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memorandum

Date: June 23, 2016

To: Brian Vick, Township Manager

cc: Jacob Rushlow, PE, OHM
Tom High, IA

From: Ken Arnold, PE and Sherri Wright, PE – OHM Advisors

Re: Brighton Township – Additional Flow at WWTP
Monthly Operating Data – Expanded and Updated Analysis

Introduction
This memo provides an update to our previous memo dated June 1, 2016. The previous memo analyzed a limited window of monthly operating data provided to us for a time period of December 1, 2015 through April 30, 2016. This update incorporates additional data for the time period of January 1, 2010 to May 31, 2016 that was not previously available. Data from January 1, 2007 through May 31, 2016 was provided by Infrastructure Alternatives (IA) for review by OHM in regards to the unexplained additional flow increase witnessed at the wastewater treatment plant.

The data was reviewed for average flow at the plant, as well as loadings and concentrations for BOD5. TSS, NH3-N and Total Phosphorus were also plotted in regards to loadings. Additionally, OHM reviewed the average concentrations and loadings for each wastewater characteristic prior to and after January 9, 2016, which is the date that flows began to increase.

Summary
Our analysis of flow data and the wastewater nutrient data (BOD5, Total Suspended Solids, Total Phosphorus and Nitrogen) over the time frame of January 1st, 2015 to May 31st, 2016, indicates that in most cases the nutrient concentration has dropped significantly; while the loadings at the WWTP have increased in a manner that is not proportional to the additional flow. If the source(s) of the increased WWTP flow was purely sanitary, the increase in nutrient loading would be expected to increase in a proportional manner. If I/I were the sole contributing factor to flows, loadings at the plant would be expected to remain fairly constant while concentrations decreased. The disproportionate increase in nutrient loading and decrease in concentrations suggests that both I/I and sanitary sources may be contributing to the increase in flows at the WWTP. However, the data tends to support the conclusion that a significant and possibly a majority of the increased flow is due to clean water sources (I/I).

Current and Recommended Activities
We understand that one source of ground water infiltration has been identified in a manhole near a wetland and repairs are underway. We also understand that additional field investigations are planned around that same area of the sewer system to locate other possible infiltration sources. Given this information, we recommend that the WWTP flow continue to be monitored as sources of I/I are found and repaired. If flows remain elevated after I/I repairs are made we further recommend that additional investigations, possibly including additional manhole inspections, smoke testing, and flow metering to locate high I/I areas, are considered to help locate the sources of increased flow.

