pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Point and Non-Point Source Management
Technical Assistance Program

ENHANCED TECHNICAL ASSISTANCE EVALUATION

PA DCNR – Presque Isle State Park
Wastewater Treatment Plant

Millcreek Township, Erie County

NPDES #PA0032549

The Pennsylvania Department of Environmental Protection (DEP) conducted an Enhanced Technical Assistance Evaluation (ETAE) of the Presque Isle State Park (PI) wastewater treatment plant (WWTP) from May 2013 through September 2013. An ETAE is an evaluation of existing operations and practices followed by small-scale operational changes meant to optimize effluent quality. The purpose for optimizing effluent quality is to reduce nutrients in the final effluent, with an overall goal of improving surface water quality. The ETAE was performed by staff of DEP's Bureau of Point and Non-Point Source Management (BPNSM), Technical Assistance Section.

This project was conducted at the request of the Erie County Department of Health, DEP Regional Office staff, and staff from PI due to chronic effluent violations for Total Phosphorus and occasionally for Total Suspended Solids over the past several years. The PI plant has traditionally faced challenges during startup of the yearly operations in May and fluctuations throughout the operating season due to high weekend usage with a significant drop in flow during weekday operations.

PI owns a sewage treatment plant (treatment plant) and collection system that serves the state park facilities under National Pollutant Discharge Elimination System (NPDES) Permit No. PA0032549. There has been some discussion of connecting the existing sewage collection system into the municipal sewage system located near the park entrance.

The current treatment plant consists of a comminutor, influent holding tank, one sequencing batch reactor (SBR) plant, aerated sludge holding tank, and chlorine contact tank. The plant design flow is 0.03 MGD and the design loading is 63 lbs./day BOD_5. There are provisions for automatic feeding of chemical to aid in phosphorus reduction.

Findings

1. The operator at the wastewater plant was very knowledgeable with plant operations and worked to ensure the facility was producing the highest quality effluent possible considering the varying influent characteristics.

2. The operator faces significant challenges during the May startup period since the plant is not seeded with a healthy biomass.
    a. Recommendation- The plant should be seeded in the future prior to initiating operations in May of each year.

3. There is no influent flow data available.
    a. Recommendation- For 2014, staff should track influent flows to the treatment facility. Where possible, this could be done using timers on the pumps at lift stations.

4. There is limited data available on influent waste characteristics.
    a. Recommendation- For 2014 and on, staff should sample raw sewage for BOD, Ammonia Nitrogen TKN, and Phosphorus on a routine basis so the operator has information available for running the plant. Increased levels of a particular parameter could necessitate adjustments to the treatment process.

5. The waste treatment facility manufacturer can provide operational assistance.
    a. Recommendation- Park staff should request operator assistance from Aqua Aerobic systems prior to starting the plant up for the next season in May 2014.

6. The weekend flows are significantly higher than weekly flows. The influent equalization tank worked much like a holding tank with a high and low level float. The tank filled and pumped to the SBR upon hitting the high level float and shut off once reaching the low level float. It did not function to equalize the flow. Some modifications to the influent piping have helped alleviate the slug flows.

7. The operations of the wastewater plant for the 2013 operating year resulted in reductions of Total Phosphorus- 87%, NH_3-N- 41%, CBOD- 35%, and TSS- 24% compared to data for the 2012 operating year.

8. Influent Ammonia levels are very strong. Sampling data indicates the average influent ammonia level at 73 mg/L. (Average residential sewage is in the 25-30 mg/L range.) Phosphorus levels are also slightly high at 7.5 mg/L.

9. The two main limiting factors appear to be DO and pH control. With the strong, varying waste streams and current limited resources, it is likely during 2014 the operator with be faced with the same challenges as in 2012.
    a. Recommendation- The addition of on-line process monitoring equipment to monitor DO, pH, and ORP would allow the operator to effectively manage the treatment process resulting in an improved effluent discharge to Presque Isle Bay and potential reduced energy costs.

10. There is a need for improved pH control in the treatment process.
    a. Recommendation- The addition of an automated chemical feed system would help alleviate the wide variations in pH and should dramatically improve the stability and efficiency of the treatment process.

During plant startup in May the plant was not “seeded”. Seeding involves bringing in healthy biomass to encourage the growth of nitrifying bacteria. Without seeding the plant, it will be very challenging to startup the facility considering the strong influent wastewater. While there was no specific testing done during this project to identify the source of the ammonia, it is suspected that the marina area pump station could be a source. Since there are other bathhouses with holding tanks that are connected to the collection system there are other sources for the ammonia. Raw wastewater contains both organic and ammonia nitrogen. The organic nitrogen can convert to ammonia nitrogen as a result of biological decomposition, septic conditions in parts of the collection system. A way to combat this condition would be to adjust floats in holding tanks to have them empty the contents more frequently and/or seek out and eliminate septic conditions in the collection system. If the cause of the high ammonia levels were narrowed to the marina pump station then possibly something as simple as aerating the contents of this lift station would aide in minimizing ammonia levels, albeit the waste from boats will be similar to holding tank waste which tends to be higher in ammonia.

