

B. Design Standards

(To be used in conjunction with Section C – Construction Specifications)

1. General

a. Future Extensions

Generally, the capacities of sanitary sewer lines and water lines should be designed for the estimated ultimate build out population of the service area being considered for development. Any known future development shall be considered as well.

The designer shall also estimate the ultimate build out population for the total sewer shed area. Future population densities should consider the Augusta County Comprehensive Plan, Zoning Ordinance, and Subdivision Ordinance as applicable. Based on the results of this estimate, the ACSA may participate in the project in accordance with the ACSA OPPM Policy No. 10.2 System Improvements.

The developer is required to design and construct his system, properly sized, to permit future extensions to be made. Elevation of the sewer system must be designed such that future extensions can serve the entire area which naturally drains towards the system. Stubouts and/or easements for water and/or sewer shall be provided to adjoining property lines where in conformance with the Augusta County Comprehensive Plan or as deemed appropriate by the ACSA to provide for future extension of the systems. Stubouts shall be provided beyond edge of pavements to allow for future extensions without damaging pavement.

b. Design Calculations

Calculations showing estimated water demand and sewer flow based on the criteria outlined in these standards shall be submitted for review with all plans that include public utilities. Calculations shall demonstrate that the existing utility infrastructure is capable of handling the demand of the proposed development. Otherwise the calculations shall identify the deficiencies and provide recommendations for improvement as part of the proposed development. During the design phase following Preliminary Plat approval, calculations shall be refined as follows. Resubmission of calculations during the design phase may be waived upon written approval of the ACSA's Engineer.

All water line and sewer line extensions shall be accompanied by one set of hydraulic and capacity calculations respectively. Calculations should address such issues as available/required fire flow and domestic demand, pipe size and capacity, velocity, percent slope, etc. Additional guidelines and requirements for design are included in Section B.2. for Water, and Section B.3. for Sewer. Submission of calculations for minor extensions may be waived upon written approval of the ACSA's Engineering Department.

Design calculations are also required to be submitted for other water/sewer facilities such as storage tanks, booster stations, sewage pump stations etc. in accordance with these Standards. However, VDH and/or DEQ review of these items is also required. Documentation shall be provided to the ACSA that VDH and/or DEQ approval has been obtained where required.

All submitted calculations shall be signed, sealed, and dated by a professional engineer or class B land surveyor licensed in the Commonwealth of Virginia, and shall be in accordance with the Virginia Department of Health (VDH) *Waterworks Regulations* and the Virginia Department of Environmental Quality (DEQ) Sewage Collection and Treatment (SCAT) Regulations.

c. Easements and Property

1) Permanent Water and/or Sewer Easements

Shall be required for all water and sewer lines and appurtenances except where installed within a publicly dedicated right-of-way. Where water and/or sewer lines are installed within the right-of-way, additional permanent easement width shall be provided to designate a minimum of 20 foot working space between the edge of pavement and the easement boundary. All easements shall have the right of ingress and egress fully provided for in the recorded deed. Easements shall be provided up to and including the water meter and/or sewer cleanout.

When public fire hydrants and other appurtenances are installed on private property, a permanent easement shall be provided 10 feet around the feature on all sides.

The minimum permanent easement width shall be fifteen (15) or twenty (20) feet dependent upon location of easement on the property. A total of twenty (20) feet of legal working space shall be provided over water or sewer lines (5 feet may be in dedicated road right of way) with an exclusive easement area of ten (10) feet of width centered on the pipeline. Joint permanent easements combining both water and sewer mains within a single permanent easement shall be a minimum of thirty (30) feet in width; a minimum of ten (10) feet shall be the required distance between the mains (measured from edge to edge of pipes) with a minimum of an additional ten (10) feet required from the centerline of each main to the permanent easement boundary. The 10 foot wide exclusive are over each pipe shall be maintained for each pipe.

No buildings, facilities, or structures shall be located on the surface of the land within permanent easement area. No other utilities, including telephone, cable, fiber optic, gas, electric and industrial pipes shall be constructed parallel to water and sewer utilities within the ten (10) foot wide exclusive easement area. No water shall be impounded within the permanent easement area without the prior written approval of the ACSA.

Land for dedicated facilities such as booster stations, pump stations, tanks, etc., shall be transferred to the ACSA by deed. The property shall be transferred at no cost to the ACSA with general title and English covenants. For water storage tanks, minimum lot size shall be 1 acre unless otherwise demonstrated that future maintenance and replacement/expansions can occur without further land acquisition. For water booster and sewer pump stations, adequate space shall be provided to permit maintenance equipment (temporary pumps and

maintenance equipment) to be on the site without being in the road right of way or on other private properties. For sewer pumping stations a 100 foot buffer around the station shall be provided where no structures will be located unless otherwise approved. (ref. Virginia Sewage Collection and Treatment Regulations - 9VAC25-790-120.D.1). Other facilities, such as treatment facilities, will be handled on a case by case basis as in addition to maintenance of operations, other buffer requirements in accordance with the DEQ SCAT Regulations may apply.

In some instances where field conditions may dictate, and water and sewer mains are installed with greater than minimum cover, permanent easement width may need to be increased as shown in the table below. Permanent easements shall be of sufficient width to allow the ACSA to maintain the utility while working safely and in compliance with OSHA Regulations.

Easement Width Centered on Pipeline	Max. Trench Depth
20'	<8'
30'	<12'
40'	*<18'

* Maximum depth shall be 18'.

2) Temporary Construction Easements

Shall be provided where necessary to allow contractor enough room to construct the utility while working safely and in compliance with OSHA Regulations.

3) Permission to Access Private Property

Shall be required in order to permit regular inspection by the ACSA of all water and sewer mains and sub-mains which are located on private property and are privately owned and which connect to or are intended to be connected to water and sewerage facilities owned and operated by the ACSA. Such facilities on private property shall remain privately owned and maintained by and at the expense of the property owner. Provision of such access and the continued maintenance of such facilities on private property, in accordance with rules and regulations of the ACSA, shall be a condition of service.

4) Deeds of Subdivision/Easement and Recorded Plats

Deeds and plats must be submitted prior to project acceptance. If a plat is required by the County or ACSA, a copy of the recorded plat in accordance with County requirements shall be submitted to the ACSA along with proof of record. Easements shall be in accordance with the ACSA's Template Deed of Easement.

5) Dedicated Lots

A lot shall be dedicated to the ACSA for facilities including, but not limited to pump stations, booster stations, and tanks. In addition to meeting all County zoning requirements, these lots shall be of a size that permits for the future construction of a replacement facility, while maintaining operation of the

existing facility. A deed and plat shall be recorded and provided to the ACSA showing the lot dedicated to the ACSA.

d. Separation of Utilities

- 1) Separation of water and sewer lines shall be in accordance with Section 02080 Utility Pipe and Materials of the Construction Specifications.
- 2) Separation of water and sewer lines from electric, fiber optic, gas lines and other privately owned public utilities shall be in accordance with utility company requirements and state law. A minimum separation distance from ACSA utilities shall be 5 feet horizontally and 2 feet vertically unless otherwise approved by ACSA Engineering Dept.
- 3) Water and sewer mains shall be a minimum of 20 feet from buildings. Horizontal separation of water and sewer lines from other structures such as storm sewer, sidewalks, and curbing shall be a minimum of 5 feet where possible to reduce future maintenance costs. Existing Services and Disruption of Service

Existing water and sewer services shall be maintained throughout construction. The designer shall anticipate any requirements for bypass pumping and/or temporary waterlines and show the requirements on the plans. This shall include a written sequence of events in order to properly plan the service disruption (location of valves to close, manholes to plug, bypass pump sizes, order of work to complete, etc.). Any valves needed in order to isolate a section of waterline shall be included on the plans and properly labeled. Any work requiring that services be disrupted to existing customers shall only be done in close coordination with ACSA Engineering Technician and shall be planned well in advance (based on the service area affected) in order to allow proper notice. Large planned disruptions may be required to be performed during off-peak times or during nights/weekends.

e. Plan Sheet Preparation & Drafting Standards

1) General

Plans shall be of sufficient detail and scale to accurately indicate all pertinent design and construction details for a comprehensive interpretation of the work to be performed. If plans are deemed to be illegible or incomplete by the ACSA, plans will be returned with a request to revise and resubmit plans satisfactory for review.

- a) Water and sewer lines - show the location of all water and sewer line appurtenances and accessories and accurate plan and profile design drawings for the proposed lines;
- b) Water and sewerage facilities such as water storage tanks or pumping equipment, sewage pumping stations, or other like equipment - provide detailed plans and specifications on design, equipment, materials, and construction of such facilities.

