VALLEY FORGE
HIGHLAND MILLS, NEW YORK

PRELIMINARY ENGINEERING REPORT

Wastewater Treatment Plant Upgrade

July 2005
Last Revised January 2006

HDR | LMS
One Blue Hill Plaza
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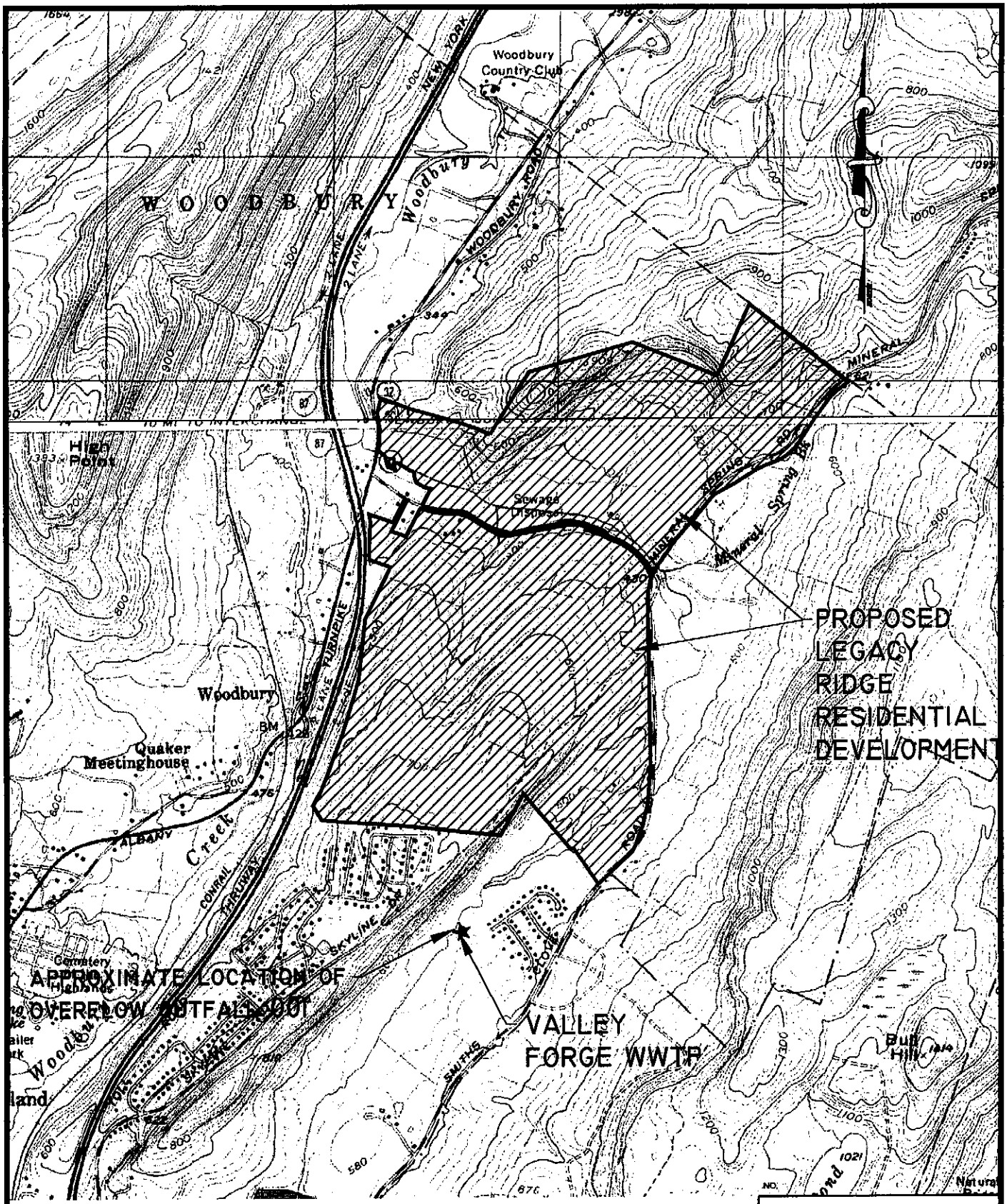
INTRODUCTION

The Valley Forge Wastewater Treatment Plant (WWTP) is situated on Section 12-Block 1-Lot 11 in the Town of Woodbury, Orange County, New York. The WWTP is owned by the Town of Woodbury. The WWTP currently treats domestic wastewater from the existing Valley Forge residential development (see Figure 1-1). The facility has a State Pollution Discharge Elimination System (SPDES) Permit #NY-0020478, which allows an effluent discharge of 56,000 gpd to an unnamed tributary of Woodbury Creek. A copy of the permit is provided in Appendix A.

