ADDENDUM
PRELIMINARY ENGINEERING REPORT

MT. CARMEL WOODS PUMPING STATION

PGM NO.: VC198-0135

CHARLES COUNTY
DEPARTMENT OF
PLANNING & GROWTH MANAGEMENT
200 BALTIMORE ST.
LAPLATA, MARYLAND 20646

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Draft Preliminary Engineering Report for the Mt. Carmel Woods pumping station submitted February, 2006 and revised June, 2006 examined the feasibility of abandoning the existing Mt. Carmel Woods Wastewater Treatment Plant (WWTP), constructing a new sewage pumping station and force main, conveying raw wastewater from the Mt. Carmel Woods collection system to the wastewater treatment plant at the College of Southern Maryland for treatment, and discharging into the Port Tobacco Creek. Per Charles County request, this addendum will further study combining the sewage currently treated by the Mt. Carmel WWTP and the College of Southern Maryland WWTP and pumping the sewage to ultimately be treated by the Mattawoman WWTP. Two potential options to convey the sewage to the Mattawoman WWTP are included in this study.

One option is to pump the sewage from the Mt. Carmel Woods to the College of Southern Maryland, as presented in the Draft Preliminary Engineering Report, replace the existing WWTP at the College of Southern Maryland with a pump station, and then pump the combined sewage across country, following existing sewer easements and County roads to tie into Manhole #23 of the Mattawoman Interceptor Plans (Manhole 23 is located along the U.S. Government Railroad south of Pomfret Road).

The other option is to replace both existing WWTPs with pumping stations, similar to the first option, however, sewage from the College of Southern Maryland will be pumped to Mt. Carmel Woods and from there pump the sewage north up Route 301 into Manhole #43 of the White Plains Sewer System.

In the following chapters, George, Miles and Buhr, LLC (GMB) will provide preliminary hydraulic design and sizing of the pumping station and force main for both options.

1.2 DESCRIPTION OF SERVICE AREAS

Located near the intersection of Maryland Route 301 and Mitchell Road, the Mt. Carmel Woods Pumping Station will serve the same area as the Mt. Carmel Woods Wastewater Treatment Plant. (Figure 1.1)

The College of Southern Maryland Pumping Station will service the College, the McDonaugh School, and the VoTech School, as the does the existing College of Southern Maryland WWTP. Figure 1.2 shows the College of southern Maryland WWTP site layout, existing influent sewer routing and the location of the proposed pumping station. The College of Southern Maryland is located northwest of the Mitchell Road and Mt. Carmel Road intersection. For report preparation purposes, we have assumed that the Mt. Carmel Pumping Station will be located on the existing Mt. Carmel WWTP site and the College of Southern Maryland pumping station will be located on the site of the existing College WWTP.

CHAPTER 2

DESIGN FLOWS

2.1 INTRODUCTION

The purpose of this section is to explain the methodology and present the results of design flow calculations for the Mt. Carmel Woods and College of Southern Maryland Pumping Stations.

2.2 DESIGN FLOW AND COUNTY STANDARDS

The Mt. Carmel Woods subdivision contributes 70 Dwelling Units (DU) at 260 gpd/DU for an average daily flow of 18,200 gpd. As per Appendix V of *Charles County Water and Sewer Ordinance,* if the average daily flow rate is less than 0.25 Million Gallons per Day (MGD), then peak flows are four (4) times average daily flow resulting in a peak flow of 72,800 gpd. An infiltration flow of 851 gpd/acre over the service area of 57 acres was added to the design flow giving a total inflow and infiltration flow of 48,507 gallons per day (gpd). Therefore, the total design flow for the Mt. Carmel Woods subdivision is 121,307 gpd or 84 gpm (85 gpm will be used for analysis purposes). The WWTP for the College of Southern Maryland, which collects sewage from the McDonaugh School and the VoTech School, is designed for an average daily flow of 60,000 gpd. Again, this average daily flow rate is less than .25 MGD and the peak daily flow, and total design flow, for the College of Southern Maryland is 240,000 gpd or 167 gpm (165 gpm will be used for analysis purposes). If pumping from the College to Mt. Carmel the combined total design flow of the, was established at 361,307 gpd or 251 gpm (250 gpm will be used for analysis purposes). However, if pumping from Mt. Carmel to the College the flows from the Preliminary Engineering Report must be used so the 167 gpm must be combined with the 115 gpm from Mt. Carmel giving a total design flow of 282 gpm (280 gpm will be used for analysis purposes).

