WASTEWATER ENGINEERING REPORT

FOR THE

ROBINSON TRACT WWTP
AND DRIP DISPOSAL SYSTEM

Westtown Township, Chester County

Prepared for

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1.0 INTRODUCTION

The Robinson Tract development is a proposed residential development in Westtown Township, Chester County, Pennsylvania. The proposed residential development will consist of two existing homes, one hundred eighteen (118) estate homes, sixty four (64) executive/courtyard homes, and one hundred thirty five (135) carriage homes for a total of three hundred and nineteen (319) residential units (317 proposed homes and 2 existing homes).

The proposed means for sewage treatment and disposal for the development plan is a community collection system that will convey the wastewater to an onsite package wastewater treatment plant (WWTP) for treatment prior to onsite disposal via drip irrigation. Westtown Township defines the flow per edu as being equal to 250 gpd/edu. Each of the three hundred and nineteen residential units will require an individual edu for a total of 319 edus. The projected sewage flow for the proposed residential development is 79,750 gpd (319 edus x 250 gpd/edu).

The wastewater generated by the proposed residential development will be conveyed to southern portion of the site. From this location the wastewater will be conveyed to the on-site wastewater treatment plant (WWTP) located adjacent to the 11.7 acre effluent disposal area. The WWTP will provide advanced secondary treatment (denitrification) of the wastewater. The effluent will be treated to the following levels, based on current PA DEP regulations:

$CBOD_5$	=	10 mg/l
TSS	=	10 mg/l
Ammonia	=	5 mg/l
Total Nitrogen	=	15 mg/l

The nitrogen balance for the drip fields will need to be performed during the design and permitting approval process to verify that the total nitrogen levels leaving the property will be less than 10 mg/l. It is noted that the background nitrogen level is less than 6.4 mg/l per the Geo-Technology Associates, Inc. "Report of Preliminary On-Site Wastewater Feasibility Evaluation" dated March 2017.

After the WWTP treats the raw wastewater, the treated effluent will be disinfected utilizing ultra-violet disinfection. The treated effluent after it has been disinfected will flow into an effluent storage tank. The effluent storage tank will provide the PA DEP recommended three days of storage and have a minimum usable volume of 239,250 gallons (79,750 gpd x 3 days). The purpose of the three days of storage is to allow for the maintenance and repair of the drip facilities. The effluent storage tank will be covered to prevent algae from forming.

The treated and disinfected effluent from the WWTP will be pumped from the effluent storage tank through an effluent (disk) filter prior to being conveyed to the drip irrigation fields. The effluent filter will remove the majority of solids that may have passed through the treatment process. This will minimize any clogging of the drip emitters by preventing solids from entering the drip tubing.

The treated effluent will then be pumped to the drip disposal area. The treated effluent will be dosed to the various zones within the disposal area that was identified by Geo-Technology Associates, Inc. After a predetermined number of dose cycles, the system will perform a flush cycle to remove any solids that may accumulate in the drip tubing. The drip disposal areas will utilize drip tubing with pressure compensating emitters. The pressure compensating emitters will discharge a constant flow per emitter of 0.6 gphr over a pressure range of 7 to 70 psi.

2.0 SCOPE OF REPORT

The scope of this report is to identify and describe the means of treating and disposing of the wastewater generated by the proposed development utilizing a community onsite treatment and disposal system. The conveyance of the raw wastewater to the treatment plant site is by others. The selection of the drip irrigation sites and the associated soil analysis, nitrogen balance, and mounding analysis of the disposal areas are done by others.