2) Engineering and Plan Requirements for Safety:

All project designs shall incorporate safety components in accordance with the Occupational, Safety, and Health Administration (OSHA), the Virginia Department of Labor and Industry (DOLI), and/or the requirements of the ACSA policies for employee safety and the ACSA Approved Products List. This shall include but not be limited to personnel safety railings, ladders, fall protection and personnel anchor systems, personnel recovery devices, ventilation systems, arc-flash studies and electrical box labeling, electrical safety matting, personal protective equipment boxes with contents applicable to the facility hazards, eye wash units, safety showers, fire extinguishers/suppression systems, proper placards/labels/lighting applicable to the facility hazards, break panels with lock-out/tag-out capability, fencing, and emergency/security lighting. All equipment specified shall meet OSHA and ANSI standards applicable to the identified hazard. Every effort shall be made to engineer out safety hazards requiring special equipment or procedures for operation and maintenance.

3) Specific Plan Sheet Requirements

- a) Plan sheets shall measure either 22 inch x 34 inch or 24 inch x 36 inch and be oriented in landscape view.
- b) All plan submittals must include a cover sheet. The front sheet shall include the following. A second sheet may be added if all of the following items will not fit legibly onto the cover sheet. Please also refer to the Submittal Checklist which can be found at www.acsawater.com.
 - Project name
 - Vicinity Map (Provide adequate detail to permit ACSA Staff to easily locate the site in the field – including existing and proposed roadways.)
 - Index of sheets
 - Standard notes as applicable (may be included on sheet 2 if necessary)
 - Legend (may be included on sheet 2 if necessary)
 - Original seal, signature, and date of the licensed Professional Engineer or Class B Surveyor. Following sheets shall bear the copy of such seal.
 - Names, addresses, and telephone numbers of the owner or developer and engineer.
 - Table of estimated quantities (may be included on sheet 2 if necessary)
 - Line sizes and lengths
 - Number of manholes and total vertical depth
 - Number of hydrants
 - Number, type, and sizes of valves
 - Number of meter boxes and cleanouts
 - Horizontal and vertical coordinate systems shall be clearly defined.

c) Standard Notes and Requirements: The following General Water and Sewer Conditions shall be shown on the cover sheet of each set of plans, as applicable:

- (i) All work shall be subject to inspection by Augusta County ACSA inspectors. **The contractor shall notify the ACSA Engineering Department at 540-245-5670 at least 48 hours prior to the start of any water and sewer utility work.** Failure to comply or properly notify may result in additional work by the Contractor in order to permit the necessary inspection and /or disconnection from the system.

All mainline taps, valve operation, opening of hydrants, manhole coring, etc. shall be done by ACSA Personnel or with ACSA Inspectors present.

- (ii) For Dedicated Facilities such as tanks, pump stations, booster stations, etc., ACSA will require the following (design/construction):

- That all safety devices, equipment, and any specialized personal protective equipment needed for the facility are included/provided with the project design and construction.
- Evaluation of all proposed devices, equipment, and specialized personal protective equipment against the Approved Products List and/or policy requirements.
- The requirements under Section 01110 – General Requirements pertaining to submittals shall apply to all safety equipment.

The contractor shall be required to provide facilities for safe access to the work by ACSA employees, as needed.

- (iii) The contractor is ultimately responsible for all job site safety and assurance that all requirements of the Occupational Safety and Health Administration (OSHA), Department of Labor and Industry (DOLI), and the current Building Code are maintained. However, in the event that an ACSA Engineering Technician observes conditions that could endanger life/limb of any person on the job, the technician will immediately notify the job site superintendent/foreman and the ACSA Engineering and Administration Offices. If a jobsite safety issue is confirmed by the superintendent/foreman/ACSA and the situation continues ACSA may contact OSHA.

On-site ACSA staff will require a preconstruction safety plan be submitted for review at least 48 hours

prior to any work involving ACSA owned facilities requiring confined space entry and/or working at heights in excess of 6 feet. The plan must be prepared by a competent person, as defined by OSHA/DOLI, and the employees performing the work must have proper training. Additionally, the contractor shall provide a plan prepared by an engineer or competent person (in accordance with OSHA requirements) for any trenching activities requiring engineered shoring, or where other hazards such as trenching with water accumulation or trenching where adjoining building/structures are endangered by the excavation.

- (iv) All existing utilities adjacent to the proposed work may not be as shown on the plans and where shown, are only approximately located. The contractor shall contact Miss Utility at 800-522-7001 to have underground utilities marked in accordance with Virginia's underground utility damage prevention act.
- (v) All materials and construction shall comply with the most current version of the ACSA Design and Construction Standards.
- (vi) All water and sewer pipes shall have a minimum of 42" of cover measured from the top of pipe unless otherwise approved. This includes all fire hydrant lines and service laterals.
- (vii) A minimum vertical separation of 42" is required between water line and storm sewer culverts. When the 42" minimum separation cannot be achieved and where freezing is a possibility the water line shall be encased in concrete and insulated as approved by the ACSA. Concrete encasement and insulation shall extend a minimum of 60" beyond the centerline of the culvert in both directions or 60" beyond ends of culvert when parallel.
- (viii) Contractor shall provide certification that proper compaction has been obtained for all backfill over and under water and sewer lines and appurtenances in accordance with the Construction Standards. This certification shall be signed by a professional geologist or engineer and state the exact area to which the certification applies. Testing shall be in accordance with the Design and Construction Standards.
- (ix) Valves on dead-end lines shall be restrained in accordance with applicable standard details.
- (x) Water lines shall not be placed within 30 horizontal feet of existing or proposed sanitary drain fields and

septic tanks. Water or sewer lines shall not be placed within 30 horizontal feet of existing or proposed underground storage tanks.

- (xi) Joint restraint shall be provided for all bends, tees, dead end lines, and stubouts, in accordance with the applicable standard details.
 - (xii) When located in VDOT rights-of-way fire hydrants and all other appurtenances shall be located behind the ditch line.
 - (xiii) Contractor shall maintain water and sewer service to all existing customers throughout construction. This may require temporary lines, connections, and/or pumping.
- d) One plan view may be shown for all proposed utilities as the scale and level of detail allows. A separate profile for each proposed utility shall be prepared with reference to other existing and proposed utilities and other features as necessary.
 - e) As a minimum the plan view shall show all items as listed on the Augusta County Submittal Checklist located at www.acsawater.com.

4) Minimum Size

- a) The water line size shall not be less than eight inches (nominal size) in diameter for lines which will be extended and serve future connections, and where there are two or more fire hydrants, and no supporting grid system provided by either the existing or proposed layout.
- b) The minimum size of the pipe where only one hydrant is to be provided or required shall be six inches in diameter provided the level of service requirements are met.
- c) The ACSA reserves the right to specify the size of water mains on any project. If the ACSA specifies a water main larger than shown necessary by approved design calculations, the ACSA may participate financially in the project in accordance with ACSA OPPM Policy No. 10.2 System Improvements. In any case, the designer shall be responsible for properly designing the water system for domestic service and fire protection under all conditions.
- d) Ten inch waterlines shall not be used.

- e) Any departure in sizing shall be justified by hydraulic analysis and future water use and shall be considered only in special circumstances.
- f) The horizontal scale for the plan and profiles shall be the same with a minimum scale of 1 inch equals 100 feet. The vertical scale shall be no smaller than 1 inch equals 10 feet.
- g) Water Booster and Sewer Pump Stations
 - (i) Drawings for water booster and sewer pump stations shall be prepared and submitted in accordance with ACSA specifications.
 - (ii) 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.
 - (iii) Drawings for water booster and sewer pump stations shall include a site plan drawn to a scale of not less than 1" equals 20' and shall contain existing and proposed contours on a two-foot contour interval. The boundaries of the site shall be clearly shown on the site plan and shall be permanently monumented in the field prior to completion of construction.
 - (iv) Detail drawings for water booster and sewer pump 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.

f. Record Plans

Record drawings shall be in accordance with Section 01110 - General Requirements of the Construction Specifications.

g. Casing Pipe

Steel casing pipe shall be provided for all road crossings, both bored and open cut, and for all railroad crossings. Casings shall be provided for all new road construction with mainline water and sewer crossings at the discretion of the ACSA. If a casing is not used for a sanitary sewer crossing, the sewer pipe shall be PVC C900 pipe, thickness Class DR-18 from manhole to manhole across the roadway. Steel casing may also be required for other special conditions as required by the ACSA. Steel casing for road crossings shall be in accordance with applicable standard details. Steel casing for railroad crossings shall be in accordance with the railroad permit for the applicable railroad company. Casing pipe shall be sized in accordance with the Construction Specifications Section 02080 – Utility Pipe and Materials 2.1.8.