During the ETAE project it was noted that the flows to the SBR varied significantly from weekday to weekend. The influent equalization tank acted more like a holding tank with pumps turning on at a preset level and off at another preset level. Since there was existing piping for decanting the sludge holding tank, a decision was made to utilize the same piping on a continual basis to return a portion of the influent flow that had gone directly to the SBR unit. This return of influent flow allows the holding tank to function more as an equalization tank which will allow the operator some flexibility in flattening the spikes that are typical for weekend flows.

Currently the air is introduced through the aspirator valve on top of the floating mixer in the SBR. When this valve opens, air is introduced into the biomass. This valve opens or closes fully each time regardless of the volume of air needed in the treatment process. The operator could add some flexible tubing to the aspirator valve and a ball valve mounted to the railing area to give more control over the amount of air provided to the treatment process. Over aeration of the mixed liquor can have the negative effect of shearing floc particles, preventing them from settling, and leading to excess solids in the discharge. Excess floc in the effluent generally contributes to excess phosphorus in the effluent. Chemical addition is used to control the phosphorus levels and additional chemical is needed when excess floc, or solids, are present in the effluent. Additional chemical usage represents additional operational costs. The Dissolved Oxygen (DO) levels, at times, can reach as high as 11 mg/L which is significantly higher than necessary for effective treatment, see Figure 1 below. Better control of the excess DO levels will also help to minimize the current wasted energy costs. The DO level would best be monitored and adjusted using on-line process monitoring equipment similar to that used during the ETAE.

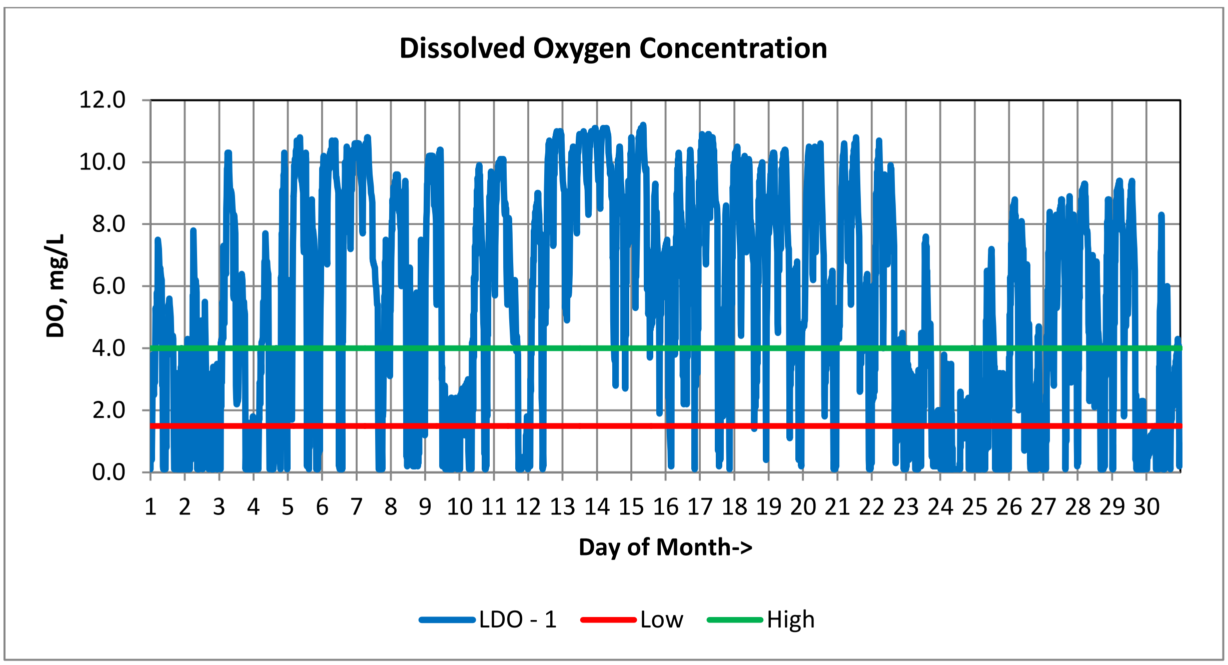

Figure 1: June 2013 Dissolved Oxygen levels in the SBR.

The reduced oxygen levels, depicted in Figure 2, lead to increases in ammonia and excess oxygen contributes to reduced ammonia levels. It is important to note that increased ammonia levels occur during or within 24hrs of a weekend.

