

Report for City of Mount Vernon, Ohio

Phosphorus Removal Planning Report



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**SECTION 1
INTRODUCTION**

This section describes the purpose and scope of the report and the location of the study area. It also summarizes previous and related studies and reports. A list of abbreviations is provided as an aid to the reader.

1.01 PURPOSE AND SCOPE

The City of Mount Vernon, Ohio (City) owns wastewater conveyance and treatment facilities that provide service to the City's residents, businesses, and industries. Treatment facilities include a 5.0 million gallons per day (mgd) (permitted average flow) wastewater treatment plant (WWTP), located at 3 Cougar Drive, Mount Vernon, Ohio, Knox County, discharging to the Kokosing River.

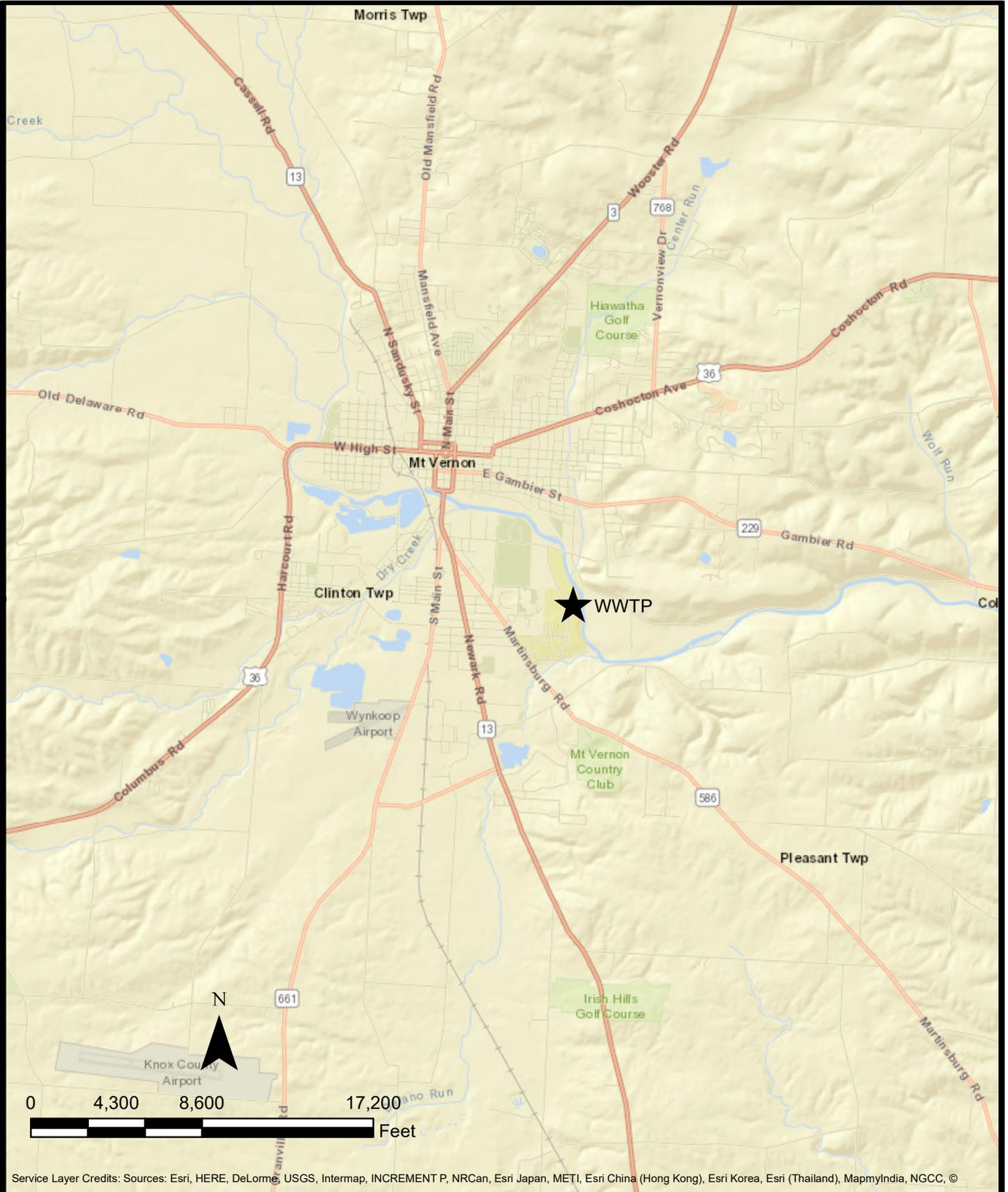
In response to Ohio Senate Bill 1 (2015), the Ohio Environmental Protection Agency (OEPA) has required all major dischargers to complete and submit a study by December 1, 2017, to evaluate the technical and financial capability of its existing facility to reduce the final effluent discharge of phosphorus to 1.0 milligrams per liter (mg/L). This report will complete the technical and financial capability evaluation to meet the OEPA requirements.

1.02 LOCATION OF STUDY

The service area for the WWTP includes the entire incorporated City, located in central Knox County at the intersection of US 36, State Route (SR) 3, and SR 13, as well as portions of Clinton Township. Figure 1.02-1 shows the location of the WWTP site. The facility is located on Cougar Drive, off Mt. Vernon Avenue, on the southeast side of the City.

1.03 RELATED STUDIES, REPORTS, AND DRAWINGS

- A. *Wastewater Treatment Plant Operations and Maintenance Manual*, prepared by Malcolm Pirnie/Arcadis, October 2014.
- B. *Wastewater Treatment Plant Upgrades*, prepared by Malcolm Pirnie, September 2010.
- C. *Wastewater Treatment Plant Operating Plan*, prepared by Malcolm Pirnie, July 2009.
- D. *Septage Receiving Station Preliminary Study*, prepared by Floyd Browne Group, December 2007.
- E. *Wastewater Treatment Plant Influent Screenings and Aeration Facilities*, prepared by BBS Corporation, 2005.
- F. *Wastewater Treatment Plant Master Plan*, prepared by Finkbeiner, Pettis & Strout, Inc., August 2003.
- G. *Wastewater Treatment Plant Improvements–Solids Handling Facilities*, prepared by Finkbeiner, Pettis & Strout, Inc., 1990.



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WWTP LOCATION MAP

PHOSPHORUS REMOVAL PLANNING REPORT MT. VERNON, OHIO



**FIGURE 1.02-1
4962.005**

1.04 ABBREVIATIONS

ADF	average daily flow
alum	aluminum sulfate
BOD	biochemical oxygen demand
BOD ₅	five-day biochemical oxygen demand
BPR	biological phosphorus removal
CBOD	carbonaceous biochemical oxygen demand
CBOD ₅	five-day carbonaceous biochemical oxygen demand
City	City of Mount Vernon, Ohio
CPR	chemical phosphorus removal
DEFA	Division of Environmental Financial Assistance
ferric	ferric chloride
FRP	fiberglass reinforced plastic
GLUMRB	Great Lake–Upper Mississippi River Board
gpm	gallons per minute
gpm/sq ft	gallons per minute per square foot
HRT	hydraulic retention time
lbs/day	pounds per day
mg/L	milligrams per liter (parts per million in dilute solutions)
mgd	million gallons per day
ML	mixed liquor
NH ₃ -N	ammonia nitrogen
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
OPC	opinion of probable cost
PAO	phosphorus accumulating organism
PO ₄ -P	phosphate
ppmv	parts per million by volume
PRI	primary influent
PRC	phosphorus removal chemical
RAS	return activated sludge
sBOD ₅	soluble five-day biochemical oxygen demand
SCADA	supervisory control and data acquisition
SR	State Route
SWD	side water depth
TKN	total Kjeldahl nitrogen
TP	total phosphorus
TSS	total suspended solids (or SS)
VFA	volatile fatty acid
VFD	variable frequency drive
WAS	waste activated sludge
WPCLF	Water Pollution Control Loan Fund
WWTP	wastewater treatment plant

SECTION 2
EXISTING WASTEWATER TREATMENT FACILITIES

2.01 BACKGROUND

The WWTP was originally constructed in 1952 and included:

- Construction of the Pump and Control Building with comminutor, bypass manual bar screen, two horizontal grit channels, and three primary pumps
- Construction of two preaeration tanks
- Construction of two primary settling tanks
- Construction of two anaerobic digesters with floating covers
- Construction of the Digester Building with boiler, two sludge recirculation pumps, and one sludge transfer pump

The 1972 secondary treatment project included:

- Replacement of the comminutor and bypass manual bar screen with a mechanically cleaned chain and rake type screen
- Replacement of the three primary pumps with four new primary pumps
- Conversion of the preaeration tanks to an aerated grit tank
- Construction of the Grit Building
- Construction of two additional primary settling tanks
- Construction of the Primary Sludge Building
- Construction of two secondary treatment units with contact zone, reaeration zone, final clarifier, aerobic digestion zone, and return activated sludge (RAS) and waste activated sludge (WAS) air lift pumps
- Construction of the Secondary Treatment Building with four secondary pumps, five centrifugal blowers, two sludge concentrators and associated feed pumps, sludge loadout facilities, one standby power generator, and chemical storage and feed facilities for gaseous chlorine, polymer, and coagulant
- Construction of the chlorine contact tanks and associated water supply, froth spray, and sump pumps

The 1990 dechlorination facilities project included:

- Construction of the Dechlorination Building
- Construction of the dechlorination chamber at the effluent end of the chlorine contact tanks

The 1990 solids handling improvements project included:

- Construction of two 50 foot-0 inch-diameter sludge holding tanks with floating covers and two sludge recirculation pumps
- Rehabilitation of two existing 40 foot-0 inch-diameter sludge digesters
- Construction of sludge loadout station
- Construction of new Sludge Control Building
- Modifications to existing Digester Building and Secondary Treatment Building
- Removal of two sludge concentrators and addition of gravity belt thickener, two sludge feed pumps, two thickened sludge feed pumps, and digester gas mixing equipment

The 2005 influent screenings and aeration facilities project included:

- Demolition of existing grit removal equipment
- Construction of new screening building with two new mechanically cleaned bar screens and two washer-compactors
- Replacement of secondary unit aeration equipment, including blowers, aeration piping, and diffusers

The 2010 improvements project included:

- Replacement of primary pumps, piping, valves, and appurtenances
- Installation of variable frequency drives (VFDs) for the primary and secondary pumps
- Construction of septage receiving station, including building, wet wells, and truck scale
- Construction of new main electrical service, switchgear, standby generator, and automatic transfer switch
- Improvements to the supervisory control and data acquisition (SCADA) system

The current WWTP is rated for 5.0 mgd average daily flow and includes raw wastewater screening, primary pumping, aerated grit removal, primary settling, secondary pumping, contact stabilization activated sludge, secondary clarification, chlorination, and dechlorination. Biosolids processing includes anaerobic digestion of primary sludge, aerobic digestion and gravity thickening of WAS, and sludge holding before disposal by land application.

Figure 2.01-1 shows a site plan of the WWTP.

2.02 INFLUENT FLOWS AND LOADINGS

Influent flow is measured by a 16-inch magnetic flow meter on the discharge side of the primary pumps. Effluent flow is measured by a level sensor in the dechlorination chamber. Influent flow data for January 2015 through June 2017 is summarized in Table 2.02-1. The influent flows are used in this report as the basis for nutrient loading pounds per day (lbs/day) calculations. The permitted design average daily flow is 5.0 mgd. The peak hourly design flow is 12.5 mgd.



WASTE WATER TREATMENT PLANT SITE PLAN



FIGURE 2.01-1
4962.005

	Influent Daily Average Flow (mgd)		
	2015	2016	2017
JAN	3.08	2.79	3.36
FEB	2.80	2.98	3.36
MAR	3.75	3.90	3.93
APR	4.36	3.61	3.44
MAY	3.07	3.05	3.12
JUN	3.74	2.38	2.52
JUL	2.77	1.96	
AUG	1.85	2.08	
SEP	1.78	2.02	
OCT	1.69	2.05	
NOV	1.80	1.96	
DEC	3.02	2.79	
AVG	2.81	2.63	3.29
MAX	4.36	3.90	3.93
MIN	1.69	1.96	2.52

Table 2.02-1 Influent Daily Average Flow Summary

Summaries of the influent wastewater concentrations and loadings for five-day carbonaceous biochemical oxygen demand (CBOD₅), total suspended solids (TSS), and ammonia (NH₃-N) are shown in Table 2.02-2, Table 2.02-3, and Table 2.02-4. The WWTP does not routinely test for influent total Kjeldahl nitrogen (TKN) or phosphate (PO₄-P). Influent samples are taken from the basement of the primary building where the influent flow enters the facility via an automatic sampler.