The project sponsor plans to develop a parcel of land in close proximity to the WWTP known as the proposed Legacy Ridge residential development. The project sponsor plans to provide the development with a central sewer system. The proposed Legacy Ridge collection system will divert all wastewater to the WWTP for treatment. The project sponsor proposes to upgrade the existing WWTP to accommodate the increase in flow from Legacy Ridge.

The purpose of this report is to provide a brief overview of the existing WWTP conditions and to offer a preliminary design of the WWTP upgrade.



SIGNATURE DATE

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0997-004	1" = 2000'
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Project

VALLEY FORGE WWTP UPGRADE
TOWN OF WOODBURY
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Sheet Title

FIG. 1-1 USGS QUADRANGLE MAP

CHAPTER 2

DESCRIPTION OF PROJECT

The project sponsor plans to construct a 287-unit residential development consisting of four bedroom single-family homes and one recreation center. The Legacy Ridge site is currently zoned as a Residential Three-Acre (R-3A). The project sponsor has requested a change in the zoning to Residential Two-Acre (R-2A) with conservation cluster. Calculations provided in this report are based on R-2A zoning.

The proposed development plan is to collect all wastewater generated by the Legacy Ridge development and convey it to the Valley Forge WWTP for treatment. Wastewater shall be conveyed to the WWTP through an 8-inch force main. The force main will travel south along County Road CR-9 and enter the Valley Forge development at Hamilton Avenue. The existing 56,000 gpd WWTP must be expanded to a 196,000 gpd capacity in order to adequately treat the wastewater and meet the permitted effluent limitations. A calculation of the projected wastewater flows is indicated in Table 1 below.

TABLE 1 – VALLEY FORGE WWTP PROJECTED DESIGN FLOW [1]

TYPE OF FACILITY	No. of Units	Flow Rate Per Unit (gpd) [1]	Projected Flow Rate (gpd)
Four Bedroom Single Family Homes	287	475	136,325
Community Recreation Center [2]	1	N/A	3,675
PROPOSED WASTEWATER FLOW FROM WP3, GPD =			140,000
EXISTING PERMITTED WASTEWATER FLOW, GPD =			56,000
PROJECTED DESIGN FLOW, GPD =			**196,000**

[1] Values for flow rate per unit (gpd) were obtained from the New York State Department of Environmental Conservation's *Design Standard For Wastewater Treatment Works, 1988*

[2] The architectural design of the recreation center has not been completed. The demand for this facility was calculated by assuming both facilities will include a pool, a gym, and a community area.

CHAPTER 3

TREATMENT OBJECTIVES

3.1 GENERAL

On May 18, 2005, a formal request was submitted to the New York Department of Environmental Conservation (NYSDEC) to determine future effluent limitations following the Valley Forge Wastewater Treatment Plant Upgrade. To date, NYSDEC has not indicated what the future effluent limitations would be following the WWTP upgrade. Current effluent limitations are specified within this section and Appendix A of this report.

The existing permit considers intermittent stream standards (ISS); therefore, effluent limitations on ammonia, temperature, chlorine residual, dissolved oxygen, in addition to the standard parameters of carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), fecal coliform, and pH are enforced.

3.2 CARBONACEOUS BIOCHEMICAL OXYGEN DEMAND (CBOD)

CBOD is the measurement of the dissolved oxygen used by microorganisms (other than nitrifying bacteria) in the biochemical oxidation of organic matter. CBOD discharged to the receiving water consumes the dissolved oxygen (DO) in the stream. High concentrations of CBOD can cause such a reduction in the stream's DO that fish, especially trout, cannot survive. In order to avoid a significant depletion of dissolved oxygen levels in the stream, an effluent limit for $CBOD_5$ is established.

The existing permit has a 5-day CBOD limit of 5 mg/L. "5-day" refers to the length of time that the sample incubates during the laboratory testing period. Assuming the concentration limits of 5 mg/L for CBOD remains constant throughout the day, the quantity limits would become 13.2 lbs/day for $CBOD_5$.