Oxidation Reduction Potential (ORP) levels were monitored along with the DO levels. DO and ORP levels tend to follow each other, generally both increase and decrease together. ORP is measured with a probe similar to a pH probe. During the ETAE, ORP levels near 250mV or higher coincided with the lowest ammonia levels. This is depicted in Appendix D, Figure 2.

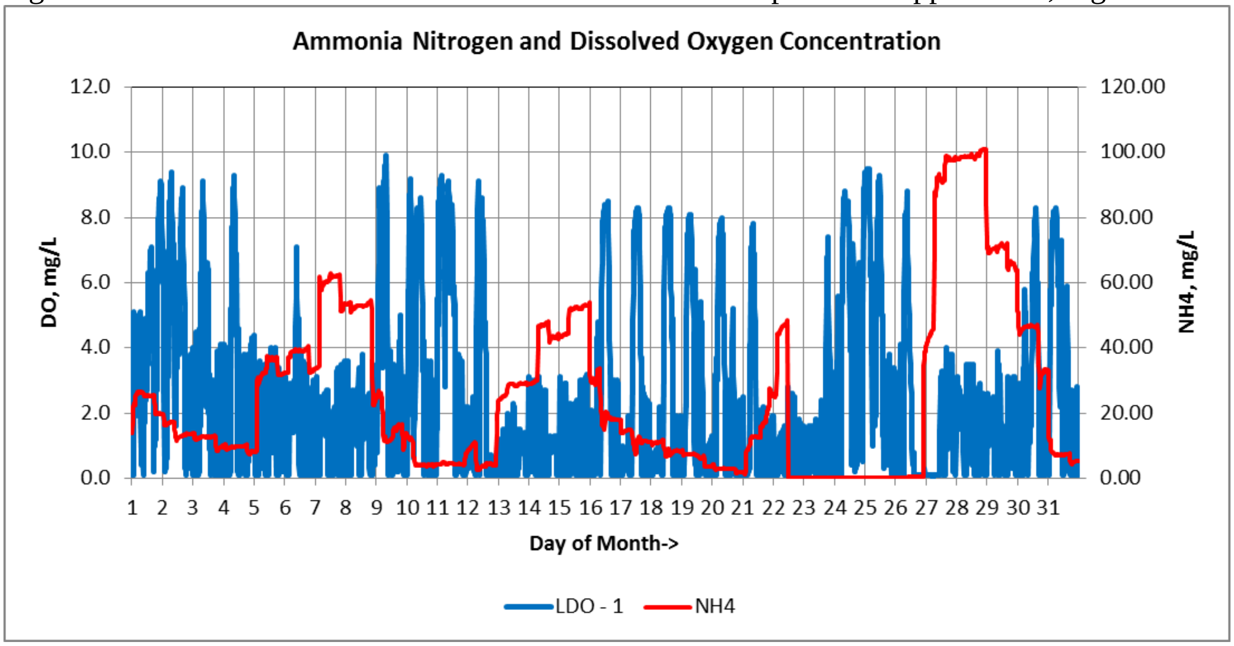

Figure 2: This figure shows the Dissolved Oxygen (DO) in relation to the NH4 levels during July. The NH4 levels depicted here are from an ammonia trending device and do not actually depict the actual concentrations. However they do effectively demonstrate the effect of oxygen, or lack thereof, on the resulting nitrification efficiency and ammonia in the treated wastewater.