	2015		2016		2017	
	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day
JAN	156	3,771	163	3,738	137	3,699
FEB	157	3,502	155	3,672	136	3,645
MAR	141	2,895	109	3,330	141	4,117
APR	117	3,236	123	3,514	153	3,956
MAY	137	3,112	121	3,041	153	3,131
JUN	118	2,980	178	3,450	157	3,244
JUL	119	2,500	207	3,376		
AUG	207	3,202	220	3,740		
SEP	207	2,832	237	3,954		
OCT	206	2,894	188	3,206		
NOV	217	3,249	248	4,041		
DEC	194	3,315	181	3,863		
AVG	165	3,124	178	3,577	146	3,632
MAX	217	3,771	248	4,041	157	4,117
MIN	117	2,500	109	3,041	136	3,131

Table 2.02-2 Influent CBOD₅ Daily Average Concentration and Load

	2015		2016		2017	
	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day
JAN	148	3,557	188	4,193	149	3,991
FEB	181	4,003	139	3,370	146	3,914
MAR	142	3,838	123	3,700	169	4,811
APR	187	6,263	142	4,168	183	4,847
MAY	164	3,695	122	3,061	206	5,092
JUN	150	4,034	179	3,576	181	3,636
JUL	148	3,445	227	3,727		
AUG	206	3,187	233	3,995		
SEP	242	3,598	251	4,204		
OCT	201	2,820	236	4,023		
NOV	199	2,966	280	4,585		
DEC	182	3,817	193	4,239		
AVG	179	3,768	193	3,903	172	4,382
MAX	242	6,263	280	4,585	206	5,092
MIN	142	2,820	122	3,061	146	3,636

Table 2.02-3 Influent TSS Daily Average Concentration and Load

	2015		2016		2017	
	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day
JAN	9.9	288	17.0	376	11.2	326
FEB	11.7	302	18.1	354	11.2	323
MAR	15.5	338	10.3	316	9.3	408
APR	11.9	256	10.7	314	9.2	329
MAY	11.1	231	12.5	349	7.6	196
JUN	19.8	404	16.3	328	17.0	428
JUL	14.1	352	21.6	452		
AUG	22.5	374	26.3	426		
SEP	19.3	306	36.1	603		
OCT	24.1	350	24.0	426		
NOV	22.5	320	7.4	126		
DEC	20.8	385	24.5	481		
AVG	16.9	325	18.7	379	10.9	335
MAX	24.1	404	36.1	603	17.0	428
MIN	9.9	231	7.4	126	7.6	196

Table 2.02-4 Influent NH₃-N Daily Average Concentration and Load

Additional influent testing performed between October 2016 and June 2017 showed an average influent total phosphorus (TP) concentration of 2.79 mg/L, with a range of 0.68 to 4.02 mg/L over 15 samples.

Additional influent testing performed in February 2017 showed an average influent TKN concentration of 18.82 mg/L, with a range of 16.30 to 21.20 mg/L over five samples.

2.03 NPDES PERMIT REQUIREMENTS

The National Pollution Discharge Elimination System (NPDES) permit limits currently in effect at the WWTP are presented in Table 2.03-1. The facility is operating under an NPDES permit (Permit No. 4PD00100*MD) that was effective March 1, 2015 and expires July 31, 2019.

Parameters	Limit Type	Limits and Units	Sample Frequency	Sample Type	Notes
Water Temperature		°C	Daily	Continuous	
Dissolved Oxygen (DO)	Daily Min	5.0 mg/L	Daily	Multiple Grab	
pH	Daily Max	9.0 S.U.	1/Day	Multiple Grab	
pH	Daily Min	6.5 S.U.	1/Day	Multiple Grab	
CBOD ₅	Weekly Avg	40 mg/L	3/Week	24-hr Comp	Nov 1 to Apr 30
CBOD ₅	Monthly Avg	25 mg/L	3/Week	24-hr Comp	Nov 1 to Apr 30
CBOD ₅	Weekly Avg	23 mg/L	3/Week	24-hr Comp	May 1 to Oct 31
CBOD ₅	Monthly Avg	15 mg/L	3/Week	24-hr Comp	May 1 to Oct 31
TSS	Weekly Avg	45 mg/L	3/Week	24-hr Comp	Nov 1 to Apr 30
TSS	Monthly Avg	30 mg/L	3/Week	24-hr Comp	Nov 1 to Apr 30
TSS	Weekly Avg	23 mg/L	3/Week	24-hr Comp	May 1 to Oct 31
TSS	Monthly Avg	15 mg/L	3/Week	24-hr Comp	May 1 to Oct 31
Oil and Grease	Daily Max	10 mg/L	1/2 Weeks	Grab	
NH ₃ -N	Weekly Avg	6 mg/L	3/Week	24-hr Comp	May 1 to Oct 31
NH ₃ -N	Monthly Avg	4 mg/L	3/Week	24-hr Comp	May 1 to Oct 31
NH ₃ -N		mg/L	3/Week	24-hr Comp	Nov 1 to Apr 30
Nitrogen Kjeldahl, Total		mg/L	1/Month	24-hr Comp	
Nitrite Plus Nitrate, Total		mg/L	1/Month	24-hr Comp	
Phosphorus, Total (P)		mg/L	1/Week	24-hr Comp	
Cyanide, Free		mg/L	1/Quarter	Grab	
Nickel, Total Recoverable		µg/L	1/Quarter	24-hr Comp	
Zinc, Total Recoverable		µg/L	1/Quarter	24-hr Comp	
Cadmium, Total Recoverable		µg/L	1/Quarter	24-hr Comp	
Lead, Total Recoverable		µg/L	1/Quarter	24-hr Comp	
Chromium, Total Recoverable		µg/L	1/Quarter	24-hr Comp	
Copper, Total Recoverable		µg/L	1/Quarter	24-hr Comp	
Chromium, Dissolved Hexavalent		µg/L	1/Quarter	Grab	
<i>E. coli</i>	Weekly Avg	284 #/100mL	3/Week	Grab	May 1 to Oct 31
<i>E. coli</i>	Monthly Avg	126 #/100mL	3/Week	Grab	May 1 to Oct 31
Flow Rate		mgd	1/Day	Continuous	
Chlorine, Total Residual	Daily Max	0.038 mg/L	1/Day	Multiple Grab	May 1 to Oct 31
Mercury, Total (Low Level)		ng/L	1/Quarter	Grab	
Acute Toxicity, Ceriodaphnia dubia		TUa	1/Year	24-hr Comp	July
Chronic Toxicity, Ceriodaphnia dubia		TUc	1/Year	24-hr Comp	July
Acute Toxicity, Pimephales promelas		TUa	1/Year	24-hr Comp	July
Chronic Toxicity, Pimephales promelas		TUc	1/Year	24-hr Comp	July
Residue, Total Filterable		mg/L	1/Quarter	24-hr Comp	

Table 2.03-1 City of Mount Vernon Current NPDES Permit Limits

2.04 WASTEWATER TREATMENT PERFORMANCE

The WWTP has consistently met the effluent limits in the NPDES permit producing a high quality effluent for discharge into the Kokosing River. Tables 2.04-1 through 2.04-4 summarize the facility’s average monthly effluent CBOD₅, TSS, NH₃-N, and PO₄-P concentrations and loads, respectively, from January 2016 to June 2017.

	2016		2017	
	mg/L	lb/day	mg/L	lb/day
JAN	7.8	183	7.3	203
FEB	9.9	267	5.6	157
MAR	9.7	310	6.1	199
APR	8.8	272	4.3	122
MAY	6.0	153	4.0	87
JUN	6.3	127	4.3	92
JUL	9.0	149		
AUG	6.2	104		
SEP	6.5	109		
OCT	3.6	62		
NOV	4.5	73		
DEC	6.4	151		
AVG	7.0	163	5.3	143
MAX	9.9	310	7.3	203
MIN	3.6	62	4.0	87

Table 2.04-1 Effluent CBOD₅ Daily Average Concentration and Load

	2016		2017	
	mg/L	lb/day	mg/L	lb/day
JAN	11.3	263	10.4	286
FEB	11.6	315	7.7	213
MAR	11.1	366	7.1	236
APR	12.9	407	5.8	168
MAY	8.7	222	6.0	157
JUN	7.2	142	5.5	104
JUL	11.5	190		
AUG	6.8	117		
SEP	8.2	138		
OCT	6.6	113		
NOV	7.8	126		
DEC	12.5	301		
AVG	9.7	225	7.1	194
MAX	12.9	407	10.4	286
MIN	6.6	113	5.5	104

Table 2.04-2 Effluent TSS Daily Average Concentration and Load

	2016		2017	
	mg/L	lb/day	mg/L	lb/day
JAN	3.6	83	4.9	143
FEB	3.2	87	3.4	95
MAR	4.5	138	3.1	101
APR	4.6	135	2.9	80
MAY	2.8	72	2.0	54
JUN	2.1	43	1.9	39
JUL	2.2	37		
AUG	2.5	43		
SEP	2.3	39		
OCT	1.4	24		
NOV	2.3	36		
DEC	3.2	72		
AVG	2.9	67	3.0	85
MAX	4.6	138	4.9	143
MIN	1.4	24	1.9	39

Table 2.04-3 Effluent NH₃-N Daily Average Concentration and Load

	2016		2017	
	mg/L	lb/day	mg/L	lb/day
JAN	2.1	49	2.1	57
FEB	2.3	50	2.4	74
MAR	1.8	56	2.5	63
APR	2.0	53	2.3	63
MAY	2.0	50	2.1	55
JUN	3.1	55	2.7	56
JUL	3.4	55		
AUG	3.4	56		
SEP	3.4	57		
OCT	3.4	58		
NOV	3.3	55		
DEC	2.7	53		
AVG	2.7	54	2.3	61
MAX	3.4	58	2.7	74
MIN	1.8	49	2.1	55

Table 2.04-4 Effluent PO₄-P Daily Average Concentration and Load

Analysis of this data showed removal efficiencies for CBOD₅ and TSS exceeding 95 percent. The removal efficiency for ammonia exceeded 83 percent despite the low hydraulic residence time associated with the contact stabilization process. The removal efficiency for phosphorus was found to be minimal and highly variable.

SECTION 3
IDENTIFICATION OF ALTERNATIVES

This section provides descriptions of the alternative treatment modifications considered for the Mount Vernon WWTP. The alternatives were selected to meet the City's future TP limit. The alternatives discussed are CPR, BPR, and side stream treatment. Evaluation of the alternatives is discussed in Section 4.

3.01 CHEMICAL PHOSPHORUS REMOVAL (CPR)

Chemical phosphorus removal (CPR) involves the addition of a metal salt to flocculate and precipitate soluble phosphorus in wastewater. The precipitated phosphorus is then removed during clarification or filtration. CPR is a relatively simple and reliable process as it is based on stoichiometric ratios; however, these ratios are affected by competing chemical reactions, which is why jar testing is typically recommended to determine chemical dosages. Jar testing results are discussed in the following sub-section.

Typical application points for CPR occur before clarification or filtration. At the Mount Vernon WWTP, the phosphorus removal chemical (PRC) could be added to the primary influent (PRI) at the grit tank effluent channel before flow splitting to the four primary settling tanks. Or the PRC could be added to the mixed liquor (ML) before the final clarifiers by feeding it into the two secondary treatment unit contact zones.

Several PRCs are available for CPR, but ferric chloride (ferric) and aluminum sulfate (alum) are two of the most commonly used. Alum is typically favored in soft water applications, whereas ferric is used in more hard water applications. Both chemicals can affect sludge quantity, thickening, and dewaterability and can also lower the pH of the wastewater. Ferric is reddish in color, which can cause staining of equipment.

A. Chemical Jar Testing

Chemical jar testing was completed in June 2017 with ferric and alum. The chemical jar tests were used to determine which PRCs effectively lowered the phosphorus level below the proposed permit value of 1.0 mg/L. The CPR system would be designed to remove phosphorus to a concentration of 70 percent of the limit to allow for a safety factor.

The results show that ferric performed well reducing TP concentrations to under 1.0 milligrams per liter (mg/L) for the primary clarifier influent sample. However, it was unable to reduce phosphorus concentrations to under 1.0 mg/L for the ML sample. The alkalinity in the ML sample is low, and the addition of ferric lowered the samples pH out of the ideal range for CPR to work. Thus, ferric was never able to reduce TP below 1.0 mg/L because of low pH as the reaction does not perform well under approximately pH 6.5.

The results show that alum performed well for both the PRI and ML samples and was able to consistently reduce TP concentrations below 1.0 mg/L TP by the third dosing point at 120 volumetric parts per million (ppmv). It is noteworthy that the PRI TP concentration was lower than the ML TP concentration, which may indicate a biological phosphorus release happening between the two sample points. Although both feed locations are feasible, the PRI appears to serve as the better location as there is more alkalinity present and less of a pH decrease. Furthermore, the required alum dose to reach 1.0 mg/L TP or below is less than the dose required for the ML sample.

Based on the jar test results, Tables 3.01-1 and 3.01-2 summarize the anticipated dosages required for ferric and alum to remove phosphorus to around 0.7 mg/L from the primary clarifier influent and mixed liquor, respectively. Detailed test results are shown in Appendix A.

PRC	Dose (gal chemical/ MG influent)	PRC Required (gpd) at Current ADF ¹	PRC Required (gpd) at Rated ADF ²
Ferric	138.5	392.0	692.5
Alum	202.3	572.5	1,011.5

¹Current ADF is approximately 2.83 mgd.
²Current WWTP rated ADF is 5.0 mgd.

Table 3.01-1 Primary Clarifier Influent CPR Jar Test Dosages

PRC	Dose (gal chemical/ MG influent)	PRC Required (gpd) at Current ADF ¹	PRC Required (gpd) at Rated ADF ²
Ferric	N/A	N/A	N/A
Alum	264.0	747.1	1,320.0

¹Current ADF is approximately 2.83 mgd.
²Current WWTP rated ADF is 5.0 mgd.

