Village of Covington WWTP Evaluation

June 2021

PDG #300214-00007

PREPARED BY:

POGGEMEYER DESIGN GROUP

AN EMPLOYEE OWNED COMPANY

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Contents

Abbreviations

EPA	Environmental Protection Agency
NPDES	National Pollution Discharge Elimination System
WWTP	Wastewater Treatment Plant
GPD	Gallons per Day
Ft.	Feet
Gal.	Gallons
Sq. Ft.	Square Feet
Cfm	Cubic Feet per Minute
SWD	Side Water Depth
I/I	Infiltration/Inflow
°C	Degrees Centigrade
SU	Standard Units
mg/L	Milligrams per Liter
MGD	Million Gallons per Day
pH	Hydrogen Ion Concentration (Measure Of)
BOD_5	Five Day Biochemical Oxygen Demand
TSS	Total Suspended Solids
NH_3	Ammonia
P	Phosphorus
Hg	Mercury
D.O.	Dissolved Oxygen
Temp.	Temperature
SRT	Solids Retention Time
MLSS	Mixed Liquor Suspended Solids
RAS	Return Activated Sludge
WAS	Waste Activated Sludge
ADF	Average Daily Flow
PDF	Peak Daily Flow
VFD	Variable Frequency Drive
MHI	Median Household Income
LMI	Low to Moderate Income
P.E.	Population Equivalent

INTRODUCTION

The Village of Covington is located in Miami County, Ohio and is situated six miles southwest of Piqua. The Village of Covington 's location is illustrated on the general location map shown in Plate 1.

The original wastewater treatment facility was constructed in 1941 and underwent significant upgrades in 1956, 1968, and 1980. The WWTP is a trickling filter facility and discharges treated wastewater to the Stillwater River under NPDES Permit No. 1PB00013*JD. The permit expiration date is September 30, 2021. The site of the Village's WWTP is indicated on Plate 2.

The Village of Covington Wastewater Treatment Facility and sanitary sewer collection system is owned, operated, and maintained by the Village of Covington.

This plan has been prepared to address the current operations of the wastewater treatment plant and to assess the impact of current and planned growth for the Village of Covington planning area. This document is intended to be an update to a Wastewater Treatment Facility Study that was previously completed in August of 2013. A copy of this study is included in the Appendix.

Recommendations will then be made based upon our current understanding of the treatment facility, anticipated growth, and Ohio EPA water quality standards. All recommendations and alternatives will follow the "Recommended Standards for Wastewater Facilities" that is commonly referred to as "Ten States Standards."

DMZ 3/25/2021	COVINGTON WWTP EVALUATION PLATE 1 LOCATION OF COVINGTON	0 10 20 40 Miles	POGGEMEYER DESIGN GROUP
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FILE: P:\Clients\300214\00007\GIS\PLATE_1.MXD			

DMZ 3/25/2021 PDG JOB# 300214-00007 FILE: P:\Clients\300214\00007\GIS\PLATE_2.MXD	COVINGTON WWTP EVALUATION PLATE 2 LOCATION OF WWTP	0 500 1,000 2,000 Feet	POGGEMEYER DESIGN GROUP

GENERAL INFORMATION

Planning Area

The planning area under consideration for this project has been established as the Village of Covington in Covington Township, Miami County, Ohio. Miami County covers approximately 409 sq. mi. Covington is located in the northwestern area of the County as illustrated on Plate 1.

The Miami Valley Regional Planning Commission (MVRPC) serves as the designated water quality planning agency for the 5 county Miami Valley Region. The five-county area includes Darke, Miami, Preble, Montgomery, and Greene Counties. The MVRPC developed a Areawide Water Quality Management Plan most recently updated in 2011 includes wastewater collection and treatment facility planning areas. The map indicating the facility planning area for the Village of Covington WWTP is included in the Appendix.

The main residential unsewered area within the Village of Covington WWTP facility planning area is the West Covington area. The West Covington area is approximately 1,000' southwest of the current WWTP site and includes approximately 55-60 homes.

Topography

According to the Covington USGS Quadrangle Topographic map, the area around Covington is relatively level and generally drains from the north to south direction into the Stillwater River.

Geotechnical

The soils encountered in the Covington planning area are a vast array of glacial till soils. Generally, the soils are disbursed throughout the area. USDA soil maps are included in the Appendix.

Land Use

Land use within the Village of Covington is mainly residential. The surrounding area of the planning area is agricultural with scattered residential development.

Construction Constraints

Ohio Department of Natural Resources water well log records indicate that ground water can be located at depths ranging from 1' – 60' within the planning area. The water wells located at the WWTP recorded the presence of limestone at less than 10'. For any construction that occurs below grade, soil borings will be critical to determine the quantity of any rock removal.

Watershed and TMDL

The Stillwater River flows 67 miles from its headwaters in Indiana and northern Darke County to a confluence with the Great Miami River in Dayton. The watershed covers approximately 673 square miles. The Ohio EPA completed the Total Maximum Daily

Loads (TMDL) for the Stillwater River Basin in April 2004. Total Maximum Daily Loads are developed as a tool to help restore and protect waterbodies where beneficial uses are impaired or threatened. Ohio EPA uses these as a roadmap for measures that can be taken to improve water quality of the watershed.

Based on the TMDL, the stream segment of the Stillwater River with the highest biological and water quality are the lower Stillwater River mainstem from Covington to the confluence with the Great Miami River, and Greenville Creek and its tributaries originating from the Farmersville Moraine. The lower Stillwater River is in such good condition because the riparian forest is intact, development within the adjacent flood plain is largely agricultural, and the agriculture practiced employs conservation measures.

Income

Median household income (MHI) refers to the income level earned by a given household where half of the homes in the area earn more, and half earn less. According to the 2020 American Community Survey 5-year Estimates, the Median Household Income for Covington is $47,736.

Low or Moderate income (LMI) is a measure of income distribution. LMI is defined as the percentage of households that fall below 80% of the Area Median Income. The LMI for the Village of Covington according to the American Community Survey 5-year estimates is 48%

Median household income and Low to Moderate Income are metrics used by several different funding agencies to determine eligibility for loans and/or grant opportunities for infrastructure projects

Population and Demographics

Population is another important factor to consider when planning any infrastructure project. For wastewater projects specifically, population and population projections can have a significant impact on the final sizing of the facility. Population is also used as a metric for funding agencies that can provide loans and/or grant opportunities.

It is difficult to predict population growth in an area like Covington. The small size and space for new development makes it near impossible to predict.

According to the 2020 American Community Survey 5-year Estimates for Covington, the population was 2,653 people.

Based on the Ohio Department of Development 2019 Population Estimates for Cities, Villages, and Townships, the population within Covington is estimated at 2,708 and is projected to have an annual increase of 0.4%.

WASTEWATER TREATMENT PLANT FACILITY

Typical Domestic Waste

The most reproducible, if not predictable, component of wastewater treatment is the characteristic of its sanitary waste stream.

Minimum flows and pollutant concentrations are observed during the early morning hours; peak flows and pollutant concentrations are typically experienced in the late morning or early afternoon. Fifty percent of the plant's pollutant load during a weekday could arrive at the plant during an 8-hour period; the plant's maximum hourly load can be more than double the plant's average hourly load.

The "Ten States Standards" recommend that new treatment plants be designed for a sanitary waste contribution of at least 0.08 kg (0.17 lb) of BOD per capita per day and 0.09 kg (0.20 lb) of suspended solids per capita per day unless available information justifies other design criteria.

Table 1 delineates the typical major pollutant composition of wastewater

Table 1 Typical Composition of Domestic Wastewater

Parameter	*Total*
Suspended Solids	240
5-day BOD	200
Chemical Oxygen Demand	390
Total Nitrogen	30
Total Phosphorus	7

NPDES Permit

The Covington WWTP's NPDES permit will expire on September 30, 2021. Table 2 outlines current effluent limitations.

Table 2 NPDES Permit Effluent Limitations

Parameter	*Concentration*	
	30-day	*7-day*
Suspended Solids - mg/L	30	45
$CBOD_5$ - mg/L	25	40
Nitrogen, Ammonia	6.2	4.1
E. Coli - #/100 ml	126	284
pH - S.U.	6.5 S.U. to 9.0 S.U.	
Dissolved Oxygen - mg/L	6.0	

The above NPDES permit effluent limitations are more lenient than limitations that are typically required with new WWTP facilities. It is important to note that any expansion of the Covington WWTP will trigger an Antidegradation review by OEPA and more restrictive NPDES permit effluent limits will likely be implemented as a result. The Antidegradation rule requires any new facility, expansion, or major upgrades to an existing factility must meet Best Available Demonstrated Control Technology (BADCT) effluent limits. A table outlining the BADCT effluent limits is given below

Table 3 Best Available Demonstrated Control Technology (BADCT) Effluent Limitations

Parameter	***Concentration***	
	30-day	***7-day***
Suspended Solids - mg/L	12	18
$CBOD_5$ - mg/L	10	15
Nitrogen, Ammonia (summer) – mg/L	1	1.5
Nitrogen, Ammonia (winter) – mg/L	3	4.5
Phosphorus, Total – mg/L	1	1.5
E. Coli - #/100 ml	126	284
pH - S.U.	6.5 S.U. to 9.0 S.U.	
Dissolved Oxygen - mg/L	6.0	

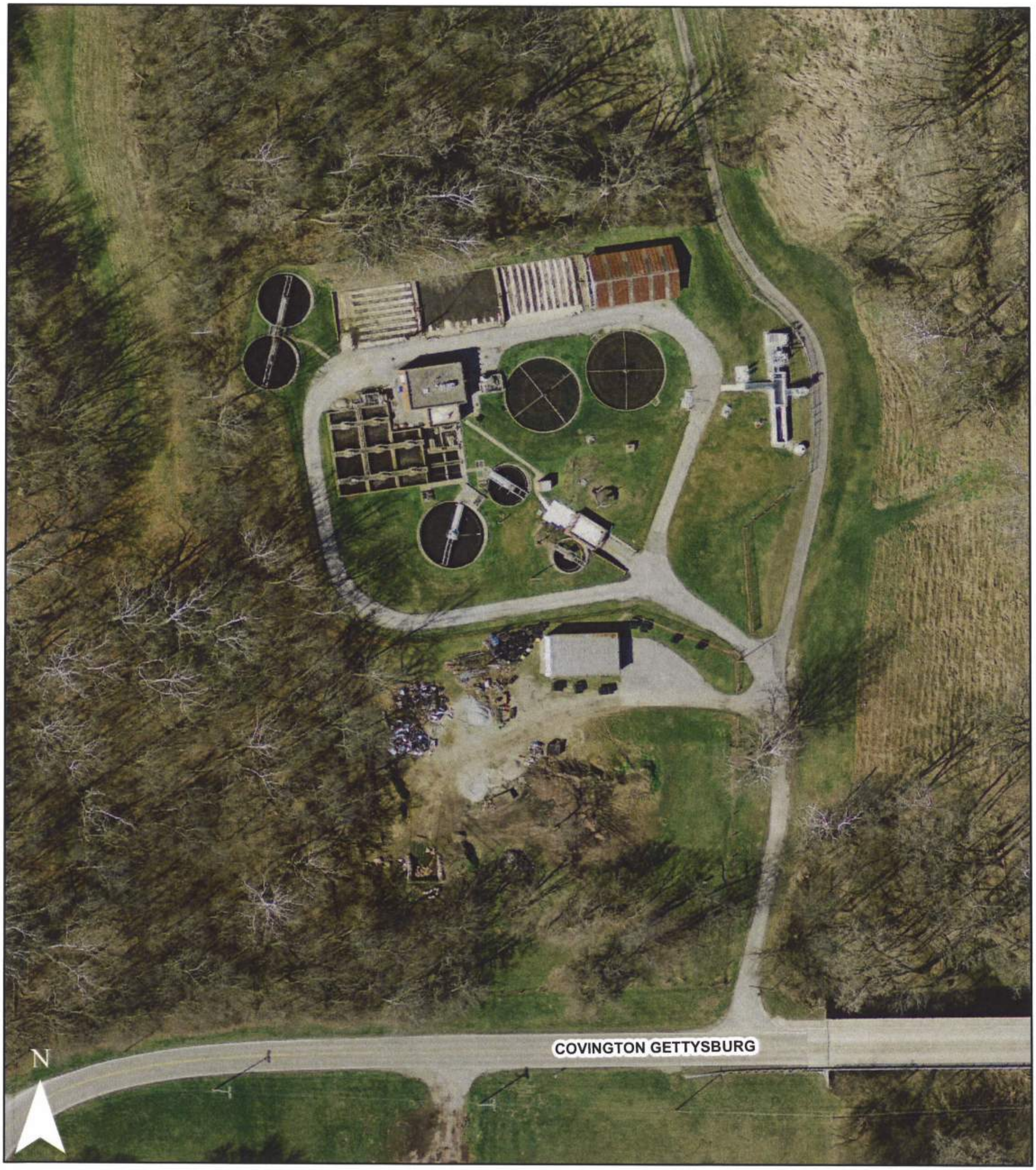
Current Data and Compliance Review

Review of the eDMR reports which contain monitoring data required by the Ohio EPA NPDES permit indicates the wastewater treatment plant experienced only 1 dissolved oxygen and 1 total suspended solids violation during the past 3 years.