Annual Average Wastewater Characteristics

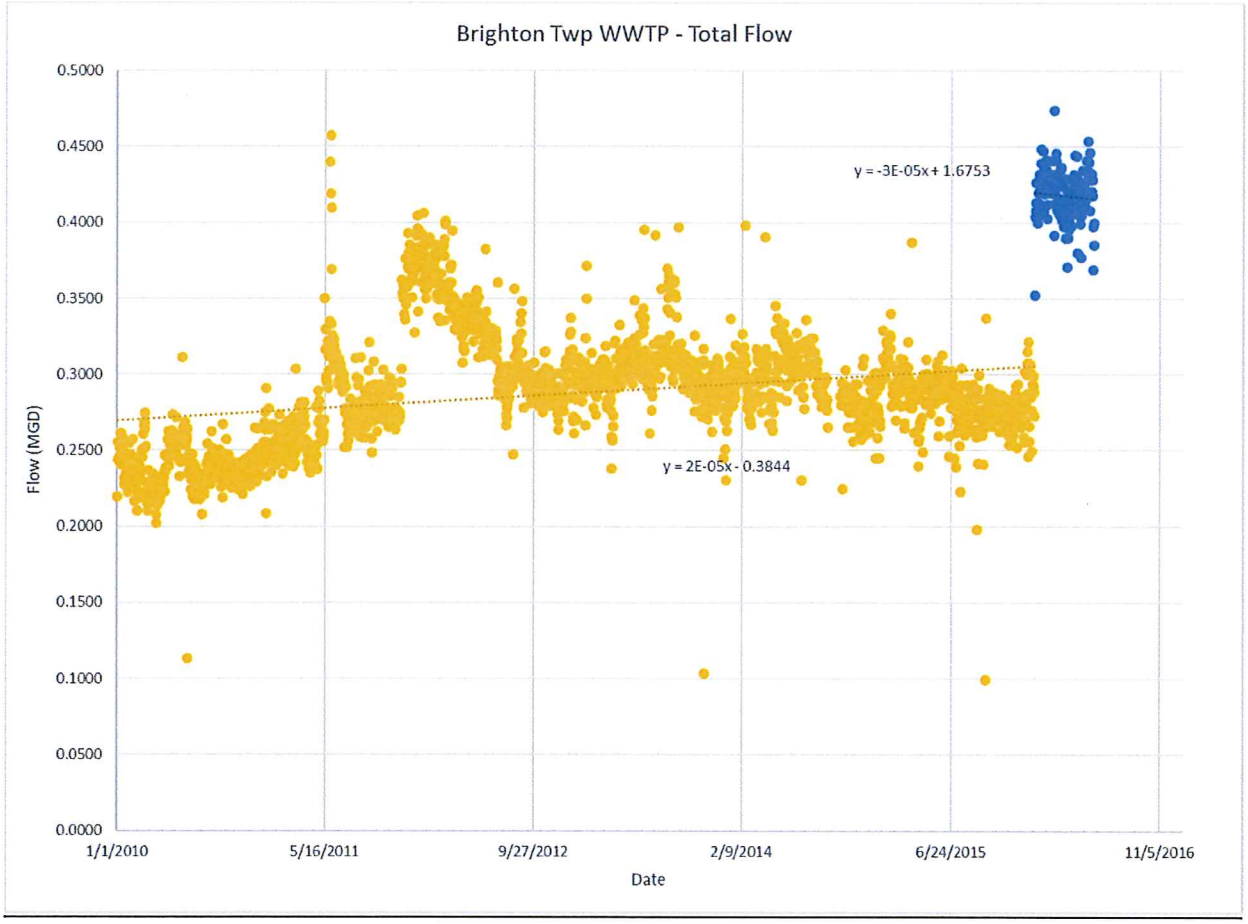
A summary of the average flow and nutrient characteristics are shown in the below table. Data was analyzed for the period of January 1, 2010 to May 31, 2016.

	Flow	BOD5		Total Solids		Phosphorus		NH3-N	
	(MGD)	mg/l	ppd	mg/l	ppd	mg/l	ppd	mg/l	ppd
2010	0.239	230	458	116	232	5.4	10.8	31.9	63.6
2011	0.287	215	509	118	284	5.1	12.0	29.6	69.7
2012	0.321	210	557	172	455	4.7	12.4	28.4	75.4
2013	0.302	224	565	191	481	4.9	12.5	26.1	65.7
2014	0.295	239	582	241	594	4.4	10.7	31.5	77.2
2015 + Jan 1 - Jan 8, 2016	0.283	260	610	281	661	4.9	11.5	18.9	44.9
2016 (Jan 9 - May 31, 2016)	0.418	206	717	163	569	4.4	15.3	19.9	69.4
% change between 2015 to 2016	48%	-21%	18%	-42%	-14%	-10%	33%	5%	55%

Blue highlighting indicates the highest value recorded for each parameter.

Flow Data – The average flow for the WWTP in 2015 and the first eight days in January 2016 was approximately 283,000 gallons per day (gpd). Flows increased to an average of 418,000 gpd for the period of January 9, 2016 to May 31, 2016. This represents an increase of 135,000 gpd (94 gallons per minute) or approximately 48%.

A plot of the average daily WWTP flow from 2010 through May of 2016 is shown below.