2.3 DESIGN CAPACITY

After preliminary capacity evaluation of the two (2) potential tie-in points, it was determined that the White Plains sewer system at Manhole #43 does not have capacity to accommodate flows from both the College and Mt. Carmel. The White Plains sewer system could accept the 85 gpm from Mt. Carmel, but does not have the capacity to accept the additional 165 gpm from the College. Because combining flows with the College of Southern Maryland is a priority, a preliminary force main size and length and pump selection will be presented; however, detailed calculations have been omitted and can be presented if Charles County wishes to explore this option further. The Mattawoman Interceptor does have the capacity to accommodate flows from both the College and Mt. Carmel. Thus, this option will be given further consideration.

2.4 PRELIMINARY DESIGN FROM MT. CARMEL TO WHITE PLAINS

To tie into the White Plains Sewer System, as shown in Figure 2.1, the force main runs north out the existing Mt. Carmel Woods WWTP access road, east on Mitchell Road, and then north along the shoulder of Route 301 to Manhole #43 of the White Plains Business Park Sewer Plans.

The force main from Mt. Carmel to the White Plains sewer system provides a net rise of approximately 73 feet over a run of 15,000 feet with discharge occurring at approximately 200 feet. The force main would be a 4-inch diameter pipe and preliminary pump selection suggests that a Flygt 3152 with a 267 impeller, a Flygt 3153 with 274 impeller, and a Flygt 3152 with a 268 impeller could meet the design parameters for a ductile iron force main, PVC force main, and HDPE force main, respectively.

CHAPTER 3

FORCE MAIN PATHS AND INSTALLATION

3.1 GENERAL

This section addresses the sizing, design, and construction of the force main running from the College of Southern Maryland to the Mattawoman Interceptor tie-in. Please refer to the Preliminary Engineering Report Revised June 2006 for preliminary design of force main, pump station, and cost estimate to pump sewage from Mt. Carmel Woods to the College of Southern Maryland. Please note that in the Preliminary Engineering Report the wastewater being treated by both the Mt. Carmel WWTP and the College of Southern Maryland WWTP was being discharged into the Port Tobacco Creek. If the water is treated, instead, by the Mattawoman WWTP, the nutrient discharge into Port Tobacco Creek would be eliminated. Further investigation should be done by the County to determine if ENR funding is available for the Mt. Carmel Woods/College of Southern Maryland project, due to the reduction of Port Tobacco Creek's total nutrient load.

3.2 FORCE MAIN ALTERNATIVES

To tie into the Mattawoman Interceptor, the force main will exit the College of Southern Maryland and follow the existing sanitary easement to the VoTech School, from there it will travel north along Marshall Corner Road, turn west onto Preston Lane and continue north, turn northwest onto the Pomfret Road, and then follow the shoulder of the railroad southwest, as shown in Figure 3.1. The tie-in manhole, Manhole #23 of the Mattawoman Interceptor Sewer, is located approximately 2,500 feet from the intersection of the railroad and Pomfret Road. Please note that if Charles County pursues this option, more detailed information regarding the College of Southern Maryland Sewer Collection System and easements along the railroad must be investigated, including information on existing sewer easements, manhole locations, and sewer inverts. For purposes of this report, easements, manhole locations and sewer inverts have been approximated.

The force main provides a net rise of approximately 150 feet over a distance of 20,800 feet. The discharge occurs at approximately 40 feet. Air release valves will be provided at localized high points along the route and blow-off valves will be provided at low points. A preliminary count suggests that there will be five (5) such air release valves and four (4) blow-off valves.

3.3 PIPELINE MATERIAL AND INSTALLATION

For evaluation purposes, we will give consideration to three (3) pipe materials for the force mains, Ductile Iron Pipe (DIP), Polyvinyl Chloride (PVC) pipe and High Density Polyethylene (HDPE) pipe. Both a DIP and PVC force main will be installed by open cut along the road shoulder. Because all stream crossings encountered are minor, the force main can be installed using the previous stated method of open cut with little required water diversion. However, if it is determined that any force main path encounters a stream crossing more significant than anticipated, the force main could be jack and bored under the stream. The third pipe material considered, HDPE, results in ease of construction and can be installed by directional drill. Directionally drilling an HDPE force main will also eliminate complications due to open cut installation across the streams. HDPE pipe (smaller than 6 inches) is available in rolls of 500 foot length and will be welded to minimize joints. Direction drill typically requires staging areas at intervals along the route the size and spacing of staging areas depends on the length at the bore and the equipment used. The spacing for the proposed force main could easily vary from 500 to 1,500 feet. Temporary easements for the staging areas may be required during construction. Please see Chapter 5 - Cost Estimate for a more detailed explanation of costs associated with each pipe material.