In 2020, the Covington Wastewater Treatment Facility received an average daily flow of 0.395 MGD. The maximum one day recorded effluent flow in 2018-2020 was 2.456 MGD. The average influent BOD concentration to the WWTP was 170 mg/L. The average influent TSS concentration to the WWTP was 150 mg/L.

As previously discussed, recommended design standards for sanitary waste is 100 gpd per capita, .17 lbs of CBOD5 and .20 lbs. of TSS. Based on average influent concentrations identified in monthly eDMR forms, the Covington Treatment Plant does not exceed the design TSS or CBOD loadings when compared to typical major pollutant composition of wastewater.

Table 4 lists design versus current loadings.



DMZ 3/25/2021 PDG JOB# 300214-00007 FILE: P:\Clients\300214\00007\GIS\PLATE_3.MXD	COVINGTON WWTP EVALUATION PLATE 3 AERIAL VIEW OF WWTP	0 50 100 200 Feet	POGGEMEYER DESIGN GROUP

DMZ 3/29/2021 PDG JOB# 300214-00007 FILE: P:\Clients\300214\00007\GIS\PLATE_4.MXD	COVINGTON WWTP EVALUATION PLATE 4 CURRENT CONDITIONS	0 50 100 200 Feet	POGGEMEYER DESIGN GROUP

Table 4 Design vs. Current Conditions

Parameter	*Basis of Design*	*Current Conditions (2020)*	*Percent (%)*
Design Flow	0.750 MGD	0.395 MGD	53
Peak Flow	1.56 MGD	1.268 MGD	81
CBOD Loading	3,634 lbs/day	560 lbs/day	15
TSS Loading	1,945 lbs/day	494 lbs/day	25
Design CBOD	21,376 capita	3,294 capita	15
Design TSS	9,725 capita	2,470 capita	25

As shown in the table above, the Covington WWTP is operating within its design capacity in terms of pollutant loading and hydraulic capacity.

An additional sampling effort was also conducted by the Village WWTP staff to provide loading information that would not typically be included within the eDMR reports. A table listing all the additional sampling data is included in the Appendix.

Perrigo is the main industrial user within the Village. They discharge an average daily flow of 100,000 gpd to the Village's sanitary sewer collection system. This flow is very high in BOD averaging 1054 mg/L. During the additional sampling period, the discharge from Perrigo had low concentrations of ammonia and phosphorus apart from 1 sample of phosphorus that measured 15 mg/L. In summary, the BOD load from Perrigo is high and phosphorus concentration can be highly variable.

Currently the WWTP is not required by their NPDES permit to sample for ammonia or phosphorus in the influent to the WWTP. However, ammonia loading to the plant can have a significant impact on the amount of aeration required for treatment. Similarly, the influent phosphorus can have an impact on how much chemical coagulant will be required to meet a phosphorus limit. The average ammonia and phosphorus influent concentrations during the additional sampling period was 3.88 mg/L and 2 mg/L respectively. In summary, these concentrations would be considered low for these contaminants based on typical domestic waste.

Wastewater Treatment Facility Evaluation

The existing wastewater treatment facility utilizes a combination of trickling filter and activated sludge biological treatment processes. Plate 3 is an aerial of the WWTP and Plate 4 illustrates the different unit processes that make up the facility. Descriptions and evaluation of each unit process are provided in each of the following sections.

Sanitary Sewer Collection System

The sanitary sewer flow from the Village is transferred to the WWTP by gravity through four (4) siphons that pass beneath the Stillwater River. The siphon lines discharge directly to the pretreatment structure.

In 2019, there were 3 sanitary sewer overflow occurrences that were reported to OEPA that originated at the 305 siphon box at 125 Bridge St. Siphons rely on consistent flow and maintenance to remain clear to transfer flow by gravity. A pump station will be needed to establish a higher hydraulic profile at an upgraded WWTP facility. The Village has the option to construct this raw sewage pump station on the east side of the Stillwater River in order to eliminate the existing siphons and replace with force main.

Pretreatment Facilities Description

The pretreatment facilities begin with an influent channel that contains a grinder. The grinder is designed to shred inert materials such as rags, plastic, wood, and other types of solid trash material. Any wastewater flow that exceeds the capacity of the grinder flows over an adjacent weir through a manual bar screen with 2" openings.

Following the grinder unit, the wastewater is transferred to the grit removal chamber that is designed to settle out inorganic materials such as sand, cinders, and gravel. If not removed, these indigestible items continue to collect in the system and require periodic removal. At the time of the PDG site visit, the grit removal chamber/system was not in operation.

The wastewater currently flows around the grit removal system directly to the pre-aeration tanks through a 14-inch pipe by gravity. The flow can also be directed to the primary settling tanks or the transfer pump station wet well where primary treatment can be bypassed entirely.

The two (2) pre-aeration tanks are rectangular tanks with sloped bottoms to collect solids that settle out. The pre-aeration tanks are operated in series and are currently used to collect as much grit as possible. The operators observe the level of grit that accumulates in the tanks until it reaches a predetermined level. At that point, the accumulated grit is removed by vactor truck.

Following the pre-aeration tanks, primary treatment is accomplished using two (2) rectangular primary clarifiers. Both tanks are 24 feet long and 9.5 ft deep. The east primary clarifier is 10 feet wide, and the west tank is 15 feet wide. The objective of the primary settling tanks is to remove readily settleable solids and floating material to reduce the TSS and BOD passed to biological treatment. Efficiently designed and operated primary settling tanks can remove 50-70% of suspended solids and 25-45% of BOD.

Pretreatment Facilities Evaluation

The existing pretreatment structure consists of a grinder unit and grit removal equipment. The existing grinder looked to be in fair condition, however, inert materials and trash should be removed from the waste stream as opposed to broken into smaller pieces and allowed to pass through. Rags, plastics, and other trash can present maintenance issues for mechanical equipment downstream causing clogging or accumulating on submerged piping.

Furthermore, as of July 1, 2015, Ohio EPA is requiring that prior to the beneficial reuse (land application) of biosolids, influent wastewater and septage or sewage sludge at a treatment facility must be screened with a maximum spacing of 5/8" to remove inert material. Inerts are considered solid waste and should always be disposed of within a landfill. PDG would recommend that a mechanical fine screen with a 6 mm perforated plate be installed in leu of the grinder unit.

The grit removal equipment in the pretreatment structure is also well beyond its useful life as it is no longer in operation. Furthermore, using the pre-aeration tanks to remove grit that accumulates is labor intensive and requires WWTP maintenance staff to come into close contact with waste materials. PDG would recommend replacing both of these existing facilities with a vortex induced grit removal system. Modern vortex grit removal systems are capable of removing 95% of high-density particles 105 micron and larger.

An upgrade of the existing pretreatment/headworks facilities will ensure efficient operation of the downstream processes. Typically, this equipment is installed in a headworks building and is configured as such that inert materials collected from the screen and grit removal equipment can be deposited directly into a dumpster container for local refuse pick up. This building usually is where an influent composite sampler is also located.

The existing primary clarifier tanks were built in 1956. This equipment is well beyond its useful life and the existing tankage for these facilities is beginning to show signs of wear. Concrete cracks and spalling were evident at the time of PDG's visit to the WWTP.

Trickling Filter Description

The method of biological treatment of the wastewater at this plant is a combination of trickling filter attached growth process and activated sludge process. Wastewater from the primary tanks is transferred to the trickling filters through a splitter chamber. Wastewater travels from the splitter chamber through two (2) 12-inch pipes to the trickling filters.

The trickling filter process is a non-submerged fixed-film biological reactor using rock over which wastewater is distributed continuously. Treatment occurs as the liquid flows over the biofilm that is attached to the rock media. The depth of the rock media in the Covington WWTP trickling filters is 6 feet deep. The trickling filter tanks are circular, and wastewater is distributed over the top of the rock bed by a rotary distributor. The west trickling filter is 54 feet in diameter and the east trickling filter tank is 58 feet in diameter. The rotary distributor consists of four (4) six-inch distributor pipes that are hydraulically driven by the wastewater flow. When the wastewater facility is experiencing low flow periods, the rotary distributor is kept in motion by recirculating partially treated wastewater with recirculation pumps. The underdrain system collects the trickling filter effluent and keeps the trickling filter as a porous structure in which air can circulate. The underdrain system consists of two (2) twelve-inch pipes that combine into a 16-inch pipe before entering the recirculation pump station wet well.

When trickling filter effluent is not being recirculated over the trickling filter media, it is transferred to the intermediate clarifier tanks via the trickling filter effluent transfer pumps. The trickling filter effluent transfer pumps direct the partially treated wastewater to the intermediate settling tanks to settle out any solids that may have been generated at the trickling filters. Trickling filter effluent enters a splitter chamber before the intermediate clarifiers to be equally split between the two tanks.

Trickling Filters Evaluation
While the existing trickling filters are generally reliable, operating problems can be caused by increased growth of biofilm due to high organic loads or small changes in wastewater characteristics (ph, CBOD, temp, and DO). The existing trickling filters require a high level of operator attention and are limited in the degree of treatment they can provide.

At the time of the PDG site visit, the distribution arms for the east trickling filter were not rotating. The staff indicated that the cold weather combined with the low flow was not creating enough hydraulic pressure to keep them rotating. The distributor arms appeared to be in poor condition showing signs of corrosion and leakage. The distributor arms are also prone to clogging due to the lack of headworks facility.

Typical trickling filter operation is such that wastewater drains through the trickling filter media promoting a green biofilm growth. The appearance of the trickling filter media at the Covington WWTP was a dark grey and some ponding of wastewater was observed indicating accumulation of solid material and biofilm overgrowth within the media.

While the current biological treatment facilities at the Covington WWTP are producing an exceptionally clean effluent, the biological process components are well beyond their useful life and require extensive operator maintenance to keep in operation. PDG would recommend that the trickling filter biological treatment process be replaced with a new biological treatment process that can provide a high degree of treatment to meet BADCT requirements while also minimizing the operator exposure to waste material during maintenance. The new biological treatment process should also provide flexibility with the variation of influent flow rates. One of the potential biological processes that can meet these demands reliably and efficiently is a sequencing batch reactor.

Intermediate Clarifier Description
Each intermediate clarifier tank is 35 feet in diameter and 10 feet deep. Wastewater entering the clarifiers is directed to the center feed well. The center feed well is utilized to distribute the flow uniformly through the tank and allow the remaining surface of the tank to remain undisturbed. This promotes the settling of particles and allows for the collection of materials that float on the surface. The skimming collector arm moves along the surface in a circular motion and directs the scum to a scum well where it can be redirected to the head of the plant. Solids that are settled to the bottom of the tanks are directed to a sludge hopper in the center of the tank. Piping from the bottom of the tank is used to transfer the sludge to the sludge well between the clarifiers. The sludge

from the intermediate clarifiers is combined with the sludge from the primary tanks in the waste sludge well.