2. Water

Water design shall be in accordance with the VDH *Waterworks Regulations* and these Design and Construction Standards.

Water mains and submains that will remain private, but will be connected to ACSA facilities, shall be designed, constructed, tested, and inspected in accordance with VDH *Waterworks Regulations* and these Design and Construction Standards.

a. Capacity

All main distribution pipelines shall be of a size to adequately serve all the needs of the proposed water system, in accordance with Section B.1.a. and b., including domestic and fire flow requirements.

1) Design Calculations

- a) Design calculations shall be in accordance with VDH *Waterworks Regulations* Section 12VAC5-590-690, Capacity of Waterworks. A minimum working pressure of 20 psi at the service connection based on the greater of maximum hour or maximum day plus applicable fire flows must be evaluated.
- b) Water line design will be based on the Hazen-Williams formula. A C-factor of 120 shall be used for new pipe and a C-factor of 100 shall be used for older pipe (steel, cast iron).
- c) A hydraulic model in accordance with Section 2.b (Design Flow and Model Development) of the Design Standard shall be submitted for all newly proposed water extensions, which demonstrates the adequacy of the proposed system. The model shall also demonstrate that the proposed system does not reduce available flows and pressure to the existing system. All requirements of Augusta County Ordinance 24 – Fire Flow shall be met in the hydraulic model.
- d) Maximum velocity allowed in design is 8 ft/s for cement lined ductile iron pipe.
- e) At the time of design calculation submittal, a hydrant flow test form(s) shall be submitted. Hydrant flow tests are available by contacting the ACSA in accordance with Section 2.b.1 Fire Flow, of these Standards. A valid test shall drop the pressure at the critical location in the system at least 25% unless waived by ACSA Engineering Department.

b. Design Flow and Model Development

Design flow shall be the greater of the required fire flow plus peak domestic demand or the target for the level of service standards. Design flow shall consider future demand, including all potential developable land within the area of extension. Below, these items are described in greater detail.

The ACSA may require a higher design flow if indicated by site conditions.

Following a flow test(s) at the proposed connection point in the field, unless waived by ACSA engineering staff all, all system extensions must be modeled to demonstrate that the proposed system extension representing the entire development can meet the performance standards of the ACSA and the Augusta County Ordinance requirements for flow and duration (2hrs) in accordance with Section 2.b. of these Standards. To achieve this, during the field flow test multiple flow and pressure data points should be recorded from 0 flow to maximum flow to provide sufficient information for setting up a performance curve in a computer model. A minimum of 2 scenarios should be submitted – 1) At the conditions observed during the flow test and 2) At system conditions following a 2 hour fire flow (lowering the tank(s) from the normal low). Where the elevation of a proposed development is within 50 ft of the base of an existing water storage tank(s), a 3rd scenario will be required to ensure that that proposed development will not impact the “effective storage” of the existing tank(s). The modeler should provide other scenarios as needed to address phases of the project that may impact fire flow in the extended system. In some instances, a construction phase may be required to include the construction of additional water infrastructure to ensure that the fire flow requirements can be met for the proposed phase of the development.

Modeling the 2 hour fire flow condition should be done by adjusting the measured pressure down to match the tank elevation(s) from a normal low (from ACSA) to an elevation that accounts for 2 hours of volume being taken from the tank(s). The maximum amount of flow available from the modeled supply must correspond with the test data and limits available flow to the point at which the critical hydrant/system location reaches 20 psi. Utilization of a tank with control valve or a pump in the computer model to mirror the system conditions observed during field testing is expected. Domestic demands should be distributed in accordance with good modeling practices to adequately spread the demands across the junctions/nodes. Fire flows should be checked at various locations that may be at higher elevations or hydraulically remote or both while ensuring that no node in the extended system drops below 20 psi. Limiting the number of dead ends and maximizing the number of loops in the system extensions will be expected in accordance with the Virginia Department of Health Waterworks Regulations 12VAC5-590-1130 – System Design.

A node and/or hydrant report, pipe report, pump/valve report, a map matching master plan layout labeled with street names, pipes, and junctions, as well as a conclusion of the results shall be included with the submittal for review.

If a sprinkler system will be utilized, the gallons per minute and the pressure required for the demand of the sprinkler system shall be submitted for review. If a pump is required for the system, that information shall also be submitted to ACSA for review.

Note: Multiple tanks, sources, and in some instances the pipe network configuration can increase the complexity of the analysis making small, partial system models for extensions more complicated and impractical for obtaining the needed results. In these instances and in areas where flows are at or near

limits required by these Standards or the Augusta County Ordinances, a more detailed system analysis in coordination and partnership with the Service ACSA should be expected.

1) Fire Flow

Chapter 24 of the Augusta County Code sets the fire flow requirements. The County will determine all nonresidential, and when necessary, residential fire flow requirements based on ISO guidelines. The Augusta County Fire Protection Design Policy is at www.acsawater.com for reference titled Augusta County Fire Protection Design Policy. Prior to submittal of design calculations, the design engineer should acquire required hydrant flow test data for design calculations in accordance with the ACSA OPPM Policy No. 10.5 Water System Flow Testing. See www.acsawater.com for the Hydrant Flow Test Form.

2) Level of Service Standards

For residential areas where the required fire flow is less than 1000 gpm, a minimum target design flow of 1000 gpm shall be used. Design flows less than 1000 gpm may be approved for local service when a level of fire protection in accordance with the County Ordinance can be obtained, and there is no possibility for a future extension of the waterline.

For schools, multi-family residential, commercial, and industrial areas, a minimum target of 2000 gpm shall be used for design purposes. If the County specifies a required fire flow greater than 2000 gpm, the water system shall be designed to provide this flow, or other on-site or off-site improvements shall be made as approved/required by the ACSA and County Fire Chief to provide the necessary level of service.

3) Domestic Demand

Domestic demand shall be estimated using the guidelines in the *VDH Waterworks Regulations*.

Average daily demand shall be calculated using the daily water consumption rates found in the *VDH Waterworks Regulations*. The ACSA currently uses an average of 2.8 persons per residence.

When a commercial or industrial development is proposed, but the specific industries are unknown, the designer shall use an average daily flow of 1500 gpd per acre for light industrial/commercial and 2000 gpd per acre for heavy industrial/commercial.

Peak domestic demand shall be calculated using twice average daily demand.

4) Future Demand

The designer shall estimate, based on the County's Comprehensive Plan and the ACSA's Master Plan, the projected demands for developable land in the project area, if the proposed waterline could be extended to serve those areas. Based in the results of this estimate, the ACSA may participate in the project in accordance with the ACSA OPPM Policy No. 10.2 System Improvements.

c. Pressure

All extensions of existing water systems or new water systems shall provide a minimum 20 psi residual pressure on the new line(s) and at the critical locations in the system under design flow conditions. Upon identification of the proposed development, the ACSA will determine the locations(s) to be monitored during flow tests.

Design flow shall be calculated according to Section 2.b. of these Standards.

The ACSA may require a higher residual pressure if required by system conditions.

The test pressure for waterlines shall be specified on the plans. Test pressure shall be 1.5 times the working pressure at point of test, but not less than 1.25 times the working pressure at the highest elevation along the test section.

d. Effective Storage

Effective storage is the volume of water in the storage tank above the level that provides 20 psi to all connections under design flow conditions. This volume may include domestic, emergency (ex. power outage), and fire flow storage.

Any proposed development or extension to the water system shall be designed so that the storage tank is 100% effective for that development or extension. The development or extension shall also not decrease the effective storage to the rest of the water system. Modeling a "tank empty" scenario will be required where the elevation of the proposed system extension may impact the effective storage of the system.

e. Pipe

Water main material shall be in accordance with Sections 02510 - Water Distribution and 02080 - Utility Pipe and Materials of the Construction Specifications.

All water pipes shall have a minimum cover of 42 inches unless otherwise approved.

1) Minimum Size

- a) The water line size shall not be less than eight inches (nominal size) in diameter for lines which will be extended and serve future connections, and where there are two or more fire hydrants, and no supporting grid system provided by either the existing or proposed layout.
- b) The minimum size of the pipe where only one hydrant is to be provided or required shall be six inches in diameter provided the level of service requirements are met.
- c) The ACSA reserves the right to specify the size of water mains on any project. If the ACSA specifies a water main larger than shown necessary by approved design calculations, the ACSA may participate financially in the project in accordance with ACSA OPPM Policy No. 10.2 System Improvements. In any case, the designer shall be responsible for properly designing the water system for domestic service and fire protection under all conditions.
- d) Ten inch waterlines shall not be used.
- e) Any departure in sizing shall be justified by hydraulic analysis and future water use and shall be considered only in special circumstances.