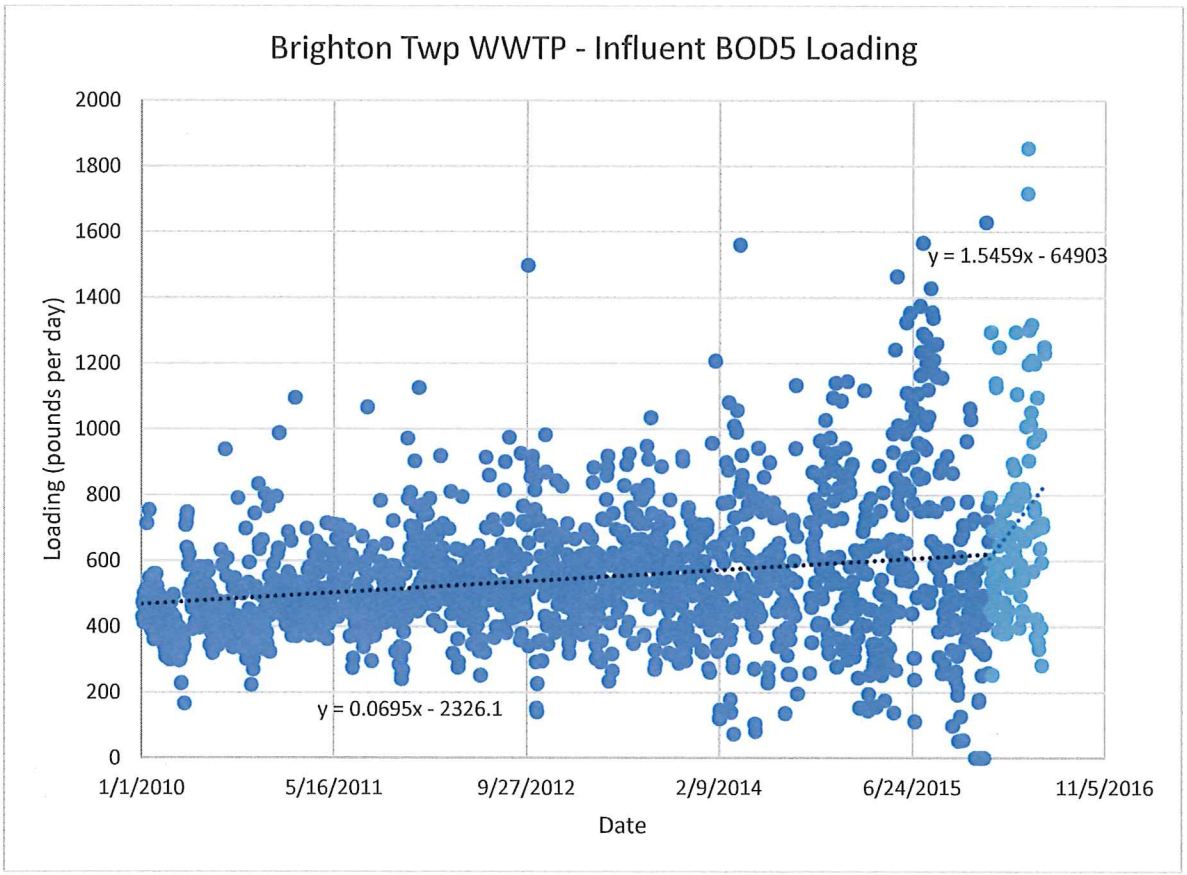


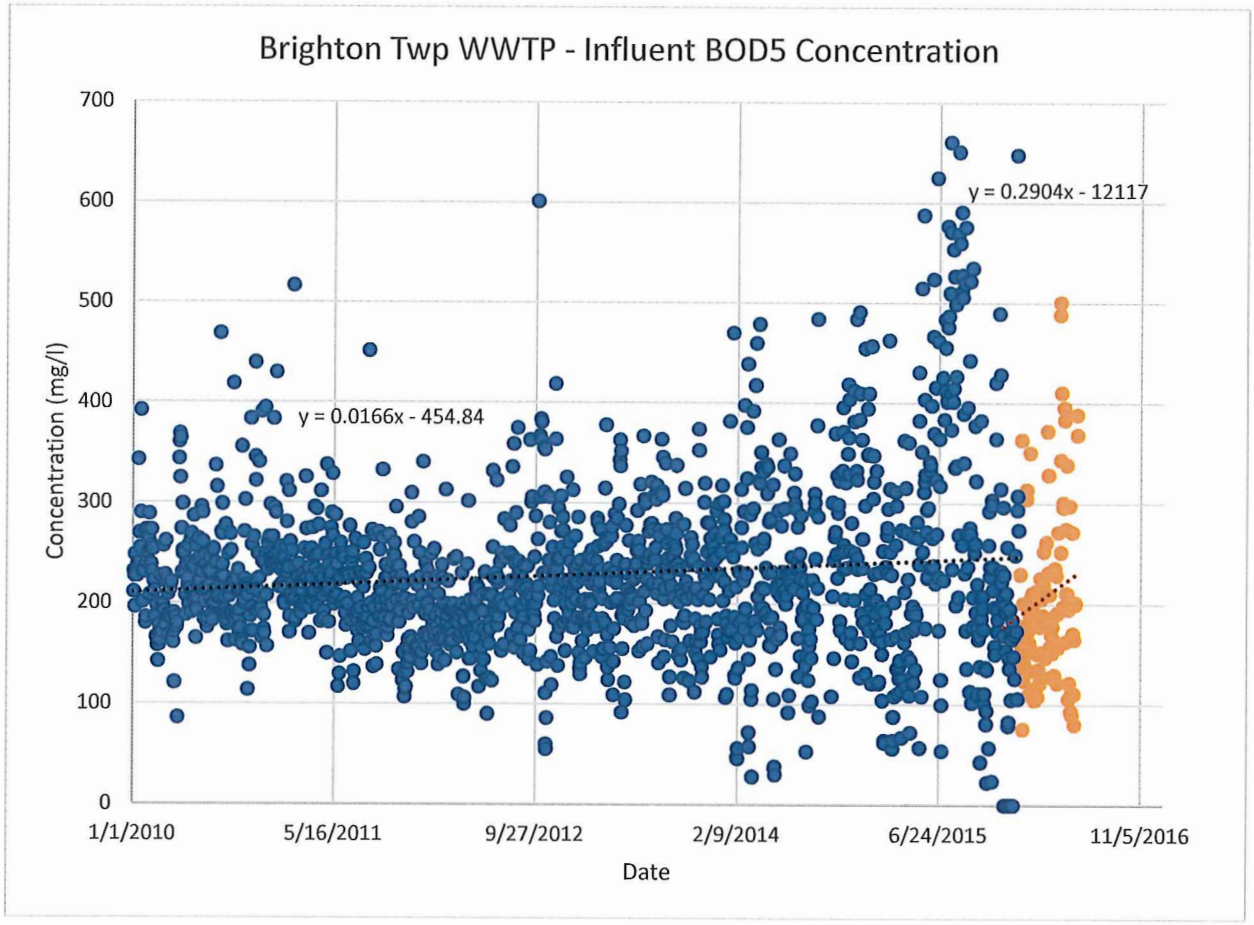
Several options were explored that could contribute to the additional flow. The existing parshall flume at the WWTP had its yearly recalibration. The date of this service was February 4, 2016 and was confirmed with IA and the service provider, so meter recalibration is not likely the cause. Another potential source would be additional service connections to the system. Per the Township, there are no known significant user connections in the Township that were made on or around that time that would provide such an increase in flow.

Since no sources of error can initially be found with the flow data, the loadings to the plant were examined. To evaluate potential sources of the increased flow, we compared the average data from 2015 to the data observed after January 8, 2016.