3.3.1. FORCE MAIN SIZING

The force main running from the College of Southern Maryland to the Mattawoman Interceptor Manhole #23 requires a 6-inch diameter pipe. A pipe diameter size of 6-inches was selected to meet the County Standards for velocities in force mains to fall in the range of 2.5 to 5.0 fps. Table 3-1 summarizes the results of the pipe sizing process for the force main.

Please note that in order to meet the high head requirements, and to keep the velocity greater than, but as close as possible to the Charles County required minimum velocity of 2.5 feet per second, flows and pipe diameter must be increased. 8-inch force main pipe sizing is shown in Table 3.2.

Table 3-1: Force Main Design Data (6-inch)

Pipe Material	Nominal Dia (in)	Inside Dia (in)	Flow Rate (gpm)	Vel. (fps)
DIP	6	6.28	280	2.91
PVC	6	6.09	280	3.09
HDPE	6	5.74	280	3.49

Table 3-2: Force Main Design Data (3-inch)

Pipe Material	Nominal Dia (in)	Inside Dia (in)	Flow Rate (gpm)	Vel. (fps)
DIP	8	8.39	450	2.55
PVC	8	7.98	440	2.56
HDPE	8	7.47	400	2.56

3.3.2 WATER HAMMER

Water hammer was checked to determine if surge protection will be required. Ductile iron pipe has a working pressure of 350 psi, PVC pipe has a pressure rating of 150 psi, and HDPE has a pressure rating of 110 psi. Appendix A shows the results of the water hammer calculations. For 8-inch DIP and PVC, the surge pressure is below the working pressure of the pipe. Thus, no special surge protection is required. However for 8-inch HDPE, the surge pressure is greater than the working pressure of the pipe, therefore, surge protection would be required. Table 3-3 provides a summary of calculations.

Table 3-3: Summary of Water Hammer Calculations

Force Main	Pipe Material	Pump Discharge Pressure (psi)	Pressure Rise (psi)	Surge Pressure (psi)
College Southern Maryland-Mattawoman	DIP	89	139	228
	PVC	86	45	132
	HDPE	110	28	137

CHAPTER 4

PUMPING STATION PRELIMINARY DESIGN

4.1 INTRODUCTION

This section addresses the preliminary hydraulic design of the College of Southern Maryland Pumping Station. The material that follows, if accepted, will form the basis for detailed drawings and specifications at a later phase in this project. This section does not address site design issues.

4.2 COLLEGE OF SOUTHERN MARYLAND PUMPING STATION

The pumping station shall contain the following elements:

- Two (2) submersible non-clog pumps with associated piping and appurtenances, arranged to operate in duplex fashion.
- A precast concrete wet well.
- Motor control center located in prefabricated concrete building.
- An emergency generator.
- An emergency by-pass pump connection.
- Bihlertech variable frequency drive system.

Please note that for purposes of this report a new emergency generator has been included in the cost estimate. In addition, per MDE, the pumping station site is not located within shellfish harvesting waters, therefore no shellfish protection storage has been provided.

4.2.1 LOCATION

As previously shown in Figure 1-2, the pumping station is proposed to be located at the site of the existing College of Southern Maryland WWTP. For purposes of this preliminary report the pumping station has been set slightly north of the existing treatment plant. During final design, the most economical and practical location for the pumping station will be determined.

4.2.2 SELECTION OF PUMPS

Pump selection was based on the worst-case scenario, which would occur when the water level drops to the pump-off elevation. In order to meet the high head requirements, flows and pipe diameter were increased. It was necessary to keep the velocity as close to the minimum required velocity because the greater the velocity, the greater the friction head. Table 4-1 provides the pump design characteristics. The information in Table 4-1 assumes a Class 52 ductile iron, DR18 PVC and DR 15.5 HDPE.

Table 4-1: Pump Design Characteristics

Pipe Material	**DIP**	**PVC**	**HDPE**
Design flow rate (gpm)	450	440	400
Static head* (ft)	128	128	128
Total Dynamic Head (TDH) (ft)	206	200	195

The model pump selected for this pumping station is Flygt model CP 3300 with a 454 impeller. A summary of pump data can be found below in Table 4-2. Appendix B contains a pump curve. Please note that for the design parameters, the selected pump would not be recommended. It is the best Flygt available pump, however, it will operate at an undesirable point along the curve. It will be an 88 horsepower pump, which is quite large for this application, and will operate at approximately 50% efficiency. Another potential option is to pump in series, or to pump the wastewater to another pump station at the high point along the alignment. Therefore, the following calculation and information is based on the above selected pump but GMB would like to discuss this option before continuing further.