Table 3.01-2 Mixed Liquor CPR Jar Test Dosages

Based on our experience, the jar test dosages typically overstate the chemical requirements by up to 30 percent allowing for a safety factor in design.

It should be noted that CPR can increase total biosolids production significantly. It is not uncommon for the biosolids mass to increase by 20 to 35 percent for a 1.0 mg/L phosphorus limit.

As noted in the Master Plan, the Final Clarifiers have a surface overflow rate of 1,412 gallons per day per square foot (gpd/sf) at the peak flow rate of 12.5 mgd, which exceeds the Great Lake–Upper Mississippi River Board (GLUMRB) Recommended Standards for Wastewater Facilities recommendation of a maximum surface overflow rate of 1,000 gpd/sf. The Master Plan noted that “additional clarifier capacity may be desirable for peak flow conditions”. The GLUMRB Recommended Standards for Wastewater Facilities reduces the maximum recommended surface overflow rate to 900 gpd/sf for facilities with CPR and phosphorus limits less than 1 mg/L. This provides further support for additional final clarification as part of the Master Plan recommendation to add a third secondary treatment unit. Three final clarifiers would provide a surface overflow rate of 900 gpd/sf at 11.95 mgd and 1,000 gpd/sf at 13.28 mgd.

Table 3.01-3 provides the anticipated annual PRC costs for ferric and alum to remove phosphorus to around 0.7 mg/L. The bulk chemical costs were based on quotations from chemical suppliers currently serving the Mount Vernon, Ohio area.

PRC	Bulk PRC Cost (\$/gal)	Injection Point	Annual PRC Cost at Current ADF ¹	Annual PRC Cost at Rated ADF ²
Ferric	\$1.66	Primary Influent	\$237,500	\$419,600
		Mixed Liquor	N/A	N/A
Alum	\$1.40	Primary Influent	\$292,600	\$516,900
		Mixed Liquor	\$381,800	\$674,500

¹Current ADF is approximately 2.83mgd.
²Current WWTP rated ADF is 5.0 mgd.

Table 3.01-3 Annual Bulk Chemical Costs

Based on the bulk chemical costs and the results of the jar tests, ferric is the more cost-effective, but either alum or ferric would be acceptable for today’s requirements. Therefore, the CPR system should be designed to accommodate the use of either coagulant in the future.

B. Chemical Storage and Feed System

Strand recommends sizing the bulk chemical tanks based upon the larger of either the ferric or alum requirements. Initially, to provide enough chemical storage for 30 days of alum at the current average daily flow (ADF), the chemical storage tanks would be sized to hold approximately 17,200 gallons. A 10-foot-diameter tank with a side water depth (SWD) of 15-feet would hold approximately 8,800 gallons. A 12-foot-diameter tank with an SWD of 10 feet would hold approximately 8,500 gallons. Two storage tanks would be required. Double wall storage tanks are recommended in order to provide containment without the cost and maintenance of a containment area. A tanker truck has the ability to deliver approximately 4,500 gallons of chemical per load. At the rated ADF of 5.0 mgd, 17,200 gallons would provide storage for 17 days.

C. CPR Alternatives

Three options are proposed for the bulk chemical tanks and pumping.

Option 1:

There is available space on the second floor of the Secondary Treatment Building in the former polymer feed area and coagulant tank area. Various configurations of chemical storage tanks were reviewed, but the existing ceiling height; existing piping, conduit, and ductwork; and lack of access for installation preclude adding tanks of sufficient volume to this space. Therefore, this option will not be considered further.

Option 2:

A second option would be to locate the chemical storage tanks on a slab on the south side of the Primary Sludge Building, between the two sets of primary settling tanks. There does not appear

to be available space in the Primary Sludge Building to house the chemical feed pumps and electrical components; therefore, a separate structure would be required to protect the equipment and provide the WWTP operators a viable space to complete maintenance work on the system. This building could be a prefabricated fiberglass reinforced plastic (FRP) building. Storing the chemical outdoors will require a cold weather protection system to avoid chemical freezing. See Figure 3.01-1 for a proposed layout of these facilities.

Option 3:

A third option would be to locate the chemical storage tanks on a slab on the south side of the Pump and Control Building, removing the existing unused covered patio. There is available space in the Pump and Control Building to house the chemical feed pumps and electrical components. Storing the chemical outdoors will require a cold weather protection system to avoid chemical freezing. See Figure 3.01-2 for a proposed layout of these facilities.

Option 4:

This option is similar to Option 3 except that a building addition would be constructed around the chemical storage tanks. This would remove the need for a cold weather protection system and the risk of chemical freezing. This would also ease maintenance on the storage tanks and associated piping. This building addition would require fire suppression to meet hazardous occupancy requirements of the building code, which requires sufficient fire capacity in the plant water service. According to the City, sufficient flow and pressure are available. See Figure 3.01-3 for a proposed layout of these facilities.

3.02 BIOLOGICAL PHOSPHORUS REMOVAL (BPR)

BPR is the process by which phosphorus is removed from wastewater through an excess uptake of phosphorus into the activated sludge microbial population and the subsequent wasting of the biosolids from the process. The main difference between typical activated sludge processes is the sequencing of anaerobic and aerobic conditions that selects phosphorus accumulating organisms (PAOs).

In the anaerobic zone, with the presence of readily degradable organics [volatile fatty acids (VFAs)], the PAOs will release phosphorus to provide energy in order to store soluble organics [i.e., soluble five-day biochemical oxygen demand (sBOD₅)]. In subsequent aerobic zones, the PAOs will uptake phosphorus in excess amounts, compared to that previously released, as they process the stored BOD₅. The stored phosphorus is then removed in the WAS. The WAS may experience additional phosphorus release during anaerobic digestion, resulting in more highly concentrated side streams and higher struvite potential as biological phosphorus removal becomes acclimated.

A. Biological Potential Bench-Testing

The BPR potential bench-test was completed in June 2017 by combining wastewater from the WWTP with RAS from a facility that has successfully implemented BPR. The sample containing the WWTP wastewater and BPR facility RAS was compared to a sample containing the WWTP wastewater, BPR



OPTION 2 LAYOUT

PHOSPHORUS REMOVAL PLANNING REPORT MT. VERNON, OHIO



FIGURE 3.01-1
4962.005



OPTION 3 LAYOUT

PHOSPHORUS REMOVAL PLANNING REPORT MT. VERNON, OHIO



FIGURE 3.01-2
4962.005



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

OPTION 4 LAYOUT

PHOSPHORUS REMOVAL PLANNING REPORT MT. VERNON, OHIO



FIGURE 3.01-3
4962.005

facility RAS, and sodium acetate. The donor RAS used for the test was from Xenia, Ohio Gladly Run WWTP. The results of the tests are summarized in Appendix A.

The test showed a phosphorus release for all samples, but the samples without sodium acetate (not spiked) did not show as much of a release as the samples spiked with sodium acetate. The lower phosphorus release could possibly mean the nonspiked samples were limited on food for the PAOs.

The influent sample showed a higher phosphorus release when spiked with sodium acetate than the spiked primary clarifier effluent sample. However, the nonspiked primary effluent sample showed more phosphorus release than the nonspiked influent sample, indicating that the WWTP is likely benefitting from fermentation products being formed in the primary clarifiers, ultimately creating an ideal food source for PAOs. Additionally, the rate of phosphorus release plateaued or decreased toward the end of the two hours for the spiked and nonspiked influent samples, meaning that fermentation has probably ceased and the food source for PAOs has been exhausted. Because phosphorus release occurred in both the influent and primary clarifier effluent samples, BPR at Mount Vernon is still feasible. BPR would most-likely not be able to lower TP concentrations below 1.0 mg/L by itself and would have to be coupled or supplemented with CPR.

B. Data Review

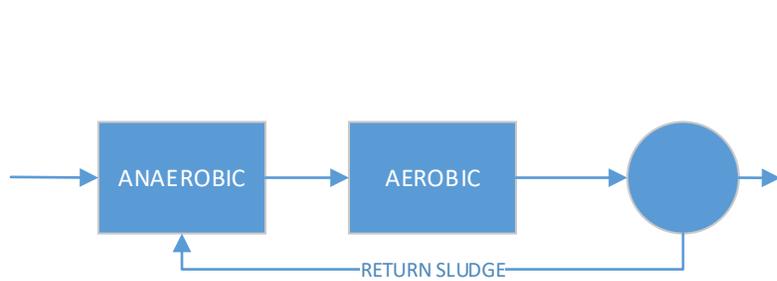
There are additional indicators that help predict BPR performance. The performance of the BPR system will be strongly affected by the characteristics of the wastewater influent to the anaerobic zone. Rules of thumb from successful treatment plants implementing BPR indicate that PRE biochemical oxygen demand (BOD) to TP ratio of 20:1 is sufficient to accomplish BPR. Data from January to September 2016 indicates Mount Vernon has a carbonaceous BOD (CBOD) to TP ratio of 47. Because CBOD is less than or equal to BOD, then the BOD:TP ratio is greater than 20. Other indicators to predict BPR performance include readily biodegradable soluble COD, soluble CBOD and volatile fatty acid concentrations, which give more information on the type and quantity of food available for the PAOs and the suitability of BPR at the Mount Vernon WWTP. Recent data has shown that these indicators average in a low range at the Mount Vernon WWTP, which further demonstrates that BPR, while feasible, is not likely to meet a 1 mg/L effluent limit without some CPR.

C. BPR Facilities

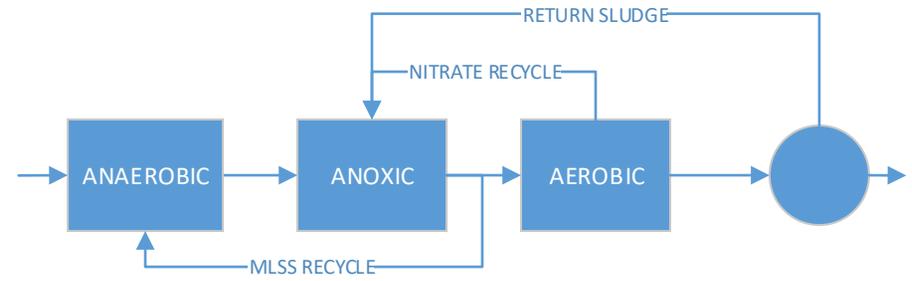
A number of processes are available for implementation of biological phosphorus removal—see Figure 3.02-1 for an example of some possible configurations. However, they all require either no nitrification or total nitrogen removal. Nitrates (a by product of nitrification) inhibit a true anaerobic zone from forming, thereby not allowing the PAOs to be competitively selected. Therefore, the contact stabilization process would need to be modified to provide sufficient aeration capacity for nitrification, denitrification, and phosphorus removal.

D. Emerging Methods

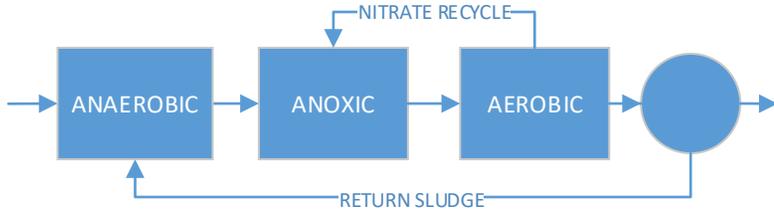
In recent years, a number of activated sludge variations have been proposed, which greatly reduce the plant impact for modifying for biological nutrient removal. Often, this involves return flow biological processes within the activated sludge process. For example, one alternative to the



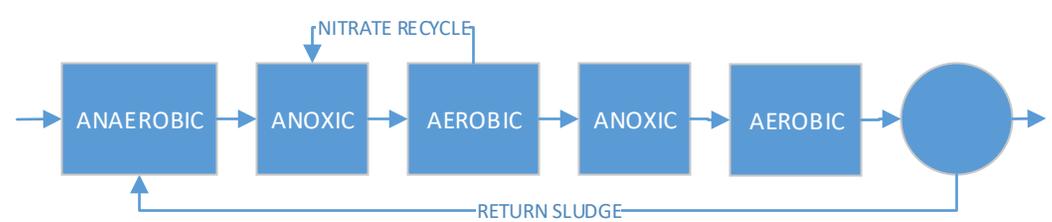
A/O™ PROCESS
2-STAGE PHOSPHORUS REMOVAL



UCT OR VIP PROCESS
3-STAGE NUTRIENT REMOVAL



A2/O™ PROCESS
3-STAGE NUTRIENT REMOVAL



MODIFIED BARDENPHO™ OR PHOREDOX PROCESS
5-STAGE NUTRIENT REMOVAL

**PROCESS FLOW DIAGRAMS
FOR BIOLOGICAL NUTRIENT REMOVAL**

**PHOSPHORUS REMOVAL PLANNING REPORT
CITY OF MOUNT VERNON, OHIO**



FIGURE 3.02-1

conventional anaerobic zone processes described above is to bypass the anaerobic zone completely with the forward flow and provide a RAS fermentation process. The fermentation process uses 10 to 20 percent of the RAS in anaerobic conditions with a 30 to 40 hour retention time and an external carbon source. This will produce a deeply anaerobic condition, which produces a different type of PAO (tetrasphaera). Alternatively, the 10 to 20 percent fraction of the RAS can be fermented with a 6-to 10-hour retention with a fermentate carbon source to produce the same conditions. This volume is much smaller than the processes described above, reduces the impact to facility layout, mixing power use, and plant hydraulics.