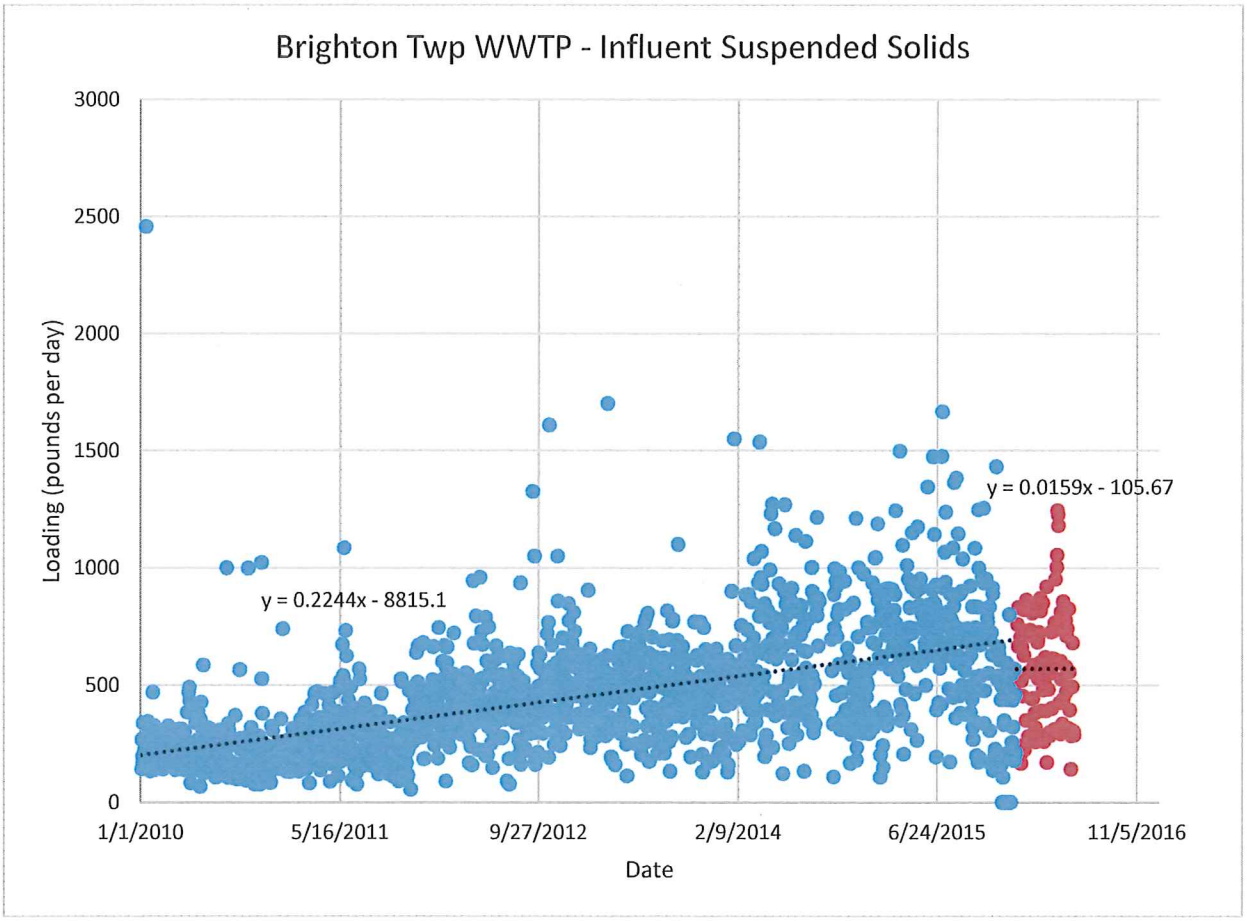
BOD5 – BOD5 was plotted for both the loading to the WWTP and the concentration. The average concentration of BOD5 in 2015 plus the first eight days of 2016 was 260 mg/l, while afterwards it decreased to 206 mg/l. In contrast, the BOD5 loading at the plant increased during this same time period from 610 pounds per day (ppd) in 2015 to 717 ppd after January 9, 2016.

If the additional average flow and previous average concentration to the plant are used to calculate the loading (0.135 mgd x 260 mg/l x 8.34 = 293 ppd) the anticipated additional load to the plant would be an average 293 pounds per day. If this is added to the 610 ppd that the WWTP experienced prior to January 9, 2016, 903 ppd would be calculated as the theoretical loading if the flow increase came from typical wastewater. This theoretical value is much higher than what the WWTP is currently experiencing (717 ppd). This disproportionate increase in loading and the decrease in concentration suggests that there may be some additional flows from inflow/infiltration (I/I) of clean ground water diluting influent concentrations. However, I/I would not fully account for increased flows since BOD5 loading has increased, suggesting that some of the additional flow may possibly be sanitary sewage in nature.




Brighton Twp WWTP - Influent BOD5 Concentration
700
600
500
400
300
200
100
0
Concentration (mg/l)
y = 0.0166x - 454.84
y = 0.2904x - 12117
1/1/2010
5/16/2011
9/27/2012
2/9/2014
6/24/2015
11/5/2016
Date

Suspended Solids- SS loading at the WWTP has steadily increased over the years with a dip in 2016. Using the same calculation that was done for BOD5 for the time frame after the flow increase, the additional load at the plant is (0.135 mgd x 281 mg/l x 8.34 = 316 ppd). Adding 316 ppd to the average load prior to January 9, 2016 provides a theoretical loading of 977 ppd pounds per day. This theoretical loading value is once again much higher the current average loading of 569 ppd.