3.3 TOTAL SUSPENDED SOLIDS

Excess TSS discharged to the receiving water adds particulates to the water and reduce the ability for plants to grow and fish to survive. The existing permit has a year round limit of 10 mg/L for TSS. Assuming the concentration limit remains constant at 10 mg/L throughout a day, the quantity limit would become 26.5 lbs/day.

3.4 AMMONIA

Excess ammonia in a treatment plant effluent will exert on oxygen demand on the stream and further reduce the concentration of DO in the receiving water. Ammonia nitrogen is readily oxidized to nitrate nitrogen by nitrifying bacteria. Each pound of ammonia nitrogen requires 4.5 lbs of oxygen for the conversion. The existing daily maximum effluent limitation for ammonia is 2.0 mg/L as NH_3. Assuming the concentration units remain the same, the quantity limits would become 5.3 lbs/day.

3.5 OTHER EFFLUENT LIMITS

The existing permit also contains the following water quality based effluent limitations:

- Settleable Solids 0.1 mL/L
- pH 6.0 – 9.0 units
- Temperature 70° F daily maximum
- Dissolved Oxygen 7.0 mg/L daily maximum

CHAPTER 4

EXISTING TREATMENT FACILITIES

4.1 EXISTING PLANT DESCRIPTION

The Valley Forge Wastewater Treatment Plant was originally constructed in the mid to late 1960's to serve the residents of the Valley Forge community. The plant was originally designed as a single train system sized to handle 36,000 gpd utilizing extended aeration activated sludge treatment. In 1989, the plant was expanded to a 56,000 gpd capacity in order to accommodate an additional 55 single family homes in the Valley Forge development. The expansion included the construction of a second train that was sized to nearly duplicate the original construction. The existing WWTP presently consists of the following components (see Appendix C for a plan view of the existing WWTP construction):

- Headworks, including a grit chamber, a wet well/dry well pumping station, a comminutor chamber, and a flow splitter chamber.
- Two (2) aeration tanks operating in parallel.
- Two (2) clarifiers operating in parallel.
- A siphon chamber for dosing to the sand filter beds.
- Three (3) sand filter beds.
- A chlorine contact tank for disinfection.
- A post aeration tank.
- A sludge pump station.
- Two (2) aerobic digesters.
- A sludge holding tank
- Discharge of the treated effluent to an unnamed tributary of Woodbury Creek (Water Index #LH89-7-4-1; Class C).

The WWTP is provided with a 20-kW on-site generator that is housed in the operations building. The operations building is a masonry block building that also includes controls, blowers, sludge pumps (clarifier to digester), chemical feed equipment, chemical storage, and laboratory equipment. Controls for the influent pump station are housed in a nearby fiberglass building. Refer to Figure 4-1 for a process flow diagram of the existing treatment works.

4.1.1 **Headworks**

The existing headworks consist of a grit chamber, a wet well/dry well pumping station, a comminutor chamber, and a flow splitter chamber. A brief description of each component is described below.

Grit Chamber – The grit chamber is a two-channel chamber with 8" diameter inlets and outlets. Slide gates are provided at the inlet and outlet divert the flow to each channel. Each channel measures 13'L x 1'W x 2'H. The overall dimensions of the chamber are 15'L x 5'H. The grit chamber removes grit from the influent prior to conveyance to the influent pump station.

Wet Well/Dry Well Pumping Station – A 7' diameter dry well is equipped with two non-clog pumps that transfer wastewater from the 4' diameter wet well to the existing comminutor chamber. Each pump is rated for 125 gpm @ 17' TDH. The pump station controls were replaced during the 1989 WWTP expansion.

Comminutor Chamber – The comminutor chamber is equipped with a barscreen and a comminutor. Wastewater flows into the chamber via a 4-inch force main and exits via an 8-inch gravity line to the flow splitter chamber. The barscreen is installed at a 45° angle. The comminutor is sized at a 0.45 MGD capacity.

Flow Splitter Chamber – The flow splitter chamber measures 3' x 5' and distributes flow to both aeration tanks. Flow distribution is accomplished using V-notch weirs.

4.1.2 **Aeration Tanks**

Wastewater flows by gravity from the flow splitter chamber to two circular concrete aeration tanks that each measure 25'-0" diameter x 12'-4" H with a 10 ft sidewater depth. At the permitted flow rate of 56,000 gpd and with a total aeration tank volume of 73,435 gal, a 31-hour hydraulic residence time is provided. Each tank requires 189 lb/d of oxygen for the removal of BOD and TKN. A mechanical aerator is provided in each aeration tank to deliver the required oxygen. The aerators have an aeration capacity of 18.5 lb O_2/hr.