The existing two (2) intermediate clarifiers are 35' diameter and 10' deep. The current design surface overflow rate is 810 gpd/ft^2 and a weir overflow rate of 7,090 gpd/ft.

OEPA design standards require that all treatment facilities that exceed 100,000 gpd provide for multiple units capable of independent operations. Per design standards, secondary clarification sizing must meet both 900 gpd/ft^2 surface overflow rate and 30,000 gpd/ft weir loading rate.

Intermediate Clarifier Evaluation
At the time of the PDG site visit, the intermediate clarifiers were both in operation and appeared to be functioning as intended. However, there was some noticeable deterioration of the tank and the mechanism within the tank is beyond its useful life.

The existing intermediate clarifier tanks are only 10 feet deep. "Recommended Standards for Wastewater Facilities" recommends that clarifiers be a minimum of 12 feet deep.

Aeration Tank Description
The clarified wastewater is then transferred to the three (3) aeration tanks where additional biological treatment takes place. Each aeration tank is 20' wide and 11.5' deep. Aeration tanks 1 & 2 are are 61' long while aeration tank 3 is only 40' long. The total estimated volume of the aeration tanks is 37,260 ft^3 or 278,704 gallons. The basic activated sludge process consists of wastes entering a reaction basin (aeration tank) where it is mixed with preformed microbial floc (return activated sludge). Return activated sludge is the sludge that has settled within the final clarifiers that is returned to the aeration tanks. Activated sludge is a suspension of living and dead microorganisms and organic and inorganic substances. The organic material serves as a source of carbon, and an energy source and is converted to microorganisms and carbon dioxide. The contents of the aeration tank is called mixed liquor suspended solids (MLSS) or (commonly) mixed liquor. The mixed liquor in the aeration tanks is aerated utilizing mechanical surface aerators. Typically, surface aerators are much less efficient than other methods of aeration such as fine-bubble diffused aeration or jet aeration. This is because the other methods of aeration introduce oxygen at the lower end of the water column and allows more contact time between oxygen and the wastewater.

The microorganisms which are developed in this process, and which are contained in the activated sludge, adsorb the organic material in the sewage in the aeration basin. Sludge wasting is necessary to maintain a balance between the organic foods and the microorganism's mass. It should be kept in mind that the microorganisms in this plant are continually growing and increasing their mass by utilizing the food present in the raw sewage. This entire process must take place in the presence of oxygen which is supplied to this system by the surface aerators.

The most important components of the aeration tank are those responsible for mixing and aerating the tank contents. Mixing is important because it causes quick dispersion of the pollutants throughout the tank in order to being them in contact with the microbial floc. Mixing also prevents sludge build-up on the bottom of the aeration tank. Aeration is necessary to provide oxygen to the microorganisms in order to develop and maintain an aerobic environment necessary for their growth.

Aeration tanks are followed by settling tanks (secondary clarifiers) which separate the mixed liquor solids from the treated wastewater. The mixed liquor solids are returned to the aeration tank via a bottom draw off pipe and generally called "return activated sludge" or RAS.

The variety of microorganisms in the aeration tank depends mostly on how long they reside in the system. The length of time MLSS stays in the aeration system is called "mean cell residence time" (MCRT). The biological process continually converts pollutants into new cells (solids). Since the biological process produces solids, it is seen that the concentration of solids in the aeration tank will continually rise. There is a maximum amount of solids in the system above which cannot be removed by the secondary clarifiers and will then overflow the clarifier weir. Thus, it is seen that a portion of these solids must be regularly removed in order to keep the system in proper balance. Removal of the solids is called "sludge wasting" and the removed solids are called "Waste Activated Sludge" (WAS).

Aeration Tank Evaluation

The existing aeration tank concrete appeared to be in fair condition. The mechanical surface aerators are inefficient and reaching the end of their useful life. The operators reported that in the current mode of operation, the dissolved oxygen within the aeration tanks is frequently high and the mechanical surface aerators are mostly used to keep solids in suspension.

The volume of the existing aeration tanks is sufficient for aerobic digestion of sludge. This is discussed in further detail in a later section of this report.

Final Clarifiers Description

Mixed liquor from the aeration tanks flows to a splitter chamber that directs the flow to the two (2) secondary clarification tanks. These two tanks have the same objective but are sized and operate differently.

The 30' diameter Spiraflo tank was constructed in 1956. In this tank, flow is distributed around the outside perimeter of the tank in a skirt baffle. The skirt baffle encourages the water to flow along the outside of the tank to the base of the tank. As the solids settle, the clear surface water is collected in a rectangular, v-notch trough located in the center of the clarifier.

The 45' diameter center feed clarifier was built in 1979. This clarifier operates similar to the previously discussed intermediate clarifiers, influent is directed to a center feed well is utilized to distribute the flow uniformly through the tank. The clarified effluent flows over a V-notch weir, located around the perimeter of the tank, into the effluent trough.

Final Clarifier Evaluation

There are two existing (2) secondary clarifiers which are 30' diameter and 45' diameter. Both tanks are approximately 10' deep. The current design surface overflow rate is 884 gpd/ft^2 and a weir overflow rate of 7,964 gpd/ft. At the time of the PDG site visit, the 30' Spiraflo clarifier was not in operation and appeared to be undergoing repair.There was some noticeable deterioration of the tanks and the mechanisms within the final clarifiers are beyond their useful life.

The existing final clarifier tanks are only 10 feet deep. "Recommended Standards for Wastewater Facilities" recommends that clarifiers be a minimum of 12 feet deep.

Ultraviolet Disinfection Description

The clarified effluent from the final clarifiers is transferred to the ultraviolet disinfection channel to be disinfected via ultraviolet light. Ultraviolet disinfection is a physical process that instantaneously neutralizes microorganisms as they pass by ultraviolet lamps submerged in an effluent channel. The process adds nothing to the water but ultraviolet light, and therefore, has no impact on the chemical composition or the dissolved oxygen content of the water.

The use of ultraviolet disinfection has grown significantly over the past few decades. Ultraviolet disinfection is becoming more prevalent due to the significant safety advantages for their plant operators and no environmental impact on local water bodies.

The UV disinfection channel was built in 2017 and consists of two (2) power distribution banks. Each bank includes six (6) modules with four (4) lamps in each module for a total of 48 UV lamps in the system. The total rated capacity of the system with both banks in operation is 1.63 MGD. Disinfected effluent then flows over a serpentine weir to the flow measurement chamber.

Ultraviolet Disinfection Evaluation

The existing ultraviolet disinfection system is a Trojan 3000 PTP low pressure system that was installed in 2017. The UV system is operating as expected and all components of the system appear to be in good working order. However, this UV disinfection equipment and channel is sized for the existing peak capacity flow of 1.56 MGD. In order to expand the current system, the existing channel will need to be widened to allow for hydraulics and additional UV lamp modules to be installed in the channel.

The only issue with the UV system is the Trojan 3000 PTP requires manual cleaning on a regular basis during the disinfection season to maintain compliance. Newer UV systems utilize an automated self-cleaning systems that cleans the bulbs based on UV transmittance. This can reduce the maintenance time spent on this system by an operator. These newer UV systems can also automatically adjust the intensity of the UV light to accommodate periods of high flow or high turbidity. During periods of low flow, these systems can adjust to conserve energy.

Post Aeration Description

Flow is measured by a level sensor and V-notch weir configuration before flowing into the post aeration chamber. The post aeration chamber measures 18' x 6' wide. The floor of the post aeration chamber is lined with coarse bubble diffusers that are designed to add dissolved oxygen before discharge on an as needed basis. Air is supplied by the blowers located in the building between the sludge thickener and digester.

Post Aeration Evaluation

Post aeration tanks are typically sized for a detention time of 10 minutes at average daily flow or 5 minutes at peak hourly flow. At 5 minutes of peak flow, 8,680 gallons would be required. The interior of the post aeration tank is approximately 6' x 18' x 10' which equates to 8,078 gallons. Under the current operation, the WWTP staff rarely use the existing post aeration tank due to the high concentrations of oxygen in effluent as a result of the secondary treatment process. For these reasons, PDG does not recommend any expansion of the existing post aeration tank.

Effluent Pump Station Description

The effluent pump station was also built in 2017 and was designed to prevent the WWTP from flooding during times when the Stillwater River water level was high. The wastewater treatment plant effluent pump station is a triplex submersible pump station with pumps rated for 570 gpm each. Following the post aeration chamber, effluent can leave the plant by gravity or through the effluent pump station. The sluice gates that determine the mode of operation is automatic based on the level of the river During times when the river water level is low, the sluice gate that allows treated effluent to flow out of the WWTP by gravity through the 12" outfall sewer is open while the sluice gate to the effluent pump station remains closed. Once the level in the river reaches a certain elevation, the sluice gate to the effluent pump station opens while the sluice gate to the gravity outfall sewer will close.

Effluent Pump Station Evaluation

The effluent pump station is designed to create additional head pressure that allows the WWTP to discharge under high stream flow conditions. In order to accommodate the increase in the peak flow, the pumps will need to be upgraded and the outfall sewer will need to be upsized to an 18"

Sludge Processing Description

Biosolids generated at the facility are collected in the primary clarifiers, intermediate clarifiers, and final clarifiers. Waste activated sludge and sludge from the intermediate clarifiers is transferred to the primary clarifiers where it is combined with primary sludge. Sludge is transferred to the sludge well and pumped to the anaerobic digester for storage

The sludge gravity thickener was built in 2017 and was designed to thicken sludge before being transferred to the anaerobic digester by the sludge transfer pumps. The gravity thickener tank is 25' in diameter and 10' deep. Thickening the sludge before being transferred to the anaerobic digester helps the efficiency of the digestion process.

Sludge Thickener Evaluation

As of the site visit by PDG, the sludge thickener tank was not in service. Plant staff indicated that the thickener caused additional operational issues when it was in service and the decision was made to bypass the thickener.

Anaerobic Digester Description

The anaerobic digester is a buried concrete tank that measures 40 foot diameter and 13 feet deep. Sludge is pumped from the anaerobic digester to a truck hauling station. The anaerobic digester is currently being used for liquid sludge storage before being hauled to another facility for processing.

Anaerobic Digester Evaluation

The existing anaerobic digester is currently being used for liquid sludge storage before transfer to the sludge drying beds. Due to the tank being below ground, the tank is difficult to maintain. It is suspected that a large amount of debris have accumulated in this tank.

PDG would recommend utilizing aerobic digestion through the use of open air tanks for treatment of sludge. Aerobic digestion provides less complicated equipment and operation. Open air tanks will allow for regular monitoring and maintenance of the contents of the tank.

Aerobic digestion sizing in "Recommended Standards of Wastewater Treatment" are based on population equivalent. At average flow of 0.75 MGD and influent CBOD of 183 mg/L the population equivalent for the facility is 6,733 people. Aerobic digesters that accept extended aeration activated sludge are required to have 3 ft^3 of digester capacity per population equivalent. Digesters that are used to thicken biosolids to 2% are required to increase the volume further by 25%. The aerobic digesters would require a volume of approximately 28,125 ft^3 between a minimum of two (2) tanks. Each aerobic digester would supply oxygen to the wasted biosolids by diffused aeration using blowers, air piping, and fine bubble diffusers.

The existing aeration tanks have sufficient volume to be repurposed as aerobic digesters.

Digested Sludge Processing Description

Biosolids from liquid sludge storage are currently transferred to the sludge drying beds for dewatering. Water drains from the sludge to the sludge bed underdrain system where it is returned to the intermediate pump station wet well. Dried sludge is loaded into trucks with a front end loader before being hauled to the local landfill.

Digested Sludge Processing Evaluation

The current method for dewatering and disposing of sludge from the facility is labor intensive and exposes the operators to direct contact with waste material.

PDG would recommend that the Village consider the installation of a mechanical sludge dewatering process and dried sludge conveyance system that would deposit sludge directly into large dumpsters that can be hauled away by the local refuse company.