Currently these emerging BPR alternatives are empirically based with a handful of full-scale installations and modeling is not yet possible. Nevertheless, by keeping these alternatives in mind, the City can have a process that provides flexibility for the operators to implement these emerging methods in the future.

E. BPR Alternatives

Based on the bench-testing results and the current contact stabilization process—which in theory provides partial nitrification and does not provide denitrification—BPR will not be considered further in this report. However, as discussed in the following, consideration of adding an anaerobic zone for BPR is recommended as part of the future ammonia removal project.

3.03 SIDE STREAM PHOSPHORUS REMOVAL

For the Mount Vernon WWTP, side stream phosphorus removal would involve removing TP from the primary sludge anaerobic digester supernatant return flows. If successful, this nutrient load reduction to the activated sludge operations would result in reduced oxygen requirements, reduced sludge production, and lower effluent TP concentrations. In addition, sidestream TP recovery could benefit the digestion process by reducing soluble phosphorus and struvite formation within the digester and downstream of the digester.

The City currently returns supernatant from the anaerobic digesters to primary clarification. The return flow is not currently equalized, and all side stream technologies would require return flow equalization. The digesters are currently operated in a conventional fashion with stratification occurring allowing supernatant draw off on a cyclical basis. The volume of supernatant removed is not regularly measured.

Side stream phosphorus removal is based on harvesting struvite (magnesium ammonium phosphate) to remove phosphorus from the filtrate or from the digested sludge directly. Three systems were evaluated for this report—Multiform Harvest, Inc. (MHI), AirPrex, and Ostara. The MHI and Ostara processes include treatment of the dewatering filtrate, while the AirPrex process includes treatment of the digested sludge itself.

A. MHI

The MHI process uses a fluidized bed reactor to achieve TP reductions. Caustic is used to increase pH and magnesium chloride is added to form struvite pellets. Struvite pellets are harvested from the reactor, screened, and discharged to a dewatering bag. MHI will pick up wet, drained product and handle distribution and ultimate disposal. The reactor for this project would be approximately 8 feet in diameter

and 20 feet tall, and additional space is required for the screen, dewatering bag, and chemical storage tanks. It is recommended that the reactor be installed in a building. A new building or building addition will likely be needed to house the system.

B. AirPrex

The AirPrex reactor is physically larger than the MHI reactor and is typically installed outside. AirPrex uses air stripping to increase pH (no caustic addition) and then adds magnesium chloride to form struvite. The struvite extracted from the reactor is then cleaned and dewatered on-site using a sludge washing unit. The reported advantages to removing struvite from digested sludge with the AirPrex process, compared to removing struvite from dewatering filtrate, include the following:

1. Struvite is removed before dewatering, which will reduce current struvite issues with the belt presses and downstream processes.
2. AirPrex claims a 2 to 5 percent improvement in dewatered cake and provides a process guarantee of 2 percent improvement.
3. AirPrex claims a 15 to 30 percent reduction in polymer needed for dewatering and provides a process guarantee of 15 percent reduction.

A small building is recommended to house the sludge extraction system, sludge washing unit, blower, and auxiliary piping, and this building is often constructed around the bottom third of the AirPrex reactor.

C. Ostara

The Ostara system is similar to MHI in that it is a fluidized bed reactor which uses caustic and magnesium to precipitate the struvite. Unlike MHI, the end product is a dried pellet. The other two technologies produce struvite pellets that are dusty and marginally marketable. Ostara purchases the pellets and sells them under the brand name Crystal Green™.

D. Sidestream Removal Alternatives

As much of a win-win as this product appears, the cost of implementation and payback period is generally not practical for facilities that are rated for less than 10 mgd, and in particular, Ostara typically will not compete for these smaller facilities. For this reason, this technology will not be considered further.

3.04 DISCUSSION

This section provides additional discussion related to phosphorus removal alternatives.

A. Operational Changes

The current contact stabilization process only provides partial nitrification. No operational changes are available to improve BPR at this time.

B. Source Reduction Potential

The City has an existing industrial pretreatment program with no categorical industrial users, six significant noncategorical industrial users, and 48 additional industrial users. The next time that the local limits are update, it is recommended that the City review the phosphorus loadings contributed by the significant industrial users and consider modifying the local limits as appropriate.

In addition, it is recommended that the City work to educate the public regarding the impacts of household products containing phosphorus and information on alternative products.

C. Effects on Anaerobic Sludge Facility Performance

Detailed analysis of the anaerobic digesters and sludge storage tanks can be found in the Anaerobic Digestion Needs Assessment Report, prepared by Strand Associates, Inc.[®], November 2017. In general, it is not anticipated that the addition of phosphorus removal processes (CPR or BPR) will negatively impact the solids loading rate to or the hydraulic retention time (HRT) of the anaerobic digesters. Although the existing anaerobic digester tanks are adequately sized to treat the volumetric volatile solids loading rate, as recommended by Ten States Standards, and meet Federal Regulations in regard to vector attraction reduction for both current and future biosolids production, the Anaerobic Digestion Needs Assessment Report highlights potential anaerobic digestion modifications that are needed to improve the overall treatment efficiency of the biosolids train. It is recommended that these modifications be completed regardless of the selected phosphorus removal alternative.

The potential increase in total biosolids production due to CPR processes coupled with proposed modifications to the anaerobic digestion operation, will require additional sludge storage capacity. According to the Ohio Administrative Code (OAC) Chapter 3745-40-10, facility storage of sewage sludge or biosolids shall be in place to provide 120 days of storage for the design capacity of the treatment works. Clarification to this Code has recently been provided that notes the 120 days of facility storage shall be dedicated to storage, not treatment. Therefore, based on the calculations and resulting tables presented in the Anaerobic Digestion Needs Assessment Report, it is estimated that the WWTP will need approximately 750,000 additional gallons of sludge storage to meet the OAC. Additional details on the sizing and location of the proposed sludge storage tank can be found in the Anaerobic Digestion Needs Assessment Report.

D. Effects on Future Ammonia Removal Processes

While the existing contact stabilization activated sludge process does not fully nitrify; (i.e. remove ammonia), the WWTP consistently meets the existing 4 mg/L NH₃-N effluent limit. The *Wastewater Treatment Plant Master Plan*, prepared by Finkbeiner, Pettis & Strout, Inc., August 2003 (Master Plan), discussed alternatives for achieving ammonia removal if a stricter effluent limit were imposed. The recommended alternative included construction of a third secondary treatment unit (aeration zone and aerobic digestion zone concentrically constructed around a final clarifier) and conversion of all three units from contact stabilization to extended aeration. This conversion would provide the hydraulic retention time (HRT) to provide for denitrification as well. An additional benefit is that the third final clarifier would decrease the surface loading rate at peak flows, providing better settling.

The addition of CPR at this time would not preclude or hamper the proposed ammonia removal project. In fact, the CPR consumes alkalinity, some of which will be regained by adding denitrification facilities. Also, CPR increases primary sludge production and slightly lowers the organic loading to the secondary treatment process, resulting in a slightly lower design loading rate.

When the ammonia removal project is undertaken, it is recommended that the addition of an anaerobic zone be considered for BPR. The anaerobic zone would be sized for a hydraulic retention time of one to three hours. It could be constructed in between the two sets of primary settling tanks, hydraulically located between the primary settling tank effluent and the secondary pumping wet well. While BPR may not be able to achieve a 1 mg/L TP level in the effluent, it would reduce the amount of chemical required, provide a better settling secondary sludge, and reduce overall sludge volume. A cost-benefit analysis could be performed at that time.

SECTION 4
EVALUATION OF ALTERNATIVES

Previous sections of the report have provided background information and reviewed alternatives necessary to provide phosphorus removal. This section evaluates capital and operational costs and nonmonetary factors. Detailed evaluations of capital costs and present worth for alternatives are included in Appendix B.

Opinions of probable capital cost were developed by obtaining equipment costs from equipment manufacturers or recent projects that had similar equipment. An installation factor of 35 percent was added to all equipment costs. Demolition, new structures, or structural modification costs are included where necessary. The equipment and structure subtotal was then used to develop cost estimates for electrical, mechanical (valves and piping), HVAC, and site work elements of the project based on typical factors. These costs were then subtotaled, and 10 percent of the subtotal was added for the contractor's General Conditions. The subtotal was then increased by a factor of 40 percent to account for contingencies, legal services, and technical services.

4.01 DESCRIPTION OF ALTERNATIVES

Effluent phosphorus limits of 1 mg/L are expected in the near future. In Section 3, three CPR alternatives were identified for consideration. Because of the BPR potential bench-testing results, no BPR alternatives are being considered at this time. No side stream phosphorus removal alternatives are being considered at this time either.

The proposed CPR components will be designed based on the current WWTP's ADF of 2.83 mgd and rated ADF of 5.0 mgd. Implementation of CPR will require chemical bulk storage tanks with spill containment, chemical metering pumps, and chemical piping. No increase in additional struvite production beyond the existing is expected under this alternative.

A. PR1–No Action

This report provides a plan to address an impending 1 mg/L permit limit. At present, the existing facility is not designed to remove phosphorus. As such, the No Action Alternative will receive no additional consideration.

B. PR2–CPR near Primary Sludge Building

Two 12-foot diameter, 10-foot SWD chemical storage tanks would be located on a slab on the south side of the Primary Sludge Building, between the two sets of primary settling tanks. A cold weather protection system would be added to the tanks and associated piping to avoid chemical freezing. A prefabricated FRP structure would be added to house the chemical feed pumps and electrical components. See Figure 3.01-1 for a proposed layout of these facilities.

C. PR3–CPR in Pump and Control Building, Exterior Chemical Storage Tanks

Two 12-foot diameter, 10-foot SWD chemical storage tanks would be located on a slab on the south side of the Pump and Control Building, removing the existing unused covered patio. A cold weather protection system would be added to the tanks and associated piping to avoid chemical freezing. Chemical feed

pumps and electrical components would be housed in former laboratory space in the Pump and Control Building. See Figure 3.01-2 for a proposed layout of these facilities.

D. PR4–CPR in Pump and Control Building, Building Expansion for Chemical Storage Tanks

This alternative is the similar to PR3 except that the chemical storage tanks would be located in a building addition on the south side of the Pump and Control Building, removing the need for a cold weather protection system. A fire suppression system would be incorporated into this building addition. See Figure 3.01-3 for a proposed layout of these facilities.

4.02 MONETARY EVALUATION

Table 4.02-1 summarizes the opinion of probable costs (OPC) for these alternatives. A detailed breakdown for each alternative is included in Appendix B. PR3 carries the lowest capital cost. Quotes for the bulk chemical tanks are included in Appendix D.

	Total Opinion of Probable Capital Cost
PR2-CPR near Primary Sludge Building	\$722,000
PR3-CPR in Pump and Control Building, Exterior Chemical Storage Tanks	\$550,000
PR4-CPR in Pump and Control Building, Building Expansion for Chemical Storage Tanks	\$790,000

Table 4.02-1 Opinion of Probable Cost for Phosphorus Removal Alternatives

4.03 NONMONETARY EVALUATION

For Options PR3 and PR4, the storage tanks would be located near the existing roadway for convenient refilling, and the chemical feed equipment would be housed in existing unused space in the Pump and Control Building. For Option PR2, the storage tanks and feed equipment would be more centrally located near the feed points, but the storage tanks would be located further from the roadway and a separate building would be required for the feed equipment. In addition, this location could be used for the addition of a future anaerobic tank for BPR instead. Option PR4 would remove the need for heat tracing and insulation of the chemical storage tanks and piping for cold weather protection, and the Chemical Building would provide a more operator-friendly space for operations and maintenance.

4.04 RECOMMENDED ALTERNATIVE

PR3–CPR in Pump and Control Building, Exterior Chemical Storage Tanks is recommended because the capital cost is lowest and the location is preferred over the location of PR2 between the primary settling tanks.

**SECTION 5
RECOMMENDATIONS**

This section presents a summary of the recommended project, along with a schedule for implementation and a fiscal impact analysis.

5.01 RECOMMENDED ALTERNATIVE

The recommended plan (PR3) includes the following improvements to the WWTP.

1. Two 12-foot diameter, 10-foot SWD chemical storage tanks would be located on concrete slabs on the south side of the Pump and Control Building, removing the existing unused covered patio.
2. A cold weather protection system would be added to the tanks and associated piping to avoid chemical freezing.
3. Chemical feed pumps and electrical components would be housed in former laboratory space in the Pump and Control Building.

See Figure 3.01-2 for a proposed layout of these facilities.

This plan is intended to meet the pending phosphorus limit of 1 mg/L with a total OPC of about \$430,000 as summarized in Table 5.01-1.

Item	Cost
Chemical Storage Tanks	\$ 130,000
Heat Tracing and Insulation	\$ 52,000
Concrete Slabs for Tanks	\$ 16,000
Pump and Control Building Modifications	\$ 20,000
Chemical Feed Equipment	\$ 33,000
Subtotal–Equipment and Structures	\$ 251,000
Site Work	\$ 25,000
Yard Piping	\$ 15,000
Electrical	\$ 36,000
Instrumentation and Controls	\$ 30,000
Subtotal	\$ 106,000
Contractor’s General Conditions (10%)	\$ 36,000
Subtotal - Construction	\$ 393,000
Technical Services and Contingencies (40%)	\$ 157,000
Total Opinion of Probable Cost	\$ 550,000

Table 5.01-1 CPR Proposed Project Opinion of Probable Cost

In addition, it is recommended to implement all aspects recommended in the Anaerobic Digestion Needs Assessment which includes approximately \$10,732,000 in work. This brings the total cost of the recommended project to \$11, 282,000.