4.1.3 **Clarifiers**

The effluent from the aeration tanks flows by gravity to two (2) concrete peripheral feed type clarifiers with mechanical scraper arms for sludge collection. The clarifiers differ in dimension. The clarifier constructed with the original design measures 18'-0" diameter x 8'-0" sidewater depth. In 1989, an additional clarifier was installed and measures 16' diameter x 13.5' H with a 12' sidewater depth.

Sludge is removed from the bottom of the clarifier and is either recycled to the aeration tanks or wasted to the aerobic digesters. A telescoping valve chamber was installed off the clarifiers to shut off the sludge withdrawal line. Two self-priming sludge pumps are provided in the operations building that transfer the sludge. The pumps can deliver at a variable rate 50% to 150% of the average daily flow. The sludge pumps are manufactured by Gorman Rupp and are rated for 80 gpm at 14 ft total design head.

4.1.4 **Sludge Pump Station**

The sludge pump station was included as part of the original design. The pump station houses two (2) non-clog dry pit type centrifugal pumps to recycle clarifier sludge to the aeration unit. The sludge pumps are rated for 75 gpm at 14 ft total design head. The pumps were replaced during the WWTP expansion in 1989.

4.1.5 **Aerobic Digesters**

The existing WWTP employs two aerobic digesters, each having different dimensions. The digester included in the original design measures 11'-0" x 11.75" deep and provides 1,116 ft^3 of storage capacity.

A 12'-0" diameter x 10'-0" sidewater depth reinforced concrete digester was constructed as a result of the 1989 WWTP expansion. This digester provides 1,130 ft^3 of storage capacity. Supernatant overflow from each digester is connected to the nearest aeration tank. Each digester is provided with two air drop lines that include 8 diffusers for aeration and mixing of sludge contents. 34 cfm of air is provided to the 12' diameter (expanded) digester. 33 cfm of air is provided to the 11' diameter (original) digester.

Two (2) air blowers (one operating, one standby) manufactured by Roots, Inc. provide air to both digesters and the post aeration tank. Each blower is rated for 85 cfm @ 5 psi.

4.1.6 **Sludge Holding Tank**

The existing sludge holding tank is used to store waste sludge prior to hauling off-site. The tank measures 26'L x 12'W x 10'D and is divided into 3 compartments by partition walls.

4.1.7 **Dosing Chamber**

Effluent from the clarifier flows to the dosing chamber prior to the sand filter beds. The existing dosing chamber measures 15'-6" x 10'-0" x 30" drawdown depth. The operating volume of the chamber is 2,917 gallons. The chamber has three 6" dosing siphons complete with necessary air piping and bells. The siphons alternate in operation in order to dose the sand filter beds sequentially.

4.1.8 **Sand Filter Beds**

Three (3) open sand filter beds, two 48' x 48' and one 58' x 40' are provided to handle 56,000 gallons per day of flow. The total area of all three sand filters is 6,928 ft^2 and handles an average dosing rate of 8.08 gallons/ft^2/day. The siphon chamber operating volume of 2,917 gallons provides approximately 2" of flow over the entire sand filter bed at each dosing. The 48' x 48' sand filter beds were included with the original design. The 58' x 40' filter bed was constructed with the 1989 WWTP expansion. New piping and sand was installed in the original filter beds at the time of the previous expansion.

4.1.9 **Disinfection Facility**

The existing chlorine contact tank receives the sand filter bed effluent and measures 13'-0" long x 7'-0" wide x 3'-6" water level. The effective volume of the tank is 2,380 gallons. The chlorine contact tank volume provides more than 30 minutes of contact time in the chlorine contact tank.

A separate chlorine room is provided in the operating building. A gas feed type chlorination system with a capacity of 0 to 10 lb/day is provided in the chlorine room. A new exhaust fan was installed in the chlorine room during the WWTP expansion.

4.1.10 **Post-Aeration Tank**

A post-aeration tank is installed between the existing chlorine contact tank and the outfall. The post aeration tank was included with the 1989 WWTP expansion and measures 8'-0" diameter x 4'-0" sidewater depth. The effective volume of the tank is 1,500 gallons, which provides more than the required 30 min contact time.

An air line from the blower room to the post-aeration tank is installed. An air drop line with four diffusers will be installed in the post-aeration tank to raise the D.O. greater than 7.0 mg/L. 15 cfm of air is provided to the post aeration tank by the same blowers used for the digester units.