Different types of dewatering processes include belt press, screw press, fan press, centrifuge. All these types of technology are designed to remove water from the biosolids generated during wastewater treatment in order to minimize hauling and disposal costs.

Based on the annual sludge reports for the past three years, the WWTP processed a three year high of approximately 57 dry tons of sludge in 2018. To dewater this amount of sludge over a 40 hour period, the dewatering unit would need to be sized for at least 54 lbs/hr on a dry weight basis. It is important to allow some additional capacity for future flow and also consider the time of operation of a dewatering unit. The WWTP staff may prefer to operate the equipment 20 hours per week to allow some flexibility in schedules and maintenance. For these reasons, PDG would recommend a mechanical sludge dewatering process that is sized for a minimum of 200 lbs/hr.

WWTP EXPANSION ALTERNATIVES & RECOMMENDED IMPROVEMENTS

Flow Information

At the current flows and loadings, the Covington WWTP appears to be performing below its design capacity in terms of CBOD and TSS loading. However, the WWTP periodically experiences flows above the peak daily design flow rate. Exceeding the peak flow rate through a wastewater treatment facility can cause solids washout, flooding, or damage to equipment.

Historically, the influent flow has averaged 0.395 MGD and reached a maximum flow of 2.456 MGD (April 2018). While this magnitude of a flow event happens a few times per year, generally over time peak flow events can be expected to increase. Without rigorous sanitary sewer maintenance and repair plans, inflow and infiltration will increase as the age of the sanitary infrastructure increases and condition of the sanitary infrastructure slowly degrades. Furthermore, development and population can be expected increase over time as well. Based on this information, an average daily design flow of 0.75 MGD and a peak daily design flow of 2.5 MGD was selected as design flows for improvements.

Three alternatives will be presented as part of this WWTP Evaluation. Alternative 1 will consist of replacement of individual processes within the existing wastewater facility that are beyond their useful life while utilizing processes or infrastructure that are in good condition. Alternative 2 will consist of abandonment of the existing facility and constructing a new facility at a site adjacent to the existing WWTP site. Alternative 3 will consist of a regional connection to the City of Piqua sanitary sewer system. Alternative 1 and Alternative 2 will consider the sequencing batch reactor type treatment process to minimize the footprint and number of treatment tanks required. The alternatives and options are summarized below

- Alternative 1: Rehabilitation of the Covington WWTP utilizing sequencing batch reactor (SBR) type treatment designed to treat an average daily flow of 0.75 MGD and a peak of 2.5 MGD. This option will reuse the existing structure of the UV disinfection, post aeration, effluent pump station, and the aeration tanks as aerobic digesters

- Alternative 2: Abandonment of the existing Covington WWTP and building a completely new wastewater treatment facility utilizing sequencing batch reactor (SBR) type treatment designed to treat an average daily flow of 0.75 MGD and a peak of 2.5 MGD.

- Alternative 3: Regional pump station connection to the City of Piqua for an average daily flow of 0.75 MGD and a peak of 2.5 MGD.

The biological treatment design criteria that the improvements are based on are summarized in the table below

Table 6 WWTP Improvement Design Parameters

Parameter	
Average Daily Flow	0.75 MGD
Peak Daily Flow	2.5 MGD
Influent CBOD	183 mg/L
Influent TSS	172 mg/L
Influent Phosphorus	8 mg/L
Influent Ammonia	25 mg/L

Alternative 1

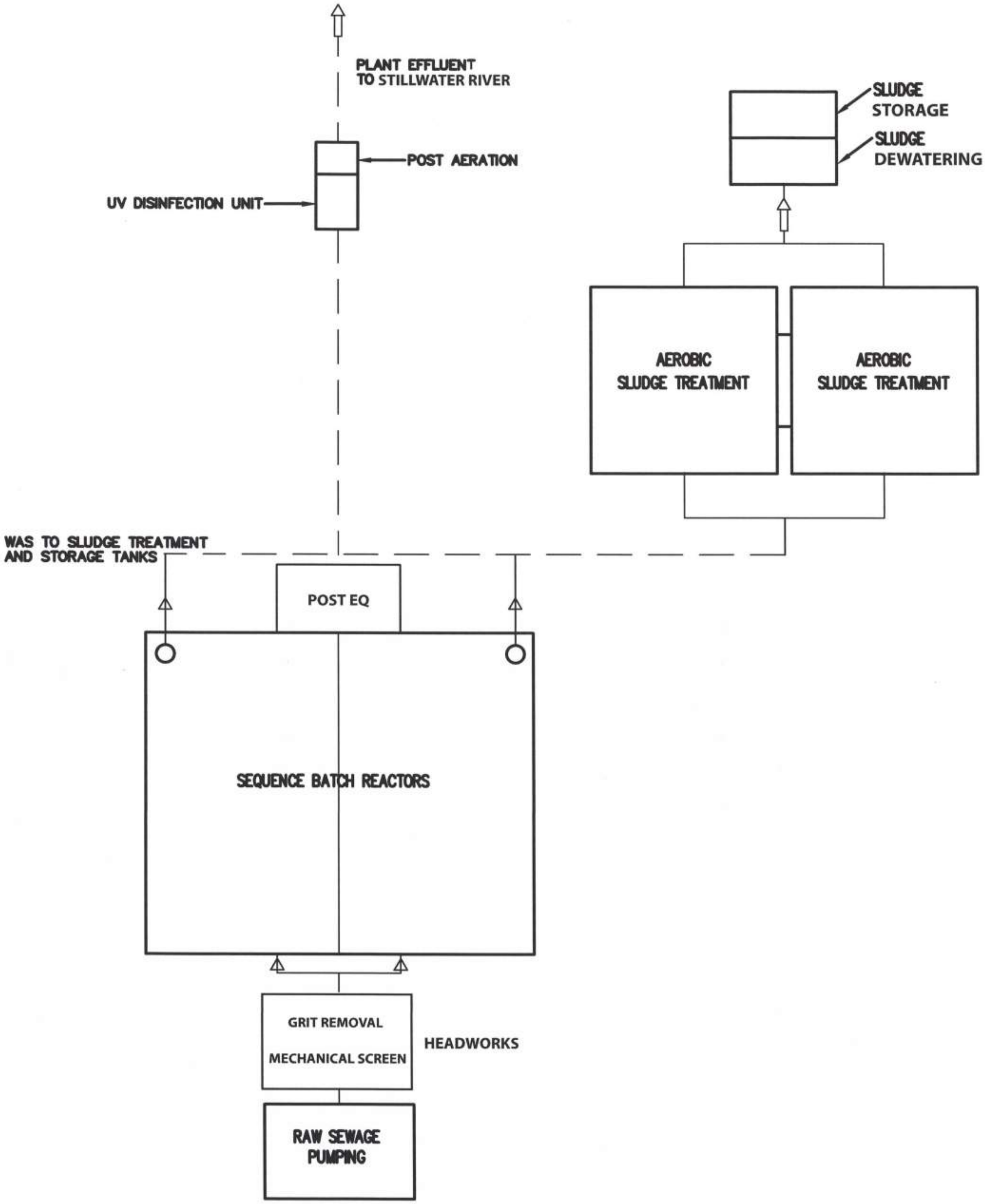
This alternative would consist of the construction of a new headworks, sequencing batch reactor (SBR) and dried sludge storage facilities.

The Sequencing Batch Reactor is a modified activated sludge fill and draw wastewater treatment process that does not require final settling tanks. The SBR system consists of at least two tanks that incorporate aeration and clarification that take place as a timed process in a single tank. The SBR enables removal of nutrients (nitrogen and phosphorus) by incorporating anoxic and/or anaerobic mixing during fill and cycling (on/off) of aeration blowers during react, fill, and decant phases. The cyclic operation of the SBR is

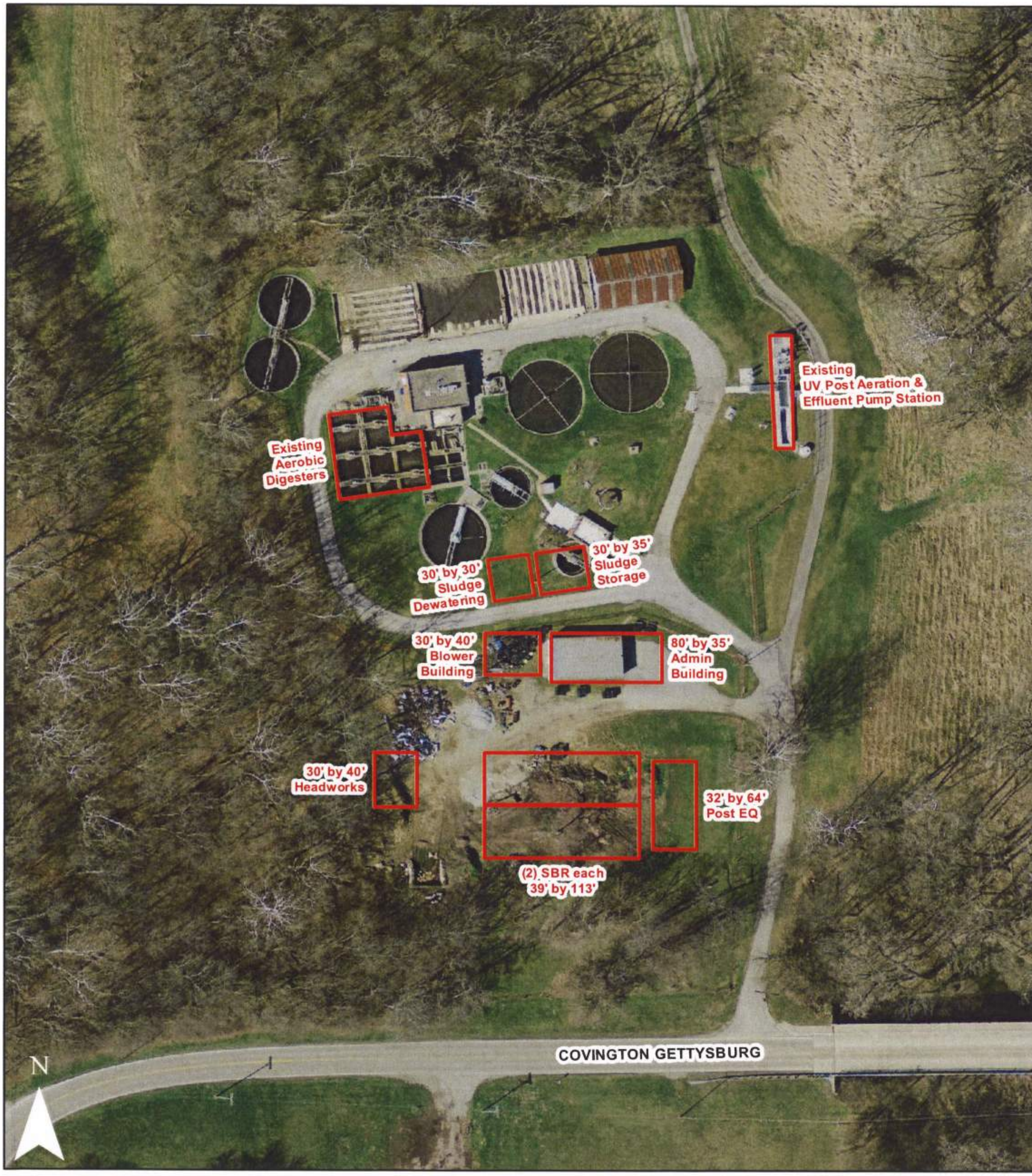
- **Fill** - At the beginning of each cycle the liquid level is set at the bottom water level. The wastewater is fed during fill to a reactor which contains acclimated microorganisms (activated sludge). The fill phase will be anoxic and/or anaerobic mix fill or react fill with or without air, depending on system objectives
- **React** - During the react phase, wastewater is diverted to the other SBR tanks. Reactions for substrate removal initiated during fill phase are completed during react phase. The treatment is controlled by air on or off to produce anaerobic, anoxic, or aerobic conditions. Controlling the time of mixing and/or aeration produces the degree of treatment required
- **Settle** - After the react phase, mixing and aeration are terminated, and the biomass is allowed to settle under quiescent conditions.
- **Decant** - During the decant phase, clarified effluent is removed from the reaction without drawing floating scum or disturbing the settled sludge blanket. A decanter is mechanically designed to operate with a constant rate of discharge to operate with a constant rate of discharge without stop-start operation. This prevents straggler floc scour from the sludge blanket
- **Idle** - In a multiple tank SBR facility, idle time may be possible waiting for the next batch of influent. The idle phase occurs when actual flows are less than design flows

1. Advantages
    a. Does not require any settling tanks
    b. Process flexibility (nitrification and phosphorus removal)
    c. Operational flexibility provided by separate mixing
    d. Provides a stable sludge
    e. Will meet BADCT effluent requirements
    f. Automatic storm treatment mode
2. Disadvantages
    a. Will generate additional sludge due to improved solids removal
    b. Biological process requires blowers for diffused aeration
    c. Waste sludge has a lower solids concentration

The SBR flow diagram is on Plate 5 and the preliminary site plan is shown on Plate 6.