Table 4-2: Pump Data

Parameter	Value
Impeller size (inches)	15.8
Motor size (hp)	88
Pump speed (rpm)	1775
Pump efficiency (%)	~ 50

Although the pump has been selected for the design parameters shown in Table 4-1, it is important to ensure that the pump will operate properly for a range of conditions. After a long period of operation the C-factor of the pipe may decrease. Table 4.3 summarizes change in total head resulting from a lower C-factor for each pipe material. Appendix C contains the system pump curves for each pipe material.

Table 4-3: Anticipated Operation Conditions

	Ductile Iron		PVC		HDPE	
C-Factor	120	100	130	100	140	100
TDH (ft)	206	237	200	244	195	253

4.3 WET WELL DESIGN

A preliminary layout of Mt. Carmel Woods indicated that the ground elevation at the pumping station would be approximately 76 feet. Assumptions based on the gravity collection system indicated that the invert elevation of the influent sewer would be approximately 67 feet. Thus, the total depth of the proposed pumping station would be approximately 16 feet.

The active volume between the “pumps off” and “lead pump on” elevations of the wet was determined according to the Maryland Department of the Environment standard:

$$V = Qt/4$$

Where **“V”** is the volume, **“Q”** is the pumped flow rate, and **“t”** is the time between pump starts. As per Charles County Water and Sewer Ordinance, the time **“t”** is 15 minutes. The pumped flow rate is taken to be the same as the design flow rate. An inside diameter of ten (10) feet was used. Table 4-4 shows the required volumes and the depths corresponding to the active volumes for each pipe material.

Table 4-4: Wet Well Geometry

Pipe Material	DIP	PVC	HDPE
Pumped Flow Rate (gpm)	450	440	400
Time Between Pump Starts (min)	15	15	15
Required Active Volume (gal)	1650	1500	1500
Wet Well Diameter (ft)	10	10	10
Required Depth of Active Volume (ft)	2.87	2.81	2.55

To translate the required volume and elevation constraints into action levels for the wet well, several standards were used. First, the required depth for the active volume was rounded up to the next increment of 0.5 feet. Second, a separation of six (6) inches was used between alarms and between pump action levels. Third, a one-foot (1-foot) separation was used between the low-level alarm and pump inlet and between the pipe inlet and the top of the base slab was used. Table 4-5 below summarizes these results. Appendix D shows this calculation in more detail.

Table 4-5: Wet Well Action Elevations

Finished grade (ft)	76.00
Gravity sewer invert (ft)	67.00
High level alarm (ft)	66.50
Lag pump on (ft)	66.00
Lead pump on (ft)	65.50
Pumps off (ft)	62.50
Low level alarm (ft)	62.00
Pump inlet (ft)	61.00
Top of base slab (ft)	60.00
Height of active volume (ft)	3.00

To protect against possible flotation of the wet well, an oversized circular base slab has been added to the wet well. Its sizing is based upon the following assumptions. First, the ground water table is equal to the finished grade. Second, the wet well is empty. Third, only the soil directly above the base slab works against flotation. In reality, this would be conservative since the soil shear angle and a cone-shaped volume of soil would work against flotation. Additionally, a safety factor of 1.25 was used in the sizing of the base slab. Table 4-6 summarizes the results.

Table 4-6: Base Slab Sizing

Base slab—diameter (ft)	15
Base slab—thickness (in)	24
Wet well—interior depth(ft)	16.50
Wet well—inside diameter (ft)	10
Wet well—wall thickness (in)	10

For these calculations, the following specific weights were used: 150 lb/cf for concrete, 62.4 lb/cf for water, 100 lb/cf for dry soil, and 37.6 lb/cf for submerged soil. Appendix E provides more details on these calculations.

4.4 PUMP CONTROLS AND APPURTENANCES

4.4.1 Controls

The pumps will make use of a Bihlertech drive. Effectively, it combines the benefits of a variable-frequency drives with a programmable logic controller to optimize pump efficiency and minimize electrical demands at the beginning of a pump cycle.

Pump on and off levels will be controlled by a pressure transducer system with backup float switches at each action level. An uninstalled backup transducer will be provided. The pumps will be set up to alternate which one serves as the lead pump. The switch will occur on each pump cycle.

For monitoring of flows, the pumping station is equipped with a magnetic flow meter and a 7-day circular chart recorder.

4.4.2 Alarms and Communication

The station will make use of a Motorola Intrac 2000 MRU for signal status and control. The following alarm conditions shall be detected and transmitted via telemetry system: high water level, low water lever, power failure, emergency generator power failure, equipment failure, and intrusion.