3.0 TREATMENT PROCESS

There are numerous treatment processes and manufacturers of package treatment plants that can meet the effluent limits required for this project. We have provided a description of three possible WWTP(s) that could be used to treat the wastewater that will be generated by this proposed project. All of the package wastewater treatment plant options will contain the following components:

1. Influent Sampling and Metering
2. Influent Equalization
3. Biological Treatment Process
4. Effluent Equalization
5. Ultra-Violet Disinfection
6. Aerobic Sludge Digestion (30 Days)

The raw wastewater will first flow through an influent sampling and metering facility. The rate and volume of the influent flows will be recorded. The raw wastewater will be sampled to determine the organic contaminants in the wastewater for any required PA DEP reporting as well as for operational uses.
The wastewater will then flow into an influent equalization tank. The influent equalization tank will equalize the diurnal variation of the wastewater and provide a more uniform flow to the treatment system. The influent equalization tank will

be sized for approximately 15% of the design capacity of the WWTP. The influent equalization tank will be a useable volume of approximately 11,963 gallons (0.15 x 79,750 gpd). The influent equalization tank will be aerated using coarse bubble diffusers designed to supply a minimum of 1.25 cfm per 1,000 gallons of storage capacity. The aeration system will provide the required mixing as well as be able to maintain a minimum oxygen level of one mg/l at all times. The influent equalization tank can also be utilized to store flows during the initial start up of the WWTP when only one of the two treatment units is operational if the SBR treatment process were to be utilized. There will be two submersible pumps set up in an alternating sequence to uniformly convey the raw wastewater to the biological treatment process.

WWTP OPTIONS

OPTION ONE – SBR PROCESS

The first treatment process that could be used is the sequential batch reactor (SBR) process. This process operates on the concept of introducing a quantity of raw wastewater to the reactor, providing an adequate time period for the treatment of the wastewater and subsequently discharging a volume of effluent and waste sludge that is equal to the original volume of wastewater introduced to the reactor.

This "Fill and Draw" principle of operation will involve the basic steps of fill, react, settle, decant and sludge wasting. The SBR will utilize multiple individual cycles of the overall "Fill and Draw" mode.

The SBR process allows one of the two SBR treatment basins to treat the raw wastewater and decant the treated effluent to the post equalization tank while the other SBR treatment basin is filling. Any additional influent flows are then stored in the influent equalization tank until the available treatment cycle.

The SBR treatment process normally consists of four to five treatment cycles per treatment basin per day. This allows for a total of eight to ten treatment cycles per day for a two basin SBR treatment system. The SBR control process allows the operator to change the operating level and number and duration of the treatment cycles per day to match the influent flows and organic strength of the wastewater.

OPTION TWO – MODIFIED BARDENPHO PROCESS

The second treatment process that could be used is the Modified Bardenpho (MLE) process. This is an aerobic / anoxic treatment process. This is a flow through style treatment process with final clarifiers after the biological treatment process. The wastewater from the influent equalization tank will be evenly divided between two parallel biological treatment trains. Each treatment train will have its own final clarifier.

The raw wastewater from the influent equalization tank will flow first through an aerobic treatment zone. This zone provides the oxygen required for nitrification and biological oxygen demand reduction. The wastewater then flows into an anoxic zone where de-nitrification will occur, and the nitrogen is given off as a gas. The next treatment zone is re-aeration, where any ammonia that may have reformed in the anoxic stage is removed through aeration and biological activity. This is the same treatment process as the first stage of aeration. The wastewater will then flow through the final clarifier, where the solids will be removed and the treated effluent is conveyed to the ultra violet unit for disinfection.

OPTION THREE – BESST PROCESS

The third treatment process that could be used is the Biologically Engineered Single Sludge Treatment Process (BESST) by Purestream ES, LLC. This would also be a parallel dual treatment train system. This treatment system utilizes an anoxic / aeration biological treatment process. The wastewater from the influent equalization tank will be evenly divided between two parallel biological treatment trains. Each treatment train will have its own final clarifier.

The wastewater is conveyed from the influent equalization to the anoxic treatment zone where the raw wastewater is combined with oxygen rich return activated sludge and de-nitrification of the wastewater occurs. The wastewater will then flow to the aeration zone for biological oxygen demand reduction and nitrification of the wastewater. The final step in the biological treatment process is the clarification stage, where the treated wastewater flows through an up flow final clarifier. The up flow final clarifier design allows for more efficient removal of small solids such as pin floc.