2) Surface Water Crossings

The water line shall be a minimum of 42 inches below the stream bed surface. Where water lines are intended to cross streams, rivers or other surface waters (either continuous or intermittent flows), only underwater crossings will be permitted in accordance with the Standard Details. The water line shall be of special construction having flexible watertight joints depending on installation depth. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding. A water meter and valve shall be installed at one end of a major crossing and not subject to flooding for the purpose of locating leaks.

f. Appurtenances

1) Dead Ends

In accordance with Virginia Department of Health Water Works Regulations 12V4C5-590-1130 – System Design, dead end lines shall be minimized by looping of all water lines where practical. Where dead end lines occur, a fire hydrant or blow-off hydrant for flushing purposes shall be provided (See Standard Details). Fire hydrants are preferred where practical and where waterline is a minimum of 6 inches. The ACSA reserves the right to require water lines to be looped.

2) Valves

a) Gate Valves

Approved gate valves shall be installed at all pipe junctions and street intersections in such a manner as to control and cut off flows in all segments of the system. All tees shall be isolated with three valves; crosses by four. At intersections valves shall be located together and on the same side of the roadway outside the pavement, unless otherwise approved by ACSA Engineering Department and VDOT.

In other areas, gate valves will be required every 800 feet at a minimum, except as may otherwise be approved by the ACSA. Valves shall be located upstream and adjacent to all existing and proposed fire hydrants.

Locations of valves shall consider potential service interruption to customers as may be required for future maintenance.

b) Air Release Valves

Approved automatic air release valves shall be installed at high points in the water main. Valve shall be provided with a 1 inch tap and the orifice shall be sized according to the manufacturer's literature. Air release valves shall also be in accordance with the Standard Details.

c) Blow-Off Valves

Blow-off hydrants shall be provided at any dead end in a water main and low points. Blow off hydrants shall also be in accordance with Standard Details.

Automatic blow off assemblies shall be provided as required for water quality specified by the ACSA.

No flushing device shall be directly connected to any sewer. Chambers or pits containing blow-offs shall be drained to atmosphere where they will not be subject to flooding, or to an absorption pit located above the seasonal groundwater table.

3) Hydrants

Fire hydrant location shall be in accordance with Augusta County Fire Protection Design Policy as found at www.acsawater.com.

In addition to the Augusta County Fire Policy, the following requirements shall apply. No hydrant shall be more than 800 feet from any other hydrant measured along the centerline of the street or other

public right-of-way. Fire hydrants shall be placed no closer than 40 feet from any existing or proposed structures.

Fire hydrants shall be connected only to water systems adequately designed for fire flows and domestic flow, unless otherwise approved by the ACSA. In addition fire hydrants shall not be connected to any waterline smaller than 6 inches.

All cul-de-sacs with public water shall include a fire hydrant in lieu of a blow-off assembly where practical and where the line size is a minimum of 6 inches. Hydrants in lieu of blow-down assemblies shall also be located at low places in proposed waterlines where practical.

For non-residential on-site fire hydrants and the fire service line is solely intended for fire protection and no domestic usage will be provided from line, a double check-detector assembly backflow preventer (privately owned and maintained) shall be provided in a vault at the property line. **Fire hydrants placed on private property in such a manner will be private hydrants. Maintenance and proper operation of these hydrants shall be the sole responsibility of the property owner.**

Fire hydrants shall be provided with bollards for protection where not located behind curb or other form of physical barrier.

Reference Appendix 2 for the Augusta County Fire Protection Design Policy.

4) Service Laterals

- a) Taps, laterals and meter boxes are to be installed for all lots or parcels of land within developments and commercial/industrial lots and shall extend from the main to the property line of the lot or parcel by the Contractor, unless otherwise authorized by ACSA. (A hook-up fee discount may be applied as detailed in the ACSA Rate Schedule). For services requiring a 2 inch meter or smaller, the lateral shall be stubbed out at the property line with a female adapter and plug in accordance with the Standard Details. Services shall be shown for commercial/industrial lots at the site plan stage; for residential lots at the construction plan stage.
- b) For single residential services located on the same side of the street as the main, laterals may be $\frac{3}{4}$ inch diameter. For double residential services and services located on the opposite side of the street as the main, the lateral shall be 1 inch diameter.
- c) If laterals are to cross under the roadway, they shall be installed within 2 inch rigid, Schedule 40 PVC pipe as a casing in accordance with the Standard Details.

- d) Lateral material type shall conform to the ACSA Approved Products List and the Standard Details.

5) Water Meters

Individual water meters are required for all single family homes, town homes, and other buildings and structures.

- a) Temporary and permanent meters shall be supplied and installed in accordance with Section 02080 - Utility Pipe and Materials.
- b) All water meters will be sized by the ACSA based on the fixture unit count of the facility. The peak demand of the facility shall be calculated using the ACSA's water meter sizing form, a copy of which is found at www.acsawater.com. This form is to be completed by the owner of the facility or his representative and submitted to the ACSA when submitting site plans for review. All standard residential connections are equipped with 5/8" meters.
- c) For fire service lines, a separate connection and meter, in addition to the domestic meter for the property, is required. The meter shall be specified by ACSA and sized in cooperation with the fire sprinkler designer and ACSA. Hook-up Fees and installation requirements shall also be in accordance with the ACSA Rate Schedule. Backflow prevention shall be provided by the Developer in accordance with Section 2. d. 6) -Backflow Prevention, Policy 18.7 - Cross-Connection Control and Standard Details.

6) Backflow Preventers

All backflow prevention measure shall be in accordance with ACSA OPPM Policy 18.7 Rules and Regulations - Cross Connection Control and Backflow Prevention.

For interior sprinklers used for fire protection, backflow prevention shall be installed inside the building in accordance with BOCA requirements.

For on-site fire hydrants used solely for fire protection and not domestic flow. See Section 2.f.3 of these Design Standards.

g. Booster Stations & Hydro-pneumatic Tanks

Prior to submitting a booster station or hydro-pneumatic tank design, a Preliminary Engineering Report (PER) shall be submitted and approved by the agencies having jurisdiction. These agencies shall include, but not be limited to the VDH and the ACSA. The PER shall address such items as the proposed

service area, the overall effect on the existing water system, an analysis of future demands for water, cost and availability of providing service utilizing the ACSA's existing pressure zones, and a cost benefit analysis of any feasible alternative to providing public water.

1) General Requirements

Water booster stations may be provided for the conveyance of potable water. Water booster stations will not be allowed for providing fire flow. System design shall include but not be limited to the technical provisions of these Standards and those of the VDH *Waterworks Regulations*.

Provisions shall be made to accommodate future needs if the initial flow is significantly less than the ultimate demand. The sizing and configuration of the pumping station shall be within the parameters set forth in the approved PER. The proposed facilities shall be based on ultimate flows unless an interim flow design shall have been incorporated in the approved PER.

Construction must meet all BOCA Code standards and be inspected by the Augusta County Building Inspections Department as well as the ACSA.

2) Capacity

Capacity design for the booster station shall take into consideration such parameters as minimum, average, and peak demands. Initial and ultimate demands shall be taken into account.

3) Hydraulic Analysis

Pump selection shall be based on a hydraulic analysis of the system. This shall include domestic flows and fire flows and available supply to the booster station.

Calculations shall be prepared and system head capacity curves developed that will show static head, and total dynamic head for both single and multiple pump operation. The curve 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.

Particular attention shall be given to the available versus required net positive suction head (NPSH) of the proposed system. Booster pump shall not create negative pressure in the suction line and shall not reduce the available flow below established standards or further degrade the available flow. Improvements to the existing system shall be provided as necessary to maintain required pressure and flow.

4) Pump Selection & Equipment

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.

Equipment selected for use in the booster station shall be in accordance with the Approved Products List coordinated with the ACSA in order to provide a system that is consistent with other satisfactory systems in operation.

At least two pumping units shall be provided in accordance with the Approved Products List. If only two units are provided, each shall be capable of delivering the peak demand. If more than two units are installed, they shall have sufficient capacity so that if any one pump is out of service, the remaining pumps are capable of carrying the peak demand. Pump selection shall consider operating speeds, motor efficiency, and cycle times. The pumping units shall:

- a) Have ample capacity to supply the peak demand without overloading.
- b) Be driven by a prime mover able to operate against the maximum head and air temperature which may be encountered.
- c) Be designed so that at full capacity, each pump will run no greater than 16 hours per day.
- d) Be designed to run for a minimum of one minute each time they start and shall not exceed three starts per hour, per pump, unless permissible by pump manufacturer and approved by ACSA.