4.4.3 Preliminary Treatment

The pumping station will not be equipped with preliminary treatment.

4.4.4 Odor Control

According to County personnel the generation of odors is not a major concern for this pumping station. Corrosion control, due to the formation of hydrogen sulfide, however, is a potential concern because of the force main's length and the potential of the pumping station to experience flow flows. This issue will be explored further in the design phase. Specific solutions, will be included in the Contract Documents. Possible solutions include chlorine addition (in a non-gaseous form) and calcium nitrate addition (as in the proprietary Biox system by U.S. Filter)

4.4.5 Piping and Valving

The control building will house the discharge piping and valving. Each line shall be equipped with a resilient seat gate valve for isolation. An air and vacuum release valve will be located after the point at which the discharge piping from the two (2) pump joints. Similarly, a pigging connection will be located after this junction. The pumping station will also be equipped with an emergency bypass connection. This shall be located in such a way as to maximize the access to other equipment by maintenance personnel undertaking repairs while the bypass connection is being used. A floor drain will convey any spillage back to the wet well. Furthermore, a dual sump system will keep the pumping station dry.

All discharge piping on the interior of the pumping station will be 350 psi ductile iron piping with cement interior lining. Where necessary, harnessed flexible couplings will be used for the disassembly of piping.

4.4.6 Miscellaneous Appurtenances

Other features for the wet well include the following:

- a ventilation fan, automatically activated fan complete with ventilation piping.
- a manual hoist to assist with pump removal.
- A dual sump pump system for the pumping station.

4.4.7 Plumbing

Inside the control building there will be an electric water heater, service sink, potable water line with backflow preventer and a non-freeze hydrant with hose bib. No bathroom or toilet will be provided due to the small size of the facility.

4.5 STRUCTURAL ISSUE

The control building will be a 12 foot by 20 foot pre-fabricated concrete building with a flat roof, as manufactured by Smith-Midland. The exterior face of the building will resemble red brick. The building will be placed on a concrete slab. The roof of the building has a slight ridgeline running in the direction of the length. The drop is approximately ½ -inch from the ridge. It should be noted that the roof is one continuous concrete slab that overhangs the wall slabs.

4.6 ELECTRICAL ISSUES

4.6.1 Electric Service

SMECO provides 120/240-volt/3-phase/60-Hz service to the existing site. The cost to provide 480 volt/3-phase/60Hz service to the site is estimated at $ 60,000.00 and has been included in the cost estimate. The pumping station will have a diesel-power emergency generator.

4.6.2 Exterior Lighting

Exterior lighting will be provided in the following places:

- at the generator
- at the wet well

4.6.3 Building Heat

An electric unit heater will provide sufficient heat to maintain a temperature above 40 degrees F inside electrical devices. A cooling system will be provided to maintain temperatures below 95 degrees F inside electrical devices. Separate thermostats will be provided for both heating and cooling.

4.7 GEOTECHNICAL ISSUES

A geotechnical investigation has not yet been performed on the site. Further site investigation will need to be done during the design.

4.8 SITE ISSUES

The following features will be provided:

- an asphalt driveway with a WB-40 truck access and circulation and/or turn-around.
- a 8-foot-high, 3-strand barbed wire fence around the exterior of the site, complete with a locking gate
- truck access to the wet well
- storm drainage away from pumping station
- sufficient space within the fencing for snow removal
- gravel underlain with weed barrier fabric, over all non-paved exterior area within fenced area and two (2) feet beyond fenced area.
- two (2) parking spaces.

CHAPTER 5

COST ESTIMATE

5.1 FORCE MAIN AND PUMPING STATION

Table 5-1 below summarizes the preliminary cost estimate for force main and Ductile Iron Pipe and PVC being installed by open cut in the road shoulders and HDPE pipe being installed via directional drilling. These costs include the materials, labor, installation, traffic control and contractor overhead and profit. The cost of obtaining easements is included but may vary according to results of further investigation. The cost for temporary easements for directional drill staging has not been included. A contingency of 25% is also included.

Table 5-1: Force Main Cost Estimate Summary

Ductile Iron Pipe	$ 2,453,800
PVC	$ 2,193,800
HDPE	$ 1,933,800

The cost of the pumping station includes a ten (10) foot diameter, pre-cast concrete wet well, valve vault, two (2) non-clog submersible pumps, automatic duplex pump control system, equipment enclosure cabinet, emergency generator, by-pass connection, and all necessary appurtenances. The construction cost of the pumping station with a 5% mobilization and a 25% contingency is estimated at $ 864,000.

Appendix F contains a more detailed breakdown of costs.

5.2 RECOMMENDATIONS

To be completed after Charles County review.