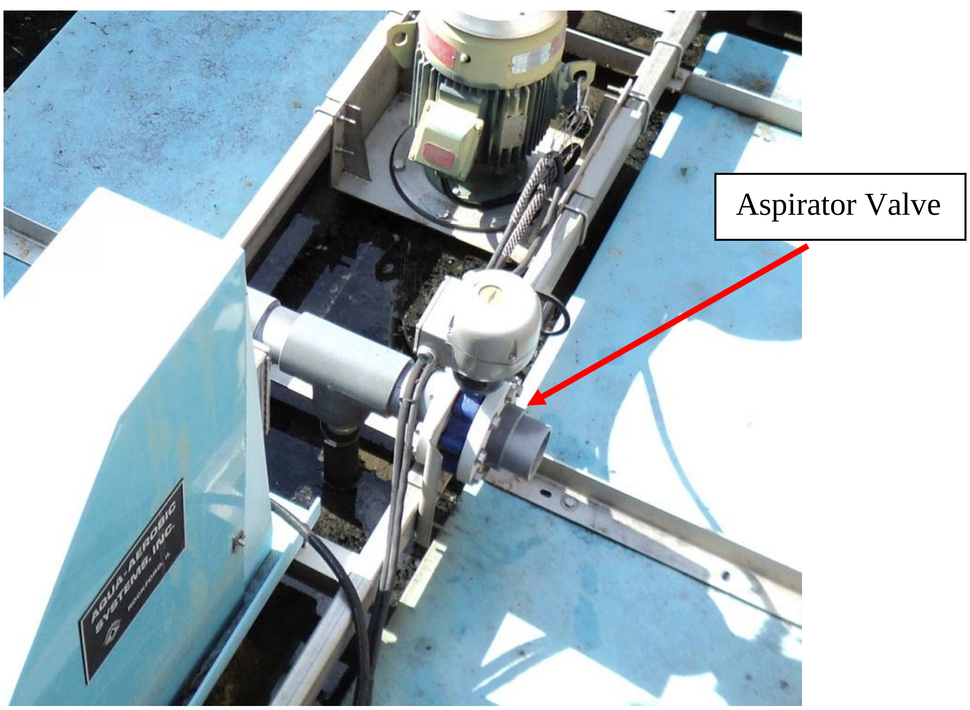

Figure 3: Photo of the aspirator valve on the SBR unit. A more defined control of this valve will allow the operator to better control the DO levels in the basin.

The pH values in the SBR unit fluctuate frequently as seen in the graph below. Nitrifying bacteria generally prefer a pH range of 7.5 to 8.5. Should the pH vary significantly as seen in the graph below, then the nitrification treatment process is impacted. The pH is currently controlled by a manual soda ash addition; the spikes on the chart below are when the soda ash is added. The pH then drops as its effects diminish. The park should consider installing a system that is fed automatically to maintain a steady pH level.

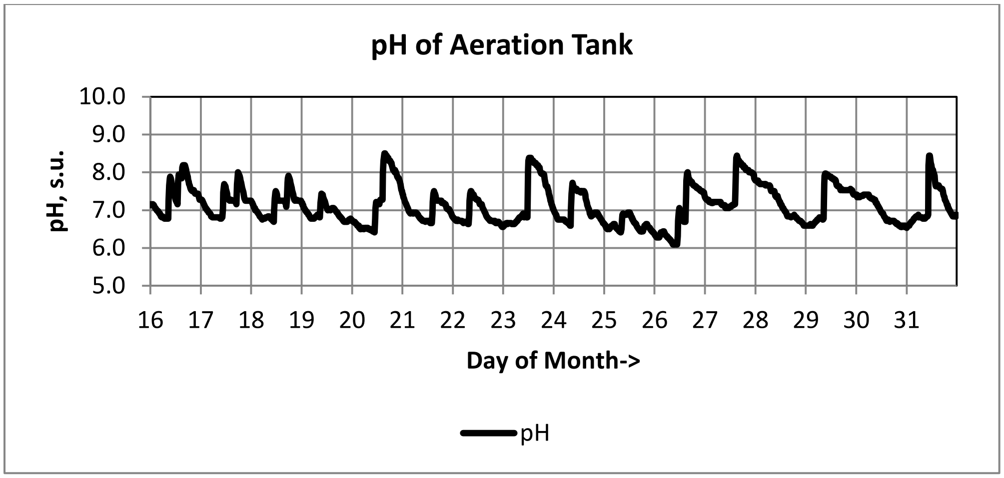

Figure 4: pH levels in the aeration basin during the month of August 2013.

Figure 5: Chlorine contact tank area with nitrate and ammonia probes installed.