Additional information regarding pump selection and equipment can be found in Section 11315 – Water and Wastewater Pump Station, Section 16010 – Electrical Requirements for Pump Stations, and the Approved Products List.

5) Power Requirements

Consideration must be given to designs which produce minimum power requirements to accomplish the functions required. On all motors 5 HP or greater, three phase power shall be considered to provide the necessary starting torque and to provide the most efficient and cost effective design. If three phase power is not available, a variable frequency drive shall be provided as approved by the ACSA to provide three phase power to the pumps. An energy analysis shall be provided which demonstrates that the design is the most efficient and cost effective system for the ACSA to operate.

Transient voltage surge protection must be provided on all incoming power sources. A phase monitor to protect against phase imbalances. Three-phase service shall be provided, shall be either closed delta or four-wire wye, in order to reduce the risk of phase imbalances.

Back-up generators approved by the ACSA must be provided by the developer with all water booster stations.

6) Gauges and Meters

Pressure gauges shall be installed on both the suction and discharge lines of booster pumps. A flowmeter in accordance with the Approved Products List shall be provided by the Developer to provide totalized flow on a remote digital display as well as components provided for SCADA monitoring. All booster pumps shall have run time meters.

7) Controls & SCADA

Booster pumps shall be located and controlled so that:

- a) The intake pressure shall be at least 20 psi (unless conditions could dictate different minimum pressures) when the pump is on normal operation.
- b) An automatic pressure cutoff or a pressure regulating valve shall be provided to prevent suction line pressure from dropping below 10 psi.
- c) The pumps shall not start more than three times per hour unless permissible by pump manufacturer and approved by ACSA. Calculations shall be prepared which demonstrate this.
- d) The following items shall be monitored and transmitted via the SCADA system as applicable.
 - (i) power failure to each pump
 - (ii) discharge pressure
 - suction pressure
 - phase failure
 - pump failure – each pump
 - run time – each pump
 - pumping rate (gpm)
 - total gallons pumped

- building temperature
- clear well level
- control valve position status
- storage tank levels
- generator status on/off, start failure

e) Components of the SCADA system shall be as shown in the Approved Product List. Panels shall be assembled by an electrical contractor or system integrator experienced and qualified to perform such work.

8) Electrical

The designer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The designer shall also determine the need for primary service extension. All costs for extension of electric service shall be the responsibility of the Developer and made part of the overall construction cost. Costs for extension of electric service shall not be rolled into a minimum consumption billing for startup of the facility.

All motors, motor control and other electrical equipment shall be housed in a weatherproof, above-ground structure in accordance with Part 13 of this Section. Adequate provisions shall be incorporated for the proper heating, ventilation, drainage and flood protection in order to insure maximum security, reliability, electrical and personnel safety.

Conduits of non-ferrous material buried underground shall have a detectable tracer buried in the trench approximately 6 inches above the conduit.

9) Lighting

Booster stations housed in buildings shall be adequately lighted in accordance with VOSH and other applicable codes and standards. Interior and exterior booster station lighting shall be in accordance with Section 16500 – Lighting.

10) Ventilation

Adequate ventilation shall be provided for all booster stations. Forced draft ventilation of at least six changes of air per hour (continuous operation) shall be provided.

11) Heating

Provision shall be made for adequate heating for comfort of the operator and the safe and efficient operation of the equipment. Heaters shall be electric hydronic baseboard type or as otherwise approved by the ACSA. In booster stations not occupied by personnel, only enough heat needs be provided to prevent freezing of equipment.

12) Moisture Control

Dehumidification equipment shall be provided for all booster stations.

13) Building Design

The architecture of the booster station shall be compatible with the surrounding neighborhood. The booster station shall be of block or concrete construction, in accordance with Section 03310 – Insulated Concrete Forms or Section 04100 – Generic Block Building Construction (CMU). All booster stations shall be of sufficient size and contain adequate clearances to provide ample room for maintenance. A minimum workspace of three feet shall be provided around all piping and equipment.

14) Site Grading

Site grading, seeding or sodding, trees or shrubs shall be provided to present a finished appearance, as approved by the ACSA, consistent with the zoning, site construction for pump stations, general appearance of the surrounding area, and Section 02200 – Site Construction for Pump Stations.

15) Fencing

Approved fencing with gates shall be provided to properly protect the facility, in accordance with Section 02821 – Chain Link Fences and Gates.

16) Access

An all-weather road, with storm drainage, parking shall be provided for easy access to the booster station, in accordance with Section 02200 – Site Construction for Pump Stations.

17) Vandalism

Booster station should be designed so as to minimize the risk of vandalism.

h. Cross-Connection Control

All applicants for water services to serve nonresidential buildings must meet the ACSA Cross-Connection Control Program requirements. Both residential and non-residential buildings which have sprinkler and/or irrigation systems must also meet the ACSA Cross-Connection Control Program requirements for these types of systems. Construction plans shall indicate the location and type of backflow prevention for the project. A gate valve shall be provided at the right-of-way or easement boundary to separate the public system from the private.

The Augusta County Cross-Connection Control Program is included in ACSA OPPM Policy 18.7 Rules and Regulations and Backflow Prevention.

3. Sewer

Sewer design shall be in accordance with the DEQ SCAT Regulations and these Design and Construction Standards.

a. Gravity Sewers

1) General

Private extensions shall be constructed in accordance with the applicable building codes using cleanouts in lieu of manholes when line sizes and other factors permit. This assists the ACSA in removing potential sources of Inflow and Infiltration and should provide a more cost effective and less maintenance intensive system for the owner.

Sewers shall not be located in areas subject to flooding or in drainage ditches or basins that encourage inflow and infiltration unless otherwise approved by the ACSA. Sewers shall be located outside of jurisdictional wetland areas whenever possible.

General Structural Design - The structural design of sewers shall conform to the methods given in the ASCE Manuals of Practice 60 for the Gravity Sanitary and Sewer Design and Construction.

2) Capacity

a) Population Served

Generally, the capacities of lateral, trunk, and interceptor sewer systems should be designed for the estimated ultimate build out population of the service area being considered for development. Any known future development shall be considered as well.

The designer shall also estimate the ultimate build out population for the total sewer shed area. Future population densities should consider the Augusta County Comprehensive Plan, ACSA Master Plan, Zoning Ordinance, and Subdivision Ordinance as applicable. Based on the results of this estimate, the ACSA may participate in the project in accordance with ACSA OPPM Policy 10.2 System Improvements.

b) Average Daily Flow

New sewer systems shall be designed on the basis of an average daily per capita flow of sewage in accordance with the DEQ SCAT Regulations.

For residential developments, this flow is 100 gallons per person per day. These figures are assumed to cover infiltration. The ACSA currently uses an average of 2.5 persons per residence.

Equivalent flows from motels, schools, hospitals, etc. shall be based upon that of the DEQ SCAT Regulations.

When a commercial or industrial development is proposed, but the specific industries are unknown, the designer shall use an average daily flow of 2000 gpd per acre.

When deviations from the foregoing per capita or per acre rates are proposed, the designer shall supply sufficient information, substantiated by sound engineering judgment to verify the design, with the submission. This information shall be subject to approval by the ACSA.

c) Peak Flow

(i) Laterals & Sub-Mains

Minimum Peak Design Flow shall be 400 percent of the average daily flow.

(ii) Main Trunk and Interceptor Sewers

Minimum Peak Design Flow shall be 250 percent of the average daily flow.

3) Alignment & Slope

a) General

Sewers shall have a uniform slope and straight alignment between manholes. Gravity sewer size shall normally remain constant between manholes.

b) Minimum Slope & Velocity

Minimum grades shall not be less than those required to produce a velocity of no less than two feet per second when the size pipe selected is flowing full using a material roughness coefficient, "n" value, of 0.014, in the Manning Formula.

Pipe sizes shall be based on design flow and not increased in size in order to take advantage of a decreased grade, except with ACSA approval.

Minimum grades shall be in accordance with the following table.

Table 1. Minimum grades for non-settled sewage

SEWER SIZE (Inch)	MINIMUM SLOPE IN FT/100 FT
3	Not Allowed
4	Not Allowed
6	0.49*
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
36	0.046

(Source: DEQ Sewage Collection and Treatment Regulations)

* - Used only in unusual circumstances.

c) Maximum Slope & Velocity

The maximum slope of a sewer line shall normally be 15%. When steeper slopes are necessary, a drop manhole connection shall be used.