5.02 IMPLEMENTATION SCHEDULE

It is acknowledged that the City does not currently have a phosphorus removal effluent limit nor a compliance plan to install new facilities. However, based on conversations with OEPA, it is anticipated that in the very near future all NPDES permits with a rated average flow greater than 1.0 mgd will receive a phosphorus limit. It may be at the City’s advantage to use funding opportunities available today that may not be available or be more difficult to obtain when the OEPA ultimately issues the new effluent limitations. It is recommended that this project follow the implementation schedule in Table 5.02-1 in order to take advantage of the reduced rate loan opportunities from the OEPA Division of Environmental Financial Assistance (DEFA) for Nutrient Reduction projects. All aspects of the planning and design of this project need to be completed and approved by the OEPA in order to secure the DEFA Water Pollution Control Loan Fund (WPCLF) loan with nutrient reduction rates and implement the recommended plan.

	Schedule Date
Submit Design Loan Application	February 2018
Begin Design	May 2018
Submit PTI to OEPA	February 2019
Submit Construction Loan Application	February 2019
Receive PTI	May 2019
Project Bid Date	August 2019
Begin Construction	September 2019
Construction Completion	January 2021

Table 5.02-1 Proposed Project Implementation Schedule

5.03 PROJECT FINANCING

The preparation for these improvements could begin immediately and be complete within 3 years (2017 to 2020). A DEFA WPCLF loan could be used to pay for this project. The fund provides lower interest loans for a percentage of eligible costs for construction of WWTPs. Loans are available for public or private applicants for the planning, design, and construction of a wide variety of projects to protect or improve the quality of Ohio's rivers, streams, lakes, and other water resources. These projects include wastewater treatment plant improvements/expansions, new/replacement sewers, excess sewer infiltration/inflow correction, facilities for unsewered areas, and combined sewer overflow correction. Currently, DEFA is offering a nutrient reduction discount (NRD), providing a 0 percent interest rate for the portion of the project directly attributed to nutrient reduction. The recommended CPR project is entirely attributable to nutrient reduction but the anaerobic digestion work is not. All loan projections are based on the 0 percent interest rate for the NRD portion and 1.88 percent for the remaining work. A more detailed cost opinion will be completed along with any future loan application. DEFA interest rates may also change between now and when the WPCLF loan closes, which may impact debt service costs.

Depending upon the City’s mean household income and population, Ohio Public Works Commission (OPWC) grants and low interest loans may also be available.

5.04 FISCAL IMPACT ANALYSIS

The impacts of the recommended plan on users in the City are based upon the changes to annual operations and maintenance costs and the increased debt service costs associated with repaying DEFA funds. The projected revenue in 2020 (year of project completion) is assumed to be approximately equal to 2017 revenue adjusted with a 2.2 percent inflation rate to approximately \$2.9 million. Projected operation and maintenance expenses and debt service in 2020 (without accounting for changes resulting from the project) are approximately equal to 2017 expenses adjusted with a 2.2 percent inflation rate to approximately \$3.1 million. Existing debt service is approximately \$0.4 million annually. New debt service associated with the project is anticipated to be maintained at approximately \$0.7 million annually. Accounting for all these items, including additional operation, maintenance, and chemical costs, total anticipated annual expenses following project completion will be approximately \$0.95 million requiring an increase over projected year 2020 revenues of approximately 38 percent. A summary of the financial impact is included in Appendix E.

5.05 RECOMMENDED NEXT STEPS

Before December 1, the City should submit the OEPA “Technical and Financial Capability Study to Reduce Phosphorus,” which is included in Appendix C of this report. This will complete the City’s obligations to the OEPA with respect to Senate Bill 1. It is recommended that the City of Mount Vernon submit a nomination form for a WPCLF design loan using the nutrient reduction discount to finance the technical services to establish drawings and specifications for the recommended work. At this point, it is anticipated that the OEPA guidance will be in place to begin bidding and construction with confidence that the phosphorus effluent limit will be in force soon after the construction is complete. If the OEPA has yet to further define the timeline at that point, the bidding and construction can be put on hold until this clarity is provided.

**APPENDIX A
PHOSPHORUS REMOVAL TESTING RESULTS**



Strand Associates, Inc.®

4433 Professional Parkway

Columbus, OH 43125

(P) 614-835-0460

(F) 614-835-0466

July 24, 2017

Mr. Mathias Orndorf
City of Mount Vernon
3 Cougar Drive
Mount Vernon, OH 43050

Re: Phosphorus Removal Testing Results

Dear Mr. Orndorf:

Enclosed are three copies of the report for the phosphorus removal testing. This report summarizes the tests and results of the chemical phosphorus removal (CPR) and biological phosphorus removal (BPR) testing performed at the City of Mount Vernon's Wastewater Treatment Plant (WWTP) and their effectiveness towards removing total phosphorus (TP) concentrations to under 1.0 mg/L as required by Senate Bill 1.

Please call me with questions.

Sincerely,

STRAND ASSOCIATES, INC.®

A handwritten signature in cursive script that reads "James I. Mills, Jr.".

James I. Mills, Jr., O.I.T.

Enclosure: Report

Report for City of Mount Vernon, Ohio

Phosphorus Removal Testing Results



Anthony J. Akles, P.E., BCEE, ENV SP
July 24, 2017

Prepared by:

STRAND ASSOCIATES, INC.®
4433 Professional Parkway
Columbus, OH 43125
www.strand.com

July 2017



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Figure 6	BPR Potential Test Results–PRE	8

CHEMICAL JAR TEST RESULTS

Chemical phosphorus removal (CPR) jar testing was completed for WWTP primary clarifier influent (PRI) and mixed liquor (ML). The influent sample was taken upstream of the primary clarifiers, and the mixed liquor sample was taken from the mixed liquor splitter structure upstream of the secondary clarifiers. The primary influent sample was composited over a 2-hour period. Ferric chloride and alum were the phosphorus removal chemicals (PRCs) used during the test. Tables 1 and 2 present a summary of chemical jar testing results at each location.

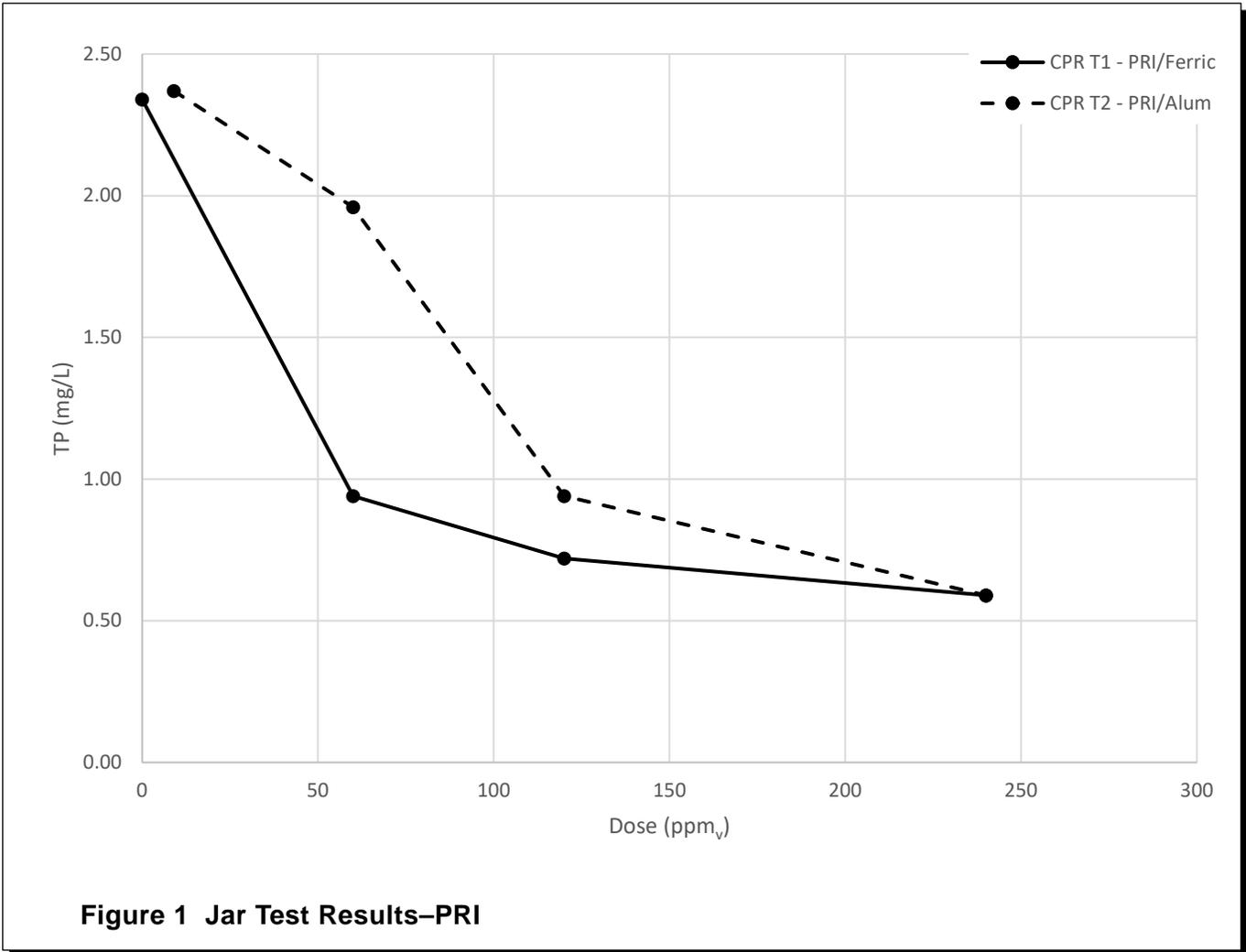
PRC	Jar	Dose (ppmv)	TP (mg/L)	Alkalinity (mg/L as CaCO ₃)	pH (S.U.)
Ferric Chloride	CPRT1J1	0	2.34		7.55
	CPRT1J2	60	0.94	224	7.15
	CPRT1J3	120	0.72		6.90
	CPRT1J4	240	0.59	134	6.55
Alum	CPRT2J1	9	2.37		7.47
	CPRT2J2	60	1.96	238	7.26
	CPRT2J3	120	0.94		7.07
	CPRT2J4	240	0.59	182	6.80

Table 1 Chemical Jar Testing Full Results–PRI

PRC	Jar	Dose (ppmv)	TP (mg/L)	Alkalinity (mg/L as CaCO ₃)	pH (S.U.)
Ferric Chloride	CPRT3J1	0	1.25		7.00
	CPRT3J2	60	1.65	90	6.68
	CPRT3J3	120	1.03		6.49
	CPRT3J4	240	1.06	20	5.75
Alum	CPRT4J1	0	3.36		7.66
	CPRT4J2	60	2.06	96	7.46
	CPRT4J3	120	1.00		7.16
	CPRT4J4	240	0.75	50	6.81

Table 2 Chemical Jar Testing Full Results–ML

Figures 1 through 4 show the jar test results and pH results.