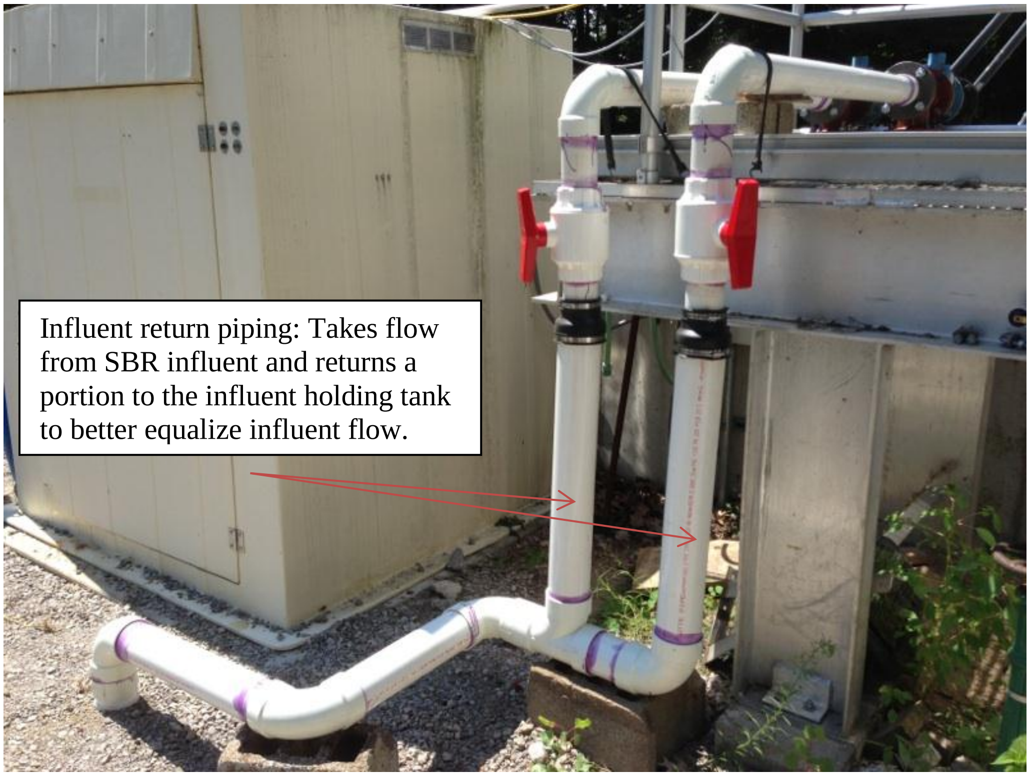

Figure 6: Influent return flow piping to more effectively equalize influent flow from the holding tank.

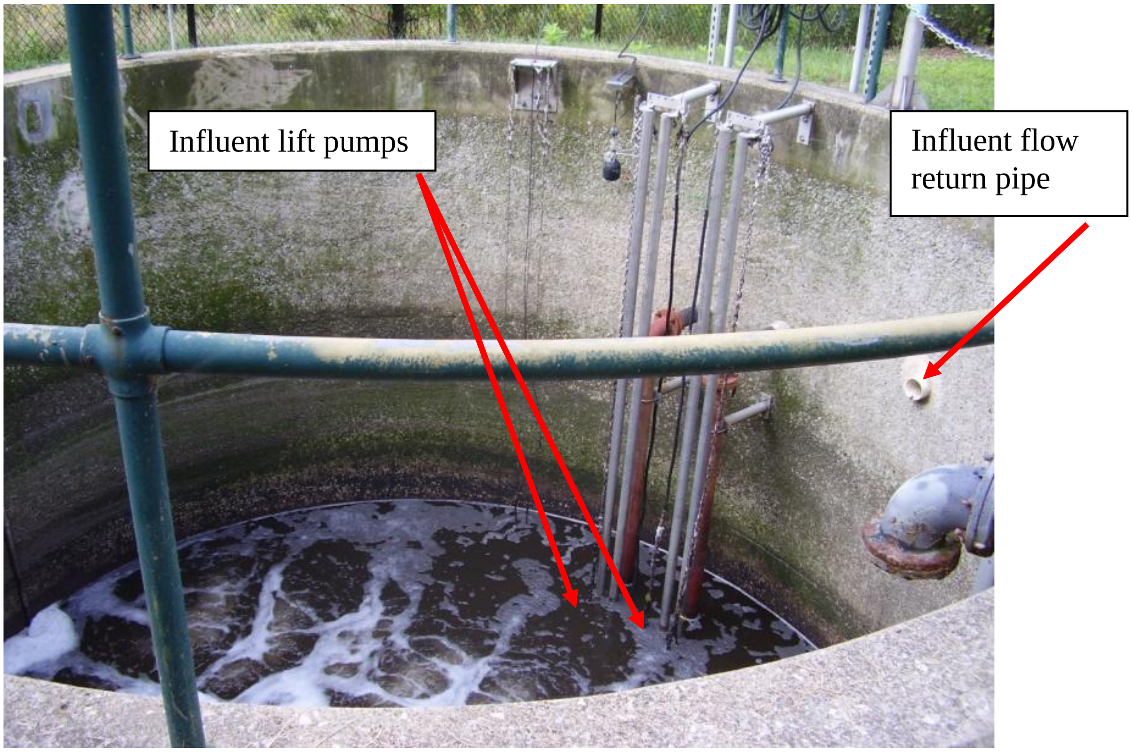

Figure 7: Influent holding tank controlled by high/low level floats.

Flows at the wastewater plant vary significantly from weekday to weekend due to the increased amount of visitors to the park as shown on the graph below. The green lines on Figure 8, below, indicate weekends and directly correlate to increases in flow. Increases in flow appear to be more related to increased activity than rainfall.