REFERENCE: ACAD DWG D. ZUBENKO 04/28/2021 JOB #300214-00007 FILE: PLATE 9	PLATE 5 OHIO	VILLAGE OF COVINGTON WWTP EVALUATION	POGGEMEYER DESIGN GROUP



DMZ 5/13/2021 PDG JOB# 300214-00007 FILE: P:\Clients\300214\00007\GIS\Alternate_1A.MXD	COVINGTON WWTP EVALUATION ALTERNATE 1A	0 50 100 200 Feet	POGGEMEYER DESIGN GROUP

POGGEMEYER DESIGN GROUP

Engineer's Opinion of Probable Costs

Covington WWTP Evaluation — *5/26/2021*

Alternative 1 - Rehab w/Sequencing Batch Reactor Facility

PDG Job No 300214-00007

NO.	ITEM	QTY	UNITS	UNIT COST	TOTAL
	Raw Sewage Pump Station				
1	3 Self Priming Pumps and Controls in FRP Enclosure	1	LS	$400,000	$400,000
2	Wet Well and Accessories	1	LS	$100,000	$100,000
3	Precast Manhole including Casting and Frame	4	Each	$2,000	$8,000
4	12" Gravity Sewer	1700	LF	$120	$204,000
5	10" PVC Forcemain	1600	LF	$100	$160,000
	Headworks				
6	25' x 35' Two Story Headworks Building	1	LS	$550,000	$550,000
7	Monorail and Hoist	1	LS	$15,000	$15,000
8	Magnetic Flow Meter	1	LS	$10,000	$10,000
9	6mm Centerflow Mechanical Screen and Screenings Washer/Compactor	1	LS	$350,000	$350,000
10	Grit Removal Equipment	1	LS	$375,000	$375,000
11	Odor Control Equipment	1	LS	$120,000	$120,000
12	Flow Paced, Refrigerated, Composite Sampler	1	LS	$20,000	$20,000
	Sequencing Batch Reactor				
13	Concrete Tanks	1	LS	$1,500,000	$1,500,000
14	Excavation, Backfill, Disposal	1	LS	$133,000	$133,000
15	Aluminum Handrail	1	LS	$40,000	$40,000
16	Aluminum Grating	1	LS	$35,000	$35,000
17	Stairs	1	LS	$25,000	$25,000
18	Sequencing Batch Reactor Equipment including Blowers, Diffusers, Decanter, Pumps, VFD's, and Controls	1	LS	$912,500	$912,500
	Ultraviolet Disinfection				
19	Concrete Channel Modifications	1	LS	$50,000	$50,000
20	Ultraviolet Disinfection Equipment	1	LS	$50,000	$50,000
21	Unpunched Aluminum Grating over UV	1	LS	$20,000	$20,000
22	Effluent Composite Sampler	1	LS	$15,000	$15,000
	Solids Handling				
23	Aerobic Digester Blowers	3	LS	$30,000	$90,000
24	Aerobic Digester Diffusers	1	LS	$50,000	$50,000
25	Aerobic Digester Mixer	5	LS	$25,000	$125,000
26	Biosolids Dewatering Equipment	1	LS	$425,000	$425,000
27	30' x 30' Sludge Dewatering Building	1	LS	$275,000	$275,000
28	Concrete Floor on Existing Sludge Storage Bed	1	LS	$20,000	$20,000
29	Dried Sludge Conveying System	1	LS	$200,000	$200,000
	Miscellaneous Items				
30	Supervisory Control and Data Aquisition System	1	LS	$200,000	$200,000
31	Effluent Pump Upgrade	1	LS	$75,000	$75,000
32	18" Outfall Sewer	250	LF	$150	$37,500
33	Plant Drain Pump Station	1	LS	$75,000	$75,000
34	Diesel Generator	1	LS	$300,000	$300,000
35	Administration Building (Office, Lab, Restroom, Garage, etc.)	1	LS	$800,000	$800,000
36	Blower Building	1	LS	$275,000	$275,000
37	Demoliton (Pretreatment, PreAeration,Primary Clarifiers,Trickling Filters,Anaerobic Digester,Sludge Thickener)	1	LS	$250,000	$250,000
	General Project Requirements				
38	Sitework (Grading, Sidewalks, Drives)	1	LS	$200,000	$200,000
39	Insurance, Bonds, Supervision, Mobilization, Demobilization	1	LS	$130,000	$130,000
40	General Piping Requirements	1	LS	$1,000,000	$1,000,000
41	General Electrical Requirements	1	LS	$1,150,000	$1,150,000
	Subtotal				**$10,770,000**
	Contingencies (10%)				$1,077,000
	Total Opinion of Probable Construction Costs				**$11,847,000**
	Project Costs (20%) Permitting, Engineering, Legal, Etc.				$2,154,000
	Total Opinion of Project Costs*				**$14,001,000**

Alternative 2

This alternative would consist of the complete abandonment of the existing wastewater treatment plant and construction of a new sequencing batch reator type wastewater treatment facility. The new sequencing batch reactor facility would consist of the following

- Administration building
- Raw sewage pumping
- Headworks building with mechanical screening and grit removal equipment
- Sequencing batch reactor tanks
- Blower building
- Ultraviolet disinfection
- Post aeration
- Aerobic sludge digestion
- Mechanical sludge dewatering building and equipment
- Dried sludge storage

The area south of the WWTP has sufficient area to build a new wastewater treatment facility.

POGGEMEYER DESIGN GROUP

Engineer's Opinion of Probable Costs

Covington WWTP Evaluation — *5/26/2021*

Alternative 2 - New Sequencing Batch Reactor Facility

PDG Job No 300214-00007

NO.	ITEM	QTY	UNITS	UNIT COST	TOTAL
	Raw Sewage Pump Station				
1	3 Self Priming Pumps and Controls in FRP Enclosure	1	LS	$400,000	$400,000
2	Wet Well and Accessories	1	LS	$100,000	$100,000
3	Precast Manhole including Casting and Frame	4	Each	$2,000	$8,000
4	12" Gravity Sewer	1700	LF	$120	$204,000
5	10" PVC Forcemain	1600	LF	$100	$160,000
	Headworks				
6	25' x 35' Two Story Headworks Building	1	LS	$550,000	$550,000
7	Monorail and Hoist	1	LS	$15,000	$15,000
8	Magnetic Flow Meter	1	LS	$10,000	$10,000
9	6mm Centerflow Mechanical Screen and Screenings Washer/Compactor	1	LS	$350,000	$350,000
10	Grit Removal Equipment	1	LS	$375,000	$375,000
11	Odor Control Equipment	1	LS	$120,000	$120,000
12	Flow Paced, Refrigerated, Composite Sampler	1	LS	$20,000	$20,000
	Sequencing Batch Reactor				
13	Concrete Tanks	1	LS	$1,500,000	$1,500,000
14	Excavation, Backfill, Disposal	1	LS	$133,000	$133,000
15	Aluminum Handrail	1	LS	$40,000	$40,000
16	Aluminum Grating	1	LS	$35,000	$35,000
17	Stairs	1	LS	$25,000	$25,000
18	Sequencing Batch Reactor Equipment including Blowers, Diffusers, Decanter, Pumps, VFD's, and Controls	1	LS	$912,500	$912,500
	Ultraviolet Disinfection				
28	Concrete Channel	1	LS	$125,000	$125,000
29	FRP Prefabricated building for Controls/Storage	1	LS	$100,000	$100,000
30	Ultraviolet Disinfection Equipment	1	LS	$200,000	$200,000
31	Aluminum Grating over UV	1	LS	$45,000	$45,000
32	Effluent Composite Sampler	1	LS	$15,000	$15,000
	Post Aeration and Flow Measurement				
33	Post Aeration Tank	1	LS	$85,000	$85,000
34	Post Aeration Blowers	1	LS	$50,000	$50,000
35	Post Aeration Diffusers	1	LS	$50,000	$50,000
36	Parshall Flume	1	LS	$15,000	$15,000
37	Ultrasonic Level Sensor	1	LS	$10,000	$10,000
38	Unpunched Aluminum Grating	1	LS	$28,000	$28,000
	Solids Handling				
39	31' x 31' x 18' SWD Aerobic Digester Tanks	2	Each	$175,000	$350,000
40	Aerobic Digester Blowers	3	Each	$30,000	$90,000
41	Aerobic Digester Diffusers	2	Each	$15,000	$30,000
42	Aerobic Digester Mixer	2	LS	$25,000	$50,000
44	Biosolids Dewatering Equipment	1	LS	$500,000	$500,000
45	30' x 30' Sludge Dewatering Building	1	LS	$275,000	$275,000
46	40' x 60' Winkler Type Sludge Storage Building	1	LS	$250,000	$250,000
47	Dried Sludge Conveying System	1	LS	$200,000	$200,000
	Miscellaneous Items				
48	Supervisory Control and Data Aquisition System	1	LS	$200,000	$200,000
49	Plant Drain Pump Station	1	LS	$75,000	$75,000
50	Diesel Generator	1	LS	$300,000	$300,000
51	80' x 50' Administration Bldg.	1	LS	$800,000	$800,000
52	30' x 30' Blower Building	1	LS	$275,000	$275,000
	General Project Requirements				
53	Sitework	1	LS	$270,000	$270,000
54	Insurance, Bonds, Supervision, Mobilization, Demobilization	1	LS	$450,000	$450,000
55	General Piping Requirements	1	LS	$1,300,000	$1,300,000
56	General Electrical Requirements	1	LS	$1,600,000	$1,600,000
	Subtotal				**$12,695,500**
	Contingencies (10%)				$1,269,550
	Total Opinion of Probable Construction Costs				**$13,965,050**
	Project Costs (20%) Permitting, Engineering, Legal, Etc.				$2,539,100
	Total Opinion of Probable Project Cost				**$16,504,150**

Alternative 3

This alternative would consist of the complete abandonment of the existing wastewater treatment facility and the construction of a two regional pump stations and force mains. The two regional pump stations would transfer flow to the City of Piqua wastewater collection system.

Gravity sewers would intercept flow ahead of the two siphon boxes on Bridge St and Water St. The gravity sewers would divert flow to the intersection of Spring St. and Main St. to the new regional pump station wet well. The first regional pump station will have three submersible pumps rated for 600 gpm and transfer flow through a 10" force main approximately 10,000 LF to the next regional pump station. The second regional pump station will have three submersible pumps rated for 600 gpm and transfer flow through a 10" force main the remaining 19,000 LF to the City of Piqua

Using the City of Piqua Industrial Class user charges for 400,000 gpd of current flow to the WWTP the estimated annual user charge for sanitary service from the City of Piqua would be $835,000. This does not include any capital or operation and maintenance costs of the regional pump stations.

The other fact to consider is that this user charge rate is estimated at the current flow and loadings to the plant. This would be expected to increase with any further development and as any further deterioration of the sanitary sewer collection system that causes more inflow and infiltration.