When an excessive number of drop manholes is required to due steep slopes, a steeper than maximum slope and/or additional depth may be used upon approval by the ACSA.

The maximum recommended velocity at average daily flow is ten (10) feet per second. Velocity shall be calculated using a Manning's "n" value of 0.014.

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

d) Anchors

When slopes 20% or greater are approved for use by the ACSA, concrete anchors shall be specified. Anchors shall be in accordance with Standard Detail G-5 and spaced in accordance with the following table.

e) Deflection

The maximum deflection between the inflow and outflow lines at a manhole shall be 90 degrees.

4) Depth

In general, sewers should be sufficiently deep as to receive sewage from basements. Elevations shall be shown on the plans for service lateral inverts as well as the finished floor of the lowest floor proposed to be served.

All sewers shall be constructed in such a manner that a minimum of 3.5 feet of cover is maintained between the top of the pipe and the finished grade or ground elevation. Greater depths may be required if deemed necessary to provide service to adjacent properties or to serve lower lying properties. Where approved by the ACSA and conditions dictate that the cover be less than 3.5 feet, ductile iron pipe, thickness class 50 shall be required. Sewers installed with 15 feet of cover or greater shall be constructed of C900 PVC pipe, thickness Class DR-18. Maximum depth shall be 18 feet unless otherwise approved by the ACSA.

5) Size

No public sewer shall be less than 8 inches in diameter. The ACSA reserves the right to specify the size of sewer mains on any project. If the ACSA specifies a sewer main larger than shown necessary by approved design calculations, the ACSA may participate financially in the project according to ACSA OPPM Policy No. 10.2 System Improvements. In any case, the designer shall be responsible to properly design the sewer system for the estimated population to be served.

6) Sewer Connections

- a) Connections to sewer lines 18 inches in diameter or larger shall only be made at manholes.
- b) When connections are made to existing manholes, invert shaping shall be modified by the Contractor to accommodate the new connection.
- c) For residential connections, a minimum 6 inch sewer lateral may be provided for a maximum of two residential connections and minimum 4 inch for individual connections in accordance with Standard Detail S-2.

For commercial subdivisions, sewer service laterals shall be provided by the ACSA at the time of payment of connection fees (typically at the time of site plan approval for each additional lot.

Site plans submitted for lots located in commercial subdivisions shall indicate proper closure of existing unused sewer laterals as part of the site plan. This includes removal of

all cleanouts and permanently capping the line on the same side of the road as the main.

- d) Sewer laterals shall be constructed to the property line and a cleanout provided immediately at its terminus, installed to a point flush with the finish grade, or when the finish grade is unknown, to a point sufficiently above the existing grade. All openings shall be plugged and sealed with a watertight plug until line is put in to use. See Standard Detail S-2.
- e) Direct connections to the public sewer of roof drains, sump pumps, holes in floor drains, foundation drains, leaking laterals and other direct sources on inflow or infiltration into the public sewer system are prohibited.
- f) At all junctions where a smaller diameter sewer discharges into a larger one and at all locations where the sewer increases in size, the invert of the larger sewer shall be lowered so that the energy gradient at design flow of the sewer at the junction is at the same level. Two approximate methods for securing this result which may be used are as follows:
 - (i) Align the 80% capacity flow level of both sewers at the same elevation, or
 - (ii) Position the crown of both sewers at the same elevation.
- g) Sewer joints shall be in accordance with ASTM design standards and/or according to manufacturer's recommendations. Sewer joints shall be designed to prevent infiltration and to prevent the entrance of roots.

7) River or Stream Crossings and Pipe Installation in Marshy Areas

Each river or stream crossing shall be submitted for review to the Virginia Marine Resource Commission (VMRC) using the Joint Permit Application (JPA) process and proof of approval by VMRC shall be provided to ACSA.

River and stream crossings shall be constructed of ductile iron pipe, thickness class 50, manhole to manhole, and encased in concrete in accordance with Standard Detail G-6 and as required by the JPA process. The ACSA reserves the right to require ductile iron river-crossing pipe and concrete encasement for pipe installation crossing rivers, streams, ditches, shallow areas or marshy areas. The pipe and joints shall be tested in place and shall exhibit zero infiltration. The pipe joints shall be designed and constructed for impacts due to hydraulic longitudinal and vertical loads and protected from erosion.

Minimum cover over the concrete encasement shall be 3 feet, in accordance with Standard Detail G-6.

Sewers shall remain fully operational during 25-year flood/wave action.

Sewers shall be allowed to lie on piers across ravines or streams when it can be demonstrated that no other practical alternative exists. Such sewers on piers shall be constructed in accordance with the requirements for sewers entering or crossing under streams. In addition, a stream flow analysis using HEC methods to determine the effect of the piers shall be performed by the designer as required by the ACSA or other agencies having jurisdiction.

Construction methods and materials or construction shall be such that sewers will remain watertight and free from change in alignment or grade.

b. Manholes

1) General

Standard and drop manholes, service connections and other appurtenances shall be designed and constructed in accordance with the Standards.

2) Layout

Manholes shall be installed at the end of each line, at all grade, size, or alignment changes, and at all sewer line intersections. Terminal cleanouts may be permissible in sidewalk collectors or as approved by ACSA.

In addition, manholes shall be provided at intervals not exceeding 400 feet on all sewers 15 inches in diameter or less and not more than 500 feet apart on sewers 16 inches in diameter or larger.

3) Size

Size of sewer manholes shall be in accordance with Standard Details. Manholes larger than minimum size may be required where pipe deflection or intersection of two or more upstream lines occur.

Monolithic bottoms with extended base may be required in unstable soil conditions or where floatation may be a problem. In areas subject to flooding or unstable soil conditions, calculations shall be performed which demonstrate that the standard manhole will not float, or that an extended base has been provided to prevent the manholes from floating. If extended bases are shown to be necessary, they shall be detailed on the plans.

4) Frame and Cover

In areas subject to flooding, and as required by the ACSA, manhole tops shall be raised above the flood elevation, or watertight manholes shall be provided in accordance with Standard Details.

Where the length of sewer line containing watertight manholes exceeds 1000 feet, a non-watertight or vented watertight manhole shall be provided every 1000 feet. Vented manholes shall be in accordance with Standard Detail S-8.

5) Inverts and Slope

Invert shaping shall be provided for all manholes in accordance with Standard Details S-5 and S-6. The slope through the manhole shall be the same as the slope of the main line incoming pipe or shall be a minimum of 2.5%. This incoming or minimum slope shall determine the drop across the manhole. Inverts in and out of the manhole shall be shown on the plans. The minimum slope of 2.5% across a 4 foot manhole is a drop of 0.10 feet. The maximum slope across a manhole shall be 15 percent which, across a 4 foot manhole, is a drop of 0.60 feet. The maximum slope of a gravity sewer line is also 15 percent.

Slopes of gravity sewers shall be in accordance with the Standards.

6) Force Main Receiving Manholes

Interior of force main receiving manhole and two downstream manholes shall receive an epoxy coating. Coating shall be 100 percent solids based epoxy binder combined with fibrous and flake fillers to minimize water vapor transmission and increase flexural strength. Material shall be specifically designed for manhole rehabilitation. Coating shall be corrosion resistant. Material shall be applied at 40-60 mils thick on vertical and overhead surfaces.

The invert shall be modified as necessary in the receiving manhole to ensure a smooth flow transition to the gravity flow section. Special consideration should be paid to design of the termination in order to prevent turbulence at this point.

7) Drop Manholes

When approved by the ACSA, drop manholes in accordance with Standard Detail S-5 shall be provided to break steep slopes, to limit the velocities in the connecting sewer pipes, and reduce splashing effects of large falls which may release gasses. Where drop manholes are impractical for a reduction in velocity, and as approved by the ACSA, the sewer main shall be of ductile iron.

A drop pipe shall be provided on the exterior of the structure for a sewer entering a manhole at an elevation of 8 inches or more above the manhole base or as may otherwise be required to conform to the use of standard fittings in the drop pipe construction.

Inside drops may be allowed for pipe sizes less than or equal to 6 inches.

Every effort should be made by the designer to minimize the use or number of drop manholes.

8) Doghouse Manhole

Doghouse manholes shall not normally be allowed. If approved by the ACSA, doghouse manholes may be used in cases where a new manhole cannot be cut in and pumping of sewage is not possible. Installation of additional materials may be required to ensure water tightness.

c. Force Mains & Pump Stations

1) General Requirements

ACSA strongly discourages the installation of pump stations and force mains where reasonable alternatives exist. ACSA will consider all such requests received from the perspective of the best interests of total sewer system development and operation. Convenience of any individual development and/or developer is a secondary consideration.