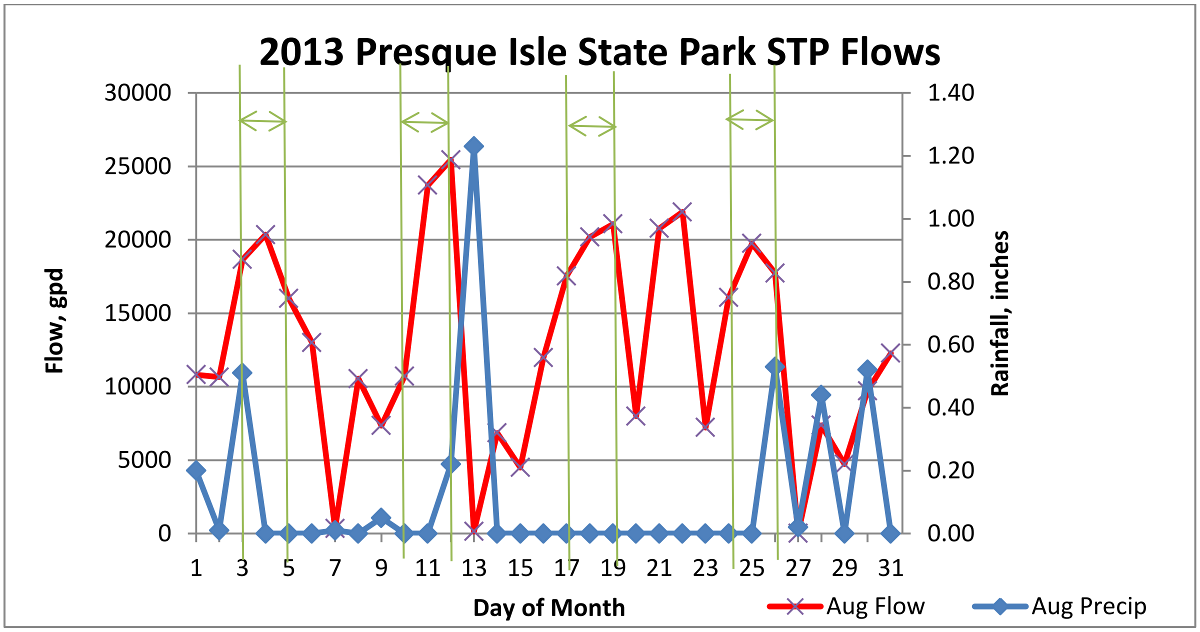

Figure 8: July 2013 wastewater plant flows.

Permit Modifications— Any modifications to the permitted treatment process may require an amendment to the Water Management Permit. If you are unsure whether a permit modification is necessary, please contact the Erie County Department of Health and/or DEP prior to making any modifications.

Disclaimers:
The mention of a particular brand of equipment is in no way an endorsement for any specific company. DEP urges the permittee to research available products and select those which are the most applicable for its situation. The goal of the Enhanced Technical Assistance Evaluation is to reduce nutrients in wastewater plant discharges. This often times involves permittees achieving effluent quality above and beyond any permit requirements.

Attachment A— ETAE Team

PI Wastewater Treatment Plant

ETAE Team

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Attachment B— Equipment Deployed

Digital, Continuously Monitoring Probes

Laboratory Equipment On-Loan

Digital, Continuously Monitoring Probes:

1 – Laptop computer with signal converter, 2 – SC1000s, 1 – LDO probes, 1– pH probe, 1 – ORP probes, 1 – NH_4D, 1 – Nitrate Probe, 1 – Solitax probe

Laboratory Equipment On-loan:

1 – Hach HQ40d handheld pH and LDO meter, 1 – DR2800 spectrophotometer, TNTplus test vials for measuring Nitrate-LR, Ammonia-LR, and Alkalinity

Figure B.1: Photo showing example of online monitoring equipment installed at the PI plant.

Figure B.2: Photo showing example of online monitoring equipment installed in the SBR at the PI plant.