PLATE 7 REGIONAL CONNECTION TO PIQUA	VILLAGE OF COVINGTON WWTP EVALUATION	POGGEMEYER DESIGN GROUP

	Engineer's Opinion of Probable Costs				
	Covington WWTP Evaluation				*5/26/2021*
	Alternative 3 - Regional Connection to Piqua				
	PDG Job No 300214-00007				
NO.	***ITEM***	***QTY***	***UNITS***	***UNIT COST***	***TOTAL***
	Regional Pump Station #1				
1	3 Submersible Pumps including Above Ground Valve Package	1	LS	$400,000	$400,000
2	Wet Well and Accessories	1	LS	$100,000	$100,000
3	Precast Manhole including Casting and Frame	4	Each	$2,000	$8,000
4	12" Gravity Sewer	1700	LF	$100	$170,000
5	10" PVC Forcemain	10000	LF	$100	$1,000,000
6	Air/Vacuum Release Valves	10	Each	$4,000	$40,000
7	20' x 20' Chemical Feed Building	1	LS	$120,000	$120,000
8	Chemical Feed Equipment	1	LS	$60,000	$60,000
9	Odor Control Equipment	1	LS	$100,000	$100,000
10	Standby Power Generator	1	LS	$125,000	$125,000
	Regional Pump Station #2				
11	3 Submersible Pumps including Above Ground Valve Package	1	LS	$400,000	$400,000
12	Wet Well and Accessories	1	LS	$100,000	$100,000
13	10" PVC Forcemain	19000	LF	$100	$1,900,000
14	Air/Vacuum Release Valves	20	Each	$5,000	$100,000
15	20' x 20' Chemical Feed Building	1	LS	$120,000	$120,000
16	Chemical Feed Equipment	1	LS	$60,000	$60,000
17	Odor Control Equipment	1	LS	$100,000	$100,000
18	Standby Power Generator	1	LS	$125,000	$125,000
19	Demolition of Existing Wastewater Treatment Plant	1	LS	$300,000	$300,000
20	Sitework	1	LS	$75,000	$75,000
21	Insurance, Bonds, Supervision, Mobilization, Demobilization	1	LS	$100,000	$100,000
22	General Electrical Requirements	1	LS	$200,000	$200,000
	Subtotal				**$5,703,000**
	Contingencies (10%)				$570,300
	Total Opinion of Probable Construction Costs				**$6,273,300**
	Project Costs (20%) Permitting, Engineering, Legal, Etc.				$1,140,600
	Total Opinion of Probable Project Cost				**$7,413,900**

SUMMARY AND RECOMMENDATIONS

This Wastewater Treatment Plant Evaluation provided a general review of current and future sanitary flow rates along with effluent requirements for meeting both current and future National Pollutant Discharge Elimination System (NPDES) requirements based on nutrient loadings being discharged into the Stillwater River Watershed.

The Engineering Evaluation reviewed both historical influent and effluent operating data along with projected sanitary flows. It was determined that the existing trickling filter biological treatment system due to its age, limited treatment capability, and capacity would not provide adequate treatment for future effluent limitations.

Based on our review and understanding of the existing treatment facility's operations and treatment capacity, the proposed improvements were based on the following

- Average daily design flow of 0.75 MGD and peak flow of 2.5 MGD
- Future effluent permit requirements, especially phosphorus and ammonia – nitrogen discharge requirements.
- Antidegradation requirements to meet Best Available Demonstrated Control Technology (BADCT) effluent requirements.

The alternatives evaluated for improved biological and nutrient treatment for projected effluent requirements and increased flow rates are as follows

Table 7 WWTP Alternative Summary

	Rehabilitation of WWTP Facility	New Wastewater Treatment Facility	Regional Connection to Piqua
Project Cost	$14,000,001	$16,666,000	$7,414,000
Annual Debt Payment	$345,386	$408,550	$181,746
Estimated O&M	$600,000	$600,000	$200,000
User Charges			$850,000
Total Annual Cost	$945,386	$1,008,550	$1,231,746

Recommended Alternate

Based on the preliminary findings of this report and on-going discussions with the Village representatives, it is our recommendation that the Village of Covington consider as their wastewater treatment strategy, Alternative #1 – the upgrade of the existing wastewater treatment plant utilizing the sequencing batch reactor treatment process designed for an average daily design flow of 0.75 MGD and a peak daily flow of 2.5 MGD. The project is estimated at $14,000,001 and includes the following

- New Raw Sewage Pump Station

- New headworks building with mechanical screen and grit removal equipment
- New sequencing batch reactor biological treatment tanks
- Expansion of ultraviolet disinfection channel and equipment
- Expansion of the existing effluent pump station
- New sludge dewatering equipment
- New sludge dewatering and storage building
- New standby power generator
- New administration building

FUNDING AND FINANCING OPTIONS

State Capital Improvements Funds (OPWC)
The Ohio Public Works Commission has established a program for the purpose of providing financing to public infrastructure capital improvement projects. Local subdivisions (Cities, Villages, Townships, Counties, etc.) in Ohio are eligible for funding. The financial assistance can be in the form of a grant or loan. Grants can be up to 50% for new construction and 90% for replacement type construction. The probability of a grant from this source is low due to the state-wide competition in the small government category.

USDA Rural Development
The USDA Rural Development (USDA RD) provides financing to small communities for water and sewerage projects. The financing terms are dependent on the Median Household Income (MHI) of the community. Unless an acceptable income survey has been performed, the income figure used is from the most recent census. Loans are made for up to 40 years with an annual interest rate dependent on the Median Household Income. Presently the funding levels are as follows: MHI above $55,217: the community would qualify for market rate financing at 2.25% (no grant). MHI between $44,173 to $55,216: the community would qualify for intermediate interest rate at 1.75% and is also eligible for a grant. The interest rate for MHI below $44,172 is at 1.375%. USDA awards a combination of grant and loan funding to bring a project's cost down to an "affordable" monthly rate per household. The current MHI for Covington is $47,736.

Ohio Water Development Authority
The Ohio Water Development Authority (OWDA) offers a loan program to finance design and construction of such projects up to a maximum of $3,000,000. The payback period can be up to 30 years. There is also an OWDA five-year planning loan for design of these facilities. The current OWDA interest rate is 2.2%. OWDA also has funding of .75% for up to 30 years for communities when conventional financing will result in an economic hardship on an open cycle for communities with populations below 5,000, or to Districts that serves 2,000 customers or less. The additional criteria for qualification at .75% is that the sewer or combination of sewer and water rates must be at the following percent of MHI.

Water 1.1% of the MHI
Sewer 1.5% of the MHI
Combination 2.6% of the MHI

Communities can earn additional discounts if the community is under Ohio EPA Findings and Orders, if connecting to a regional system, or already has an OWDA loan. The Village of Covington's 2020 MHI was $47,736. To qualify for the .75% money and/or reduced interest rate, the sanitary sewer bill will need to be at or above $716.04 per year or $59.67 per month.

Ohio Environmental Protection Agency
Ohio EPA, in cooperation with OWDA, provides financing through a revolving loan fund, called the Water Pollution Control Loan Fund (WPCLF) program. Sewerage projects can be financed

at an interest rate for 20 years at 0.38% and 0.45% for 30 years. For Village's with a population of less than 5,000.

Ohio EPA maintains the Project Priority List (PPL), as described below. This list governs the availability of funds.

Projects are prioritized on the state level, depending on the severity of documented water quality problems which the project will solve. To get a project on the priority list, the applicant community nominates its receiving stream(s) for rating. Factors considered in rating the water pollution impact include the number of failed septic systems, water quality analyses of local surface and groundwater, documented outbreaks of water-borne disease, and how far downstream the community impacts water quality. There are separate priority lists for presently sewered and presently unsewered areas.

Ohio Small Cities Community Development Block Grant (CDBG) Program

The primary goal of the CDBG Water and Sanitary Sewer Program is the creation of a safe and sanitary living environment for Ohio Citizens, through the provision of safe and reliable drinking water and proper disposal of sanitary waste.

Total funding is approximately $8.5 million annually with a grant ceiling of $500,000. The grantee will be allowed up to 26 months to complete and closeout the project. The Water and Sanitary Sewer Program will only fund projects which provide water and/or sanitary sewer service to primarily residential users and distressed communities or areas in which have a low and moderate income population of at least 51%. The current LMI of Covington is 48%.

The program rating criteria requires a minimum score of 55 points for funding consideration. The rating criteria includes LMI Benefit, Combined Water and Sewer Rate, Readiness to Proceed, and Health Hazard.

Sewer Capital Improvement Fund

Accumulated monies in a sewer capital improvement fund could be a source of funds to aid in financing this type project.

THE FOLLOWING IS A LIST OF CURRENT RATES FOR FINANCING (LOANS)
AVAILABLE FOR COMMUNITIES
Rates for period 06/01/2021-06/30/2021

OWDA

- ***Market Rate Program** – ***1.91%*** - 5-20 year term ***2.10%*** - 21-30 year term, No max. amount, See available discounts below, For planning/design and/or construction.
- **Community Assistance** – ***.50%*** - 5-20 year term ***.75%*** - 21-30 year term, Communities w/ 5,000 or less or districts with 2,000 or less customers. Must have: Water rate of 1.1% of MHI; Sewer rate of 1.5% of MHI; Water/Sewer combined rate of 2.6% of MHI. - 20-30 year term, $3 million max loan amount, for construction (may include planning/design)

***1/2% discounts available for following (1% max) through Market Rate Program:**

- If they are under OEPA Findings and Orders or have documented health risks
- If they are regionalizing - Connecting to an existing system not owned by applicant or providing for a new municipality
- If they took a previous OWDA loan
- If they are purchasing another system
- If they are acquiring W/WW facilities from a Chapter 6119 District
- If they are in compliance with a Balanced Growth Plan certified by the State

OEPA
Water Pollution Control Loan Fund (WPCLF)* and
Water Supply Revolving Loan Account (WSRLA)

- **WPCLF Standard Rate Construction Loan** – ***.66%*** - 5-20 year term ***.80%*** - 21-30 year term, ***.95%*** - 31-45 year term (WPCLF only), Planning/design and/or construction.
- **WPCLF Small Community Construction Loan** – ***.33%*** - 5-20 year term ***.40%*** - 21-30 year term, ***.48%*** - 31-45 year term - Service population 5,000 and under, 5-20 year term, Planning/design and/or construction.
- **WPCLF Small Systems Hardship Loan** – **Varies**: ***0%*** - Service population ≤2,500 and MHI $54,533 **(2021)**; OR ***1%*** - Service population 2,500-10,000 and MHI $54,533 **(2021)**; 5-30 year term, Planning/design and/or construction

- **WSRLA Standard Rate Construction Loan** – ***.66%*** - 5-20 year term ***.80%*** - 21-30 year term, Planning/design and/or construction.
- **WSRLA Small Community Construction Loan** – ***.16%*** - 5-20 year term ***.30%*** - 21-30 year term - Service population 10,000 and under, 5-20 year term, Planning/design and/or construction.
- **WSRLA Small Systems Hardship Loan** – ***2%*** - Service population 10,000 and under

USDA, RURAL DEVELOPMENT - Water and Wastewater Lending Rates
04/01/2021 – 06/30/2021

- **Poverty rate** -1.375%; MHI $0.00 to $44,173 (80% of state non-metro MHI)
- **Intermediate rate** -1.750% MHI $44,174 to $55,216 (80-100% of state non-metro MHI)
- **Market rate** -2.25%; MHI $55,217 (NOT ELIGIBLE FOR GRANT)

Loans - all categories: Up to 30 year term or useful life of the facility/affordability of project
NOTE: COMMUNITY FACILITY LOAN RATES
4.5% FOR POVERTY GROUP
3.375% for intermediate
2.25% for market rate groups

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DESIGN GROUP
A Kleinfelder Company

Covington
Sewer Rate Analysis

Sewer Revenue – 2020 (without Tap Fees)

Rent			
	Fixed Fee	$173,626	
	Volume	$342,817	
	Adjustment	$ 14,305	
		$530,748	
Sewer Exp		$429,750	Budget 2021
		$452,190	Actual 2020

Debt continues through 2037 and 2046

New Sewer Expense

$14,000,000 Capital Cost (Assuming No Grant Funds)
Operations & Maintenance Costs Similar – More Efficient Equipment

$14,000,000 Debt Funding Examples

OEPA	30 yr	0.45%	$504,674
	40 yr	0.55%	$394,281
USDA	40 yr	1.75%	$345,386 ($9,800,000) (30% Grant)

Without American Rescue Funds being utilized and without any surplus reserves being used.