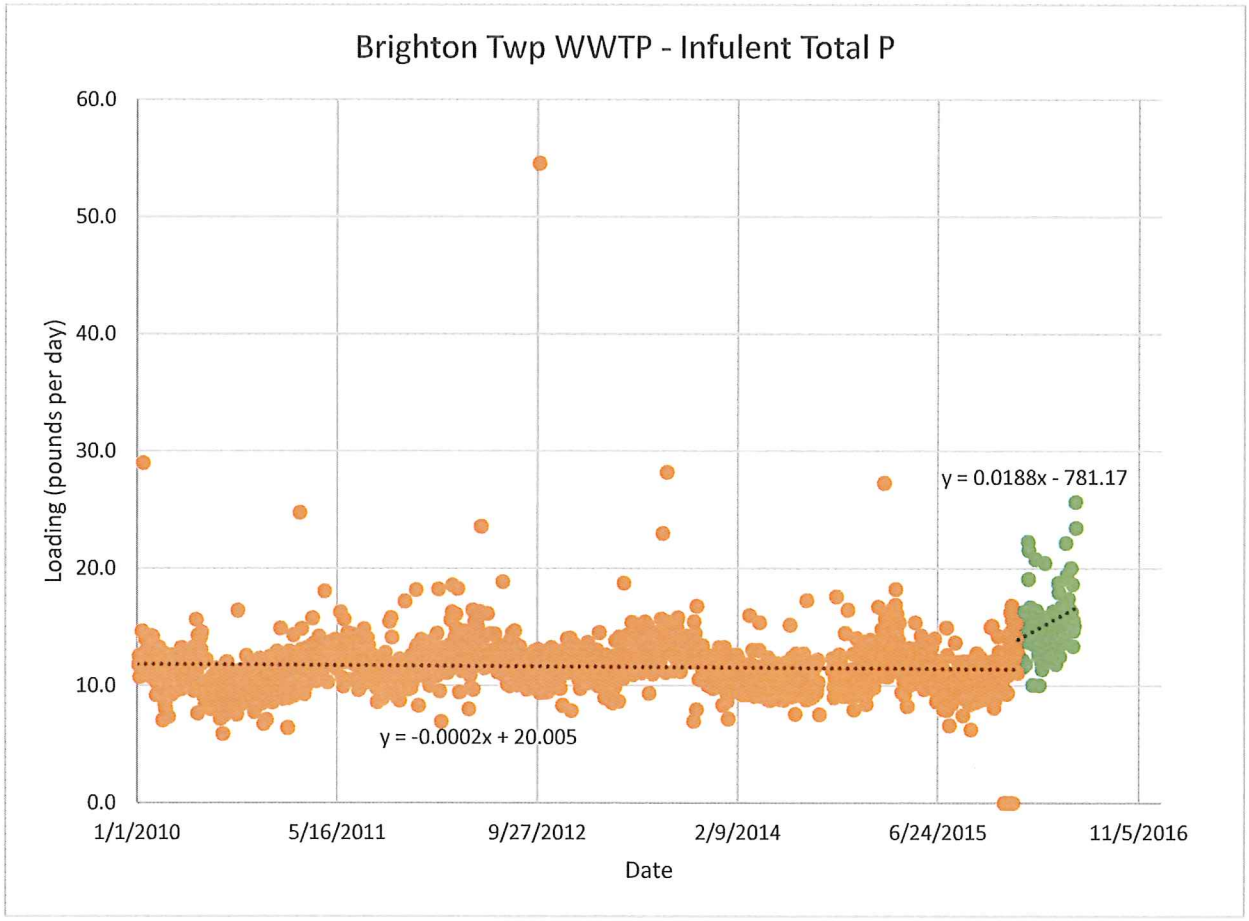


Total Phosphorus –There was a spike in the TP loading shortly after the flow increased and it has been increasing since.

Pre-flow loading from 1/1/15 to 1/8/16 was 11.5 ppd (average concentration 4.9 mg/l)
Post-flow loading from 1/9/16 to 5/31/16 was 15.3 ppd (average concentration 4.38 mg/l)