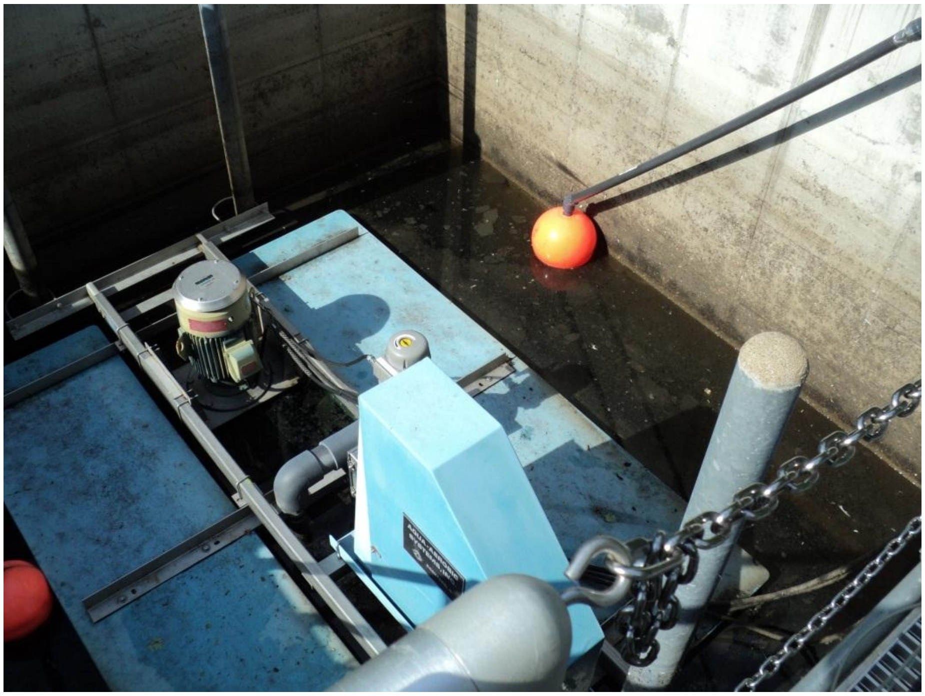

Figure B.3: Photo showing example of online monitoring equipment installed in the SBR at the PI plant.

Attachment C— Sampling Data

Presque Isle Lab Results

EFFLUENT										
Date	**CBOD**	**TSS**	**ALK**	**NH3-N**	**CHL**	**NO3**	**NO2**	**pH**	**Phos**	**Fecal**
6/28/2012	7.6	14							5.991	
6/28/2012										20
7/10/2012	19.9	45							7.126	90
7/16/2012		16							6.801	30
7/24/2012		44								880
8/7/2012	18.2	28							7.437	20
8/21/2012	7.1	21		16.53					6.288	40
9/24/2012	10	13							4.446	20
Average	12.6	26		16.53					6.348	157
6/3/2013	3.7	6		2.53					0.14	
6/18/2013	7.6	20								
6/24/2013	5.5	11		11.39					0.273	
8/5/2013	10.4	30		8.67					1.2	
8/19/2013	13	36		11.88					1.453	
9/7/2013	9.1	18	541.2	14	137.3	51.79	0.38	8.4	1.123	
9/30/2013		18								
9/30/2013		18								
Average	8.2	20	541.2	9.69	137.3	51.79	0.38	8.4	0.838	
2012 - 2013 reduction	35%	24%		41%					87%	

INFLUENT									
Date	**BOD**	**TSS**	**ALK**	**NH3-N**	**CHL**	**NO3**	**NO2**	**pH**	**Phos**
6/22/2012		110	341.2	64.03				7.6	6.724
6/28/2012	52.9	86	300.8	72.07	58.9	0.18	0.87	8	5.763
7/10/2012	61.2	92	377	79.23	73.3	0.04	1.25	8.1	8.096
7/16/2012		64	338.4	62.64	65.6	0.04	0.04	8.1	6.676
7/24/2012	59.3	118	381.6	70.45	73.2	0.04	0.06	8.1	7.488
8/7/2012	75.5	118	389.2	80.5	76.7	0.04	0.07	8.2	8.752
8/21/2012	75.8	96	411.6	83.01	75.4	0.04	0.01	7.9	9.043
Average	64.9	98	362.8	73.13	70.5	0.06	0.38	8.0	7.506

Table C.1: This table shows results of influent and effluent sampling data compiled by DCNR staff.

