS SUBJECT TO VEHICULAR TRAFFIC.

2. DOUBLE DETECTOR CHECK ASSEMBLY MUST BE U.L. LISTED OR F.M. APPROVED AND APPROVED BY CAROLINE COUNTY.

3. ISOLATION VALVES ON LOW FLOW BYPASS SHALL BE 1/4 TURN BALL VALVES WITH SINGLE LEVER HANDLE. GATE VALVES WITH HANDWHEEL ACTUATOR ARE STRICTLY PROHIBITED.