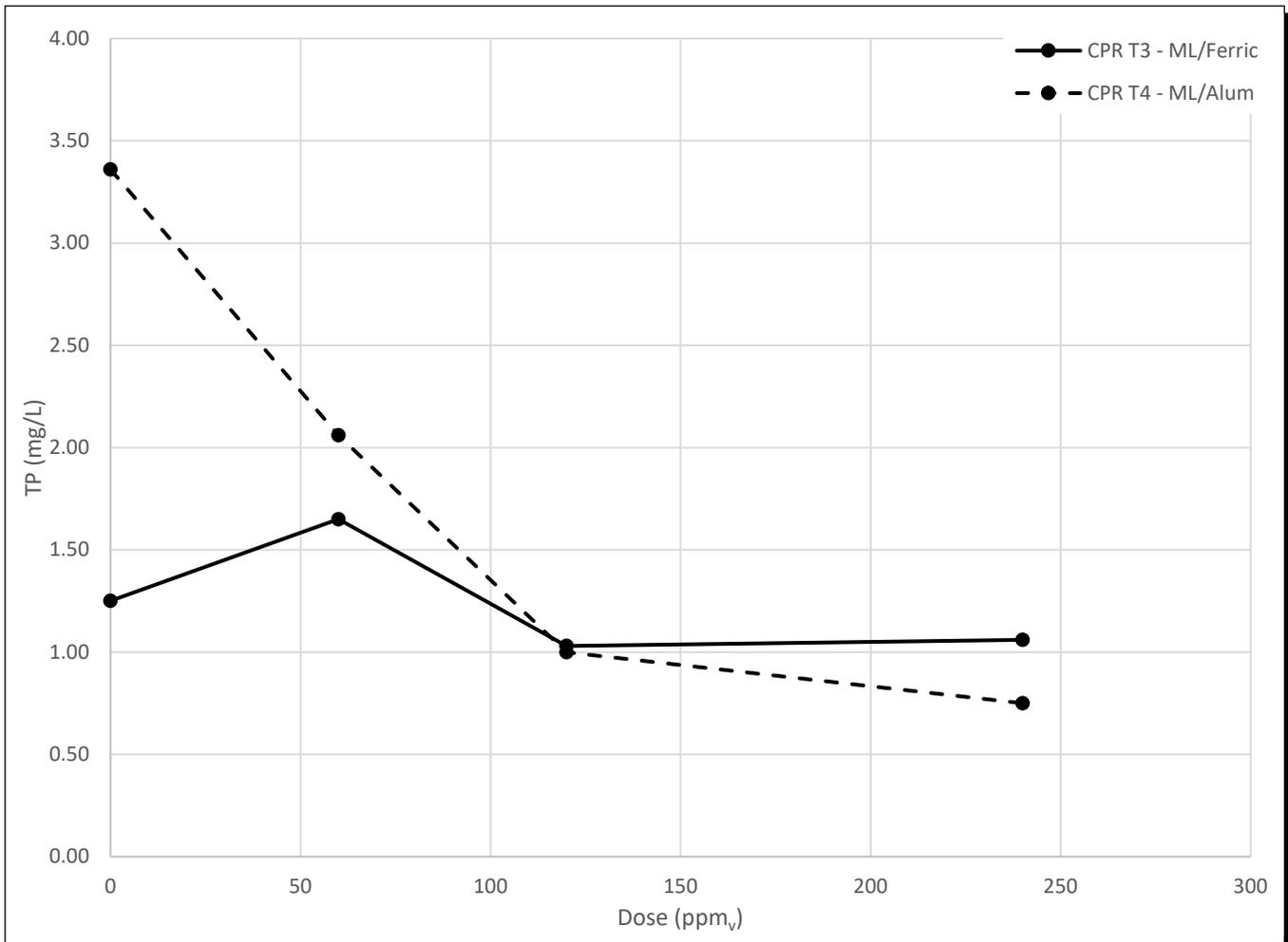


Figure 2 Jar Test Results–ML

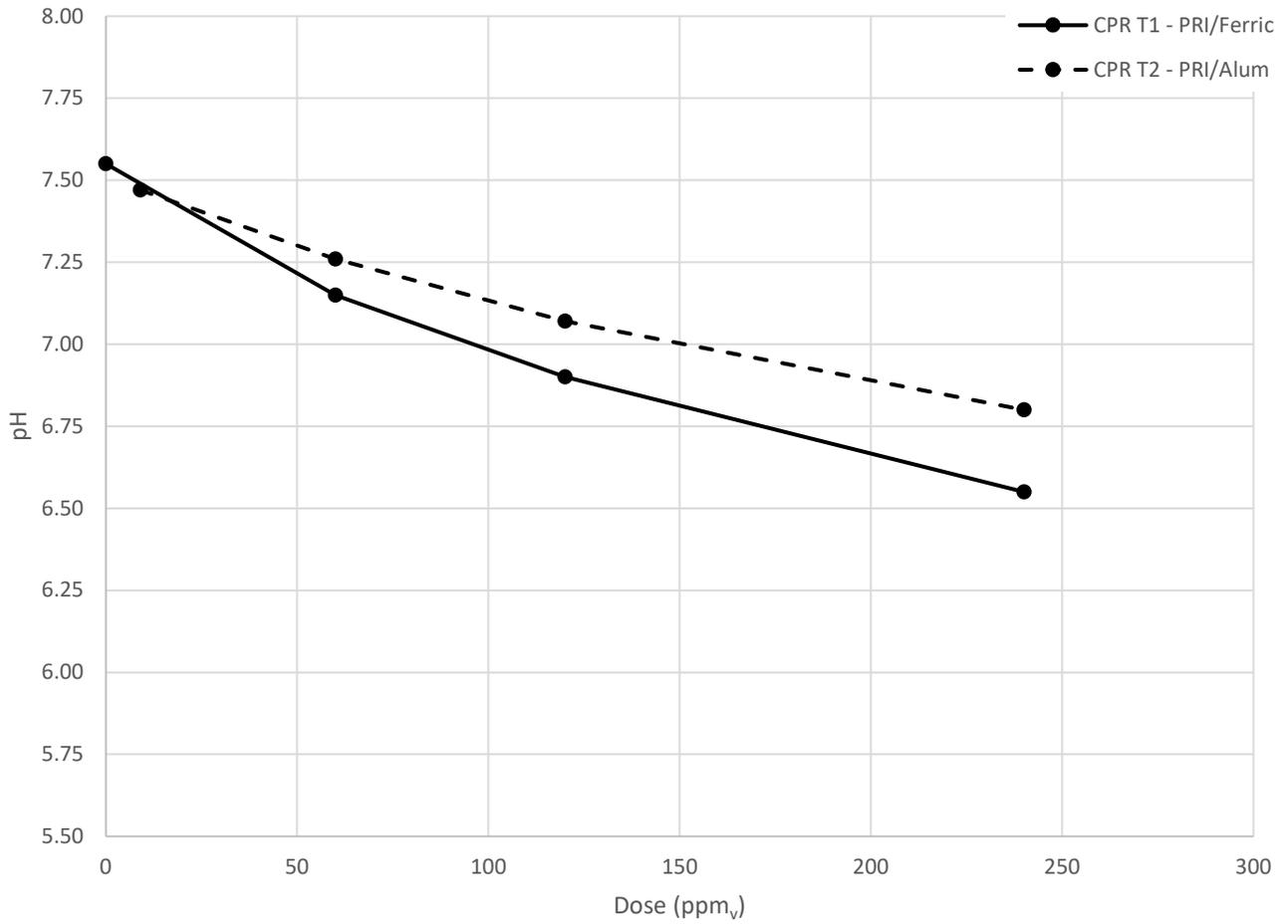


Figure 3 Jar Test pH Results–PRI

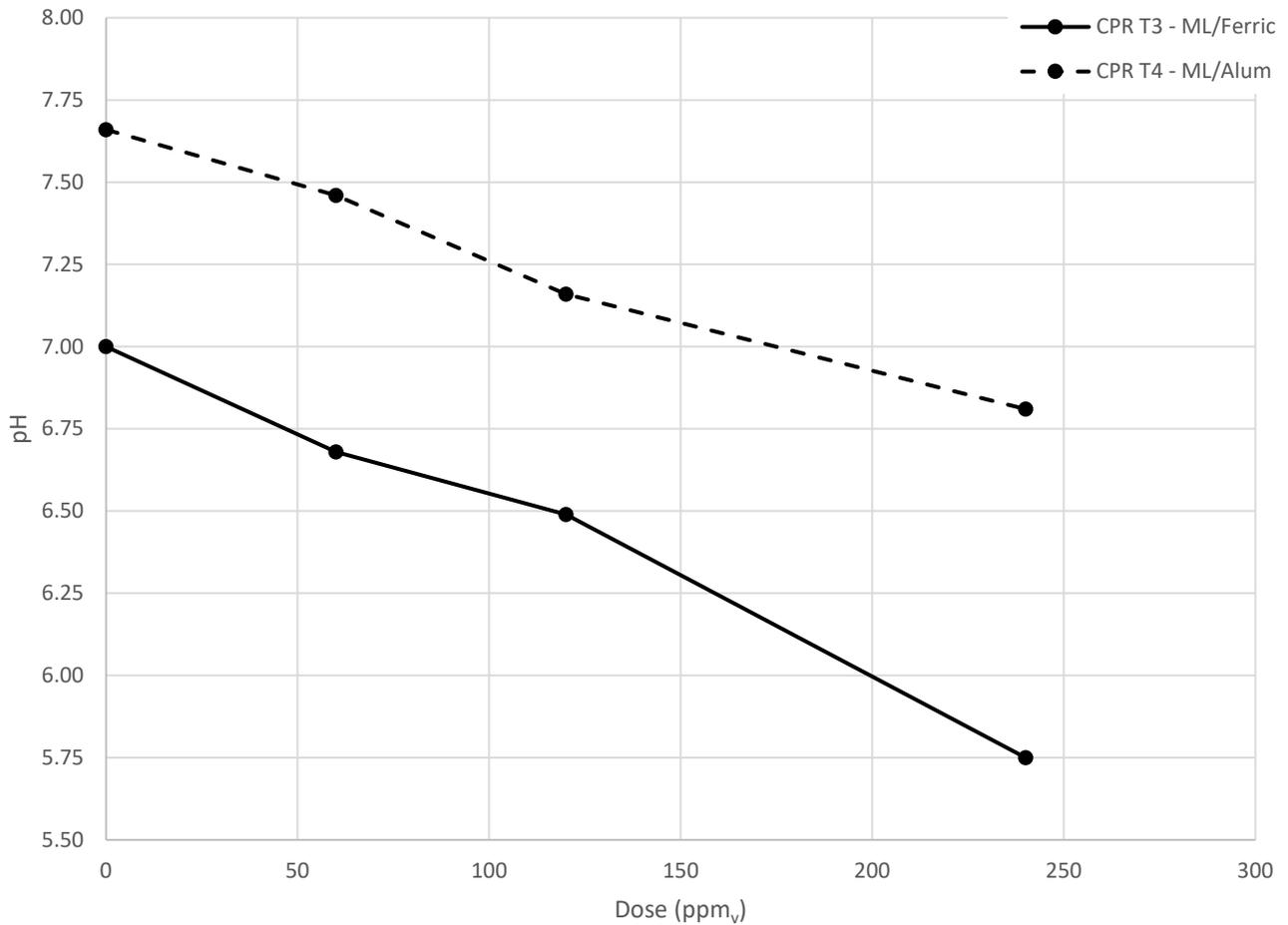


Figure 4 Jar Test pH Results–ML

The results show that ferric chloride performed well reducing total phosphorus (TP) concentrations to under 1.0 milligrams per liter (mg/L) for the primary clarifier influent sample. However, it was unable to reduce phosphorus concentrations to under 1.0 mg/L for the ML sample. The alkalinity in the ML sample is low, and the addition of ferric chloride lowered the samples pH out of the ideal range for CPR to work. Thus, ferric chloride was never able to reduce TP below 1.0 mg/L due to low pH as the reaction does not perform well under approximately pH 6.5.

The results show that alum performed well for both the PRI and ML samples and was able to consistently reduce total phosphorus concentrations below 1.0 mg/L TP by the third dosing point at 120 volumetric parts per million (ppm_v). It is noteworthy that the PRI TP concentration was lower than the ML TP concentration, which may indicate a biological phosphorus release happening between the two sample points. Although both feed locations are feasible, the PRI appears to serve as the better location as there is more alkalinity present and less of a pH decrease. Furthermore, the required alum dose to reach 1.0 mg/L TP or below is less than the dose required for the ML sample.

BIOLOGICAL PHOSPHORUS REMOVAL (BPR) POTENTIAL TESTING RESULTS

The BPR potential bench test was completed by combining primary clarifier effluent (PRE) wastewater from Mount Vernon’s WWTP with return activated sludge (RAS) from a facility that has successfully implemented BPR. A sample containing the WWTP wastewater and BPR facility RAS was compared to a sample containing the WWTP wastewater, BPR facility RAS, and sodium acetate (spiked). The donor RAS used for the test was from Xenia, Ohio, Glady Run WWTP. Tests were completed on both the WWTP influent and primary clarifier effluent, and results of the test are presented in Tables 3 and 4, and Figures 5 and 6.

Time (Minutes)	Jar 1 (Influent)	Jar 2 (Influent Spiked)	Jar 3 (PRE)	Jar 4 (PRE Spiked)
0	5.59	7.61	6.48	6.03
30	6.48	9.57	8.56	8.69
60	7.23	11.30	9.01	10.50
90	7.99	11.50	8.31	10.10
120	7.23	11.80	9.51	11.50

Table 3 BPR Testing Results–Phosphorus Release (TP in mg/L)

Time (Minutes)	Jar 1 (Influent)	Jar 2 (Influent Spiked)	Jar 3 (PRE)	Jar 4 (PRE Spiked)
0	81	110	71	67
60	58	56	63	63
120	61	54	65	50

Table 4 BPR Testing Results–Chemical Oxygen Demand (mg/L)