$530,748	Revenue 2021 Estimate
$452,190	Expense 2020
$ 78,558	Balance
$394,281	New Debt (OEPA)
$315,723	New Revenue Required 40 yr (with no O&M increase)
$ 78,558	Balance
$345,386	New Debt (USDA)
$266,828	New Revenue Required 40 yr (with no O&M increase)

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$315,723 / $530,748	= ± 60% increase	$849,200	2024
		$727,889	1st ½ Payment
$266,828 / $530,748	= ± 50% increase	$796,123	2024
		$703,441	1st ½ Payment

New debt payment July 2023 or January 2024, ½ payment collected in first half of 2023 or last half of 2023.

Expenses

Average 2% per year increase

$452,190	2020	
$461,234	2021	
$470,458	2022	
$479,868	2023	
$489,464	2024	$662,157 First ½ payment ($172,693)
$499,254	2025	$844,640 Full Debt ($345,386)

Revenues Projected

3% per year per current ordinance			Option A		Option B
$530,748	2020				
$546,670	2021	3%	$546,670	3%	$546,670
$563,070	2022	10%	$601,337	10%	$601,337
$579,962	2023	10%	$661,470	12.5%	$676,504
$597,361	2024	10%	$727,618	15%	$777,979
$597,361 (Not sched)	2025	10%	$800,379	10%	$855,778
Note: 45% increase minimum -required in 2025-		10%	$880,417	5%	$898,567

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Potential
Tentative Schedule

Design	07/2021 – 11/2021
OEPA PTI	12/2021 – 03/2022
Bid Advertise	05/2022
Bid Award	07/2022 Depends on Funding Approvals
Begin Construction	08/2022
Complete	08/2023
First Debt Payment	01/2024 (1/2 Debt) Collected in last six (6) months 2023

Alternate
Potential Schedule

Design	09/2021 – 01/2022
OEPA PTI	02/2022 – 05/2022
Bid Advertise	07/2022
Bid Award	09/2022 Depends on Funding Approvals
Begin Construction	10/2022
Complete	10/2023
First Debt Payment	01/2024 (1/2 Debt) Collected in last six (6) months 2023

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Rate Analysis

Year	3% current		Option A		Option B	
2021	11.28 3.66	3%	11.28 3.66	3%	11.28 3.66	3%
2022	11.62 3.77	3%	12.40 4.02	10%	12.40 4.02	10%
2023	11.97 3.88	3%	13.64 4.42	10%	13.95 4.52	12.5%
2024	12.33 4.00	3%	15.00 4.86	10%	16.04 5.20	15%
2025	17.88 5.80	45%	16.50 5.35	10%	17.65 5.71	10%
2026	18.77 6.09	5%	18.15 5.88	10%	18.53 6.00	5%

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Village of Covington

Annual Increase:		3%	2%		Revenue -	Ending
Year	Balance	Revenue	Expenses	Debt	Expenses	Balance
2022	$493,265	$563,070	$380,520		$182,550	$675,815
2023	$675,815	$579,962	$388,130		$191,832	$867,647
2024	$867,647	$597,361	$395,893	$172,693	$28,775	$896,422
2025	$896,422	$615,282	$403,811	$345,386	-$133,915	$762,507
2026	$762,507	$633,740	$411,887	$345,386	-$123,533	$638,974
2027	$638,974	$652,752	$420,125	$345,386	-$112,758	$526,215
2028	$526,215	$672,335	$428,527	$345,386	-$101,578	$424,637
2029	$424,637	$692,505	$437,098	$345,386	-$89,979	$334,658
2030	$334,658	$713,280	$445,840	$345,386	-$77,946	$256,713
2031	$256,713	$734,679	$454,757	$345,386	-$65,464	$191,249
2032	$191,249	$756,719	$463,852	$345,386	-$52,519	$138,730
2033	$138,730	$779,421	$473,129	$345,386	-$39,094	$99,636
2034	$99,636	$802,803	$482,591	$345,386	-$25,174	$74,462
2035	$74,462	$826,887	$492,243	$345,386	-$10,742	$63,720
2036	$63,720	$851,694	$502,088	$345,386	$4,220	$67,939

Annual Increase:		4%	2%		Revenue -	Ending
Year	Balance	Revenue	Expenses	Debt	Expenses	Balance
2022	$493,265	$563,070	$380,520		$182,550	$675,815
2023	$675,815	$585,593	$388,130		$197,462	$873,277
2024	$873,277	$609,017	$395,893	$172,693	$40,431	$913,708
2025	$913,708	$633,377	$403,811	$345,386	-$115,820	$797,888
2026	$797,888	$658,712	$411,887	$345,386	-$98,561	$699,327
2027	$699,327	$685,061	$420,125	$345,386	-$80,450	$618,877
2028	$618,877	$712,463	$428,527	$345,386	-$61,450	$557,427
2029	$557,427	$740,962	$437,098	$345,386	-$41,522	$515,905
2030	$515,905	$770,600	$445,840	$345,386	-$20,626	$495,279
2031	$495,279	$801,424	$454,757	$345,386	$1,282	$496,561
2032	$496,561	$801,424	$463,852	$345,386	-$7,814	$488,747
2033	$488,747	$801,424	$473,129	$345,386	-$17,091	$471,657
2034	$471,657	$801,424	$482,591	$345,386	-$26,553	$445,104
2035	$445,104	$801,424	$492,243	$345,386	-$36,205	$408,899
2036	$408,899	$801,424	$502,088	$345,386	-$46,050	$362,849

Annual Increase:		5%	2%		Revenue -	Ending
Year	Balance	Revenue	Expenses	Debt	Expenses	Balance
2022	$493,265	$563,070	$380,520		$182,550	$675,815
2023	$675,815	$591,224	$388,130		$203,093	$878,908
2024	$878,908	$620,785	$395,893	$172,693	$52,199	$931,107
2025	$931,107	$651,824	$403,811	$345,386	-$97,373	$833,734
2026	$833,734	$684,415	$411,887	$345,386	-$72,858	$760,876
2027	$760,876	$718,636	$420,125	$345,386	-$46,875	$714,001
2028	$714,001	$754,568	$428,527	$345,386	-$19,346	$694,655
2029	$694,655	$792,296	$437,098	$345,386	$9,812	$704,467
2030	$704,467	$831,911	$445,840	$345,386	$40,685	$745,152
2031	$745,152	$873,506	$454,757	$345,386	$73,364	$818,516
2032	$818,516	$873,506	$463,852	$345,386	$64,269	$882,785
2033	$882,785	$873,506	$473,129	$345,386	$54,992	$937,776
2034	$937,776	$873,506	$482,591	$345,386	$45,529	$983,305
2035	$983,305	$873,506	$492,243	$345,386	$35,877	$1,019,183
2036	$1,019,183	$873,506	$502,088	$345,386	$26,032	$1,045,215

Annual Increase:		6%	2%		Revenue -	Ending
Year	Balance	Revenue	Expenses	Debt	Expenses	Balance
2022	$493,265	$563,070	$380,520		$182,550	$675,815
2023	$675,815	$596,854	$388,130		$208,724	$884,539
2024	$884,539	$632,665	$395,893	$172,693	$64,079	$948,618
2025	$948,618	$670,625	$403,811	$345,386	-$78,571	$870,047
2026	$870,047	$710,863	$411,887	$345,386	-$46,410	$823,637
2027	$823,637	$753,515	$420,125	$345,386	-$11,996	$811,640
2028	$811,640	$798,726	$428,527	$345,386	$24,812	$836,453
2029	$836,453	$846,649	$437,098	$345,386	$64,165	$900,618
2030	$900,618	$897,448	$445,840	$345,386	$106,222	$1,006,840
2031	$1,006,840	$951,295	$454,757	$345,386	$151,152	$1,157,992
2032	$1,157,992	$951,295	$463,852	$345,386	$142,057	$1,300,050
2033	$1,300,050	$951,295	$473,129	$345,386	$132,780	$1,432,830
2034	$1,432,830	$951,295	$482,591	$345,386	$123,318	$1,556,147
2035	$1,556,147	$951,295	$492,243	$345,386	$113,666	$1,669,813
2036	$1,669,813	$951,295	$502,088	$345,386	$103,821	$1,773,634

Covington WWTP Additional Sampling

Perrigo Sampling Summary

Date	Contaminant	Concentration (mg/L)
3/10/2021	Ammonia	Non-Detect
3/17/2021	Ammonia	Non-Detect
3/18/2021	Ammonia	Non-Detect
3/24/2021	Ammonia	0.5
3/25/2021	Ammonia	0.5
3/10/2021	Phosphorus	15.4
3/17/2021	Phosphorus	0.33
3/18/2021	Phosphorus	3.08
3/24/2021	Phosphorus	1.11
3/25/2021	Phosphorus	0.89