Prior to submitting a pump station and force main design, a Preliminary Engineering Report (PER) shall be submitted and approved by agencies having jurisdiction. These agencies shall include, but not be limited to the DEQ and the ACSA. The PER shall address such items as the proposed service area, the overall effect on downstream facilities, peaking factor, and a cost benefit analysis of an alternative gravity sewer design. Force main and pump station detention times, wet well aeration, and odor control shall also be addressed. This shall consider start up flows as well as design build-out flows.

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 PER. The facilities to be provided shall be based on ultimate flows unless an interim flow design was incorporated in the approved PER.

System design shall include but not be limited to the technical provisions of these Standards and those of the DEQ SCAT Regulations.

Stations must comply with all provision of the BOCA Code and be inspected by the Augusta County Building Inspections Department in addition to ACSA inspectors.

2) System Design

a) Capacity

Pump Selection Capacity design for the pumping station and force main shall take into consideration such parameters as minimum, average and peak station inflows as

well as minimum, average and maximum pumping rates. Initial capacity as well as capacity required to serve the entire drainage basin shall be taken into account.

Sewage pump station design shall consider the needs of the ultimate build out population of the service area being considered. Any known future development shall be considered as well. Provisions shall be made to accommodate future needs if the initial flow is significantly less than the ultimate demand.

The designer shall also estimate the ultimate build out population for the total sewer shed area. Future population densities should consider the Augusta County Comprehensive Plan, ACSA Master Plan, Zoning Ordinance, and Subdivision Ordinance as applicable. Based on the results of this estimate, the ACSA may participate in the project in accordance with the ACSA OPPM Policy No. 10.2 System Improvements.

b) Flood/Wave Action

All mechanical and electrical equipment, which could be damaged or inactivated by contact with or submergence in water, shall be physically located above the 100-year flood/wave action or otherwise protected against the 100-year flood/wave action.

All stations shall be designed to remain fully operational during the 25 year flood/wave action.

c) Hydraulic Analysis

Pump selection and force main sizing shall be based on a hydraulic analysis of the required flows, pipeline velocities, and receiving gravity sewer capacities. Each pump in the duplex system shall be capable of handling flows in excess of the expected maximum flow or a minimum of two and one-half (2.5) times the average design flow, whichever is greater.

Calculations shall be prepared and system head capacity curves developed that will show static head, and total dynamic head (TDH) for both single and multiple pump operation, and high and low wet well levels. TDH calculations shall also show consideration of any and all high points in the discharge force main. 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. When a VFD is used, factory variable speed curves shall be utilized and provided with the design calculations. Particular attention shall be given to the available versus required net positive suction head (NPSH) of the proposed system.

3) Pump Stations

a) General

The design engineer shall consider the need for protection of the pumping station, force main, and downstream manholes against hydrogen sulfide attack and shall provide the proper equipment if such protection is found to be justified by the design calculations. The designer shall prepare an operations and maintenance manual for the pump station.

b) Pumping Equipment

All pumping equipment and controls shall be in accordance with the ACSA approved products list.

(i) Pump Selection

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. Pump selection shall consider operating speeds and motor efficiency. Except in special cases, sewage pumps shall not exceed an operating speed of 1800 RPM. Design of those pump stations which discharge to sewage treatment facilities without dissipation of flow shall consider the need for variable speed pumps and be sized to handle matched flows. Pumps shall be selected such that their discharge under operating conditions is no greater than 120% or less than 60% of the noted discharge at the best efficiency point.

Pump stations shall consist of a minimum of two submersible sewage pumps and be protected against clogging. Pneumatic ejectors shall not be used. The station shall be equipped with one automatic flushing valve per duplex system. Pumps in which solids are able to pass through the impeller(s) shall be capable of at least passing a sphere three (3) inches in diameter. Suction lift pumps may be considered by the ACSA on a case by case basis.

The pump station shall be designed so that at full capacity each pump will run no greater than 16 hours per day and each pump can handle the peak flow individually. In addition, the pumps shall be designed to run for a minimum of one minute each time they start, and shall not exceed 3 starts per hour, per pump.

c) Power Requirements

Consideration must be given to designs that require the least power to accomplish the functions required. An energy analysis shall be provided which demonstrates that the design is the most efficient and cost effective system for the ACSA to operate.

Transient voltage surge protection must be provided on all incoming power sources. A phase monitor to protect against phase imbalances. Three-phase service shall be provided, shall be either closed delta or four-wire wye, in order to reduce the risk of phase imbalances.

d) Vibration

Maximum allowable acceleration and amplitude of vibration must be specified, variable speed pump designs and installations must consider avoiding sympathetic resonant vibration.

e) System Layout

Suitable shut-off valves shall be placed on each discharge line of each pump for normal isolation. No shut-off valve need be placed on the suction side of the submersible pumps. The shut-off valve and check valve on the discharge lines of submersible pumps operating at flows greater than 25 gpm shall be located in a separate vault outside of the wet well allowing accessibility for inspection. Pump suction and discharge piping shall not be less than four inches in diameter. Discharge check valves shall not be of diameter significantly larger than the pump discharge size, such that it would create excessive startup pressure on the pump (through mechanical advantage).

When suction lift is approved by the ACSA, each pump shall have its own suction/intake line. Velocity in the suction lines shall be in the range of 2 to 6 feet per second. Air relief valves shall be located on the discharge piping. The pumps, shut off valves, and check valves shall be located outside the wetwell.

Pressure gauges shall be provided on the pump side of the discharge check valve for each pump. Where possible a pressure gauge shall be installed on the force main side of the check valves to indicate static pressure. Ball valves shall be provided at all gauges to allow for removal and/or cleaning during operations.

Equipment shall be installed to facilitate removal of pumps, motors, etc. without interrupting system service and without requiring personnel to enter the wet well.

A quick connect shall be provided in the piping layout that will accommodate a portable pump in the situation that both pumps must be taken off-line. At this same location and at the discretion of ACSA, a pigging station connection will be required.

f) Controls & SCADA

- (i) Float controls are preferred for all sewage pump stations. Provisions shall be made to automatically alternate the pumps in use referred to as lead-lag operation. Depending on the site, transducers may be required instead of floats.

In stations where wet well aeration is provided, controls shall automatically halt aeration prior to starting pumps and for the duration of their run time. Aeration controls shall include 24 hour time clocks for automatic operation.

- (ii) The following items shall be monitored and transmitted via the SCADA system.

- wet well levels
- high/low alarms
- power and phase failure
- generator status
- run time – each pump
- flow meter

- (iii) Components of the SCADA system shall be as shown in the Approved Product List found at www.acsawater.com. Panels shall be assembled by an electrical contractor or system integrator experienced and qualified to perform such work.

- (iv) Transient voltage surge protection shall be provided on all communication lines.

g) Wet Well

Wet well design shall take into account the selection criteria for pumps. Wet well capacity shall be such that start and stop set points can be achieved without loss of required net positive suction head. Capacity shall also account for pump cycle time such that no pump is started more than three times per hour. When the station is expected to operate at a flow rate less than one-half (0.5) times the average design flow for an

extended period of time, the design of the wet well shall also address measures to prevent septicity due to long holding times in the wet well.

In cases where wet well or force main detention times may exceed 12 hours, either at start up or build out flows, provisions shall be made for aeration of the wet well to maintain the highest possible dissolved oxygen level in the force main. If detention times may exceed 24 hours, consideration shall be given to chemical feed systems to control odors. All odor control alternatives to chemical feed shall be considered. Chemical feed systems shall be considered a last resort for odor control.

The base of the wet well shall be filleted at a minimum slope of 1:1 in order to prevent the build up of solids in the bottom of the wet well. The pump shall be located at a distance from the sloped area in accordance with the manufacturer's recommendations to prevent the accumulation of solids. Low water level for stations with submersible pumps shall maintain complete submergence of the pump motor for cooling.

Sewage pump stations which pump sewage prior to grit removal shall pay special attention to design of the wet well and discharge piping in order to prevent solids from settling in the pumps' discharge lines.

Floatation calculations shall be provided which demonstrate that the wet well will not be subject to floatation. An expanded base shall be required if necessary to eliminate floatation.

h) Dry Well

Dry well design should not be required in the case of submersible pumps. Should a dry well be required:

- (i) A separate pump shall be provided in the dry well to remove leakage or drainage, with the discharge above the high water level of the wet well. All floors and walkway surfaces shall have an adequate slope to a point of drainage. If the dry well contains equipment which may be damaged by water, a dry well flood alarm shall be provided and communicated to the SCADA system.
- (ii) 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.