Attachment D— Continuous Monitoring Charts

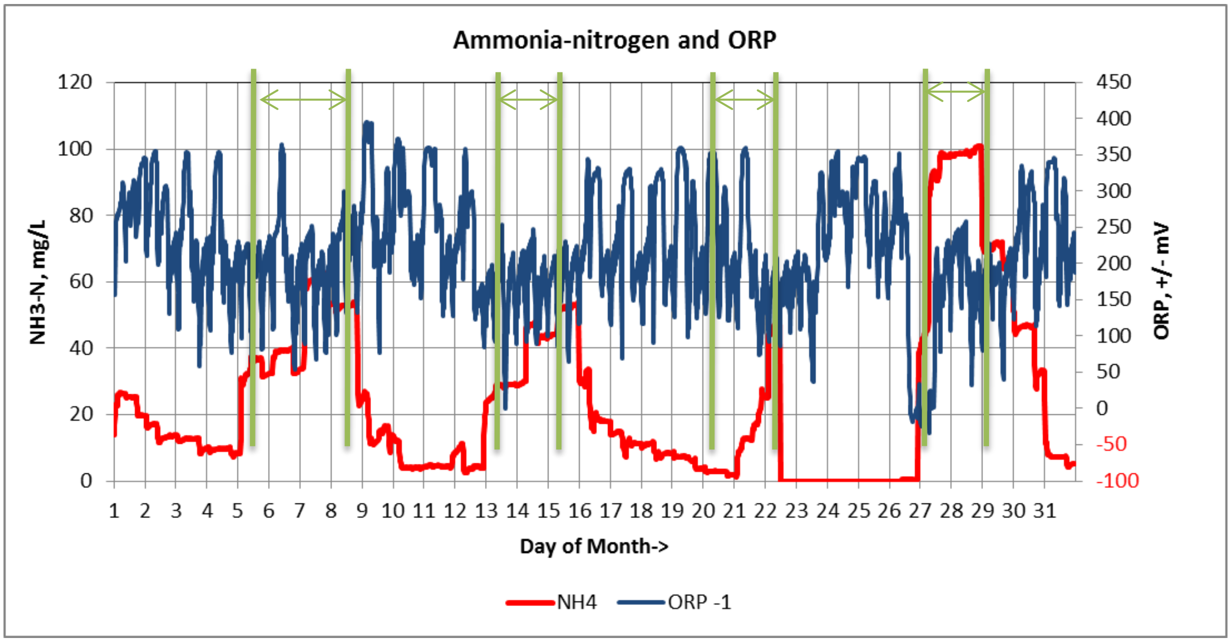

Figure D.1: This figure shows nitrification and ORP during the month of July. ORP levels of 250mV and above coincide with the most reduction in ammonia levels.

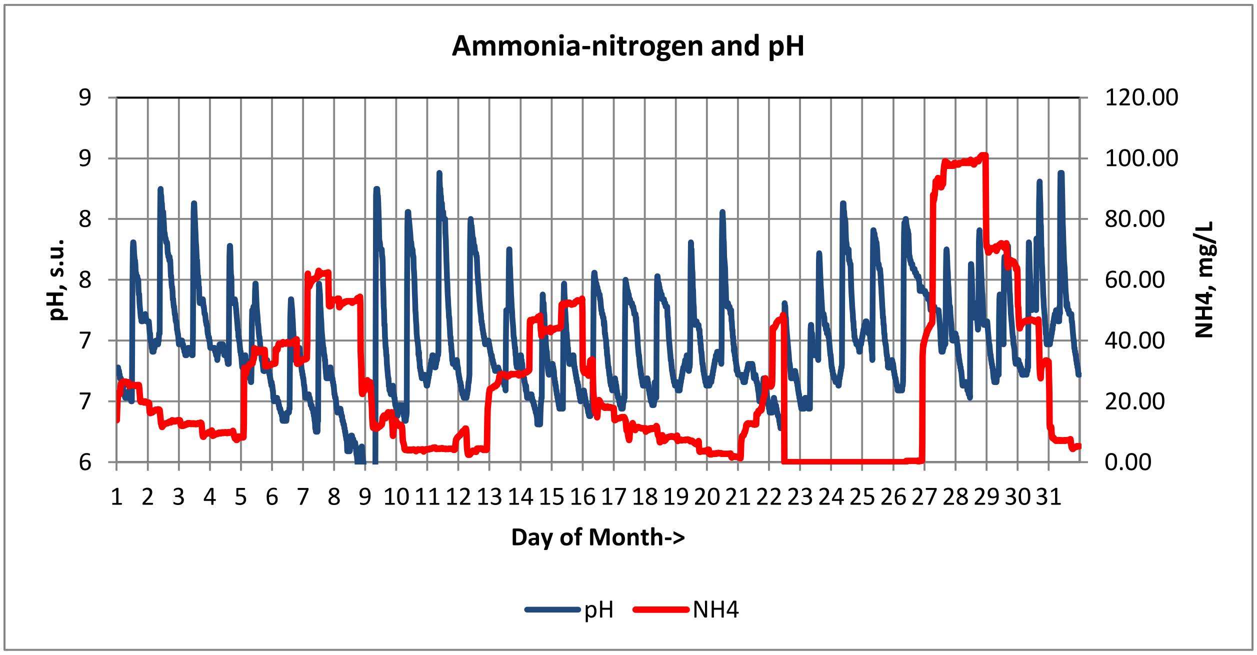

Figure D.2: This figure shows nitrification and corresponding pH levels during July. The higher pH levels generally correlate to the lower levels of ammonia and low pH levels correspond to higher ammonia levels.

Attachment E—NPDES Effluent Discharge Limits

PI Sewage Treatment Plant
NPDES PA0032549

Discharge Parameter	Effluent Limitations						Monitoring Requirements	
	Mass Units (lbs/day)		Concentrations (mg/L)					
	Average	Maximum	Minimum	Monthly Average	Weekly Average	Instantaneous Maximum	Minimum Measurement Frequency	Required Sample Type
Flow (MGD)	xx						1/week	Measured flow
$CBOD_5$				25		50	2/month	8-hr comp
Total Suspended Solids				30		60	2/month	8-hr comp
Phosphorus				1.0			2/month	8-hr comp
Total Residual Chlorine				0.5		1.2	1/week	Grab
pH			6.0			9.0	1/week	Grab
E. Coli			126/100 ml as a geometric average				2/month	Grab

Table E.1: PI- NPDES effluent limitations