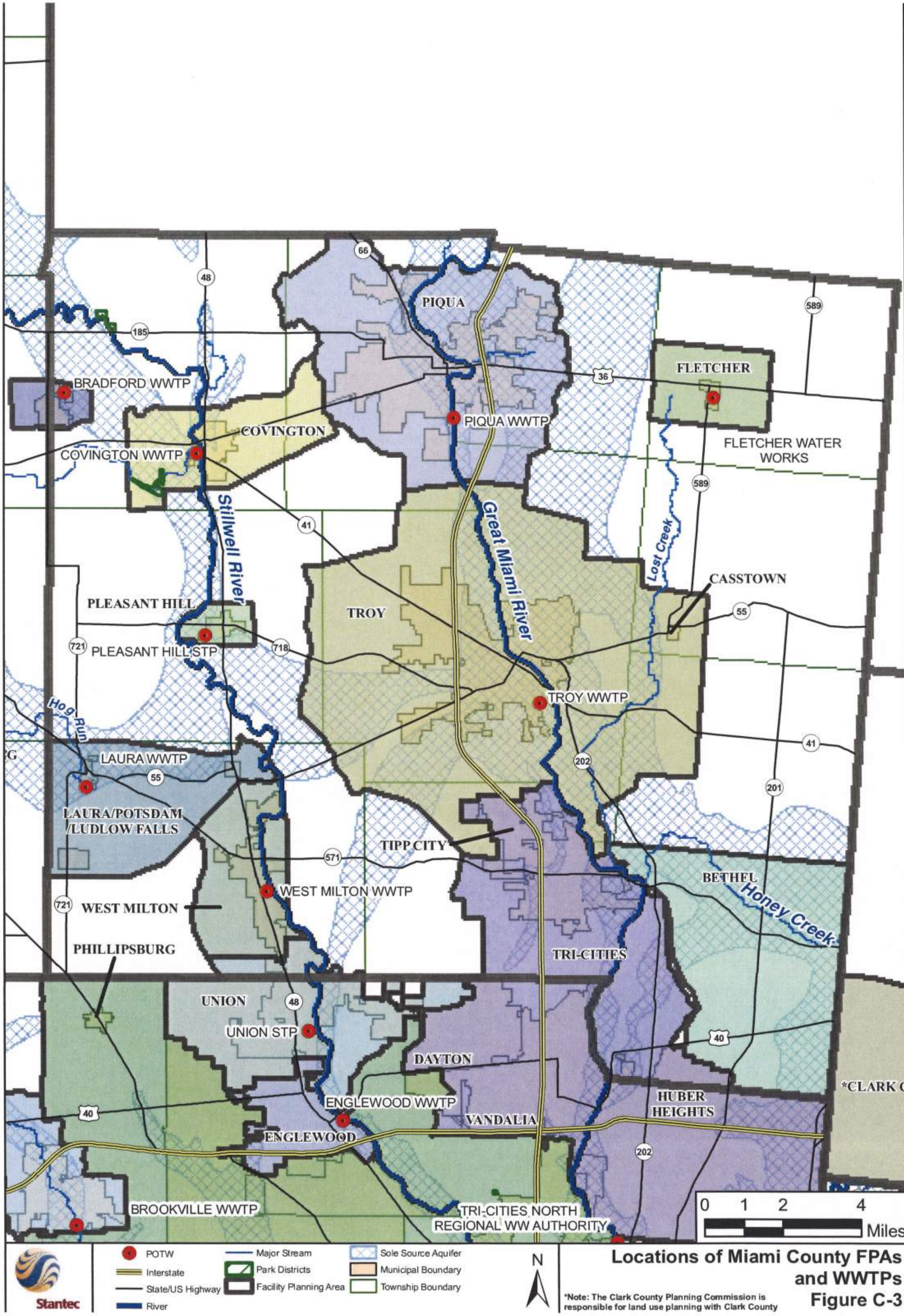
WWTP Influent Sampling Summary

3/3/2021	Ammonia	3.8	3.8875
3/4/2021	Ammonia	0.6	
3/4/2021	Ammonia	3.8	
3/10/2021	Ammonia	5.6	
3/11/2021	Ammonia	2.7	
3/17/2021	Ammonia	5.6	
3/19/2021	Ammonia	Non-Detect	
3/24/2021	Ammonia	5.3	
3/25/2021	Ammonia	3.7	
3/3/2021	Phosphorus	1.43	1.96125
3/4/2021	Phosphorus	1.33	
3/10/2021	Phosphorus	2.73	
3/11/2021	Phosphorus	2.87	
3/17/2021	Phosphorus	2.96	
3/19/2021	Phosphorus	0.99	
3/24/2021	Phosphorus	1.88	
3/25/2021	Phosphorus	1.5	

WWTP Effluent Sampling Summary

3/3/2021	Ammonia	0.2
3/3/2021	Ammonia	Non-Detect
3/4/2021	Ammonia	Non-Detect
3/10/2021	Ammonia	Non-Detect
3/11/2021	Ammonia	Non-Detect
3/11/2021	Ammonia	0.3
3/17/2021	Ammonia	1.3

3/18/2021	Ammonia	1.1
3/24/2021	Ammonia	1.3
3/25/2021	Ammonia	1.6
3/3/2021	Phosphorus	0.8
3/3/2021	Phosphorus	3.93
3/4/2021	Phosphorus	2.87
3/10/2021	Phosphorus	0.75
3/11/2021	Phosphorus	9.27
3/17/2021	Phosphorus	0.93
3/24/2021	Phosphorus	0.12
3/3/2021	Total Dissolved Solids	1,160
3/10/2021	Total Dissolved Solids	1,320
3/24/2021	Total Dissolved Solids	1,160

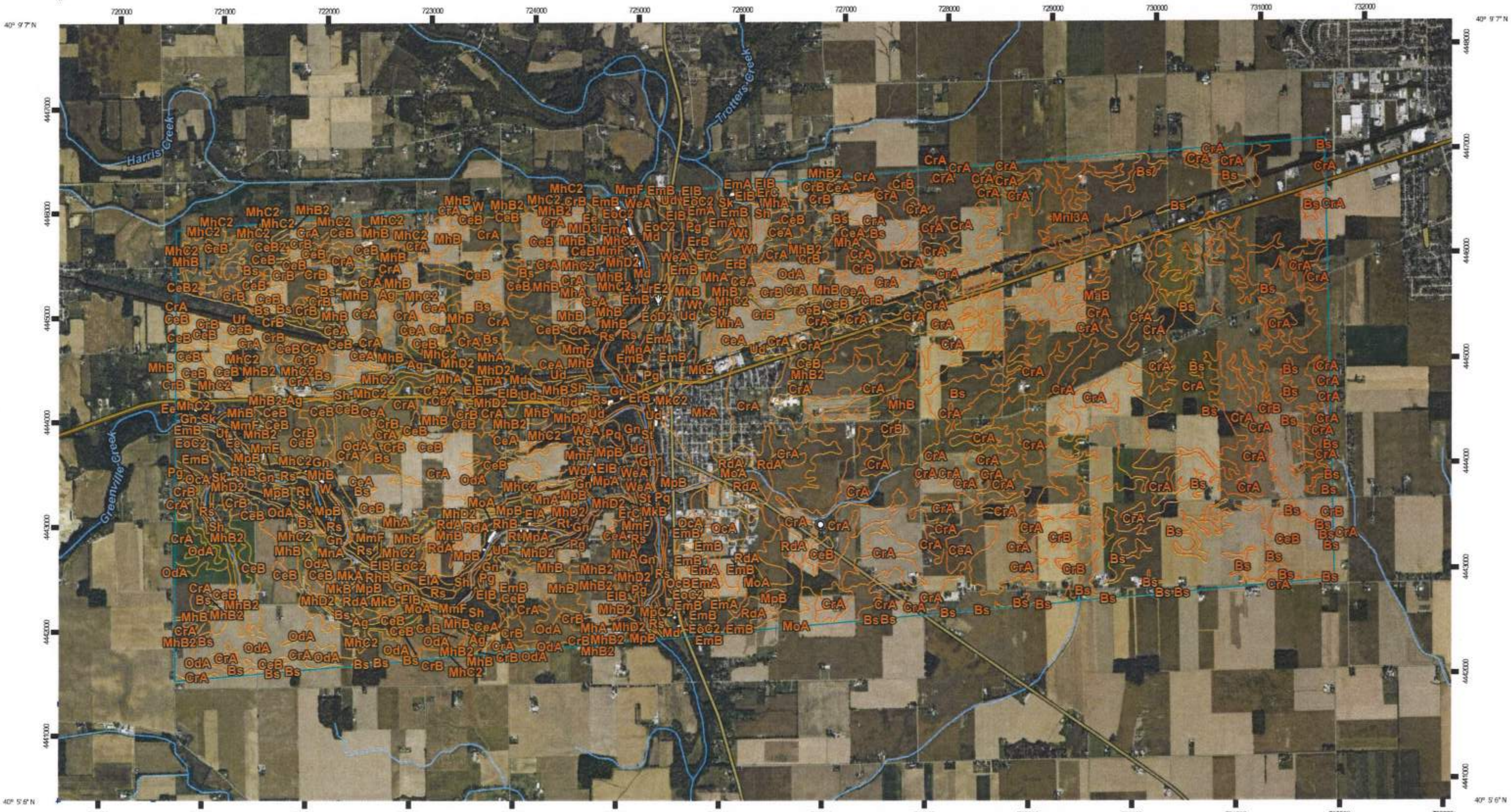


Locations of Miami County FPAs and WWTPs

Figure C-3

*Note: The Clark County Planning Commission is responsible for land use planning with Clark County

Soil Map



Map Scale: 1:36,200 if printed on B landscape (17" x 11") sheet.

0 500 1000 2000 3000 Meters

0 1500 3000 6000 9000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Miami County, Ohio
Survey Area Data: Version 19, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 14, 2019—Oct 23, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ag	Algiers silt loam	23.3	0.2%
Bs	Brookston silty clay loam, fine texture, 0 to 2 percent slopes	2,339.3	19.9%
CeA	Celina silt loam, 0 to 2 percent slopes	214.2	1.8%
CeB	Celina silt loam, 2 to 6 percent slopes	438.8	3.7%
CeB2	Celina silt loam, 2 to 6 percent slopes, eroded	11.2	0.1%
CrA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	4,312.0	36.7%
CrB	Crosby silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	383.6	3.3%
Ee	Eel silt loam, 0 to 2 percent slopes, occasionally flooded	7.6	0.1%
ElA	Eldean loam, 0 to 2 percent slopes	13.9	0.1%
ElB	Eldean loam, 2 to 6 percent slopes	75.7	0.6%
ElB2	Eldean loam, 2 to 6 percent slopes, eroded	7.1	0.1%
EmA	Eldean silt loam, 0 to 2 percent slopes	111.1	0.9%
EmB	Eldean silt loam, 2 to 6 percent slopes	211.0	1.8%
EoC2	Eldean-Casco gravelly loams, 6 to 12 percent slopes, moderately eroded	33.7	0.3%
EoD2	Eldean-Casco gravelly loams, 12 to 18 percent slopes, moderately eroded	16.0	0.1%
ErB	Eldean-Miamian complex, 2 to 6 percent slopes	33.6	0.3%
ErC	Eldean-Miamian complex, 6 to 12 percent slopes	9.4	0.1%
Gn	Genesee silt loam, 0 to 2 percent slopes, occasionally flooded	157.5	1.3%
LrE2	Lorenzo-Rodman gravelly loams, 18 to 50 percent slopes, moderately eroded	2.4	0.0%
MaB	Martinsville and Ockley loams, till substratum, 2 to 6 percent slopes	1.6	0.0%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Md	Medway silt loam	107.3	0.9%
MhA	Miamian silt loam, 0 to 2 percent slopes	162.0	1.4%
MhB	Miamian silt loam, 2 to 6 percent slopes	790.0	6.7%
MhB2	Miamian silt loam, 2 to 6 percent slopes, eroded	203.8	1.7%
MhC2	Miamian silt loam, 6 to 12 percent slopes, moderately eroded	248.3	2.1%
MhD2	Miamian silt loam, 12 to 18 percent slopes, eroded	59.9	0.5%
MkA	Miamian silt loam, limestone substratum, 0 to 2 percent slopes	122.5	1.0%
MkB	Miamian silt loam, limestone substratum, 2 to 6 percent slopes	73.7	0.6%
MkC2	Miamian silt loam, limestone substratum, 6 to 12 percent slopes, moderately eroded	7.2	0.1%
MlD3	Miamian clay loam, shallow to dense till substratum, 12 to 18 percent slopes, severely eroded	7.9	0.1%
MmE	Miamian and Hennepin silt loams, 18 to 25 percent slopes	27.7	0.2%
MmF	Miamian and Hennepin silt loams, 25 to 50 percent slopes	120.9	1.0%
MnA	Millsdale silt loam, 0 to 2 percent slopes	56.9	0.5%
MnB	Millsdale silt loam, 2 to 6 percent slopes	3.3	0.0%
Mnl3A	Minster silty clay loam, till substratum, 0 to 1 percent slopes	3.7	0.0%
MoA	Millsdale silty clay loam, 0 to 2 percent slopes	161.1	1.4%
MpA	Milton silt loam, 0 to 2 percent slopes	39.2	0.3%
MpB	Milton silt loam, 2 to 6 percent slopes	182.8	1.6%
MpC2	Milton silt loam, 6 to 12 percent slopes, moderately eroded	10.7	0.1%
OcA	Ockley silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	49.2	0.4%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
OcB	Ockley silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	1.8	0.0%
OdA	Odell silt loam, 0 to 2 percent slopes	171.7	1.5%
Pg	Pits, gravel	13.1	0.1%
Pq	Pits, quarry	24.0	0.2%
RdA	Randolph silt loam, 0 to 2 percent slopes	173.8	1.5%
RhB	Ritchey silt loam, 2 to 6 percent slopes	17.0	0.1%
Rs	Ross silt loam, 0 to 2 percent slopes, occasionally flooded	115.0	1.0%
Rt	Ross silt loam, shallow variant	20.2	0.2%
Sh	Shoals silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	62.7	0.5%
Sk	Shoals silt loam, moderately shallow variant	17.0	0.1%
St	Stonelick loam	8.2	0.1%
Ud	Udorthents	56.7	0.5%
Uf	Udorthents, Sanitary landfill	63.5	0.5%
W	Water	87.7	0.7%
WdA	Warsaw silt loam, 0 to 2 percent slopes	2.8	0.0%
WeA	Wea silt loam, 0 to 2 percent slopes	22.2	0.2%
Wt	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	61.5	0.5%
Totals for Area of Interest		**11,763.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made