POST TREATMENT COMPONENTS

The treated effluent will then flow into a post equalization tank where it will be aerated prior to being disinfected. The treated effluent will then be disinfected utilizing two parallel ultra-violet disinfection units. The treated effluent will then flow into the effluent storage tank.

The treated and disinfected effluent will then be filtered prior to being conveyed to the drip irrigation disposal fields.

ADDITIONAL WWTP FACILITY COMPONENTS

The WWTP will have a control building that will house the blowers, electrical equipment, operator's office, laboratory, restroom and chemical storage. The WWTP will also have a sludge holding tank sized for a thirty day retention time. The liquid sludge will be removed by a contract hauler to a larger municipal WWTP for final disposal. The WWTP will have an emergency generator to supply back up power. The generator will be a diesel-powered unit with a fuel tank sized for twenty-four hours of continuous operation. The generator will be located outside within a sound enclosure.

4.0 DRIP IRRIGATION SYSTEM

The project proposes to dispose of an average daily flow of 79,750 gpd in various drip disposal irrigation fields located on the project site. The drip fields were identified by the project soil consultant as having a total area of approximately 26.8 acres. The location, size and soil characteristics of the disposal fields are identified in the Geo-Technology Associates, Inc. "Report of Preliminary On-Site Waster Feasibility Evaluation" dated March 2017 and the additional report entitled "Additional Preliminary On-Site Wastewater Disposal Feasibility Evaluation" by Geo-Technology Associates, Inc. dated August 9, 2019.

The effluent from the WWTP after it has been disinfected will flow into a covered effluent storage tank. The PA DEP recommends three days storage holding tank. The holding tank for this project will require a useable volume of 239,250 gallons (79,750 gpd times 3 days).

The treated effluent will be conveyed to the drip fields by a pre-engineered pump, filter and valve skid.

The drip irrigation system will require approximately 279,825 linear feet of tubing. The following is the calculation of the length of tubing.

$$79{,}750 \text{ gpd}/\ 0.1425 \text{ gpd}/\ \text{ft}^2 = 559{,}650 \text{ ft}^2$$
$$559{,}650 \text{ ft}^2 / 2 \text{ ft (spacing between tubes)} = 279{,}825 \text{ LF}$$

The drip tubing will be installed on contour across each of the drip disposal fields. Each drip field will be broken down into sub zones. Each sub zone will contain varying numbers of laterals that will be spaced between two to four feet apart. The length of the laterals will vary by field and will be identified as part of design and permitting approval process. The laterals (drip tubing) will have emitters spaced every two feet along their length.

In addition to the normal flushing of the drip tubing, chemicals may need to be periodically injected into the tubing as a maintenance item. The chemical addition will be the injection of a root inhibitor twice a year and a dilute acid wash four times a year to minimize biological growth in the tubing and emitters.

5.0 CONCLUSION

All three treatment options can be constructed and installed at the proposed Robinson Tract development. Regardless of the treatment selected, it will require that all DEP effluent standards are met prior to being disposed through the drip irrigation system. The treated wastewater will then be disposed of through a drip irrigation disposal system that will adequately dispose of the treated effluent on-site. Based upon on-site soils testing, the proposed drip irrigation fields are capable of absorbing the treated effluent. As such, it is feasible that the wastewater generated by the proposed Robinson Tract development can be adequately conveyed, treated and disposed of as needed for the operations of the proposed development. The WWTP would be offered for dedication to Westtown Township. If the Township does not desire to own and operate the WWTP and drip irrigation disposal system, then it would be owned and operated by a third party Public Utility Commission regulated entity. Moreover, the three sewage treatment options and the drip disposal system have been and are likely to be approved and permitted by DEP.