SECTION 3 - DESIGN STANDARDS FOR SEWAGE PUMPING STATIONS AND FORCE MAINS

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 and roof, foundation, surface or sub-surface or any other form of storm drainage be allowed to pass through the proposed facility.

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

3.1.04 The design must conform to the minimum standards set forth in the Commonwealth of Virginia "Sewerage Regulations". New Kent County requirements for specific equipment and submittals will be detailed during engineering review.

3.1.05 Two copies of all Shop Drawings and Submittals shall be submitted to the County when they are returned to the contractor. The County reserves the right to reject such submittals if, in its judgment, such submittals are not in conformance with County water & sewer standards.

3.1.06 The design engineer shall be responsible for preparing and obtaining approval for an O&M manual as required by state regulations and shall turn over all manufacturer's O&M manuals to the County before the County will accept the station for operation.

3.1.07 Prior to the County accepting the station for operation, all O&M manuals, utility account information, record drawings, and spare parts shall be received by the County and all deficient items noted in the final inspection shall be corrected.

3.1.08 All sewer pump stations shall be required to be provided with SCADA per Volume I, Section 8 of these standards.

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 in general conform to the following types:

Pump Type	Flow Range
Grinder Pumps	Up to 30 gpm or forcemains less than 4" in diameter
Suction Lift or (see below)	30 to 1736 gpm (2.5 MGD) (Suction Lift - Gorman-Rupp)
Dry Pit**	1735 gpm (2.5 MGD) and over (KSB or Flygt dry-pit submersible)

**suction lift may be considered in limited circumstances

All flows above are peak design flows.

Suction lift pumps are the preferred arrangement for sewer stations from 30 to 1736 gpm. Suction lift stations are allowed up to 23' in suction depth. Stations at depths of 23' or less shall be suction lift unless compelling evidence can be presented to the Department demonstrating why a submersible station should be constructed in favor of a suction lift station. Air releases shall have been piped to the wet well for each individual pump, with unions so they can be taken apart.

D. An ample, all-weather road, including full-thickness paving (with base course), storm drainage and parking, shall be provided for easy access to the pumping station. Pavement design shall be full thickness bituminous pavement unless otherwise specified.

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. Buildings shall be constructed of "maintenance-free" materials (i.e., vinyl siding, aluminum soffits, brick veneer, etc.). Pre-fabricated concrete utility structures are generally acceptable provided that they otherwise comply with zoning requirements.

F. The Design Engineer shall determine the "Reliability Class" in accordance with the State "Sewerage Regulations" and shall comply with the requirements thereof. Each pumping station shall have a permanently installed emergency generator per Section 16620 of these standards.

G. 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.

H. The Design Engineer shall consider the need for odor control in the design of the pump station and forcemain. At a minimum, odor control chemical feed shall be provided at the pump station when odor control facilities are required. The Department may also require the installation of vapor phase odor control at forcemain discharge points and/or air/vacuum valves on the forcemain.

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

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 mag meters are installed in dry well an air release shall be installed upstream of the meter. Each dry pit shall have a drain back to the wet well or a sump pit and pump installed and pumped to the wet well. .

L. 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.

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

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

O. Forcemain locations shall generally conform to Section 2.2.01 - "System Layout" of these Standards. Forcemains shall have a positive slope from the pumping station to the point of discharge unless unusual conditions make it impractical. Consideration shall be given to extra depth of bury in lieu of combination valves. Every effort shall be expended to maintain the force main below the hydraulic gradient. Where a relief valve is required, a combination valve shall be provided and installed inside a standard manhole with adequate means of drainage.

P. In cases where the hydraulic gradient dips below the forcemain, a combination valve of sufficient size shall be provided to allow the forcemain to drain by gravity below that point. For purposes of these specifications, such forcemains shall be known as

"pressure sewers" and the point of hydraulic grade crossing the forcemain shall be known as the "high point". Pressure sewer design is a complex hydraulic problem that must be evaluated carefully by the design engineer. Care shall be taken to ensure that the pressure sewer will flow by gravity from the high point under all hydraulic conditions or that expansion capacity is provided in the station and/or lines to allow flow under pressurized conditions in the future.

Q. All high point in forcemains shall have air valves installed. Generally, combination valves should be provided on forcemains unless justification can be shown that air relief only or air/vacuum valves should be installed instead.

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

S. Sizing of main shall be such that velocity shall not be below 2 F.P.S. flushing facilities.

T. All forcemains shall be ductile iron, or polyvinylchloride (PVC). PVC and HDPE may be used for directional drilling with Department approval. Forcemains that may be subjected to sulfide attack shall be PVC or ductile iron with Protecto 401.

U. Design Engineer shall consider ground conditions in the case of ductile iron and provide suitable cathodic protection where necessary.

V. Steel casing pipe shall have a minimum yield strength of 35,000 p.s.i. and a minimum internal diameter of 4" 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 0.250 inches.

W. Conduits buried underground shall have a marking tape and tracing wire buried in the trench. Marking tape shall be installed approximately 18" above the conduit, but no less than 24" below grade. Tracing wire shall be taped directly on the pipe in a manner that a continuous tract results.

X. Yard hydrants at pump stations shall be Woodford Model Y2

Y. All sewer pump stations are to have TVSS (Electrical Surge Suppression) along with lightning protection installed in electrical panels.

Z. All VFD's should have proper fan ventilation and temperature control.

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 forcemain sizing shall be based on a hydraulic analysis of the required flows, pipeline velocities and receiving gravity sewer capacities. Normal operation greater than 100 psi will not be acceptable. Systems with pressures greater than 80 psi must provide surge and hammer protection through cushion swing check valves and/or surge relief valves.

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 Department. This may require the use of variable frequency drives or reduced voltage starters (a.k.a. soft starts). The Department reserves the right to require such items be incorporated into the design if, in its judgment, such installation shall be beneficial to station operation.

E. Where a grinder is required in a wet well, the grinder motor shall be water and explosion proof.

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 blocking, pipe anchorage or other suitable means to prevent movement of pumping equipment and pipelines. Mechanical joint restraint shall also be provided.

(2) Structural requirements for forcemains 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 forcemains 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.

C. Drawings for pumping stations shall include a site plan drawn to scale of not less than 1" equals 20' and shall contain existing and proposed contours on a 2' contour interval. The boundaries of the site shall be clearly shown on the site plan and shall be permanently mounted in the field prior to completion of construction.

D. Drawings for pumping stations shall be drawn on a scale of not less than ¼" equals 1'-0". Drawings required to clarify construction details shall be drawn on an appropriately larger scale.

E. Drawings for forcemains shall show stationing, pipe size, pipe material, bedding, direction of flow, deflection angles and curve data.

F. Profiles for forcemains shall show the ground line, forcemain profile, underground utility lines and structures that might affect forcemain 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 crossing of existing and proposed water mains and storm sewers shall be shown to clearly indicate vertical clearance between utilities.

G. Details shall be shown for all blocking, 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 / County Erosion and Sedimentation Control Handbook.

I. Potable water at each station shall utilize a Woodford Y2 yard hydrant or approved equal at the line termination

J. Provide fence shading for all pump station fencing

K. Safety Placards to include but not limited to the following:

a. Confined Space
b. No fuel trucks beyond this point
c. Physical address for the particular site with County Logo

END OF SECTION