- (iii) Suitable and safe means shall be provided to access both dry and wet wells.
- (iv) Wet and dry wells shall be separated to prevent leakage of gas into the dry well.

i) Electrical

The designer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The designer shall also determine the need for primary service extension. All costs for extension of electric service shall be the responsibility of the Developer and made part of the overall construction cost. Costs for extension of electric service shall not be rolled into a minimum consumption billing for startup of the facility.

All motors, motor control, external disconnect switch and other electrical equipment shall be housed in a weatherproof, above-ground structure. Adequate provisions shall be incorporated for the proper heating, ventilation, drainage and flood protection in order to insure maximum security, reliability, electrical and personnel safety.

If wet well is contained within a building, 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 its use is required. If electrical boxes are contained in a separate structure from wet well and piping, boxes shall be NEMA 12.

The design engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.

An electrical schematic shall be shown on the plans which details all construction requirements for a complete working system.

j) Lighting

Pump stations housed in buildings shall be adequately lighted in accordance with VOSH and other applicable codes and standards. Pump station lighting shall be in accordance with Section 16500 – Lighting - of the Construction Specifications.

k) Ventilation

Shall be required in accordance with VOSH requirements and the DEQ SCAT Regulations for enclosed

spaces within pump stations during all periods when the station is manned.

A properly screened vent with a diameter of at least four (4) inches, with the end turned downward or a "mushroom" cap shall be provided as ventilation for the wet well.

Dampers shall not be used on exhaust or fresh air ducts, and fine mesh screens or other obstructions in air ducts should be avoided to prevent clogging.

Switches for the operation of the ventilation system shall be located above grade and located near the entrance.

There shall be no interconnection between the wet well and dry well ventilation systems.

Where the pump is permanently mounted below the ground, mechanical ventilation is required and shall be arranged so as to independently ventilate the dry well.

Wet well:

Continuous ventilation: 12 air changes/hour minimum

Intermittent ventilation: 30 air changes/hour minimum

Dry well:

Continuous ventilation: 6 air changes/hour minimum

Intermittent ventilation: 30 air changes/hour minimum

l) Flow Measurement

A flowmeter shall be provided from the Approved Products List which can be found at www.acsawater.com.

m) Water Supply

A sanitary frost proof yard hydrant in accordance with the approved products list shall be provided within 15' of the wet well. There shall be no cross connection between any potable water supply and a sewage pump station. When a sanitary type hydrant is utilized, additional backflow prevention if not required.

Consideration shall be given to the need for a water supply well in locations where a public water supply is not available.

n) Building Design

A building or wooden shelter, at the discretion of ACSA, shall be provided for all above ground piping and all electrical panels. The architecture of the pumping station shall be compatible with the surrounding neighborhood in

accordance with ACSA Construction Standards. All pumping stations shall be of sufficient size and contain adequate clearances to provide ample room for maintenance. A minimum work space of three feet shall be provided around all piping and equipment. Additional space shall be provided around electrical enclosure, in accordance with local building and electrical codes.

o) Site Grading

Site grading, seeding or sodding, trees or shrubs shall be provided to present a finished appearance, as approved by the ACSA, consistent with the zoning, general appearance of the surrounding area, and 02200 – Site Construction for Pump Stations.

p) Fencing

Fencing with gates shall be provided in accordance with 02821 – Chain Line Fences and Gates to properly protect the facility and provide public safety.

q) Reliability Class Designation

Unless otherwise approved by ACSA/DEQ, a generator shall be provided to ensure that the pump station can operate for a minimum of 24 hours at 100% load without refueling during a power outage.

Should it be determined that standby power is not required, a hookup for a portable generator shall be installed, compatible with existing ACSA equipment, and coordinated with the ACSA operation personnel.

r) Access

An all-weather road, storm drainage and parking shall be provided for easy access to the pumping station in accordance with 02200 – Site Construction for Pump Stations.

s) Vandalism

Pump stations shall be designed so as to minimize the risk of vandalism.

4) Force Mains

a) General

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

b) Capacity

Sizing of the main shall be such that at pumping capacity, a minimum velocity of 2.25 feet per second be maintained to provide adequate flushing. A velocity of eight (8) feet per second should not be exceeded. A minimum velocity of 3.5 feet per second may be required to re-suspend solids in longer force mains. Detention times shall be examined and appropriate odor control measures shall be provided in accordance with these Standards.

The minimum size of force mains shall be four (4) inches in diameter unless otherwise approved by the ACSA.

c) Materials

All force mains shall be cement lined ductile iron pipe, thickness class 50.

d) Alignments and Grade

Force mains shall have a positive slope from the pumping station to the point of discharge unless unusual conditions make this impractical. Extra depth or 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. Air relief valves, should they be required at the system high points, shall have an automatic valve installed inside a standard manhole with adequate means of drainage in accordance with Standard Details.

e) Point of Discharge

Force mains shall enter a gravity sewer system at the invert of the receiving manhole. The force main should enter the manhole with its center-line horizontal to prevent air from traveling up into the pipeline. Invert shaping and protective coatings in the receiving manhole shall be in accordance with Section B.3.b. - Manholes of these Standards. Drum scrubbers shall be considered at the discharge manhole, if necessary to control odor.

f) Test Pressure

All force mains shall be tested at a minimum pressure at least 50% above the design operating pressure and pump shutoff head. This test pressure shall be shown on the plans.

g) Installation

See Section 02080 – Utility Pipe and Materials for bedding and installation of sewer lines.

h) Anchoring

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

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.

d. Rules and Regulations for Waste Water Discharge

1) Connection of any storm water or ground water pumping system to the sanitary sewer system is prohibited.

2) Industrial Pretreatment Application

The applicant for sanitary sewer services, which produce processed wastewater, to serve industrial establishments shall conform to the requirements of the ACSA's Industrial Pretreatment Program.

The ACSA Lab & Compliance Manager will contact the Developer/Owner when an industrial connection is to be made to determine if a processed waste is to be sent to one of the ACSA wastewater treatment facilities. There is an application procedure for acceptance of processed waste and the Owner/Developer must comply with the ACSA Rules and Regulations for Wastewater Discharges. Information regarding plant location, type of industry, raw and finished products, approximate volume of utility requirements, types of industrial wastes to be discharged, proposed facilities for pretreatment of industrial wastes and other data pertinent to the industry, shall be accompanied by the application for review and enforcement by the ACSA Lab & Compliance Manager that can be contacted at 540-245-5670.

3) Oil/Water Separator

Any sanitary sewer connection that will be discharging waste that contains fat, oil, or grease in concentrations greater than the limits defined in the ACSA Pre-treatment Policy shall provide an oil/water separator as described below.

The Oil Water Separator shall be designed in accordance with Stokes Law and the American Petroleum Institute Manual on Disposal of

Refinery Wastes, Volume on Liquid Wastes as stated in Chapter 5, Oil Water Separator Process Design and API 1630 First Edition, Waste Water Handling and Treatment Manual for Petroleum Marketing Facilities.

The free petroleum hydrocarbon concentration in the effluent from the Oil Water Separator shall not exceed 15 mg/l (15 ppm). To achieve this goal, it will be necessary to remove all free oil droplets equal to and greater than 60 microns

The Oil Water Separator capacities, dimensions, construction, and thickness shall be in strict accordance with Underwriters Laboratories, ANSI/UL 58.

Oil Water Separator Corrosion Control System shall be in strict accordance with STI P 3 specifications as applied by a licensee of the Steel Tank Institute. Manufacturer must be a licensee of Steel Tank Institute. No assigning or subcontracting of tank fabrication shall be permitted.

The Oil Water Separator shall be cylindrical, horizontal, and atmospheric-type steel vessel intended for the separation and storage of flammable and combustible liquids. The separator shall have the structural strength to withstand static and dynamic hydraulic loading while empty and during operating conditions.

The Oil Water Separator shall have an oil storage capacity equal to about 45% of the total vessel volume and an emergency oil spill capacity equal to 80% of the total vessel volume.

Each Oil Water Separator shall consist of inlet and outlet connections, non-clogging flow distributor and energy dissipater device, stationary under flow baffle, presettling chamber for solids, sludge baffle, oil coalescing chamber with a parallel corrugated plate coalescer to optimize separation of free oil from liquid carrier, effluent downcomer positioned to prevent discharge of free oil that has been separated from the carrier liquid, access for each chamber, fittings for vent, oil pump out, sampling, gauging and lifting lugs.

The oil/water separator shall be shown and detailed on the plans.

- 4) The complete ACSA Rules and Regulations for Wastewater Discharge are included in Appendix 3 of the Design and Construction Standards.