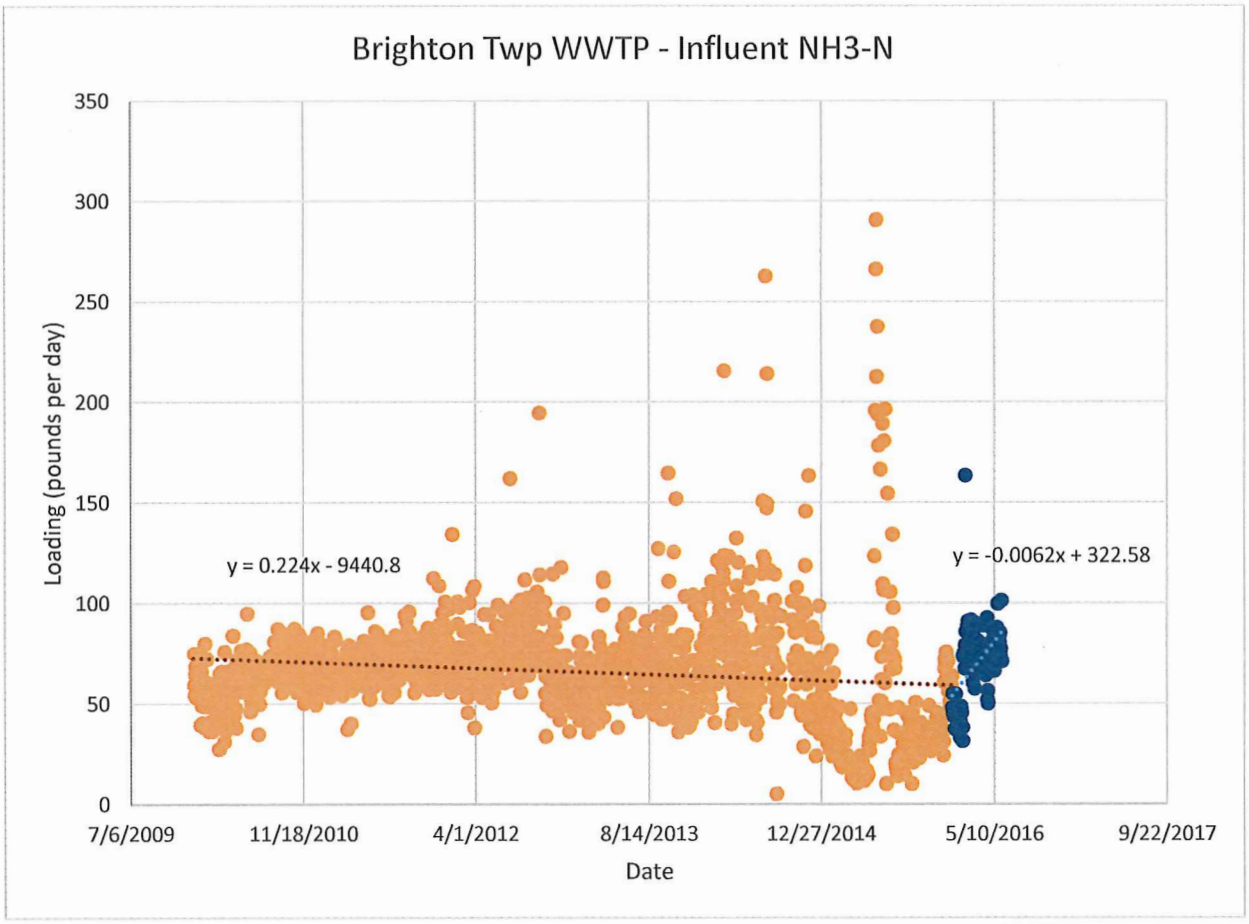
(0.135 mgd x 4.9 mg/l x 8.34 = 5.5 ppd) + 11.5 ppd = 17.2 ppd (compared to 15.3 ppd observed at WWTP)

This suggests that there is additional phosphorus being discharged to the plant, it's just not as concentrated as it was previously.



NH3-N – Large spikes in ammonia loading were seen in 2014 and 2015 with lower average levels. A consistently higher average loading was seen after January 9, 2016 however the extreme spikes have not been as prevalent.

Pre-flow loading from 1/1/15 to 1/8/16 was 44.9 ppd (average concentration 18.9 mg/l)
Post-flow loading from 1/9/16 to 5/31/16 was 69.4 ppd (average concentration 19.9 mg/l)

(0.135 mgd x 18.9 mg/l x 8.34 = 21.3 ppd) + 44.9 ppd = 66.2 ppd. (compared to 69.4 ppd observed at WWTP)

This suggests that some additional nitrogen in the form of ammonia is being discharged at the plant at slightly higher concentrations than it was previously.