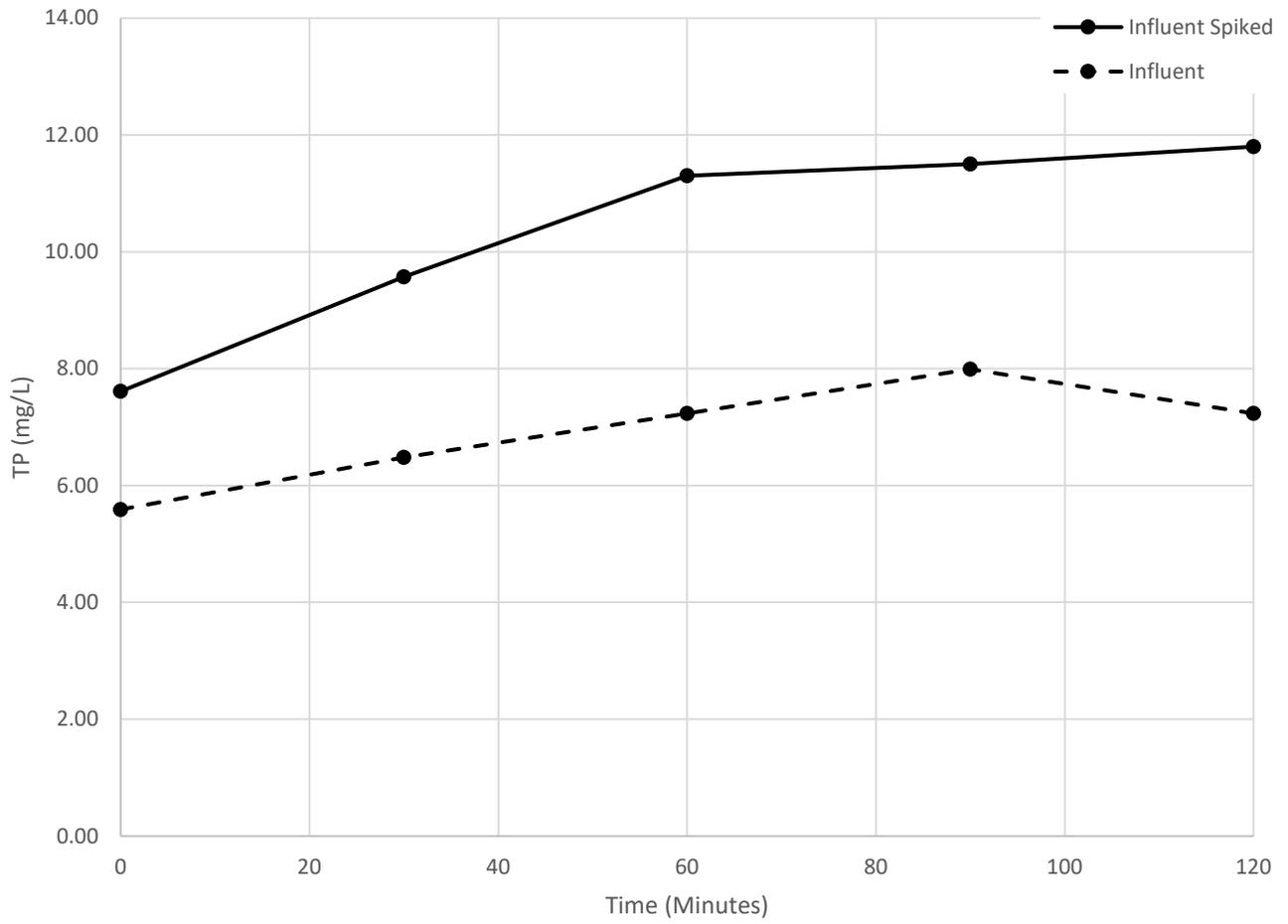


Figure 5 BPR Potential Test Results–Influent

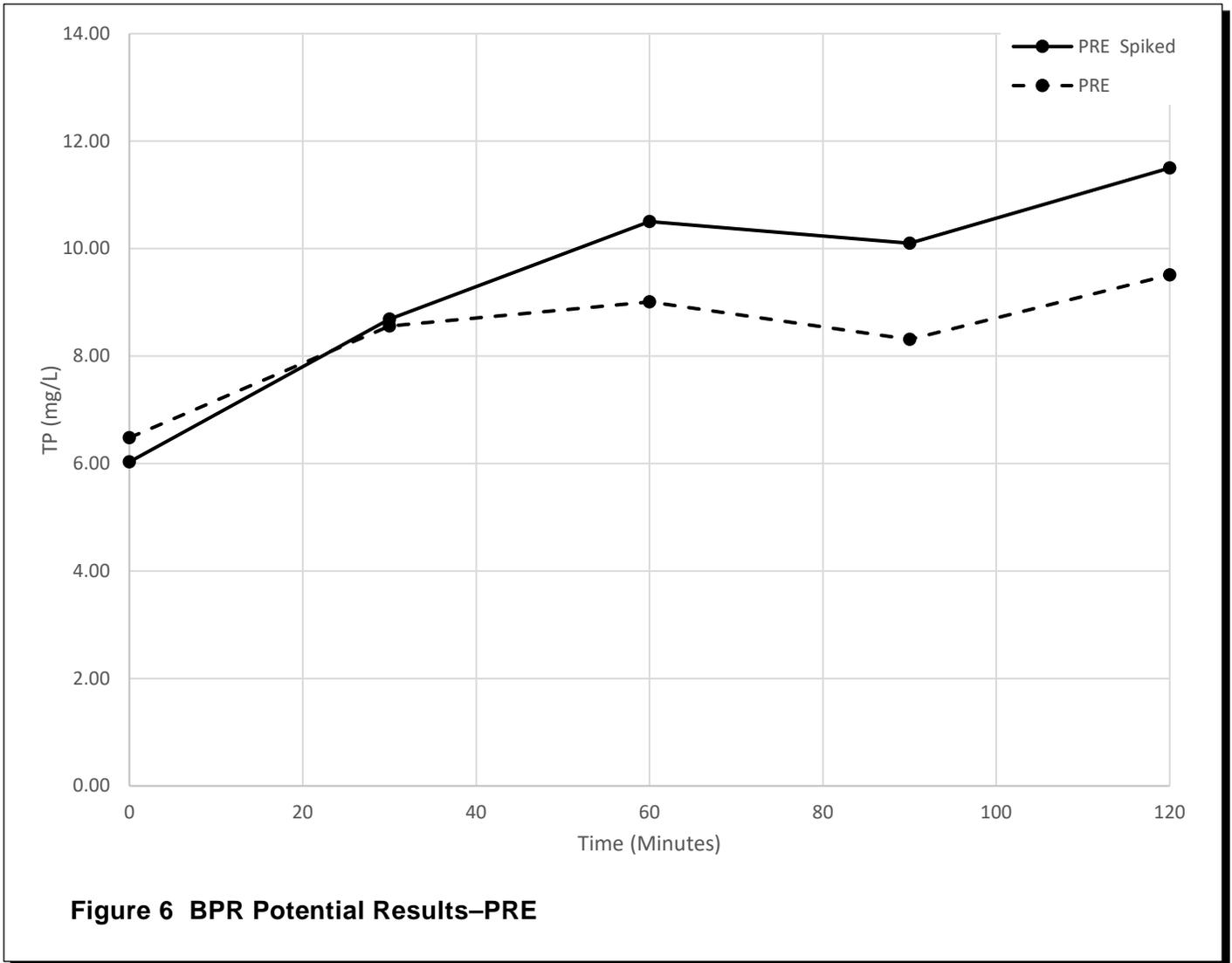


Figure 6 BPR Potential Results--PRE

The test showed a phosphorus release for all samples, but the samples without sodium acetate (not spiked) did not show as much of a release as the samples spiked with sodium acetate. The lower phosphorus release could possibly mean the nonspiked samples were limited on food for the phosphorus accumulating organisms (PAOs).

The influent sample showed a higher phosphorus release when spiked with sodium acetate than the spiked primary clarifier effluent sample. However, the nonspiked primary effluent sample showed more phosphorus release than the nonspiked influent sample, indicating that the WWTP is likely benefitting from fermentation products being formed in the primary clarifiers, ultimately creating an ideal food source for PAOs. Additionally, the rate of phosphorus release plateaued or decreased towards the end of the two hours for the spiked and nonspiked influent samples, meaning that fermentation has probably ceased and the food source for PAOs has been exhausted. Because phosphorus release occurred in both the influent and primary clarifier effluent samples, BPR at Mount Vernon is still feasible. BPR would most likely not be able to lower TP concentrations below 1.0 mg/L by itself and would have to be coupled or supplemented with CPR.

There are additional indicators that help predict BPR performance. The performance of the BPR system will be strongly affected by the characteristics of the wastewater influent to the anaerobic zone. Rules of thumb from successful treatment plants implementing BPR indicate that PRE biochemical oxygen demand (BOD) to TP ratio of 20:1 is sufficient to accomplish BPR. Data from January to September 2016 indicates Mount Vernon has a carbonaceous BOD (CBOD) to TP ratio of 47. Because CBOD is less than or equal to BOD, then the BOD:TP ratio is greater than 20. Other indicators to predict BPR performance include readily biodegradable soluble COD, soluble CBOD and volatile fatty acid concentrations, which give more information on the type and quantity of food available for the PAOs and the suitability of BPR at the Mount Vernon WWTP. Recent data has shown that these indicators average in a low range at the Mount Vernon WWTP, which further demonstrates that BPR, while feasible, is not likely to meet a 1 mg/L effluent limit without some CPR.

APPENDIX B
OPINION OF PROBABLE CONSTRUCTION COSTS

Option PR2: CPR near Primary Sludge Building	
Opinion of Probable Construction Cost	
Item	Cost
Chemical Storage Tanks	\$ 130,000
Heat Tracing and Insulation	\$ 52,000
Concrete Slabs for Tanks	\$ 16,000
Chemical Feed Building	\$ 68,000
Concrete Slab for Building	\$ 15,000
Chemical Feed Equipment	\$ 33,000
Subtotal - Equipment and Structures	\$ 314,000
Site Work	\$ 31,000
Yard Piping	\$ 15,000
Mechanical/Plumbing	\$ 31,000
Electrical	\$ 48,000
Instrumentation and Controls	\$ 30,000
Subtotal	\$ 155,000
Contractor's General Conditions (10%)	\$ 47,000
Subtotal - Construction	\$ 516,000
Technical Services and Contingencies (40%)	\$ 206,000
Subtotal - Capital Costs	\$ 722,000

Option PR3: CPR in Pump and Control Building, Exterior Chemical Storage Tanks	
Item	Cost
Chemical Storage Tanks	\$ 130,000
Heat Tracing and Insulation	\$ 52,000
Concrete Slabs for Tanks	\$ 16,000
Pump and Control Building Modifications	\$ 20,000
Chemical Feed Equipment	\$ 33,000
Subtotal - Equipment and Structures	\$ 251,000
Site Work	\$ 25,000
Yard Piping	\$ 15,000
Electrical	\$ 36,000
Instrumentation and Controls	\$ 30,000
Subtotal	\$ 106,000
Contractor's General Conditions (10%)	\$ 36,000
Subtotal - Construction	\$ 393,000
Technical Services and Contingencies (40%)	\$ 157,000
Subtotal - Capital Costs	\$ 550,000

**Option PR4: CPR in Pump and Control Building, Building Expansion for Chemical Storage Tanks
Tanks Opinion of Probable Construction Cost**

Item	Cost
Chemical Storage Tanks	\$ 130,000
Concrete Slabs for Tanks	\$ 16,000
Pump and Control Building Modifications	\$ 20,000
Chemical Feed Equipment	\$ 33,000
Chemical Storage Building	\$ 160,000
Subtotal - Equipment and Structures	\$ 359,000
Site Work	\$ 25,000
Yard Piping	\$ 15,000
Mechanical/Plumbing	\$ 36,000
Electrical	\$ 48,000
Instrumentation and Controls	\$ 30,000
Subtotal	\$ 154,000
Contractor's General Conditions (10%)	\$ 51,000
Subtotal - Construction	\$ 564,000
Technical Services and Contingencies (40%)	\$ 226,000
Subtotal - Capital Costs	\$ 790,000



Division of Surface Water: *Technical and Financial Capability Study to Reduce Phosphorus*

(Read accompanying instructions carefully before completing this form)

This form may be used by publicly owned treatment works with a design flow of 1.0 million gallons per day or more or otherwise designated as a major by the director and that did not have total phosphorus limits as of July 3, 2015 to fulfill obligations set forth in ORC Section 6111.03 that require a study of the technical and financial capability of the existing treatment works to reduce the final effluent discharge of phosphorus to one milligram per liter using possible source reduction measures, operational procedures, and unit process configurations.

Completion of this form does not take the place of any previously required nutrient related reports. Submit this form to Ohio EPA Division of Surface Water by December 1, 2017.

I. Applicant Information

Facility Name:	Mount Vernon WWTP	Ohio EPA Permit Number:	4PD00100*MD
Outfall Number:	001	Type of Treatment:	Activated Sludge

II. Total Phosphorus Data from the Previous Twelve Months

Select which of the following best describes the numeric total phosphorus concentrations in the influent at your facility:

Monitored as Required by Permit

Include the average monthly effluent concentration for total phosphorus for the most recent twelve months below. Unless you marked "Unknown" above, also include the average monthly influent concentration for total phosphorus as well.

Month	Average Monthly Concentration of Total Phosphorus	
	Influent (mg/L)	Final Effluent Outfall (mg/L)
November 2016	3.80	3.31
December 2016	2.72	2.71
January 2017	3.67	2.07
February 2017	2.69	2.37
March 2017	1.79	2.46
April 2017	0.68	2.31
May 2017	2.63	2.10
June 2017	2.65	2.72
July 2017	3.52	2.42
August 2017	3.76	3.09
September 2017	4.32	3.60
October 2017	5.14	3.10

Based on the above discharge information, does the permittee believe that it is currently able to discharge total phosphorus at or below a one milligram per liter monthly average concentration without any additional changes to treatment processes?

Yes (Continue to Section III) No (Continue to Section IV)

III. Identification of the methods currently used by the permittee to reduce the discharge of total phosphorus to a monthly average concentration of 1.0 mg/L or lower. Identify below a summary of source reduction measures, operational procedures [including biological phosphorus removal], and unit process configurations that have previously been performed and contribute to decreased total phosphorus discharges. Once this section is completed, continue to section VI.

Not Applicable.