4.1.11 **Operation Building**

The existing operation building is used to house the generator, blowers, sludge pumps, electrical equipment, chemical feed equipment and storage and laboratory equipment. The building is constructed of masonry block walls and a continuously sloped roof. A 23'-8"L x 14'W addition was added and the building following the 1989 WWTP expansion.

CHAPTER 5

PROJECTED WASTEWATER CHARACTERISTICS

5.1 WASTEWATER FLOW

The existing SPDES permitted flow is 56,000 gpd; after expansion it is anticipated that the average daily flow will be 196,000 gpd. Projected design flow calculations are provided in Section 2 of this report. The peak daily flow is assumed to be two times the average daily flow or 392,000 gpd. Peak hourly flow is based on a 3.66 peaking factor and is computed at 498 gpm.

The peaking factor which is used in the determination of peak hourly flow can be calculated using the following equation as specified in Chapter 10 of the *Recommended Standards for Wastewater Facilities © 2004:*

$q = Q_{PEAK} / Q_{AVG} = *(18 + P^{0.5}) / (4 + P^{0.5})$ where;

q = peaking factor
Q_{PEAK} = peak hourly flow
Q_{AVG} = average daily flow
P = population in thousands = 1.66 (assumed)

5.2 WASTEWATER CHARACTERISTICS

The influent wastewater to be treated is typical domestic sewage and is assumed to have the following characteristics:

- BOD_5 250 mg/L
- TSS 250 mg/L
- TKN 40 mg/L
- NH_3 27 mg/L
- Phosphorus 10 mg/L
- Wastewater Temperature 50 to 77° F

CHAPTER 6

DESIGN OF UPGRADED TREATMENT SYSTEM

6.1 DESIGN SUMMARY

HDR|LMS compared the membrane biological reactor (MBR) versus conventional treatment to determine the optimal solution for the expansion of the Valley Forge WWTP. Constructability, treatment, and operation were major factors that weighed heavily upon the choice of treatment technology. MBR treatment technology proved to be the optimal solution for the Valley Forge WWTP expansion. The MBR treatment process involves activated sludge of a high concentration mixed liquor suspended solids (MLSS) that passes through a membrane to filter out solids. The following gives explanation as to why the MBR system was chosen:

Constructability: Recent discharge monitoring reports for the Valley Forge WWTP, as referenced in Appendix D of this report, indicate that the average daily flow to the WWTP ranges between 24,000-16,000 gpd. This confirms that, the WWTP is capable of treating the wastewater with one train out of service. This benefit is ideal for an MBR system upgrade because a large portion of the existing tankage that is in good condition can be utilized without interrupting existing operations. Furthermore, the MBR system would require the least amount of tankage when compared to the conventional treatment processes. This would minimize disturbance and reduce construction costs.

Treatment: The MBR system provides tertiary treatment of the wastewater and discharges a high quality effluent in terms of low bacteria, TSS, BOD, and turbidity (<5 mg/l BOD, <10 mg/l TSS, <10 mg/l TN, <1 mg/l ammonia). The MBR system also provides pathogen removal prior to disinfection to reduce disinfection costs.

Operation: MBR systems reduce operating costs by reducing UV dosage and labor. Secondary clarifiers and effluent filters, as required in conventional wastewater treatment, are eliminated in the MBR system. The MBR of choice is the Kubota® Membrane as manufactured by Enviroquip, Inc. This membrane comes with a 5-year warranty and requires cleaning 1-2 times per year. The membrane cleaning is performed in-situ within the tanks, avoiding the need for membrane removal, interruption in operation and tank draining. The membrane does not require backwashing, eliminating the need for additional pumps and instrumentation.

As indicated in Chapter 2, the Valley Forge WWTP will be expanded to accommodate a design flow of 196,000 gpd. The MBR treatment process was designed based on the influent characteristics as described in Table 6-1 below. Effluent characteristics are also included in this table.

Table 6-1: Influent/ Effluent Characteristics

Parameter	Influent Quantity		MBR Effluent
Average Daily Flow	0.196	MGD	
Peak Daily Flow	0.392	MGD	
BOD	250	mg/L	< 5 mg/L
TSS	250	mg/L	< 10 mg/L
TKN	40	mg/L	---
NH3	27	mg/L	< 1 mg/L
TN	40	mg/L	< 10 mg/L
TP	8	mg/L	< 1 mg/L
Wastewater Temperature	10 to 25	°C	