IV. Identification of the most economically feasible method(s) to reduce the discharge of total phosphorus to a monthly average effluent concentration of 1.0 mg/L. Complete the following questions to identify which phosphorus reduction methods have been evaluated or attempted and which could be used in the future to reduce the total phosphorus monthly average effluent concentration to 1.0 mg/L or lower.

IV. A. Has **Source Reduction** been evaluated? Yes No

If yes, has Source Reduction been identified as a potentially feasible means to reduce Phosphorus in the effluent?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Have Source Reduction concepts been implemented?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
IV. B. Have Operational Changes been evaluated?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
If yes, have Operational Changes been identified as a potentially feasible means to reduce Phosphorus in the effluent?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Have Operational Changes been implemented?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
IV. C. Have Unit Process Configuration Changes been evaluated?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
If yes, have Unit Process Configuration Changes been identified as a potentially feasible means to reduce Phosphorus in the effluent?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Have Unit Process Configuration Changes been implemented?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
IV. D. Has Additional Treatment (beyond your existing facility) been evaluated?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
If yes, has Additional Treatment been identified as a potentially feasible means to reduce Phosphorus in the effluent?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Has Additional Treatment been implemented?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

IV. E. Include a brief summary as to how the procedures identified above could be performed and/or installed to reduce the total phosphorus monthly average effluent concentration to 1.0 mg/L or lower.

The Mount Vernon WWTP will consider source reduction in their next pretreatment program local limits reevaluation. This is not expected to reduce the effluent phosphorus to below 1.0 mg/L. The next step will be to install two chemical bulk tanks and feed pumps to dose phosphorus removal chemicals (Alum or Ferric) in the primary influent.

V. Economic Information and Total Estimated Costs of Reducing Total Phosphorus Concentrations

Were chemical treatment additives identified in Section IV as part of the most economically feasible method(s) to reduce the discharge of total phosphorus to a monthly average concentration of 1.0 mg/L or lower?

Yes (Continue to Section V.A) No (Continue to Section V.B)

V.A. Economic Information Associated with Chemical Feed

Capital Cost Associated with Chemical Feed:

Chemical Tank Cost:	\$209,000	Pump Cost:	\$102,000
Piping and Dosing Mechanism Cost:	\$42,000	Any Other Expected Capital Costs (e.g.: new building):	\$77,000
Total Associated Capital Costs (summation of the above capital costs):		\$430,000	

Associated Operations and Maintenance (O&M) Cost Associated with Chemical Feed:

Monthly Chemical Cost:	\$20,000	Monthly Labor Costs:	Negligible
Monthly Electric Cost:	\$150	Other Monthly Costs:	None Known

Additional Monthly Costs Associated with Increased Sludge Volumes: [Click here to enter text.](#)

Monthly Associated O&M Costs (summation of the above O&M costs): \$20,150

V.B. Economic Information Associated with Non-Chemical Feed Alternatives

Complete the following information for each option identified in Section IV. Please provide an explanation for the costs (electric cost, labor, etc.) in the column titled 'Reasoning':

TP Reduction Method:	Capital Cost:	Monthly O&M Cost:	Reasoning:
Choose an item.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Choose an item.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Choose an item.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Choose an item.	Click here to enter text.	Click here to enter text.	Click here to enter text.

VI. Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this form and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the form, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Name:	Jason Belcher	Official Title:	Chief Operator
Signature:		Date Signed:	Click here to enter text.

APPENDIX D
CHEMICAL STORAGE TANK QUOTE



200 N. Gooding Street – P.O. Box 160 – Belding, MI 48809-0160
 Phone: (616) 794-1130 Toll Free: (800) 253-4252 Fax: (616) 794-3666
 E-Mail: sales@beldingtank.com Website: www.beldingtank.com

“Quality Is Our Standard...Customer Service Is Our Specialty

Quote# HP0819171BT

Neil Raymond
 The Henry P. Thompson Company
 8980 Technology Drive, Suite 102
 Fishers, IN 46038

Ph: 317-576-6565
 Fx: 317-576-6569

Dear, Neil

We are pleased to provide the following proposal for Fiberglass tanks as fabricated by Belding Tank Technologies, Inc., Belding MI 48809.

- Condition 1:** Ferric Chloride at ambient temperature, atmospheric pressure, and 1.5 specific gravity
- Condition 2:** Alum at ambient temperature, atmospheric pressure, and 1.5 specific gravity

- Quantity:** One (1) model, DW-C-CFV-10-8852, filament wound, flat bottom dome top Double Wall FRP tank built to (ASTM D 3299.)
- Wind Load:** 115 mph wind load design
- Seismic Design:** ASCE 7-10 seismic design: site class D, O.C. II, SDS=0.127 & SD1=0.099.
- Size:** 120" diameter X 180" straight side X 201" overall height.
- Capacity:** 8,852-US gallons
- Material:** Premium grade vinyl ester resin Derakane 441-400 in the corrosion barrier and isophthalic polyester in the structural filament wound layer.
- Veil:** Single C glass
- U.V.** U.V, Absorber required in exterior resin layer.
- Support:** Tank rests on fully supported flat foundation. Tank to be installed per Belding Tank Technologies Handling & Installation Instructions.
- Lugs:**
 - 4 Standard heavy powder coated mild steel lifting lugs.
 - 4 Standard heavy powder coated mild steel hold down lugs.

- Nozzles:**

<ul style="list-style-type: none"> 1 8" Flange. 1 2" Flange with plate gusset. 1 3" Side bottom flange with plate gusset 1 3" Siphon flange with plate gusset. 1 4" Flange with plate gusset 1 3" FRP half coupler 1 2" FRP half coupler 1 1" FRP half coupler 6 FRP pipe support brackets 1 24" Top manway with stainless steel bolts, EPDM gasket 1 24" Side manway with stainless steel bolts, EPDM gasket 	<ul style="list-style-type: none"> Vent Nozzle Fill Nozzle Drain Nozzle Discharge Nozzle Overflow Nozzle Level Nozzle Vent Drier Nozzle Interstitial Nozzle Top Manhole Side Manhole
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- Budget Price:** One (1) model, DW-C-CFV-10-8852 - \$37,000.00 plus freight & options



200 N. Gooding Street – P.O. Box 160 – Belding, MI 48809-0160
 Phone: (616) 794-1130 Toll Free: (800) 253-4252 Fax: (616) 794-3666
 E-Mail: sales@beldingtank.com Website: www.beldingtank.com

“Quality Is Our Standard...Customer Service Is Our Specialty

Optional Equipment:

- Ladder:** 1 FRP Ladder assembly with mounting lugs
Budget Price: \$4,900.00
- Top Handrail:** 1 FRP top handrail with step off platform
Budget Price: \$6,400.00
- Insulation:** 1 2” Polyurethane foam insulation with FRP over wrap and gray exterior gel coat.
Budget Price: \$11,400.00
- Heat panels:** 6 400 Watt, 120-volt heat panels with (1) NEMA 4X control box to maintain 50 degrees F. product temperature-20 degrees F. ambient temperature.
Budget Price: \$11,200.00
- Air Filter:** 1 Drierite Model #105 desiccant air filter with 2” pipe support (Piping by customer)
Budget Price: \$1,400.00
- Leak Detection:** 1 Leak detection system with visual indicating alarm module and FRP Bracket
Budget Price: \$2,700.00

- Condition 1:** Ferric Chloride at ambient temperature, atmospheric pressure, and 1.5 specific gravity
 - Condition 2:** Alum at ambient temperature, atmospheric pressure, and 1.5 specific gravity
 - Quantity:** One (1) model, DW-C-CFV-12-8537, filament wound, flat bottom dome top Double Wall FRP tank built to (ASTM D 3299.)
 - Wind Load:** 115 mph wind load design
 - Seismic Design:** ASCE 7-10 seismic design: site class D, O.C. II, SDS=0.127 & SD1=0.099.
 - Size:** 144" diameter X 120" straight side X 144" overall height.
 - Capacity:** 8,537-US gallons
 - Material:** Premium grade vinyl ester resin Derakane 441-400 in the corrosion barrier and isophthalic polyester in the structural filament wound layer.
 - Veil:** Single C glass
 - U.V.** U.V. Absorber required in exterior resin layer.
 - Support:** Tank rests on fully supported flat foundation. Tank to be installed per Belding Tank Technologies Handling & Installation Instructions.
 - Lugs:** 4 Standard heavy powder coated mild steel lifting lugs.
 4 Standard heavy powder coated mild steel hold down lugs.
 - Nozzles:**
 - 1 8” Flange.
 - 1 2” Flange with plate gusset.
 - 1 3” Side bottom flange with plate gusset
 - 1 3” Siphon flange with plate gusset.
 - 1 4” Flange with plate gusset
 - 1 3” FRP half coupler
 - 1 2” FRP half coupler
 - 1 1” FRP half coupler
 - 6 FRP pipe support brackets
 - 1 24” Top manway with stainless steel bolts, EPDM gasket
 - 1 24” Side manway with stainless steel bolts, EPDM gasket
 - Vent Nozzle**
 - Fill Nozzle**
 - Drain Nozzle**
 - Discharge Nozzle**
 - Overflow Nozzle**
 - Level Nozzle**
 - Vent Drier Nozzle**
 - Interstitial Nozzle**
 - Top Manhole**
 - Side Manhole**
- Budget Price:** One (1) model, DW-C-CFV-12-8537 - \$38,000.00 plus freight & options



200 N. Gooding Street – P.O. Box 160 – Belding, MI 48809-0160
Phone: (616) 794-1130 Toll Free: (800) 253-4252 Fax: (616) 794-3666
E-Mail: sales@beldingtank.com Website: www.beldingtank.com

“Quality Is Our Standard...Customer Service Is Our Specialty

Optional Equipment:

- Ladder:** 1 FRP Ladder assembly with mounting lugs
Budget Price: \$3,800.00
- Top Handrail:** 1 FRP top handrail with step off platform
Budget Price: \$6,600.00
- Insulation:** 1 2” Polyurethane foam insulation with FRP over wrap and gray exterior gel coat.
Budget Price: \$11,200.00
- Heat panels:** 6 400 Watt, 120-volt heat panels with (1) NEMA 4X control box to maintain 50 degrees F. product temperature-20 degrees F. ambient temperature.
Budget Price: \$11,200.00
- Air Filter:** 1 Drierite Model #105 desiccant air filter with 2” pipe support (Piping by customer)
Budget Price: \$1,400.00
- Leak Detection:** 1 Leak detection system with visual indicating alarm module and FRP Bracket
Budget Price: \$2,700.00

Estimated Freight: From Belding, MI to Columbus, OH is \$2,900.00 total for 1 – 10’ Diameter tank on 1 load.
From Belding, MI to Columbus, OH is \$4,100.00 total for 1 – 12’ Diameter tank on 1 load.

- F.O.B.** Belding Michigan
Terms: 25% down payment, balance net 30 days, subject to credit approval.
Drawings: 10-15 working days after receipt of purchase order and general nozzle orientation.
Production: 9-11 weeks after drawings have been approved and released for production.
Shipment: Following production completion, delivery arrangements will be made with the “Ship To” contact. Shipment is subject to change, due to availability of materials and /or prior sales commitments.

Unless otherwise specifically stated, acceptance of this proposal shall be in accordance with Belding Tank Technologies, Inc. Form “TC100 titled Standard Terms and Conditions of Sale and Trade Customs”.

Note: Prices and terms are valid for 30 days.

This proposal DOES NOT include any of the following unless specified.

- A. Unloading or installation of equipment or any required permits.
- B. All flexible expansion joints, fasteners and gaskets.
- C. Any electric instrumentation and secondary piping hook up.
- D. Testing such as: Hydrostatic, Physical Property Testing, A/E Testing, Etc.
- E. Any local, state, or federal taxes.

Please include a written SALES AND USE TAX EXEMPTION CERTIFICATE or indicate TAX STATUS on the purchase order.

In the event of an order, please issue the purchase order to:

Belding Tank Technologies
C/O Chemical Containment Solutions.
200 North Gooding Street
Belding, MI 48809-0160
Fax: 616-794-3666

Thank you for your continued interest in Belding Tank Technologies, Inc.
Sincerely,

Christopher D. Garn

FILAMENT WOUND / CONTACT MOLDED FRP TANKS, SCRUBBERS, AND CUSTOM FABRICATIONS.

APPENDIX E
FINANCIAL IMPACT SUMMARY

Without Accounting for Changes from Project	
2017 Wastewater Revenue	\$2,728,700
2020 Projected Revenue (2.2% Inflation)	\$2,912,785
2017 Wastewater O&M Expenses	\$2,503,028
2017 Debt Load	\$403,201
2017 Wastewater Expenses	\$2,906,228
2020 Projected Expenses (2.2% Inflation)	\$3,075,089
Accounting for Changes from Project	
Annual PRC Expense	\$237,500
Other Annual Additional O&M Expense	\$40,000
Capital Cost Loan	\$11,282,000
Loan Interest Rate	1.79%
Loan Term (years)	20
Annual Debt Service	\$676,260
Annual O&M and Loan Expenses Increase/Decrease	+\$953,760
Net 2020 Expenses	\$4,028,849

Without Project	
2020 Windfall/Shortfall	-\$162,304
Necessary Revenue Increase	5.6%
With Project	
2020 Windfall/Shortfall	-\$1,116,063
Necessary Revenue Increase	38.3%